

IAS

INSTITUTE FOR
ADVANCED STUDY

Report for the Academic Year
2018–2019

Cover: On March 19, 2019, Visiting Professor KAREN UHLENBECK became the first woman to win the Abel Prize. Uhlenbeck was cited “for her pioneering achievements in geometric partial differential equations, gauge theory, and integrable systems, and for the fundamental impact of her work on analysis, geometry, and mathematical physics.”

Opposite: South Lawn

COVER PHOTO: ANDREA KANE

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REPORT OF THE CHAIR

On March 14, 2019, the Institute for Advanced Study celebrated the value and astounding influence of basic research and invited others to support IAS's purpose and mission with the inaugural IAS Einstein Gala held in New York City.

I was honored to chair the gala, along with Sir James Wolfensohn, former Chair of the Board (1986–2007). The event raised \$3.5 million for the IAS and honored James Simons, IAS Trustee Emeritus, and a former Member in the School of Mathematics who served as an IAS Trustee from 2001 to 2018. One of our most generous patrons, Jim was presented with the IAS Bamberger Medal, the highest honor given by IAS to recognize visionary philanthropy in the spirit of Louis Bamberger and Caroline Bamberger Fuld, the brother and sister who founded and endowed IAS in 1930, providing for its lasting and essential independence.

The Institute's mission to advance understanding across the sciences and humanities without concern for immediate application is made possible only through visionary philanthropists like Jim.

In May 2019, we recognized Brian Wruble's exceptional

twenty-seven-year service on the Board. Brian had served as Treasurer of the Corporation since 2006 and was one of our longest-serving Trustees. We are grateful for Brian's broad and deep dedication to the Institute.

We were delighted to welcome new Trustees R. Marty Chavez, Global Co-Head of the Securities Division at Goldman Sachs, and Jörn Rausing, a non-executive director of the Tetra Laval Group Board.

I am immensely proud to lead an institution that provides an exceptional environment for outstanding researchers and scholars of the highest caliber, curiosity, and self-motivation to push the frontiers of knowledge. The ideas that are given the time and space to emerge and evolve at the Institute lead over time to long-term utility and innovation. I am deeply grateful for the dedication of our Trustees, Faculty, Members, Staff, and donors who help produce enduring and transformative knowledge and understanding around the world.

Charles Simonyi
Chair of the Board

REPORT OF THE DIRECTOR

On April 10, 2019, the first image of a black hole made headlines around the world. It was the outcome of a large international collaboration, but it started with a spectacular prediction of the general theory of relativity by IAS founding Professor Albert Einstein. The Institute cultivates this type of deep thinking, often decades ahead of its time, that leads to knowledge of lasting value, providing greater returns in the long run in terms of practical applications and impact on disciplines.

We were pleased to welcome four new Professors in 2018–19: Myles W. Jackson and Francesca Trivellato in the School of Historical Studies; and Camillo De Lellis and Akshay Venkatesh in the School of Mathematics. We were also delighted to announce the appointments of five new Professors—Suzanne Conklin Akbari in the School of Historical Studies, Jacob Lurie in the School of Mathematics, Alondra Nelson in the School of Social Science, and Jim Stone and Misha Tsodyks in the School of Natural Sciences—who will join IAS in 2019–20 and bring new fields and depth of study to IAS, from literary studies to neuroscience.

We were profoundly saddened by the deaths of three of our Professors: Christian Habicht, Professor Emeritus in the School of Historical Studies, on August 6, 2018, at the age of 92; Jean Bourgain, Professor in the School of Mathematics, on December 22, 2018, at the age of 64; and Irving Lavin, Professor Emeritus in the School of Historical Studies, on February 3, 2019, at the age of 91. Christian, Jean, and Irving are greatly missed by the Institute community and family, friends, and colleagues throughout the world.

We express deep appreciation to Patrick Geary, a leading historian of the Middle Ages, who transitions to Professor Emeritus in the School of Historical Studies as of July 2019. We are deeply grateful for Patrick's scholarship, generosity, and leadership as a Professor since 2012, and we look forward to his continued involvement in the IAS community.

In two particularly uplifting moments of the year, Akshay Venkatesh, Robert and Luisa Fernholz Professor in the School of Mathematics, was awarded a 2018 Fields Medal; and Karen Uhlenbeck, Visiting Professor in the School of Mathematics with a forty-year affiliation with IAS, was recognized with the 2019 Abel Prize. Karen is the first woman to receive the honor and is a co-founder of the Institute's Women and Mathematics Program, and the Park City Mathematics Institute.

The Institute's endowment provides scholars with space and time and makes a critical difference to the institution's continued success. I would like to thank our many supporters, Trustees, Faculty, Members, and Staff, for sustaining founding Director Abraham Flexner's vision of an institute dedicated to assembling a group of scientists and scholars who may "devote themselves to the task of pushing beyond the present limits of human knowledge and to training those who may 'carry on' in this sense."

Robbert Dijkgraaf
Director and Leon Levy Professor



ANDREA KANE



The Institute for Advanced Study

It was founding Director Abraham Flexner's belief that if the Institute "eschews the chase for the useful, the minds of its scholars will be liberated, they will be free to take advantage of surprises, and someday an unexpected discovery, apparently leading nowhere, will be found to be an indispensable link in a long and complex chain that may open new worlds in theory and practice."



ANDREA KANE



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DAN KOWODA

THE INSTITUTE FOR ADVANCED STUDY is an international center for theoretical research and intellectual inquiry that creates time and space for solitary work as well as dialogue among some 250 visiting researchers each year from more than 100 institutions around the world and at various stages in their careers. In 2018–19, the Institute welcomed 268 visiting scholars and scientists, representing twenty-five countries. From postdocs with new perspectives and tools, to established experts who create and advance fields of inquiry, the Institute's focused yet freely inquisitive atmosphere enables advancement in unforeseeable ways, leading to societal innovation and new understanding.

Research spans four Schools—Historical Studies, Mathematics, Natural Sciences, Social Science—and is focused on long-term and fundamental outcomes with no concern for immediate application. IAS is a scholar's paradise—a campus of unparalleled energy and curiosity, free of external pressures and academic restraints where exceptional minds have limitless opportunity to explore what is not yet known. Thirty-four Nobel Laureates, forty-two of the sixty Fields Medalists, and eighteen of the twenty Abel Prize Laureates, as well as many winners of the Wolf and MacArthur prizes, have been affiliated with the Institute.

Long and complex chains of knowledge have developed in numerous and astounding ways through research originating at the Institute—from the development of programmable computers and the uncovering of deep symmetries of nature to establishing art history as a discipline in the United States and advances in societal understanding and historical practice.

Albert Einstein, Kurt Gödel, Hetty Goldman, George F. Kennan, Erwin Panofsky, John von Neumann, and Hermann Weyl were among the first in a long line of distinguished Institute scientists and scholars to produce a deeper understanding of the physical world and of humanity.

At the Institute, everything is designed to encourage scholars to take their research to the next level. This includes creating and sustaining an environment where Members live in an academic village of apartments, originally designed by Marcel Breuer in 1957, at the edge of the Institute's eight hundred acres of campus, woodland, and farmland. Members eat in the same dining hall, share common rooms and libraries, and carry out their work in an institutional setting where human scale has been carefully maintained to encourage the sharing of ideas, mutual understanding, and friendship.

Each year a new intellectual mix is created by the Members. Young scholars meet the contemporaries who, with them, will be leading figures in their field in the future. Senior Members have the time and freedom to initiate new lines of research. Freed from teaching and administration, Members are afforded opportunities for discussing their work with scholars and scientists from other fields. Here they are given the time to take advantage of serendipitous encounters at lunch, teatime, or at After Hours Conversations, an interdisciplinary program to encourage wide-ranging conversations in an informal environment.

Throughout the year, the Institute hosts a broad array of concerts, lectures, and programs for the Institute community and the public. In addition, the Institute offers numerous and varied activities for Members, Visitors, and their families—from children's activities to play readings and jazz evenings.

Faculty and Members experience precious freedom at the Institute, an independence enabled by the generosity of the Institute's founders and subsequent benefactors, which leads to pioneering theories and the development of new knowledge. In the words of mathematical physicist Robbert Dijkgraaf, current IAS Director and Leon Levy Professor: "What do we know? What do we yet need to understand? How should we try to comprehend it? Fundamental research at the Institute furthers our grasp of a world of diverse facts, structures, ideas, and cultures. We share the conviction of our founders that such unrestricted deep thinking will change this world, but where and how is always a surprise."



DAN KOMODA



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ANDREA KANE



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WHEN WRITTEN IN CHINESE, THE WORD
CRISIS
IS COMPOSED OF TWO CHARACTERS
ONE REPRESENTS
DANGER 危
AND THE OTHER REPRESENTS
OPPORTUNITY 机
John F. Kennedy



Professor ANGELOS CHANIOTIS leads an Epigraphic Friday workshop, organized annually since 2013. The workshop attracted more than forty scholars from American and European universities in 2019.



School of Historical Studies

The School of Historical Studies, established in 1949 with the merging of the School of Economics and Politics and the School of Humanistic Studies, actively promotes interdisciplinary research and cross-fertilization of ideas, thereby encouraging the creation of new historical enterprises.

THE SCHOOL OF HISTORICAL STUDIES bears no resemblance to a traditional academic history department, but rather supports all learning for which historical methods are appropriate. Its Faculty and Members embrace a historical approach to research throughout the humanistic disciplines, from socioeconomic developments, political theory, and modern international relations to the history of art, science, philosophy, music, and literature. In geographical terms, the School concentrates primarily on the history of Western, Near Eastern, and Far Eastern civilizations, with emphasis on Greek and Roman civilization, the history of Europe (medieval, early modern, and modern), the Islamic world, and East Asia. Support has been extended to the history of other regions, including Central Asia, India, and Africa.

The Faculty and Members of the School do not adhere to any one point of view but practice a range of methods of inquiry and scholarly styles, both traditional and innovative. Uniquely positioned to sponsor work that crosses conventional departmental and professional boundaries, the School actively promotes interdisciplinary research and cross-fertilization of ideas, thereby encouraging the creation of new historical enterprises.

As in the preceding year, Professor **Yve-Alain Bois**'s long-term project, the catalogue raisonné of the paintings, reliefs, and sculpture of Ellsworth Kelly took most of his time in 2018–19 (he completed a draft at the end of the summer and will spend part of the academic year 2019–20 editing it). Given his focus on this project, which involves a radical transformation of the age-old “catalogue raisonné” model, essential to the discipline of art history, the number of his publications were limited. He helped the editors of the *British Journal of Contemporary Painting* in their publication of the papers given at a symposium dedicated to his own work (including revising the translation of several of his essays, originally published in

FACULTY

Yve-Alain Bois
Angelos Chaniotis
Nicola Di Cosmo
*Luce Foundation Professor
in East Asian Studies*
Patrick J. Geary
Andrew W. Mellon Professor
Jonathan Haslam
George F. Kennan Professor
Myles W. Jackson
Sabine Schmidtke
Francesca Trivellato

PROFESSORS EMERITI

Glen W. Bowersock
Caroline Walker Bynum
Giles Constable
Christian Habicht
deceased August 6, 2018
Jonathan Israel
Irving Lavin
deceased February 3, 2019
Peter Paret
Heinrich von Staden

French, into English). Similarly, he helped edit the special issue of the journal *October* devoted to film scholar Annette Michelson, recently deceased, to which he contributed an essay on her early art criticism.

In November 2018, Bois gave a talk at the two-day symposium devoted to the art historian Robert Klein at the Villa I Tatti in Florence and in March, he was invited as the Stephen E. Ostrow Distinguished Visitor by Reed College (Portland, Oregon), where he gave a lecture on Matisse and held four seminars on various topics.

At the IAS, Bois organized a series of public lectures in art history. The first three speakers had previously been IAS Members: in December, Eric Michaud of the École des Hautes Études en Sciences Sociales (Paris) gave the talk “The Barbarian Invasions: A Genealogy of the History of Art”; in March, Nicola Suthor of Yale University spoke about Rembrandt’s drawings; and Maria Loh of Hunter College spoke about Titian’s famous painting at the Borghese Gallery in Rome, *Sacred and Profane Love*. Finally, in April, David Young Kim of the University of Pennsylvania gave a talk on the

sixteenth-century Italian painter Giovanni Battista Moroni in conjunction with the exhibition dedicated to his portraits at the Frick Collection in New York City.

The art history seminar was very productive with presentations by each participant, several of them specialists of medieval and Renaissance art (Noa Turel, Benjamin Anderson, Alison Perchuk, Catherine Fernandez, Eric Palazzo, Giulia Puma, Jeanette Kohl, and Barbara Baert), as well as a specialist of Byzantine archaeology (Ralf Bockmann), and of photography (Maggie Hennefeld). Three of these presentations were public (Perchuk on “The Unbearable Lightness of Whiteness: Racism and Medievalism in the Architecture of Prewar Los Angeles”; Kohl on “Hic Est Homo Platonis: Embodied Platonism in Renaissance Art”; and Fernandez on “Matrix as Ornament: The Medieval Afterlife of Intaglios and the Retrospection of Function”) and attracted members of the IAS community as well as scholars from Princeton University, Rutgers University, and New York University.

The main focus of Professor **Angelos Chaniotis**’s work remains the study of inscriptions and the information they provide for Greek social, cultural, and religious history. He co-edited *Supplementum Epigraphicum Graecum* LXIV (Leiden 2018) and worked on his book *Epigraphic Research at Aphrodisias, 1995–2015*, as well as on the publication of graffiti found in Aphrodisias. He also supervised the digitization of squeezes of Greek inscriptions at the IAS, a project generously funded by the Fowler Merle-Smith Family Trust and the Charles Simonyi Fund for Arts and Sciences. The workshop “Epigraphic Friday,” which he has organized since 2013, attracted on March 15, 2019, more than forty scholars and graduate students from American and European universities. Subjects related to epigraphy as well as Greek literature, religion, art history, and papyrology were treated by Members and Visitors in the Ancient Studies Seminar (October 2018–April 2019). In addition to his epigraphic research, Chaniotis edited a conference volume dedicated to the perceptions and realities of the night in the Greco-Roman world (*La nuit. Imaginaire et réalités nocturnes dans le monde*

gréco-romain, Geneva 2018); together with Christian Witschel (Heidelberg), he edited a collection of epigraphical essays of his late colleague in Heidelberg Géza Alföldy (*Die epigraphische Kultur der Römer. Studien zu ihrer Bedeutung, Entwicklung und Erforschung*, Stuttgart 2018).

Chaniotis gave twenty-five lectures at conferences, universities, museums, and cultural centers in China, Greece, Japan, Turkey, the United Kingdom, and the United States. Many of his lectures focused on his research on the history of emotions and his new research project on the transformations of night life from the fourth century B.C.E. to the fourth century C.E. He also presented a Massive Open Online Course (in Greek) on the subject “Memory, Feeling, Faith: The Human Face of Post-Classical Hellenism,” which was presented by Crete University Press.

Chaniotis’s most recent book *Age of Conquests: The Greek World from Alexander to Hadrian* (Profile Books and Harvard University Press, 2018) has been translated into Italian and Spanish, and translations in Chinese, German, Greek, and Russian are in preparation. In February 2019, Chaniotis received an honorary degree from the Ionian University in recognition of his contribution to the study of Greek history.

The research activity of **Nicola Di Cosmo**, Luce Foundation Professor in East Asian Studies, involved four separate areas; the most important is global medieval interactions and, in particular, the role of the Mongol empire in Eurasian history. Two chapters for the *Cambridge History of the Mongol Empire* were completed (both forthcoming) and basic research went into a book provisionally titled *Venice and the Mongols: Reshaping the Silk Road in Medieval Eurasia*, which hopefully will be completed during the next academic year.

A second field that continues to be actively pursued is the interaction between climate and history. The essay “Maligned Exchanges: The Uyghur-Tang Trade in the Light of Climate Data” (in *Texts and Transformations*, Cambria Press, 2018) provides a reading of historical and literary sources in tandem with climatic reconstructions, using the latter to understand the former. Similar research is now being pursued by several research

FACULTY & EMERITI HONORS

Yve-Alain Bois will give the 2020 A.W. Mellon Lectures in the Fine Arts at the National Gallery of Art in Washington, D.C.

Angelos Chaniotis was awarded the title of Doctor honoris causa by the Ionian University.

Patrick J. Geary was elected to the American Academy of Arts and Sciences, and was honored with a conference at the University of California, Los Angeles.

Myles W. Jackson was named to the Board of Directors of the American Friends of the Alexander von Humboldt Foundation.

Irving Lavin was posthumously named Grand’Ufficiale dell’Ordine al Merito della Repubblica Italiana.

Sabine Schmidtke was elected a Foreign Corresponding Member of the Académie des Inscriptions et Belles-Lettres.



Left: Recent research activities of NICOLA DI COSMO (far back), Luce Foundation Professor in East Asian Studies, include the study of global medieval interactions and the role of the Mongol empire in Eurasian history; the interaction between climate and history; the economic foundations of non-state agents; and the relationship between ancient China and neighboring communities and polities. *Right:* PATRICK GEARY, Andrew W. Mellon Professor, shown participating in a lunchtime seminar, explored the population structures and movement between the Danubian frontier and sixth-century Italy through genomic analysis.

teams across the world that focus on the congruence of scientific and historical datasets in order to achieve a better interpretation of past events. This trend has major methodological implications for both paleoclimate and historical sciences.

A third area of activity is the study of war and violence in comparative perspective. Di Cosmo completed a chapter titled “Violence in Inner Asian history” for the *Cambridge History of Violence* (forthcoming) and has been involved in the production of a book on “non-state war economies” as author and co-editor (together with Didier Fassin, James D. Wolfensohn Professor in the School of Social Science, and Clémence Pinaud of Indiana University). The collective volume aims to expand the study of the economic foundations of non-state agents both in the contemporary world and in historical perspective by adopting a multidisciplinary approach.

A fourth area of activity concerns the relationship between ancient China and neighboring communities and polities, which involves a major change of perspective in light of archaeological discoveries and comparative history, namely, a new interpretation of the origins of the Great Wall of China based on debates about borders, borderlands, and frontiers in early modern Europe and America as well as the archaeological cultures of borderland communities in ancient China’s “northern zone.” Lectures on the above topics were given at Oxford, Vienna,

Exeter (keynote), and Wake Forest.

Activities within the IAS included chairing the search for the professorship in medieval studies (completed with the appointment of Suzanne Akbari), serving on the IAS Ad Hoc Committee, Diversity Committee, and Title IX Committee, and organizing the East Asian Studies Seminar series inclusive of both Social Science and Historical Studies Members (twelve meetings were convened).

Patrick J. Geary, Andrew W. Mellon Professor, explored with his team the population structures and movement between the Danubian frontier and Italy through genomic analysis in the sixth century, the results of which appeared in *Nature Communications*. The article was cited in *Nature*’s 2019 ranking of the Institute for Advanced Study among the top five institutions in its annual normalized analysis of leading research institutions. He and his team continue their work, expanding the chronology of their investigations backward and forward in order to develop a dynamic image of population changes at the end of antiquity. He presented the preliminary results of this ongoing work in Heidelberg at the EMBO | EMBL Symposium on Reconstructing the Human Past—Using Ancient and Modern Genomics.

In October, he hosted a meeting of early career scholars from international university-based institutes for advanced study to develop an interdisciplinary

approach to the study of laws in the natural and social sciences. In March, he spent a week at the University of Birmingham’s Institute for Advanced Studies to continue mentoring this group. He presented the plenary address at an international conference in Catalonia on Bishop Oliba of Vic and his epoch and a number of presentations on contemporary directions in historical research. These included a lecture at the University of New Mexico on “Weaponizing the Middle Ages 1990–2019” and at the American Historical Association’s convention in Chicago on the impact of modern genomics research on the study of history. At the March meeting of the Medieval Academy of America, he spoke on the challenges of transcultural collaboration in writing world history. Also in April, all of his former students as well as colleagues from the United States, Europe, and Asia honored him at a two-day conference, “Visions of Medieval Studies in North America: A conference in honor of Patrick J. Geary,” at the University of California, Los Angeles, the institution at which he taught for eighteen years before joining the Faculty of the Institute. In May, he hosted a reunion of medievalist Members from the year 2014–15 who returned to the Institute for two days to report on the status of the work that they pursued at the Institute and on their current research. Finally, in June, he once more chaired the MA defenses in the Department of



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Left: Drawing on her research and reading from her recent publication *Studying the Near and Middle East at the Institute for Advanced Study, Princeton, 1935–2018*, Professor SABINE SCHMIDTKE explores the eighty years of Near and Middle East research that has taken place at IAS. Right: George F. Kennan Professor JONATHAN HASLAM organized the S. T. Lee Lecture by Stephen Kotkin (above) titled “Stalin at War,” which he presented to a full house in Wolfensohn Hall.

Medieval Studies at the Central European University in Budapest as he has done annually for over a quarter century. As of July 1, 2019, he became officially Emeritus Professor.

George F. Kennan Professor **Jonathan Haslam** has now completed a manuscript amounting to some 180,000 words on the role of Bolshevism and anti-Bolshevism in the origins of the Second World War. The research encompassed published and unpublished documents from many foreign ministries—Britain, Ireland, the United States, France, Germany, Poland, the Baltic states, Spain, Italy, Russia, Sweden, and (published material only) the Vatican; plus collections of private papers and, last but not least, the archives of the Communist International.

He is now preparing for his next project on the international dimensions of the civil war in Greece (1946–49) that marked the first bloodshed in the Cold War between the Soviet Union and its former allies. No one has yet pulled together all the pieces of the jigsaw that, on first sight, illustrate serious differences within the international Communist movement over how to proceed in the face of resolute British and American opposition. For this purpose and for the entire academic year to come, Haslam is focusing his time on learning modern Greek with a view to mastering all the published material in the language prior to working in the

state and Communist party archives in Athens in the year thereafter (2020–21). Crucial declassified top secret documents are also to be found in archives located in Bulgaria, Serbia, Poland, the Czech Republic, and Russia.

A good deal of time in 2018–19 was spent preparing for the S.T. Lee Lecture by Stephen Kotkin of Princeton University on “Stalin at War,” which proved an outstanding success to a packed lecture hall. The subsequent seminar, to which a stellar cast of historians from both Europe and the United States contributed their efforts, also turned up trumps. We do not know all the answers, but we certainly have a clearer sense of the questions to ask.

Haslam’s blog, *Throughrussianeyes.com*, has now reached one hundred iterations and is expected to continue through to retirement, if not beyond.

Professor **Myles W. Jackson** is working on two projects. The first is a book-length study on the exchanges between natural scientists (specifically physicists and physiologists), radio engineers, and musicians. The second project is a popular work dealing with the relationship between science and society over the past 250 years. In 2018–19, he finished an article for inclusion in a forthcoming volume on intellectual property, ownership, and knowability edited by Mario Biagioli and Dagmar Schäfer with MIT Press.

Jackson presented a paper on genomics,

intellectual property, and knowability at a conference at the Max-Planck-Institute for the History of Science in Berlin. He also delivered a keynote, university-wide lecture at the University of Venice on intellectual property, genomics, and race as well as a lecture at a conference there on music, art, and technology. Finally, he was a keynote speaker at the annual conference of the Association for Research in Otolaryngology where he spoke on the role of physics and physiology to piano pedagogy during the late nineteenth and early twentieth centuries.

In addition to giving a public lecture as part of the Board of Trustees meetings in October, Jackson also gave lectures to AMIAS (on radio engineers, physicists, and musicians in Berlin during the 1920s and ’30s), to IAS astrophysicists (on artisanal knowledge and experimental natural philosophy in nineteenth-century astronomy), and to the Biology Advisory Council headed by Arnie Levine, Professor Emeritus in the School of Natural Sciences (on HIV/AIDS, the molecular biology of race, and gene patenting).

Jackson participated in the new project of the German photographer Herlinde Koelbl on “The Fascination of Science,” which will culminate in an exhibition next year touring Germany and a forthcoming book. It details the work of “leading scholars” worldwide. Jackson has been named a research associate



DAN KOMODA

Myles W. Jackson (center) worked on a book-length study on the exchanges between physiologists and physicists, radio engineers, and musicians. Additionally, he is creating a popular work dealing with the relationship between science and society over the past 250 years.

(non-stipendiary) of the Max-Planck-Institute for the Science of Human History (Jena, Germany), and delivered the commencement address at Friedrich-Schiller-Universität Jena in June.

His IAS colloquium series in the history of science was quite strong in the spring term of 2019, averaging about eighty attendees per lecture (five lectures in total). The series will continue next year. Jackson is collaborating with the Alan Alda Center for Communicating Science of SUNY-Stony Brook in order to increase the links between the center and IAS.

He has also been playing a role in the history-of-science community at Princeton University, specifically in their graduate student colloquium, and speaking to Ph.D. students about their various dissertation subjects.

In 2018–19, Professor **Sabine Schmidtke** focused on the Zaydi tradition of Yemen and Northern Iran, the Arabic Bible, as well as Islamic doctrinal thought. In addition to several lectures on the Zaydi manuscript tradition, Schmidtke oversaw the flourishing of the partnership with Hill Museum & Manuscript Library (HMML) at St. John's University, Collegeville, in Minnesota to build up a repository that will eventually host digital surrogates of most manuscripts pertaining to the Zaydi literary tradition. In addition to funding provided for the continuation of the project by the National Endowment for the Humanities (2018–21), three

additional grants from the Gerard B. Lambert Foundation, the Charles and Lisa Simonyi Fund for Arts and Sciences, and the Ruth Stanton Foundation supported the project, allowing for the digitization of some additional collections of Yemeni manuscripts in Italy (Rome, Naples).

Within the framework of the NEH project, the collections of Yemeni manuscripts in Leiden, Munich, and Berlin have been digitized and will soon be uploaded to the HMML virtual reading room. Through additional funding provided by the Carnegie Corporation of New York, digital surrogates of three private manuscript collections in Sanaa and Sa'da have been cleaned up and prepared for upload onto vHMML. Moreover, Schmidtke published several articles on the subject as well as a monograph, *Traditional Yemeni Scholarship amidst Political Turmoil and War: Muḥammad b. Muḥammad b. Ismā'īl b. al-Muḥaḥhar al-Manṣūr (1915–2016) and His Personal Library* (Cordoba: UCOPress, 2018).

In the field of Islamic intellectual history, Schmidtke published facsimile editions of two multiple-text volumes, one held by the New York Public Library (*Materials for the Intellectual History of Imāmī Shī'ism in the Safavid Period: A Facsimile Edition of Ms New York Public Library, Arabic Manuscripts Collections, Volume 51985A*, Gorgias Press, 2018) and another one held in the Allama Tabataba'i library in Shiraz, Iran (*The Zaydī reception of Bahāmite Mu'tazilism: Facsimile Edition*

of MS Shiraz, Library of the Faculty of Medicine at the University of Shiraz (Allāma Ṭabāṭabā'i Library), majmū'a 102, Gorgias Press, 2019; with H. Ansari).

Schmidtke also completed a theme issue for the journal *Intellectual History of the Islamicate World*, "Writing in My Own Script: Allographic and Garshunographic Systems in Late Antiquity" (co-edited with G. A. Kiraz, to be published in two fascicles in September 2019 and April 2020) and did most of the work for another theme issue to be published in the same journal, "The Arabic Literary Genizah" (co-edited with G. Khan and S. Stroumsa).

In the field of the Arabic Bible, Schmidtke completed, with Camilla Adang, the monograph *Muslim Receptions and Perceptions of the Bible: Texts and Studies* (published by Lockwood Press), as well as another monograph (with Ansari), "Medieval Imami Theology: An Archaeological Inquiry into Texts and their Transmissions," which has been accepted for publication in the series *Arabo-Islamica* (Cordoba: UCOPress) and will be published in spring 2020. In the field of Shii Studies, Schmidtke completed (with H. Ansari) the third volume of the peer-reviewed journal *Shii Studies Review* published by Brill, Leiden (www.brill.com/ssr). In addition to this, she is currently finalizing, together with Long-term Member Hassan Ansari and a team of collaborators based in Iran, critical editions of three doctrinal works by

Medieval Muslim authors, which will be published before the summer of 2020 (by Gorgias Press and Brill), namely “A Mu’tazilite Commentary on a Seminal Ash’arite work: Ibn Abi l-Hadid’s Critique of the *K. al-Muhassal* by Fakhr al-Din al-Razi: A Critical Edition and Study”; “Imāmī Theology in 12th-Century Syria: ‘Abd al-Raḥmān b. ‘Alī b. Muḥammad al-Ḥusaynī and His Commentary on al-Shaykh al-Ṭūsī’s *Muqaddama*. A Critical Edition”; and “Mu’tazilite Natural Philosophy during the 5th/11th Century: *K. al-Masā’il fi l-khilāf bayn al-Baṣriyyīn wa-l-Baghḍādiyyīn* by Abū Rashīd al-Nīsābūrī. A Critical Edition.” Editions of additional works concerned with questions of doctrine and natural philosophy are in preparation.

Over the course of the year, Schmidtke organized a number of major events. In collaboration with G. A. Kiraz, senior Research Associate in the School of Historical Studies, Schmidtke convened a two-day conference “Scribal Habits in Middle Eastern Manuscripts” in May. In the framework of the Shii Studies research program (funded by the Carnegie Corporation of New York), Schmidtke convened the conference (with Ansari) “Yemeni Manuscript Collections and Zaydi Studies” in December. Moreover, in the SSRP framework, Schmidtke hosted over the course of the year some eleven international scholars specializing in Shii Studies as short-term visitors.

Schmidtke also spent much of her time

at the Institute with a large and diverse group of Members studying subjects related to the Near and Middle East, though not necessarily to Islam. The group was highly international with Members from the United Kingdom, Italy, Germany, Spain, Iran, and the United States. Over the course of the year, the Members regularly met in a biweekly lively seminar (in addition to a great deal of socializing), which was also frequented by Members from the Institute’s School of Social Science, Princeton University graduate students and faculty, former Members of the IAS, and occasional visitors.

The academic year 2018–19 was Professor **Francesca Trivellato**’s first year on the Faculty of the School of Historical Studies. She convened a seminar with Members in Early Modern Europe and adjacent fields, as well as a few colleagues and graduate students from Princeton University. In the course of fourteen sessions, presenters covered topics as diverse as medieval priests’ sexuality and masculinity, marine insurance, trade in East Turkmenistan, and race relations in colonial New England’s religious musical performances. A cluster of papers on sixteenth-century Europe generated some of the liveliest discussions.

The culmination of a decade of research and writing, Trivellato’s latest book appeared in February 2019 from Princeton University Press. *The Promise and Peril of Credit: What a Forgotten Legend*

about Jews and Finance Tells Us about the Making of European Commercial Society reconceptualizes Europe’s century-long struggle with idealized views of the market as a leveling playing field and the hidden dangers that lurk behind complex credit transactions. The book’s preface was reprinted in the Spring 2019 *Institute Letter* and an interview with the author is available on the New Books Network podcast.

As part of a long-term project on the business history of early modern Tuscany, Trivellato wrote three articles on the legacy of Jakob Burckhardt on the scholarship on the economic history of Renaissance Florence and its recent orientations. She also contributed an essay to the catalogue of the first exhibit of the new National Museum of Italian Jewry and the Shoah, as well as a preface to the re-edition of a book on the Italian Jewish diaspora in Palestine from the Middle Ages to the mid-twentieth century (Attilio Milano, *Storia degli ebrei italiani in Levante*, 1949).

She continues to work closely with doctoral students at Yale and other institutions, and to serve the historical profession in many capacities, including as a member of the *American Historical Review*’s editorial board.

Trivellato traveled as near as New York City and as far as Kolkata to lecture on her recently published and ongoing work. She especially appreciates the warm welcome extended to her by colleagues at Princeton University,



THOMAS CLARKE



DAN KOMODA

Left: FRANCESCA TRIVELLATO’s latest book, *The Promise and Peril of Credit* (Princeton University Press 2019) reconceptualizes Europe’s century-long struggle with idealized views of the market as a level playing field and the hidden dangers that lurk behind complex credit transactions. Right: Professor Emeritus JONATHAN ISRAEL (left) finalized the fourth and last part of his general survey of the “Radical Enlightenment,” a volume of more than 900 pages titled “The Enlightenment that Failed,” forthcoming from Oxford University Press in December 2019.

where she gave a talk in the series of the Committee for the Study of Books and Media as well as the annual Eberhard L. Faber Class of 1915 Memorial Lecture hosted by the European Cultural Studies. Along with Angela Creager, Director of the Shelby Cullom Davis Center for Historical Studies, she organized a workshop in honor of the ninetieth birthday of Natalie Zemon Davis, one of the great historians of the twentieth and twenty-first centuries, who was formerly an IAS Member and on the Princeton faculty. A video of the event is available on the IAS website and the workshop papers are published in open access as a volume of *H-France Salon*.

In August 2018, Professor Emeritus **Glen Bowersock** saw the culmination of a long-term project to digitize and make public more than 5,000 photographs that the eminent French epigraphist and historian Louis Robert had left in his personal archive when he died. They depict landscapes and inscriptions largely in Turkey, though not exclusively, over the decades from 1932 to 1962, and they are precious documents both for surviving antiquities and for the Anatolian world after Kemal Atatürk. Robert's widow had entrusted Bowersock with responsibility for this archive, and he invited former Member Jean-Louis Ferrary in Paris to join him. The entire archive of photographs, on negatives, glass plates, and prints, was digitized through the efforts of incoming IAS Members (2019–20) Thibaut Boulay and Anne-Valérie Pont. They were grateful to be able to use funds available to them through the Institut Universitaire de France.

With the indispensable help of Jonathan Peele at the IAS, the photographs were made accessible to all interested scholars on the Flickr website www.flickr.com/people/aibl_archive_of_louis_robert/. The Flickr page includes an open invitation to identify the images and to publish any of them without further permission. The response has been overwhelming. Many identifications can now be consulted on the website, and some inscriptions have already been published or incorporated in current research.

Bowersock participated in a colloquium

at New York University on the ancient site of Zafār in southwestern Yemen. This was the capital of Himyar in late antiquity, with a population of pagans, Jews, and Christians. At the epigraphic seminar that his colleague Professor Angelos Chaniotis organized on March 15, 2019, Bowersock contributed a paper on a new Greek inscription of Roman imperial date from the Heidelberg excavations at Zafār. He was delighted to be included in the volume that his colleague Professor Sabine Schmidtke recently published on Near Eastern studies at the IAS from its earliest days. He also published articles on Palestine and late Roman mosaics as well as papers to honor the retirement of Jean-Louis Ferrary and former Member Maurice Sartre. As in previous years, he profited from conversation with Members, particularly Gabriele Pedullà on seventeenth-century antiquarians, Rubina Raja on Palmyrene portraits, and Barbara Baert on *Kairos* (time) in art.

During 2017–2018, Professor Emeritus **Caroline Bynum** wrote a lengthy epilogue to the volume *Religious Materiality in the Early Modern World* edited by Suzanna Ivanič, Mary Laven, and Andrew Morrall; this essay will finally appear from Amsterdam University Press in the fall of 2019. In 2018–19, she wrote the article “Interrogating ‘Likeness’: Fake Friends, *Similia Similibus*, and Heavenly Crowns” for the journal *Historische Anthropologie* to appear late in 2019 or early in 2020. She continued to work on a collection of essays on devotional objects in late medieval and early modern northern Europe to be titled *Dissimilar Similitudes*. The essays deal with, among other things, some objects in the Metropolitan Museum of Art in New York, and Bynum enjoyed speaking to IAS Members and Faculty about these on several occasions.

The main focus of Professor Emeritus **Jonathan Israel**'s research and writing during the first half of the academic year was on finalizing the text of the fourth and last part of his general survey of the “Radical Enlightenment,” a volume of more than 900 pages titled *The Enlightenment that Failed*. It is due to be published

by Oxford University Press in December 2019. Besides taking further the widening historiographical controversy the series has provoked, and carrying forward the overall story, chronologically, into the early nineteenth century, this final volume has several retrospective chapters adding material about some earlier aspects together with two preliminary chapters showing how, at an earlier stage, “Radical Renaissance” and “Radical Reformation” laid down certain patterns of thought, attacking the supremacy of theology and sketching out ideas of equality that later became mainstays of the “Radical Enlightenment.”

One of the main themes of the book is how exactly we should differentiate the “Radical Enlightenment” tradition as a whole, over the century and a half of its history from the late seventeenth down to the early nineteenth century, from early socialism and Marxism. The volume concludes with what is presented as Karl Marx's conversion as a young intellectual, in 1844, from what previously was a democratic radicalism quite distinct from socialism into a thinker suddenly immersed, from 1844 onwards, in economics and socialism with very different views on politics, equality, and academic philosophy than he had held earlier.

During the latter half of the year, Israel also completed his smaller new book, *Revolutionary Jews from Spinoza to Marx* which seeks to explain why a powerful revolutionary consciousness arose around the fringes of the Jewish world, from Spinoza's time onwards, among Jewish intellectuals rebelling against religious tradition and filled with an avid desire to reform the world they lived in. David Nassy, Zalkind Hourwitz, Ludwig Boerne, Moses Hess, and the poet Heine are among the revolutionaries and writers portrayed in detail. This smaller book also has a chapter on Marx but here in more detail especially with respect to Marx's early notes on Spinoza, and what their significance is, and how Marx became a “Marxist” from 1844.

In recent months, having completed his work on these volumes, Israel has made a start on what will be his main research project from now to 2026 by which date he is contracted to complete a

large volume on the subject of Spinoza's life and legacy. Based partly on new research, and ongoing research being carried out, not least in the special IAS Spinoza collection, the aim is to produce a fuller more detailed biography of this major figure than has been available up until now.

Now past his ninety-fifth birthday,

Professor Emeritus **Peter Paret** has exchanged active for contemplative scholarship, barring a few exceptions. In March, he gave a lecture at Princeton University on "The Impact of Clausewitz's Early Life on his Theories and Politics," an expanded version of which will be published in the *Journal of Military History*. He has written an introduction to

a work of a former student, Donald Abenheim, *Rettet den Staatsbürger in Uniform* (Potsdam, 2018), published reviews in *The Journal of Central European History* and *The Journal of Military History*, and is currently working on essays on the history of his family to supplement his autobiographical essay "External Events, Inner Drives" that appeared in 2015.

The Institute for Advanced Study was deeply saddened by the loss of Christian Habicht and Irving Lavin, Professors Emeriti in the School of Historical Studies. A celebrated historian of the Hellenistic period and leading authority on Greek epigraphy, Habicht died at the age of 92 on August 6, 2018. Lavin, one of America's most distinguished art historians, died at the age of 91 on February 3, 2019.

Both Habicht and Lavin were appointed to the Faculty in 1973. Habicht's remarkable contributions to ancient history shed light on Athenian society in the centuries between the fall of the Athenian empire and the establishment of the Roman empire.

"With his studies on Athenian elite families from Alexander to Cleopatra, Christian Habicht redefined the study of Athenian history," said Angelos Chaniotis, Professor of Ancient History and Classics. "His book on the Hellenistic ruler cult is such an unsurpassed scholarly achievement that an English translation was published sixty years after its first edition. Although Christian Habicht hated to be in the center of attention, his research of more than sixty years has placed him in the center of scholarly attention in a variety of fields, from Greek society to Hellenistic royalty, from the traveler Pausanias to the orator and statesman Cicero, and from the epigraphy of Thessaly and Asia



CHRISTIAN HABICHT (left) and IRVING LAVIN (right) were both appointed to the Faculty of the School in 1973 and made the Institute their intellectual home for forty-five years.

Minor to Greek religion. He was also a pioneer in the use of electronic media in epigraphic and prosopographical studies. His published work is of lasting value and will remain an inspiration for ancient historians."

Lavin was distinguished by his charismatic and challenging teaching,

rigorous search for the relationship between form and meaning in the visual arts, and the conviction that the study of the history of art was the study of the history of ideas. He was renowned for his tenacious explorations of difficult subjects, and his willingness to see all the facets and possibilities of their solutions. Lavin's deep knowledge of Italian art and culture was the result of over fifty years of study, particularly in Rome, where he embraced the city and encouraged Italian art history to move into the world of intellectual creativity.

"Irving Lavin continued to be part of the life of the School of Historical Studies until a few weeks before his passing. The breadth of his knowledge on the history of art and culture was phenomenal, as was his ability to recognize connections between seemingly disparate phenomena," said Chaniotis. "With an alert mind and youthful curiosity, he took a genuine interest in the projects of the Members, created bridges between the disciplines, and stimulated discussions."

2018–19 MEMBERS AND VISITORS

f First Term ♦ *s* Second Term ♦ *m* Long-term Member ♦ *v* Visitor

Benjamin Anderson
Byzantine Art and Architecture ♦
Cornell University ♦ *f*
Funding provided by the Hetty
Goldman Membership Fund

Hassan Farhang Ansari
Islamic Law and Theology ♦ Institute
for Advanced Study ♦ *m*
Funding provided by Carnegie
Corporation of New York

Michelle Armstrong-Partida
Medieval Gender, Sexuality, Women's
History ♦ The University of Texas at
El Paso
Funding provided by The Gladys
Krieble Delmas Foundation

Barbara Baert
Iconology, Medieval Art,
Anthropology ♦ Katholieke
Universiteit Leuven ♦ *s*
Funding provided by the Fund for
Historical Studies

Eugenio Biagini
History of Ireland in the Twentieth
Century ♦ University of
Cambridge ♦ *f*
Willis F. Doney Member

Ralf Bockmann
Byzantine Archaeology and History of
Art ♦ Deutsches Archäologisches
Institut, Rome
Funding provided by the Hetty
Goldman Membership Fund

Stephen Bokenkamp
Medieval Chinese Religion and
Literature ♦ Arizona State
University ♦ *f*
Edwin C. and Elizabeth A.
Whitehead Fellow

Marilyn Booth
Arab and Arabic Intellectual History,
Gender History, Translation Studies
University of Oxford ♦ *f*
Willis F. Doney Member

Warren Brown

Early Medieval Social History ♦
California Institute of Technology ♦
s
Funding provided by the Patrons'
Endowment Fund

Juliette Cadiot

Russian and Soviet Studies ♦ École des
Hautes Études en Sciences Sociales,
Paris
William D. Loughlin Member

Cristina Carusi

Ancient Greek History, Greek
Epigraphy ♦ The University of Texas
at Austin
Martin L. and Sarah F. Leibowitz
Member

Julian Casanova

Social History, Comparative History ♦
Universidad de Zaragoza
Funding provided by The Andrew W.
Mellon Foundation

Hilde De Weerd

Chinese Medieval History ♦
Universiteit Leiden ♦ *s*
Funding provided by the Fund for
Historical Studies

Martino Diez

Intellectual History of the Islamicate
World ♦ Università Cattolica del Sacro
Cuore, Milan ♦ *s*
Willis F. Doney Member

Katherine Epstein

Modern Anglo-American Legal,
Diplomatic, and Military History ♦
Rutgers, the State University of
New Jersey
Frederick Burkhardt Fellowship funded
by the American Council of Learned
Societies

Nergis Ertürk

Comparative Literature ♦ The
Pennsylvania State University ♦ *s*
Funding provided by the Herodotus
Fund

Alejandro Garcia-Sanjuan

History of al-Andalus ♦ Universidad
de Huelva ♦ *s*
Funding provided by the Fund for
Historical Studies

Karl Gerth

History of Modern China ♦ University
of California, San Diego
The Starr Foundation East Asian
Studies Endowment Fund Member

Sabine Go

Maritime Governance Institutions in
Early Modern Europe ♦ Vrije
Universiteit, Amsterdam ♦ *f*
Funding provided by the Fund for
Historical Studies

Glenda Goodman

American Music History ♦ University
of Pennsylvania
The Andrew W. Mellon Foundation
Fellowships for Assistant Professors

Katja Guenther

History of the Human Sciences ♦
Princeton University

Sean Gurd

Classical Sound Studies ♦ University
of Missouri–Columbia
AMIAS Member

Earle Havens

History of the Book in Early Modern
Europe, Digital History ♦ Johns
Hopkins University ♦ *f*
Funding provided by the Herodotus
Fund

Yuming He

Early Modern Chinese Cultural
History ♦ University of California,
Davis ♦ *f*
Funding provided by the Patrons'
Endowment Fund

Maggie Hennefeld

Film and Media Studies ♦ University
of Minnesota, Twin Cities
The Andrew W. Mellon Foundation
Fellowships for Assistant Professors

Hans Hummer

Social History of Medieval Europe ♦
Wayne State University
George William Cottrell, Jr. Member

Carina Johnson

Early Modern Habsburg Cultural
History ♦ Pitzer College ♦ *s*
Hans Kohn Member

Sylvie Joye

Early Medieval History, Gender and
Family ♦ Université de Lorraine,
Nancy ♦ *s*
Funding provided by the Florence Gould
Foundation Fund

Seth Kimmel

Early Modern Iberian History and
Culture ♦ Columbia University
John Elliott Member

Jeanette Kohl

Art of the Italian Renaissance ♦
University of California, Riverside
Agnes Gund and Daniel Shapiro
Member

Thomas Kruse

Ancient History ♦ Österreichische
Akademie der Wissenschaften ♦ *s*
Funding provided by The Gladys
Krieble Delmas Foundation and the
Herodotus Fund

Akinobu Kuroda

Chinese and Global Monetary
History ♦ The University of Tokyo
Roger E. Covey Member in East Asian
Studies

Lydia Liu

Global History and Modern History ♦
Columbia University
Funding provided by The Andrew W.
Mellon Foundation

Scott Lucas

Islamic Intellectual History ♦ The
University of Arizona ♦ *f*

Nathan Martin

History of Music Theory ♦ University
of Michigan
Edward T. Cone Member in Music
Studies

Christian Mauder

Mamluk Studies, Islamicate Intellectual
History ♦ Universität Leipzig
Gerda Henkel Stiftung Member

Matthew Melvin-Koushki

Early Modern Islamicate Intellectual and
Imperial History ♦ University of
South Carolina ♦ *v*

Johannes Pahlitzsch

Byzantine Studies ♦ Johannes
Gutenberg-Universität Mainz ♦ *s*
Funding provided by the Herodotus
Fund

Eric Palazzo

Medieval Art History, History of
Medieval Liturgy ♦ Université de
Poitiers
Elinor Lunder Founders' Circle Member

Nikolaos Papazarkadas

Ancient Greek History, Greek
Epigraphy ♦ University of California,
Berkeley ♦ *f*
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Fund

Gabriele Pedullà

Early Modern European Intellectual
History, Political Thought ♦ Università
degli Studi Roma Tre ♦ *s*
Hans Kohn Member

Alison Perchuk

History of Art and Architecture ♦ The
California State University,
Channel Islands
Friends of the Institute for Advanced
Study Member

Cosmin Alin Popa-Gorjanu

Medieval Nobility, Social History ♦
University of Alba Iulia
Elizabeth and J. Richardson Dilworth
Fellow

Rubina Raja

Classical Archaeology ♦ Aarhus
University ♦ *s*
Funding provided by the Hetty
Goldman Membership Fund

Michele Salzman

Roman History ♦ University of
California, Riverside ♦ *f*
Elizabeth and J. Richardson Dilworth
Fellow

Dagmar Schaefer

History of Science in China ♦ Max-
Planck-Institut für
Wissenschaftsgeschichte ♦ *s*
Funding provided by the Hetty
Goldman Membership Fund

Eric Schluessel

Early Modern Chinese and East Asian
History ♦ University of Montana
The Andrew W. Mellon Foundation
Fellowships for Assistant Professors

Brian Steininger

Japanese History ♦ Princeton
University ♦ *f*
The Starr Foundation East Asian
Studies Endowment Fund Member

Seiichi Suzuki

Anglo-Saxon and Carolingian Studies ♦
Kansai Gaidai University

Tommaso Tesei

Late Antiquity, the Qur'an, Early
Islam ♦ Van Leer Jerusalem Institute
Patricia Crone Member

Pier Mattia Tommasino

Early Modern Europe and the Muslim
World ♦ Columbia University
Infosys Member

Noa Turel

Late Medieval and Renaissance Art
History ♦ University of Alabama at
Birmingham ♦ *s*
Funding provided by the Herodotus
Fund

Karina Urbach

Modern International Relations and
Jewish Family History ♦ University of
London ♦ *v*

Maartje van Gelder

Early Modern Venice ♦ University of
Amsterdam ♦ *s*
Felix Gilbert Member

Nükhet Varlık

Ottoman History, History of Plague ♦
Rutgers, the State University of
New Jersey, and New Jersey
Institute of Technology
Funding provided by the Fund for
Historical Studies

Louise Young

Modern Japanese History ♦ University
of Wisconsin–Madison ♦ *f*
Funding provided by the Fund for
Historical Studies

Maria Youni

History of Ancient Law, Greek
Epigraphy ♦ Democritus University
of Thrace
Willis F. Doney Member



The grave epigram of a traveling pig gives an unusual insight into the mobility of the era. Having traveled all the way from Dyrrhachion on the Adriatic Sea to Edessa in Macedonia, the pig was run over by a wagon on its way to a festival of Dionysus. Pella, Ephorate of Antiquities, AKA 1674.

ANGELOS CHANIOTIS ON HELLENISM FROM ALEXANDER TO HADRIAN

The developments that Alexander's campaigns set in motion ultimately led to the creation of a complex network of political, administrative, economic, and cultural connections that came close to the modern phenomenon of globalization. Of course, this network did not extend over the entire globe, but it did cover the region that contemporaries knew as the oecumene, "the inhabited earth." One might more appropriately speak of "ecumenization." Read more at www.ias.edu/ideas/chaniotis-brave-new-world.

ISRAEL FINKELSTEIN ON JERUSALEM IN BIBLICAL TIMES

On November 9, 2018, Israel Finkelstein, Jacob Alkow Professor of the Archaeology of Israel in the Bronze and Iron Ages at Tel Aviv University, gave a public lecture on "Jerusalem in Biblical Times: Comments on the Archaeology and History ca. 1350–100 B.C.E."

Finkelstein presented an up-to-date account of the archaeology of Jerusalem from the Late Bronze Age under Egyptian domination, through the days of the Kingdom of Judah, to the Babylonian destruction and near-abandonment in the Persian period and recovery in late Hellenistic times. Watch the lecture at www.ias.edu/ideas/finkelstein-video-jerusalem.



MYLES W. JACKSON ON SCIENCE AND CULTURE



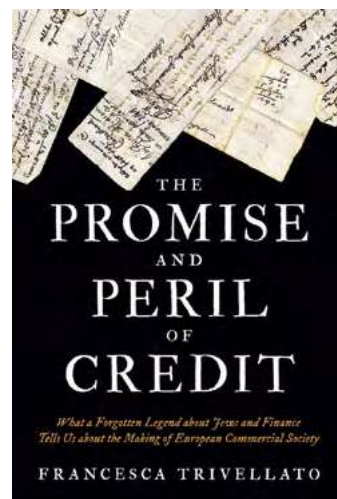
AHASOFT/20843318/VECTORSTOCK

I am interested in having the historian at the table while a scientific controversy is ongoing. We historians are rather good at illustrating that controversies have histories: how we arrived at where we are today is very informative. There have always been, and always will be, alternatives. The types of questions I am interested in investigating include: how stable are the concepts of ownership and knowability over time, extended to the molecular level of DNA? What has been the influence of natural scientists, engineers, and scientific instrument makers on musical aesthetics from the early nineteenth century to the rise of computer music? How have their interactions changed the relationships between composer, performer, and musical instrument? How do partisan beliefs intermingle with the specialization of technical and scientific knowledge, social status, and the politics of labor? Read more at www.ias.edu/ideas/jackson-science-culture.

FRANCESCA TRIVELLATO ON THE PROMISE AND PERIL OF CREDIT

The Promise and Peril of Credit examines key episodes in the West's millennium-long struggle to delineate the place that finance ought to occupy in the social and political order. It does so by introducing readers to modes of thinking about the morality of credit that have become increasingly alien to us even as the questions that animated those early modern discussions remain as vital now as they were then.

After decades of retreat from the mainstream, economic history is making its way back to college curricula and scholarly publications. Today as always, present concerns stimulate academics' choice of subject matter and approaches to historical inquiry. Income and wealth inequality, the connection between slavery and capitalist modes of production and consumption, the impact of cultural traditions on economic performance, and the timing and consequences of globalization top the list of current research topics pursued by economic historians of various persuasions. A sense of urgency infuses this research—a welcome and energizing change after decades during which North American history departments' interest in economic history lay dormant. Read more at www.ias.edu/ideas/trivellato-promise-and-peril.



SABINE SCHMIDTKE ON ISLAMIC MANUSCRIPT TRADITIONS

The Islamic manuscript tradition is huge. It is global, it is under immediate threat, and it is indispensable—intellectually, politically, and socially. The textual production in the Islamic world is enormous. We do not possess reliable data that would allow us to quantify the overall literary production by Muslim scholars in the past 1,500 years, nor do we have any estimate for the total number of preserved manuscripts. However, the following figures, randomly chosen, may provide some idea of the overall scale. Watch more at www.ias.edu/ideas/islamic-manuscript-traditions.



ANDREA KANE



ANDREA KANE

Arnold J. Levine, Professor Emeritus in the School of Natural Sciences, remembers Irving Lavin.

REMEMBRANCE IN HONOR OF IRVING LAVIN

On April 26, 2019, the Institute celebrated the life and work of Irving Lavin (1927–2019) with an all-day event that began with a series of scholarly discussions in the morning, followed in the afternoon by personal remembrances. Lavin's colleagues, friends, and collaborators, including architects Frank Gehry, Phyllis Lambert, and Greg Lynn; art historians Horst Bedekamp, Nicola Courtright, Jack Freiberg, David Levine, and Charles Scribner III; and many others, including Professor Emeritus Arnold J. Levine (pictured), gathered to remember the distinguished Professor who made the Institute his intellectual home for forty-five years. Watch the remarks at www.ias.edu/ideas/lavin-remembrance.

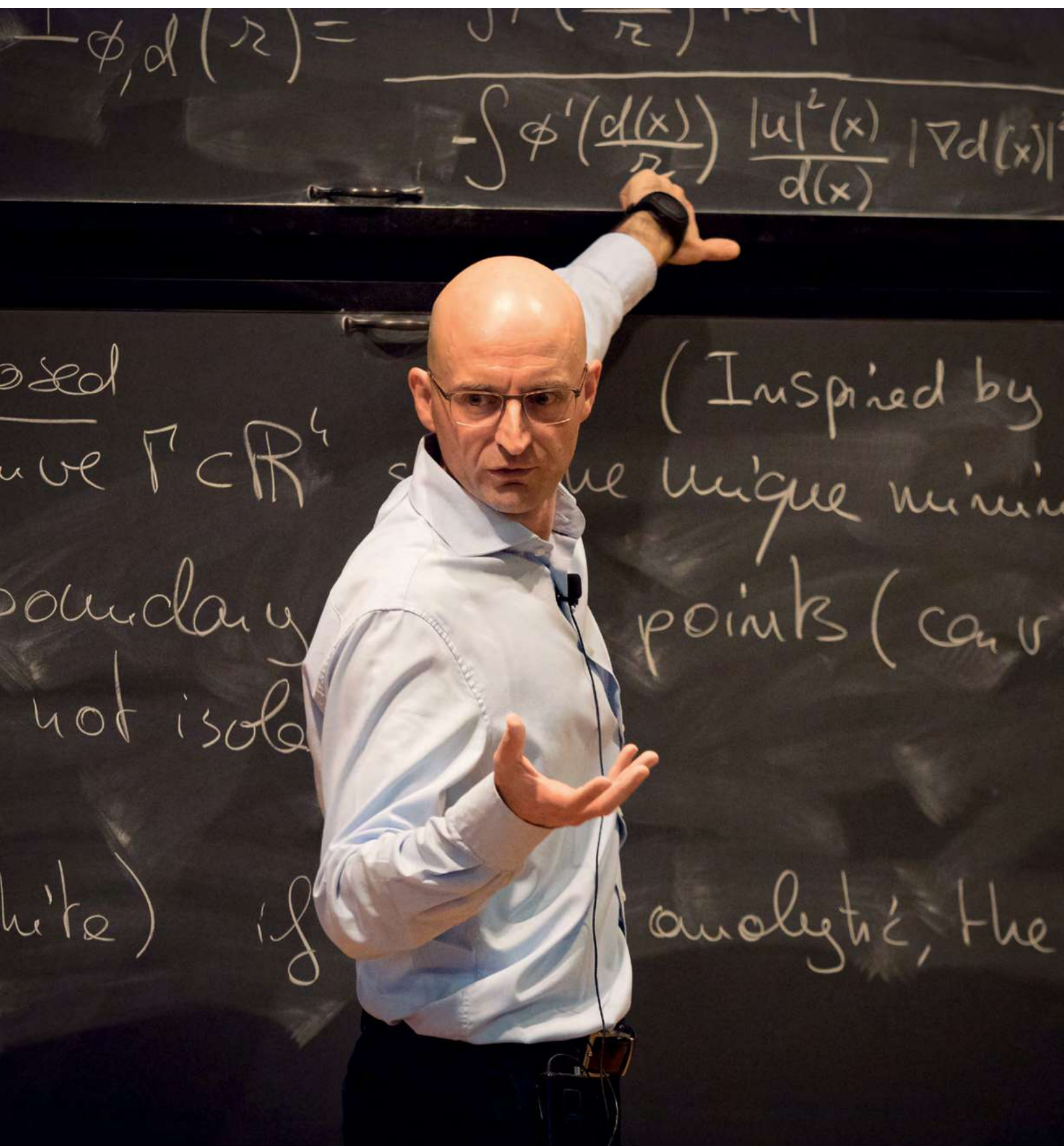
PATRICK J. GEARY ON THE CROSS-DISCIPLINARY ANALYSIS OF ANCIENT CEMETERIES

Applying a comprehensive analysis of genetic, historical, and archaeological factors in two sixth-century barbarian cemeteries, researchers have gleaned new insights into a key era known as the Migration Period that laid the foundation for modern European society. Spanning the fourth to eighth centuries, this epoch followed the decline of the Western Roman empire and was a time of major socioeconomic and cultural transformation in Europe. However, despite more than a century of scholarly work by historians and archaeologists, much about the period still remains unknown or is hotly debated, as reliable written accounts are lacking.

An international team of geneticists, historians, and archaeologists, led in part by Patrick J. Geary, Andrew W. Mellon Professor in the School of Historical Studies, has for the first time sequenced the genomes of entire ancient cemeteries—one in Hungary and one in Italy. Published in *Nature Communications*, the team's paper sheds new light on how these communities were formed, how people lived, and how they interacted with the local populations they supposedly came to dominate. Read more at www.ias.edu/news/press-releases/geary-barbarians.



SOPRINTENDENZA ARCHEOLOGIA, BELLE ARTI E PAESAGGIO PER LA CITTÀ METROPOLITANA DI TORINO



Questions regarding the formation of singularities and their descriptions are the main subjects of research of CAMILLO DE LELLIS, IBM von Neumann Professor. The two topics he recently has been focused on are the calculus of variations and the equations of incompressible fluid dynamics.



School of Mathematics

The School of Mathematics, established in 1933, was the first School at the Institute for Advanced Study. Several central themes in mathematics of the twentieth and twenty-first centuries owe their major impetus to discoveries that have taken place in the School, which today is an international center for research on mathematics and theoretical computer science.

A VARIETY OF SYSTEMS IN NATURAL SCIENCES are described through physically measurable quantities that depend on “independent variables.” For instance, we routinely measure the pressure and the temperature of the air in the Earth’s atmosphere and such measurements depend upon the time and the location of the device used. Several fundamental laws discovered by scientists through the last three centuries give relations among the rates of change of such physical quantities. The resulting mathematical objects, called partial differential equations, are therefore ubiquitous in modern science and engineering: they are efficiently used to model a variety of different phenomena like the flow of air past the wings of an airplane, the collapsing of a star into a black hole, and the spreading of a pollutant in the air.

The theoretical study of partial differential equations is a branch of pure mathematics that dates back to the dawn of modern sciences, originating in the works of Bernoulli, Fermat, Newton, Lagrange, Euler, and several others. Central theoretical questions are the existence of solutions, how they behave, what we need to know to determine them and whether they break down, for instance, when they get in a range where the validity of the equations can be challenged. The latter phenomenon is usually called singularity formation. Such questions, especially the formation of singularities and their descriptions, are the main subjects of the research of **Camillo De Lellis**, IBM von Neumann Professor. The two topics in which he has spent most of his recent efforts are the calculus of variations and the equations of incompressible fluid dynamics.

In the calculus of variations, one seeks the solution of a minimum problem, for instance, a shape that optimizes a certain feature. A prominent example is named after the Belgian nineteenth-century physicist Joseph Plateau, who proposed to study area-minimizing surfaces, namely surfaces which minimize their area among those which span a fixed contour. It is long known that such surfaces might have singularities, for instance, the formation of certain type of corners, but a complete description of the type and size of singularities is a long-standing open problem.

FACULTY

Jean Bourgain

*IBM von Neumann Professor
deceased December 22, 2018*

Camillo De Lellis

IBM von Neumann Professor

Helmut Hofer

Hermann Weyl Professor

Peter Sarnak

Richard Taylor

*Robert and Luisa Fernholz Professor
through January 1, 2019*

Akshay Venkatesh

Robert and Luisa Fernholz Professor

Avi Wigderson

Herbert H. Maass Professor

PROFESSORS EMERITI

Enrico Bombieri

Pierre Deligne

Phillip A. Griffiths

Robert P. Langlands

Robert D. MacPherson

Thomas Spencer

De Lellis and his collaborators have shown that surprisingly many singularities can occur at the junction between an area-minimizing surface and its contour, even when the latter is quite simple and smooth. However, their work also gives the first proven theoretical limitation to the size of the singularities without any special geometric assumption on the contour. When the contour is a real analytic curve, a conjecture by White asserts that in fact there can be only finitely many singularities. A recent preprint authored by De Lellis and IAS Member Zihui Zhao gives a first step in that direction. The first system of partial differential equations ever written down in fluid dynamics is given by the Euler equations, found by Leonhard Euler more than 250 years ago. The incompressible Euler equations are in fact a limiting case of another well-known system, the Navier-Stokes equations.

Whether regular solutions of the Euler and Navier-Stokes equations might form singularities in finite time is one of the biggest open problems in mathematics: for the Navier-Stokes equations, it is one of the famous millennium prize problems. In the last decade, De Lellis and László Székelyhidi, Jr., have shown that there are very irregular solutions, many more than expected, and that they might behave in a very surprising way. Their new approach borrows from the pioneering work of John Nash during the 1950s on the isometric embedding problem, a thus far completely unrelated

topic in differential geometry, another branch of mathematics. The ideas of De Lellis and Székelyhidi are at the base of recent important developments, such as the resolution by Phil Isett of a 1949 fundamental conjecture of Lars Onsager (Nobel Prize winner in chemistry) in the theory of turbulent flows, and the unexpected discovery by Tristan Buckmaster and Vlad Vicol that irregular solutions of the Navier-Stokes system are not uniquely determined by the equations.

The fields of symplectic geometry and dynamical systems originate in the work of Henri Poincaré, who had a pronounced interest in celestial mechanics. The natural questions in this field, many of them very hard problems, had great impact on the development of mathematics. Although Poincaré had an integrated viewpoint, his ideas lead subsequently to the development of different fields. While the field of dynamical systems showed a steady development, this was not the case for the field of symplectic geometry. However, after lingering for a long time, the latter took off in an unprecedented way in the early eighties, with major impact in a variety of different mathematical disciplines and even physics. This development started with the work of former Members Charles Conley and Eduard Zehnder in 1983, followed shortly afterwards by the work of Abel Prize winner Mikhael Gromov in 1985, and that of Andreas Floer, 1986–89, who introduced a novel set of ideas, which have been worked out in many contexts and are referred to as Floer-type theories.

The activities of **Helmut Hofer**, Hermann Weyl Professor, with current and former IAS Members and collaborators have focused on several directions and aspects of this development. In 2011–12, the School’s “Symplectic Dynamics” special program, led by Hofer and Member John Mather, started a new research area, built on integrated ideas from the fields of symplectic geometry and dynamical systems. These new ideas immediately lead to breakthroughs in longstanding problems. One of the

first breakthroughs, related to problems by Dmitri Anosov and Anatole Katok, was by 2011–12 Member and recent von Neumann Fellow Barney Bramham. Most recently, in December 2018, former Member (2013–15) Joel Fish and Hofer submitted a 160-page research paper “Feral Curves and Minimal Sets,” which initiates a theory for finding small closed invariant subsets for Hamiltonian systems. Incidentally, the theory also answers a question raised by former Member (1988–89) Michael Herman at his invited lecture at the International Mathematical Congress in Berlin in 1998 (in the four-dimensional case). Finding such subsets is a basic problem in the field of dynamical systems. Periodic orbits are a very special example, but they very often do not exist, and the above-mentioned work develops an approach to find the “next best thing,” namely a minimal set.

This work also holds significant promise for developments in symplectic geometry. In 2000, Hofer predicted in a long paper, jointly with Yakov Eliashberg, former Distinguished Visiting Professor (2001–02), and Alexander Givental, a very general theory of symplectic invariants, called symplectic field theory (SFT). It describes geometric properties of symplectic spaces by a wealth of algebraic invariants, which are constructed by extracting in systematic ways information from a class of Hamiltonian systems with symplectic space as a phase space. More precisely, the points of a symplectic space can be viewed as the possible states of a physical system—picking a Hamiltonian system on the space is the same as fixing the physical laws, which govern the system. SFT is built from the structure of periodic movements allowed by such systems. The algebraic framework to describe the invariants is then that of graded, filtered, differential super-Weyl algebras. Weyl algebras are named after Hermann Weyl, former IAS Professor (1933–55), who introduced them to study the Heisenberg uncertainty principle in quantum mechanics. The other adjectives “graded, super, differential” describe additional structures, which were later considered

FACULTY & EMERITI HONORS

Robert P. Langlands was appointed a Companion of the Order of Canada.

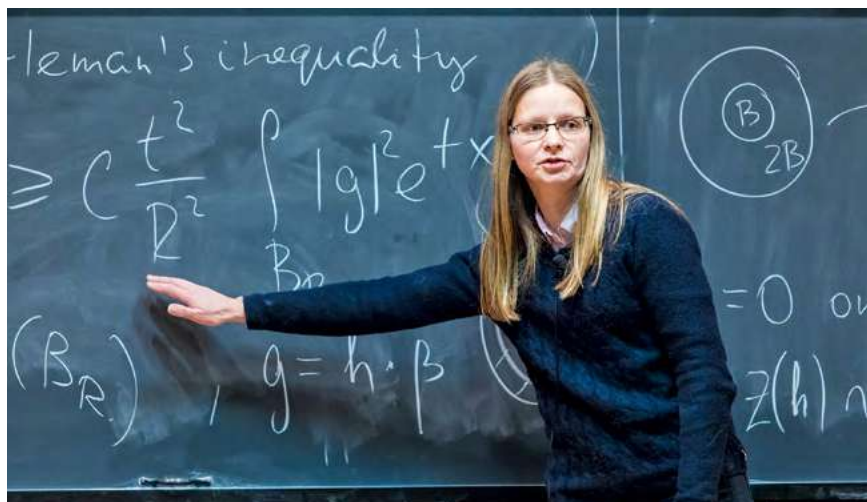
Akshay Venkatesh was awarded a 2018 Fields Medal from the International Mathematical Union, and was elected a Fellow of the Royal Society.

Avi Wigderson was awarded the 2019 Donald E. Knuth Prize from the ACM Special Interest Group on Algorithms and Computation Theory and the IEEE Technical Committee on the Mathematical Foundations of Computing.

in the Weyl context, whereas the “filtered” aspect comes from Floer-theoretic considerations, particularly those appearing in the initial construction of symplectic homology theories by Floer and Hofer, which were published in 1994–95.

In the SFT context, since these periodic movements do not always exist, there are obvious limitations, and the constructions can only be carried out in restricted situations. However, the results by Fish and Hofer strongly indicate that the natural framework for SFT should be built on minimal sets rather than periodic orbits. Incidentally, minimal sets were introduced by George David Birkhoff, a leading mathematician of his time in the field of dynamical systems, as a substitute for periodic orbits. If the constructions for SFT could be extended to use minimal sets rather than periodic orbits, one would reach the ultimate level of generality under which this type of algebraic invariants can be constructed.

The constructions in cases that can be built on periodic orbits are extremely technical—at the core lies the analysis of nonlinear partial differential equations, which exhibit so-called “bubbling-off” phenomena. The successful treatment of such phenomena in the theory of minimal surfaces goes back to the work of Karen Uhlenbeck, Visiting Professor and 2019 Abel Prize laureate. In this context, a rather sophisticated transversality theory, which allows the introduction of the notion of a “generic problem,” i.e., one with typical properties and, in general, much nicer behavior, is needed. For these generic problems, it is easier to extract the relevant data. The scheme to define invariants for a general system is then to approximate it by the generic ones to extract the data and to show that the extracted data for the approximations stabilizes if the approximation is good enough. In order to develop this scheme, Hofer with former Members Kris Wysocki and Eduard Zehnder began around 2003 to develop what is called polyfold theory, a mixture of a generalized nonlinear analysis and a generalized



EUGENIA MALINNIKOVA, von Neumann Fellow, leads an analysis seminar on “Two Questions of Landis and Their Applications.”

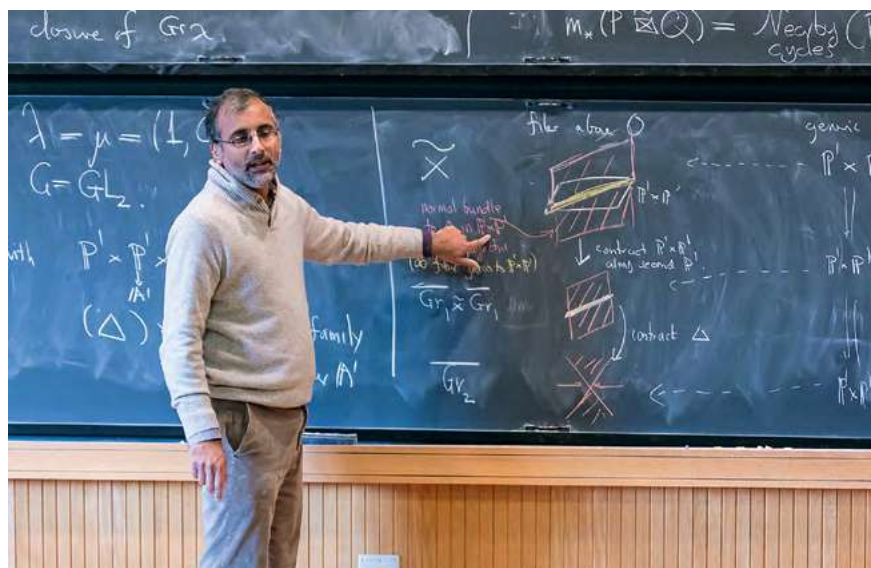
differential geometry, combined with some category theory. A research monograph of 700-plus pages, *Polyfold and Fredholm Theory*, submitted in 2017, has meanwhile been accepted for publication and is undergoing some revisions. A follow-up volume jointly with Fish, *Polyfold Constructions: Tools, Techniques, and Functors*, is in an advanced stage and the relevant mathematical issues have been worked out but still need some “beautification.”

In 2018–19, von Neumann Fellows Bramham, Umberto Hryniewicz, and Yaron Ostrover organized a Symplectic Dynamics Working Group. Besides these activities, IAS and Princeton University ran an IAS/PU Joint Symplectic Seminar, where the topics ranged over a very broad spectrum. The seminar was organized by Nate Bottman (IAS and PU), Bramham (IAS), Hofer (IAS), John Pardon (PU), Ian Zemke (PU) and Zhengyi Zhou (IAS). In addition, Hofer was the co-organizer of a workshop on dynamical systems at the mathematical research center in Oberwolfach, Germany, in July 2019, as well as the conference on C^0 -aspects of symplectic geometry and Hamiltonian dynamics at the Technion in Haifa in May 2019.

Understanding solutions of algebraic equations in integers is a central theme in the theory of numbers. In the setting where one expects to have many integer and real solutions, a central theme is to

understand the structure versus randomness of the solutions. For equations with many variables and fixed degrees, analytic tools allow for a detailed understanding of the problem, and there have been recent advances in reducing the number of variables; most notably by IBM von Neumann Professor Jean Bourgain (together with his collaborators Ciprian Demeter and Larry Guth, both former Members) before his untimely passing in December 2018. Further advances on variants on this problem were obtained by Shaoming Guo and Ruixiang Zhang.

In the case of a small number of variables, there are few available techniques or results. For example, is every integer, which doesn’t give remainder 4 or 5 when divided by 9, a sum of three integer cubes? Little is known, and even what to expect is debated by experts. Professor **Peter Sarnak** with Bourgain and former Member Alexander Gamburd, and separately with former Member Amit Ghosh, has examined some special cubic equations called “Markoff surfaces” for which they have developed a theory. These surfaces are acted on by a nonlinear symmetry group and together with tools from dynamics, combinatorics, transcendence, and analytic number theory, allow one to understand the structure versus randomness of the solutions and “local to global” principles for these cubics. The case of integral quadratic equations in



AKSHAY VENKATESH, Robert and Luisa Fernholz Professor and 2018 Fields Medalist, continued working with Member Preston Wake to understand the behavior and internal structure of zeta functions under tame variations.

few variables is classical and one asks about much finer (in fact optimal) features. The solutions to these equations are homogeneous spaces for linear orthogonal group actions, and this allows one to bring some of the most powerful tools from the modern theory of automorphic forms to bear on these fine questions. In the case of four variables, former Member Ori Parzanchevski and Sarnak have shown how the randomness in the solutions for these cases can be used to construct optimal, explicit, and efficient universal gates for quantum computation (specifically the first basic case of optimal 1-qubit gates). Member Shai Evra and Parzanchevski have found similar “golden gates” for second basic cases of 2-qubit gates, using the theory of automorphic forms on unitary groups in 4 variables (universal gates are generated by these one and two bit gates).

For random real homogeneous polynomials of high degree in a fixed number of variables, there are many connected components in their (real) solution sets. Sarnak with former Member Yaiza Canzani and Igor Wigman have shown that there is a universal distribution of the topological types of these components. Little is known about these probability distributions, and numerical simulations by Alex Barnett show there is a dramatic difference between 3 and more variables.

This indicates a dramatic change from a critical to a supercritical percolation regime as one passes from 3 to more variables. Understanding this phenomenon is a major challenge.

Akshay Venkatesh, Robert and Luisa Fernholz Professor, focused on two projects in 2018–19. Firstly, a still ongoing project with Member Preston Wake, where they tried to understand in a more systematic way the behavior of zeta functions under tame variation. In number theory, *p*-adic variation consists of studying congruences modulo higher and higher powers of a single prime. It leads to structure often having strong analogies with real analysis. “Tame variation” is an intriguing twist on this, where one studies a system of congruences at integers N for which $N-1$ is divisible by higher and higher powers of a single prime. Experience shows that these systems also have a rich internal structure, which Wake and Venkatesh are trying to understand.

Secondly, Venkatesh has been working on a research project with former Members Yiannis Sakellaridis and David Ben-Zvi. In the theory of automorphic forms, a “period” is a way of extracting an L-function from a modular form. There are many sporadic examples of periods known (starting with work of

Hecke in the 1920s) but a clear unifying theory is still lacking. Continuing on ideas developed in a seminar during the School’s 2017–18 Special Year, Venkatesh, Sakellaridis, and Ben-Zvi found that, when viewed from a “microlocal” viewpoint, a new duality becomes apparent. This duality switches one period with another (often very different) period; its existence is surprising for number theory but is very closely related to ideas introduced earlier in the physics literature by Davide Gaiotto, former Member in the School of Natural Sciences, and Edward Witten, Charles Simonyi Professor in the School of Natural Sciences.

In the past four years, Herbert H. Maass Professor **Avi Wigderson**, together with IAS Members and Visitors, Princeton University students, and other collaborators, has been pursuing a program that brings together optimization and complexity theory from computer science, and invariant theory and algebraic geometry from mathematics. The premise, motivation, and starting point is a twenty-year-old counter-intuitive result (of Valentine Kabanets and former Visiting Professor Russell Impagliazzo) showing that an efficient deterministic algorithm testing membership in a certain natural algebraic variety will lead to computational hardness results. This can make progress in the central long-term goal of proving $P \neq NP$, or its algebraic analog, $VP \neq VNP$.

The main effort has gone into the development of techniques and algorithms of this nature for related algebraic varieties. This has already resolved important open problems in several disparate areas and revealed new connections between them. Examples include efficient algorithms for the word problem for non-commutative fields, the verification and optimality of Brascamp-Lieb inequalities in analysis, entanglement problems in quantum information theory, and asymptotic Kronecker coefficients in representation theory. Besides providing algorithms, these works lead also to establishing and resolving purely structural mathematical problems.

More importantly, this project has identified general (non-convex) computational problems, which include the ones above as special cases, for which continuous (analytic) optimization tools are effective, and generally much more efficient than classical symbolic (algebraic) methods. These problems are defined by linear group actions, and include minimization of the moment map and membership in moment polytopes defined by orbits of such actions. We have general algorithms for such problems which extend classical convex optimization ones to the geodesic setting of Riemannian manifolds. These algorithms promise to be powerful for combinatorial optimization, and call for further development and applications. A week-long workshop on this topic took place at IAS in June 2018: all lecture videos and other materials are available at www.math.ias.edu/ocit2018.

In 2018–19, related connections between computational complexity and invariant theory and algebraic geometry were explored with IAS Members Visu Makam, Guy Moshkovitz, and Jeroen Zuiddam. They focused on proving lower bounds on tensor ranks (as well as upper bounds, for understanding the complexity of matrix multiplication). In particular, new barriers to proving hardness results by known methods have been obtained (with Member Visu Makam and Princeton University alumni Ankit Garg and Rafael Oliveira) through a new “implicit function theorem” for polynomial maps.

Special Year Program: Variational Methods in Geometry

During the 2018–2019 academic year, the IAS School of Mathematics conducted a special program on variational methods in geometry. The program was led by Distinguished Visiting Professor **Fernando Codá Marques** of Princeton University. Variational methods have been used in geometry since the pioneering works of Euler and Lagrange in the eighteenth century. Lagrange posed the problem of finding surfaces of least area. More recently, critical points of positive Morse index

have played an important role. The goal of the program was to develop further the critical point theories associated with different geometric functionals and to find connections between these themes. Among the topics covered by the program were minimal surfaces, constant mean curvature surfaces, Willmore surfaces, harmonic maps, phase transition regularizations, Yang–Mills connections, extremal eigenvalue problems, systolic and metric geometry, self-similar solutions to mean curvature flow, and others.

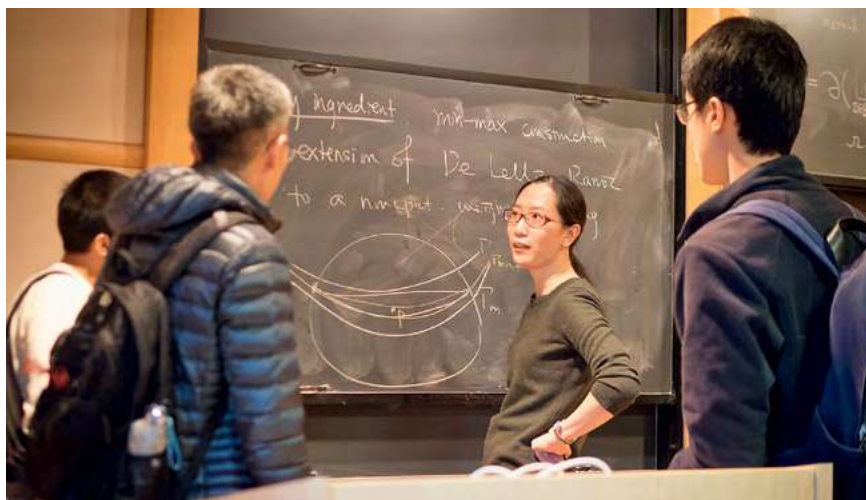
The program included senior Members Ailana Fraser, Nicos Kapouleas, Bill Meeks, Alexander Nabutovsky, André Neves, Tristan Rivière, Regina Rotman, Richard Schoen, and Neshan Wickramasekera, as well as a host of younger researchers. The weekly seminar brought together Members and Visitors for two talks every Tuesday. Speakers were asked to discuss details of their works after giving an initial overview. This format and the broad array of speakers encouraged lively discussions and interactions.

There were two week-long workshops associated with the program. The first workshop, “Mean Curvature and Regularity,” took place November 5–9, 2018. This workshop was focused on questions related to the area functional. The second workshop, “Geometric Functionals: Analysis and Applications,” took place March 4–8, 2019. The spring workshop

intended to stimulate collaboration among people working in different areas related to the subject of the program.

Two reading groups met during the first term. The Allen–Cahn/Ginzburg–Landau reading group discussed phase transition partial differential equations, which provide an approach to construct minimal varieties through the analysis of the asymptotic behavior of solutions to the equations in the singular limit. The geometric measure theory reading group covered, among other things, relevant concepts and techniques that are needed in the min–max construction of closed minimal hypersurfaces in Riemannian manifolds.

Many important results were announced during the program. In January 2019, Member Xin Zhou posted a proof of the Marques and Neves multiplicity one conjecture in the Almgren–Pitts setting. This establishes that for generic metrics any minimal hypersurface produced by min–max theory has multiplicity one. This is a statement needed in the analysis of the Morse index of such hypersurfaces. Member Celso Viana wrote a preprint with a solution to the isoperimetric problem in the real projective spaces of constant curvature in any dimension. In the seminar, Member Tristan Rivière discussed a min–max procedure that applies to families of parametrized surfaces in arbitrary codimension.



LU WANG, von Neumann Fellow and Zurich Financial Services Member, gives a talk on “Topological Uniqueness of Self-Expanders of Small Entropy” during a special-year seminar. Wang works on geometric analysis with an emphasis on geometric flows.

THOMAS CLARKE

Other significant advances were obtained, and new fruitful collaborations have started. The atmosphere during the program was extremely positive. The younger Members were particularly enthusiastic, and perhaps inspired by the occasion, approached difficult and important problems. The program has played a fundamental role in stimulating great mathematics around the calculus of variations.

Theoretical Machine Learning

The machine learning group led by Visiting Professor **Sanjeev Arora** has focused on trying to understand why the centuries-old Occam's razor of data analysis ("complicated models overfit to the data and do not predict well on new data") seems to not hold for deep nets, the dominant paradigm

in today's machine learning and artificial intelligence.

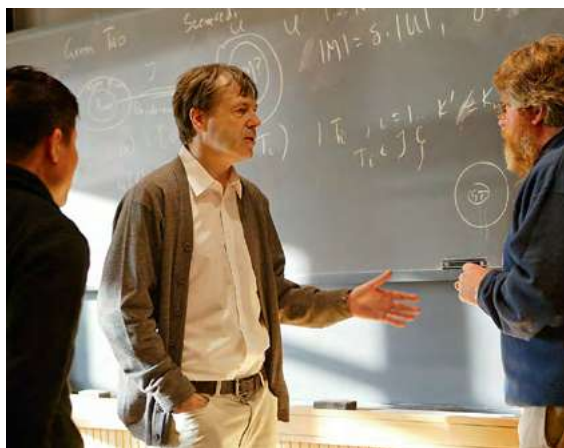
Arora has been trying to understand this over-parametrization mystery in collaboration with his graduate students at Princeton University and IAS Member Nadav Cohen. They arrived at a simple framework that exhibits this effect: deep linear net, a very simple kind of deep net. These can solve a well-known linear algebra problem, matrix completion, significantly better than classic algorithms. The analysis of the training algorithm involves an intricate analysis of the trajectory of optimization.

The trajectory of optimization also plays a central role in another related project of Arora and coauthors. This involves studying the over-parametrization phenomenon in the infinite limit (also called thermodynamic limit):

allowing the width of the deep net to approach infinity but keeping the input layer fixed so it can still be trained on a standard finite dataset. A sequence of recent papers led to the result that the training trajectory approaches a limit as well and leads to an infinite deep net termed "neural tangent kernel." Arora and his student coauthors have led to the first exact algorithm to compute this kernel and also quantify how well it generalizes to new data. Surprisingly, the performance of the infinite net turns out to be only slightly lower than that of the finite one, thus highlighting that even ridiculously over-parametrized nets make sense on real-life datasets. The analysis of the optimization trajectories used in these works has natural points of connection with older notions in dynamical systems, differential equations, and physics.

The Institute for Advanced Study was deeply saddened by the loss of Jean Bourgain, IBM von Neumann Professor in the School of Mathematics, revered for the exceptional range, depth, and power of his mathematical work. Bourgain passed away in Bonheiden, Belgium, on December 22, 2018, at the age of 64. Despite a long battle with cancer, his resilient and dauntless approach to challenges remained undeterred. He continued working through the end of his life, with great generosity and grace, while building upon a prolific career in mathematics.

Bourgain was appointed to the Faculty in 1994, the same year he received a Fields Medal, and had served as IBM von Neumann Professor since 2010.



JEAN BOURGAIN (center) was appointed to the Faculty in 1994, the same year he received a Fields Medal, and had served as IBM von Neumann Professor since 2010.

"Jean had an unequalled analytic brilliance, which together with his positive outlook allowed him to resolve many long-standing problems in a broad range of areas of mathematics," said Peter Sarnak, Professor in the School of Mathematics and a friend, collaborator, and colleague. "His breakthroughs came with unexpected novel techniques and theories which drive and define the contemporary field of mathematical analysis. The same clarity and optimism characterized his very effective

service over many years as the Chair of the School of Mathematics. His premature passing is a major loss to the Institute and to mathematics."

2018–19 MEMBERS AND VISITORS

f First Term ♦ *s* Second Term ♦ *v* Visitor ♦ *vp* Visiting Professor ♦ *dvp* Distinguished Visiting Professor ♦ *vri* Veblen Research Instructorship ♦ *vnf* von Neumann Fellowship

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Advanced Study

Funding provided by the National
Science Foundation

Preston Wake

Number Theory ♦ Institute for
Advanced Study

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Lu Wang

Geometric Analysis ♦ University of
Wisconsin–Madison ♦ vnf
Zurich Financial Services Member

Sida Wang

Machine Learning, Natural Language
Processing ♦ Institute for Advanced
Study and Princeton University
Funding provided by Eric and Wendy
Schmidt

Neshan Wickramasekera

Geometric Analysis ♦ University of
Cambridge ♦ s

Funding provided by the Charles
Simonyi Endowment

Robert Williams

Dynamical Systems ♦ The University
of Texas at Austin ♦ v

Jakub Witaszek

Algebraic Geometry ♦ Institute for
Advanced Study

Funding provided by the National
Science Foundation

Damin Wu

Differential Geometry ♦ University of
Connecticut

Funding provided by the Charles
Simonyi Endowment

Jiaxian Wu

Geometric Analysis, Hodge Theory ♦
Nanjing University of Science and
Technology ♦ v, f

Umberto Zannier

Diophantine Geometry, Algebraic
Points on Transcendental Varieties ♦
Scuola Normale Superiore di Pisa ♦
v, s

Richard Zemel

Machine Learning ♦ University of
Toronto ♦ v, s

Funding provided by Eric and Wendy
Schmidt

Zhiyuan Zhang

Ergodic Theory and Dynamical
Systems ♦ Institute for Advanced
Study

Funding provided by the National
Science Foundation

Zihui Zhao

Harmonic Analysis, Geometric Measure
Theory ♦ Institute for Advanced
Study

Funding provided by the National
Science Foundation

Rong Zhou

Geometry of Shimura Varieties ♦
Institute for Advanced Study
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Science Foundation

Xin Zhou

Geometric Analysis, General
Relativity ♦ University of California,
Santa Barbara

Funding provided by the National
Science Foundation

Zhengyi Zhou

Symplectic Geometry ♦ Institute for
Advanced Study

Funding provided by the National
Science Foundation

Jonathan Julian Zhu

Geometric Analysis ♦ Institute for
Advanced Study ♦ v

Jeroen Zuiddam

Algebraic Complexity, Combinatorics,
Quantum Information ♦ Institute for
Advanced Study

Funding provided by the National
Science Foundation



KAREN UHLENBECK ON BEING THE FIRST WOMAN TO RECEIVE THE ABEL PRIZE

It's not so easy being a role model. One of the things you learn when you're going through life and so forth is that you need role models,

but you don't need perfect role models. You need role models who fall down and pick themselves up. You need role models who show how even though you can't do everything, you can do some things. You need role models to keep you going. Read more at www.ias.edu/ideas/uhlenbeck-first-woman-abel-prize.



VIDEOS FROM DEEP LEARNING: ALCHEMY OR SCIENCE?

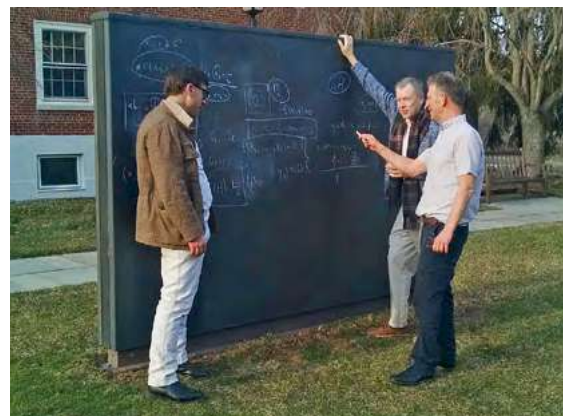
In February 2019, Visiting Professor in the School of Mathematics Sanjeev Arora hosted a day of talks titled "Deep Learning: Alchemy or Science?" Featuring lectures by Arora, Zachary Lipton, Yann LeCun, Joelle Pineau, Shai Shalev-Shwartz, and Michael Collins, along with a concluding panel discussion moderated by Director and Leon Levy Professor Robbert Dijkgraaf, the event focused on the challenges of establishing a theoretical understanding of deep learning. Watch videos at www.ias.edu/ideas/videos-deep-learning-alchemy.

AVI WIGDERSON ON MATHEMATICS AND COMPUTATION

The Theory of Computation is a vast field. Many of its subfields are directly connected with applications. These develop formal, mathematical

foundations and theories of programming languages, operating systems, hardware, networking, databases, security, robotics, and artificial intelligence, as well as numerous efficient algorithms and algorithmic techniques to solve the basic problems arising in these fields. These models and algorithms contribute directly to the amazing variety of ways in which computers affect our lives. Read more at www.ias.edu/ideas/mathematics-and-computation.

A MAJOR CHALLENGE
IS TO UNDERSTAND
WHY AND FOR WHAT
TASKS ARE DEEP
NETWORKS
SUCCESSFUL, AND
WHAT ARE THEIR
LIMITATIONS.



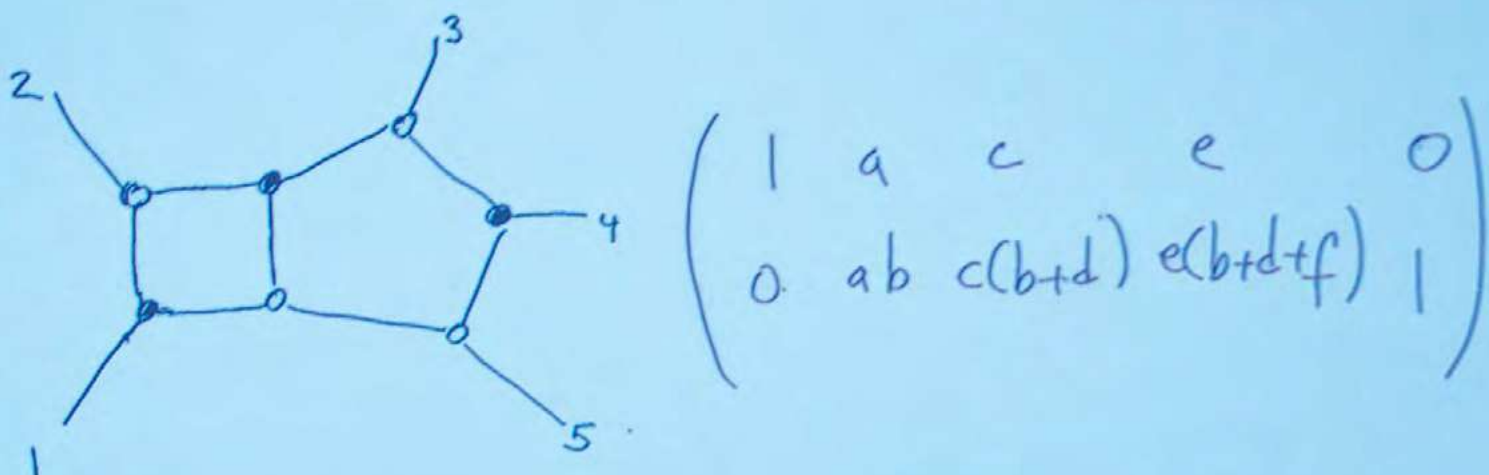
ALEXANDER GAMBURD ON THE SINGULAR ADVENTURES OF BARON BOURGAIN IN THE LABYRINTH OF THE CONTINUUM

I met Jean Bourgain in September 2005, six months after my daughter was born, while visiting IAS for the program "Lie Groups, Representations and Discrete Mathematics," led by Alex Lubotzky. I do not remember the precise date but do remember the hour: it was between 2 and 3 a.m. After changing my daughter's diaper, I could not sleep, went to Simonyi Hall, and ran into Jean walking to the library. It was in this discombobulated state that I was free of fear to speak to him. By dawn, the problem which had been resisting my protracted attack for a decade was vanquished in Jean's office. Read more at www.ias.edu/ideas/bourgain-singular-adventures.



VIDEOS FROM THE REMEMBRANCE IN HONOR OF JEAN BOURGAIN

From May 31–June 1, 2019, IAS hosted a remembrance in honor of Jean Bourgain. The public event brought together colleagues, friends, and collaborators—including Professors Peter Sarnak and Avi Wigderson (pictured), several past Members, and others—to commemorate Bourgain's life and work. Watch talks from the event at www.ias.edu/ideas/bourgain-remembrance-videos.



Professor NIMA ARKANI-HAMED (right) and THOMAS LAM (left), von Neumann Fellow in the School of Mathematics, in conversation on the connections between math and physics, the fruits of their recent collaboration, and the benefits of math-physics collaboration more broadly



School of Natural Sciences

The School of Natural Sciences, established in 1966, supports research in broad areas of astrophysics, systems biology, and theoretical physics. Areas of current interest include investigating the origin and composition of the universe; conducting research at the interface of molecular biology and the physical sciences; and elementary particle physics, string theory, quantum theory, and quantum gravity.

EACH YEAR THE SCHOOL OF NATURAL SCIENCES appoints about fifty Members, the majority of them postdoctoral fellows, who are typically at the Institute for three years, some for up to five years. Collaboration is encouraged among Members who work in the School's many scientific areas—from molecular biology to mathematical physics.

From its earliest days, the Institute has been a leading center for fundamental physics, contributing substantially to many of its central themes, which now interrelate with astrophysics and biology. Areas of current interest in theoretical physics include elementary particle physics, string theory, quantum theory, and quantum gravity, and their relationship to geometry, theoretical and observational astrophysics, and cosmology.

Research in the School's astrophysics group encompasses astronomical systems from nearby planets to distant galaxies, from black holes to the dark matter and dark energy that dominate the evolution of the universe. There is a growing cross-fertilization between astrophysics and elementary particle physics, and the work of many Members and Faculty crosses the boundary between these two disciplines. Members in the astrophysics research group employ an array of tools from theoretical physics, large-scale computer simulations, and ground- and space-based observational studies to investigate the origin and composition of the universe, and to use the universe as a laboratory to study fundamental physics. At the Simons Center for Systems Biology, the tools of modern physics and mathematics are being applied to biological investigation, on varying scales, from molecular to organismic, and in some cases focusing on understanding disease processes.

The School's collaborative and pioneering approach to the sciences, which extends to the Institute's School of Mathematics, Princeton University, and the larger scientific community, continues to transform research in these fields and to open opportunities for powerful and important discoveries.

FACULTY

Nima Arkani-Hamed

Stanislas Leibler

Juan Maldacena

Carl P. Feinberg Professor

Nathan Seiberg

Scott Tremaine

Richard Black Professor

Edward Witten

Charles Simonyi Professor

Matias Zaldarriaga

PROFESSORS EMERITI

Stephen L. Adler

Freeman J. Dyson

Peter Goddard

Peter Goldreich

Arnold J. Levine

Astrophysics

Over the past several decades, astronomers have learned that (i) galaxies form hierarchically through the merger of smaller galaxies, (ii) the centers of most galaxies are occupied by black holes with masses millions or billions of times more than the Sun. These two findings prompt the simple question: What happens to the black holes when two galaxies merge?

The black holes will spiral towards the center of the merged galaxy as they lose orbital energy through gravitational interactions to its stars. If the inspiral continues, the black holes will eventually merge. These mergers are by far the most energetic explosions in the universe, although they are difficult to detect because most of the energy is released in gravitational waves rather than light. The cataclysmic energy release cannot be detected by the ongoing LIGO gravitational-wave experiment, which is designed to detect mergers of much smaller black holes, but can be measured through its effect on the travel time of radio pulses from neutron stars—a search that is already underway—or by space-based gravitational-wave observatories planned for the 2030s.

Richard Black Professor **Scott Tremaine** is investigating whether the inspiraling black holes at the centers of galaxies merge or suffer some other fate: they could form a binary black hole that lasts for the age of the universe or be ejected by gravitational encounters with other massive objects before they merge, depending on the structure and evolution of the stellar system in the central few light years of the galaxy. Designing and interpreting experiments to detect gravitational waves from these mergers requires that we first understand their rate and properties.

Since the first direct detection of gravitational waves by the Laser Interferometer Gravitational wave Observatory (LIGO) in late 2015, the astrophysics related to gravitational wave sources has occupied many of the Members at the IAS.

During 2018–19, Professor **Matias Zaldarriaga**, together with Members Barack Zackay, Liang Dai, and Tejaswi Venumadhav, and Princeton University graduate student Javier Roulet, developed a set of new analysis techniques and applied them to the public LIGO data. It resulted in the discovery of many

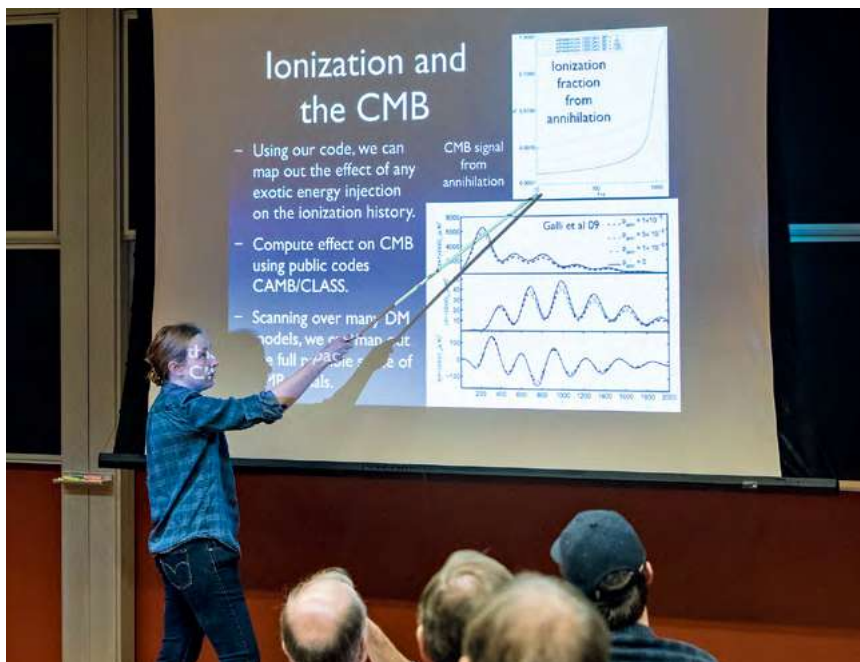
additional signals from binary black hole mergers, almost doubling the sample of existing events. Among them was the heaviest event reported so far and the one with the highest effective spin parameter. These events provide interesting clues about the formation of the black hole systems that LIGO is finding, a topic that is still enshrouded in mystery.

Zaldarriaga continues to be interested in topics related to cosmology. In the past year, together with Member Marcel Schmittfull and former Members Marko Simonović and Valentin Assassi, Zaldarriaga introduced a new way of modeling the distribution of galaxies in the universe, which could allow the next generation of cosmological observations to extract more information about the history and composition of our universe. In addition, together with Simonović and Visitor Mikhail Ivanov, Zaldarriaga reanalyzed data from the BOSS galaxy survey using techniques developed at the IAS in recent years. The new analysis showed that those observations provide among other things a measurement of the current expansion rate of the universe, independent from other cosmological probes. This is interesting because in the last few years discrepant measurements of this quantity have been reported in the literature, which might signal an inconsistency in the standard model of cosmology. The new measurement provides some constraints on the potential origins of the discrepancy.

Systems Biology

Using theoretical approaches originating in physics, Professor **Stanislas Leibler** and Members working at the Simons Center for Systems Biology are looking for general mechanisms that could operate across different length and time scales and across different organizational levels of biological systems.

In 2018–19, the focus of the research moved towards nonequilibrium aspects of biological phenomena. Together with Member Pablo Sartori, Leibler continued his work on the so-called “multifarious assembly,” namely assembly of systems made of a large variety of building-block



TRACY SLATYER, Junior Visiting Professor and John N. Bahcall Fellow, presents a colloquium talk on the dark history of the early universe, “Seeking Imprints of Dark Matter Interactions on the Cosmic Dawn.”



ALL PHOTOS ANDREA KANE

Marta Łuksza (left), Janssen Fellow (2014–18) in the Simons Center for Systems Biology, former Long-term Member Benjamin Greenbaum, and Professor Emeritus Arnold Levine (right), produced a mathematical model (*Nature* 2017) that can predict how a tumor will evolve under immunotherapy. They are now teaming up with experimentalists and clinicians to study pancreatic cancer patients, aiming to find unique principles that enable cancer cells to prevent immune recognition.

components, such as proteins, which can assemble into multiple aggregate states. Previously, using a simple equilibrium model, they found that assembling reliably a set of proteins into many different coexisting protein complexes demands these complexes to have a heterogeneous composition and to use only a small fraction of the full proteome. Presently, Leibler and Sartori are trying to extend these results to include various kinetic and out-of-equilibrium phenomena.

Natural selection, which lies at the basis of evolution, can also be viewed as a strongly out-of-equilibrium phenomenon. Together with Leibler, Member Riccardo Rao is studying simple mathematical models to explore quantitatively the dynamical and nonequilibrium aspects of natural selection. They are also interested in possible applications of recent advances on nonequilibrium statistical mechanics to the functioning of metabolic reaction networks.

The work of the past twenty-five years has demonstrated that tumor suppression by the p53 gene is a regulated, integrated, and coordinated set of responses mediated by the p53 protein in response to environmental perturbations, resulting in the maintenance of cellular homeostasis. In 2018–19, Professor Emeritus **Arnold Levine** and others explored the concept that initial mutations play a dual role in tumor formation, both enhancing survival of the initiating cancer cell, and selecting for secondary mutations that

contribute to tumor progression, and that the order of mutations is often determinative of the tissue undergoing transformation (*Cancer Cell* 2019).

One exploration of these concepts, undertaken with former Member Chang Chan, studied the contribution of genetics to tumor penetrance and tumor type specificity in mice with heterozygous germline mutations in p53 that predispose them to cancer. Because additional somatic mutations are required for tumor formation, Levine and Chan examined the role that chance plays in tumor penetrance, as well as the pattern of somatic mutations that were selected for, depending on tumor type and the genetic background of the mice.

Levine and collaborators also continue to study fundamental aspects of immunity. The immune system is remarkable in that it recognizes almost any foreign substance, remembers whether it has seen it before or not, and responds much more efficiently to subsequent exposure. T-cells are a major component of the adaptive immune system. They help an organism fight infection and cancer and regulate the immune response. These cells possess a diverse repertoire of receptors that can recognize small protein fragments. Receptor sequence data allows an improved understanding of the receptor ensemble of an organism at the level of sequences. However, it has not been possible yet to predict what protein fragments a receptor with a given sequence

would recognize, or to develop a good understanding of the receptor ensemble at the level of specificities. Levine and Research Associate Victor Mikhaylov, using an approach based on a combination of protein structure modeling and artificial neural networks, are studying this problem, aiming to develop a new machine-learning algorithm that would learn to predict the specificity of a T-cell receptor, given its sequence.

In addition, Levine, former Long-term Member Benjamin Greenbaum, and former Janssen Fellow Marta Łuksza, are extending their studies (*Nature* 2017) on neoantigens detected by fitness-based algorithms used to create immune-based tumor evolutionary models. Together with experimentalists and clinicians at Memorial Sloan Kettering Cancer Center, the group is studying the patterns of evolution and immune resistance mechanisms in pancreatic cancer patients, with the goal of finding the unique principles that enable the immune system to overcome self-tolerance and effectively recognize cancer cells, as much as to understand how cancer cells prevent the recognition. The group is especially interested in elucidating the possibilities of immune recognition of frequently mutated genes in tumors such as p53, which confer a positive evolutionary benefit that can outweigh the cost of immune detection. Understanding these evolutionary constraints can also help to find universal targets for patient treatments.

Theoretical Physics

2019 saw a surprising convergence between several threads of research. Professor **Nima Arkani-Hamed** has been pursuing for the past decade, on the connection between mathematical structures in combinatorics and geometry, and basic observables directly connected to the real-world physics of particle scattering, centered around the notion of “positive geometries.” These include the story of the “amplituhedron” tied to gluon scattering as well as generalized associahedra related to scalar particles such as the Higgs boson. These ideas, together with structures relevant to scattering processes in string theory, overlap in a fascinating way on nearly identical mathematical territory.

One of the central ingredients in the geometry/combinatorics–physics connection is a certain “canonical form” associated to a positive geometry, with the property of having logarithmic singularities on (and only on) the boundaries. For the case of polytopes, there are a number of intrinsic definitions for determining this canonical form. Arkani-Hamed and collaborators found a new definition, which naturally deforms these objects to have interestingly “stringy” properties, subbed “stringy canonical forms.” An application of these forms to the associahedron polytopes relevant to particle scattering remarkably produces expressions familiar from string computations, providing a more structural new path from particles to strings.

Another new set of ideas linking the physics of scattering to modern mathematics are the notion of “cluster algebras,” an aspect of which has already played a role in the story of the amplituhedron. About a decade ago, it



AMIAS Member YVONNE GEYER discusses recent progress in studying 6d super Yang-Mills and supergravity amplitudes in a high energy physics meeting. An IAS Member since 2016, Geyer has been working on scattering amplitudes in gauge theory and gravity, focusing on their mathematical structures.

was realized that a particular cluster algebra is also intimately related to the transcendental functions appearing in amplitudes of maximally supersymmetric theories. But for the same period of time there have been fundamental obstructions to seeing this work in general—both because the cluster algebras are generically infinite (while only some finite part should be of relevance to physics), and because physics involves certain functions that are not associated with the “cluster variables” of the cluster algebra. Applying the general idea of stringy canonical forms to the relevant cluster algebra immediately suggests a way of overcoming both hurdles, and Arkani-Hamed and his collaborators showed that the associated geometries passed a number of non-trivial consistency conditions. This work opens the door to a completely “non-perturbative” geometric underpinning for understanding scattering amplitudes in the theory.

Back in 2017, Arkani-Hamed and collaborators found that a certain “associahedron” in kinematic space determining the data of particle scattering, determines the amplitudes for certain scalar field at the leading “tree” level. Mathematicians subsequently realized that these “ABHY

associahedra” gave a conceptual understanding for certain polytopes associated with all (finite) cluster algebras. In 2019, Arkani-Hamed and collaborators found that these general polytopes can be understood in very simple physical terms, linking positivity, the notion of “causal diamonds,” and the one-dimensional wave equation. He also showed that these more general polytopes are also directly relevant to physics, describing scalar particle scattering through to “one-loop” order.

Arkani-Hamed and collaborators also introduced the notion of “binary” positive and complex geometries, giving a completely rigid geometric realization of the combinatorics of generalized associahedra attached to any Dynkin diagram, and defined “open” and “closed” stringy canonical form integrals associated with these spaces. The binary geometry of simplest “type A” Dynkin diagrams are associated with ordinary string integrals, while the binary geometries and generalized string integrals for other Dynkin types provide a generalization of particle and string scattering amplitudes. These reduce to the ABHY polytopes in the “field theory limit.” These represent new objects with much of the standard magic usually attributed to the physics

FACULTY & EMERITI HONORS

Juan Maldacena was awarded the 2018 Richard E. Prange Prize from the University of Maryland Department of Physics and Condensed Matter Theory Center, and the Galileo Galilei Medal from the National Institute for Nuclear Physics and Galileo Galilei Institute.

of the strings but without invoking the string “worldsheet.”

This connection between the mathematics of cluster algebras and positive geometry, and the physics of gluon, scalar, open, and closed string scattering, has exposed unexpected simplicity and hidden symmetries relevant to real-world physics while at the same time uncovering new structures in mathematics. Arkani-Hamed will explore the subject from this unified perspective in the coming years.

In a different vein, in 2017, Arkani-Hamed and collaborators introduced a new formalism to describe scattering processes involving particles of any mass or spin. Among other things, this suggested a new notion of what “the most elementary particle” interaction should be for a particle of any spin. It is natural to ask whether there are any massive particles in nature enjoying this so-called “minimal coupling,” and this question has been found to have a delightful answer. Spinning black holes—described by the famous Kerr solution in general relativity—when looked at from long distances, are precisely “elementary particles” with minimal coupling to gravity. In 2019, Arkani-Hamed and collaborators gave a simple understanding of how this comes about by looking at probe particle scattering off Kerr black holes. More generally, the link between particle scattering and black hole physics is something Arkani-Hamed plans to further investigate in the coming year.

In the past year, Carl P. Feinberg Professor **Juan Maldacena** studied some aspects of two-dimensional gravity theories. The dynamics of gravity in two dimensions is simple because there are no propagating gravitons; however, it still captures interesting gravitational phenomena such as black holes, the expansion of the universe, etc.

With Gustavo Turiaci and Zhenbin Yang, Maldacena studied two-dimensional theories with an expanding universe similar to the one appearing in the inflationary theory. In these cases, the computation of the

wavefunction of the universe, or cosmological observables, is particularly simple since the effects of gravity can be taken into account by a mode that lives in one less dimension, just one dimension in this case. This shows that the simplicity that is present for these theories for negative cosmological constant, where they describe black holes, is also present for positive cosmological constant, where they describe an expanding universe. This model gives the simplest situation where one can compute the effects of gravity on cosmological observables.

With Henry Lin and Ying Zhao, Maldacena studied another problem involving two-dimensional gravity theories. In the application of these theories for black holes, one important question is how one describes the evolution of fields in the bulk from the point of view of the full quantum system that lives on the boundary. Some symmetries, such as time evolution, are simple on both sides. However, the bulk theory has three approximate symmetries, the symmetries of two dimensional approximately flat (or constantly negatively curved) space. In the simplest two-dimensional gravity theory, it is possible to construct exact generators for these symmetries. There are similar approximate generators in the full quantum boundary system. These symmetries are closely related to observables that display chaos in the quantum system dual to the black holes. So in some sense, we get “order” (symmetries) from “chaos.” This is closely related to the following two facts. Near-horizon gravitational scattering processes generate simple displacements of the bulk particles. But also these same processes can be interpreted as arising from chaos in the microscopic theory.

Maldacena and Charles Simonyi Professor Edward Witten organized and gave lectures at the 2018 Prospects in Theoretical Physics summer school “From Qubits to Spacetime.” Maldacena also lectured at the Theoretical Advanced Study Institute in Elementary Particle Physics 2019 summer

school, supported by the University of Colorado, Boulder, and the National Science Foundation.

Professor **Nathan Seiberg** continued his explorations of quantum field theory—a framework combining quantum theory with Einstein’s special theory of relativity. Quantum field theory is important in many branches of physics including particle physics, string theory, condensed matter physics, and cosmology, and it leads to many insights in mathematics. There is no doubt that we are still very far from a clear and complete understanding of it.

One theme of Seiberg’s work is the use of the symmetries of the system (including various generalized symmetries) and the anomalies in these symmetries to extract new lessons about the dynamics.

With Members Kantaro Ohmori and Shu-Heng Shao, Seiberg studied two-dimensional nonlinear models whose target space is a flag manifold. This generalizes the well-known model based on the complex projective space. The general flag model exhibits several new elements that are not present in that special case. It depends on more parameters, its global symmetry can be larger, and its anomalies can be more subtle. The analysis, based on symmetries and anomalies, suggests that in certain cases and for specific values of the parameters, the model is gapless and is described by a simple known low-energy theory.

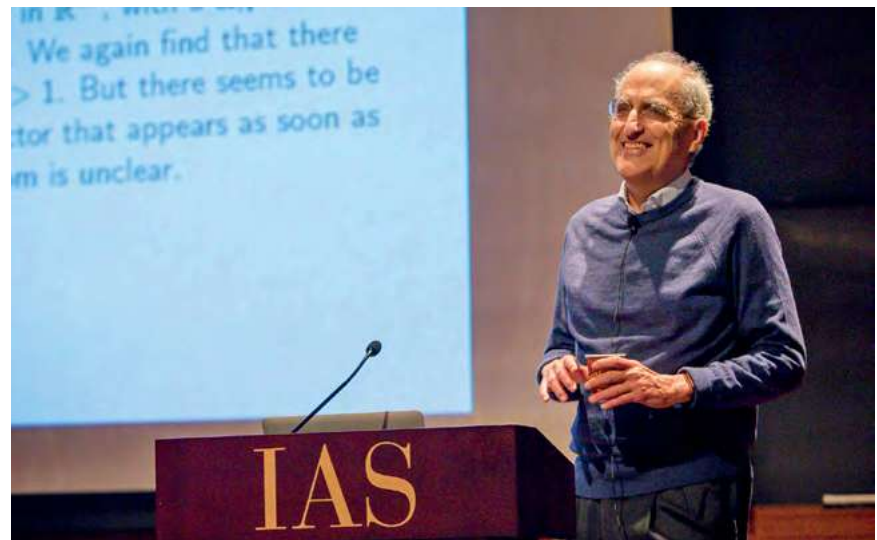
With his students Po-Shen Hsin and Ho Tat Lam, Seiberg studied various systems in three and four dimensions with a one-form global symmetry. They explored its consequences and analyzed its gauging. A three-dimensional quantum field theory with such a symmetry has special line operators that generate it. The properties of these operators are characterized by a single integer p . Depending on p in certain special cases, the full theory factorizes as a product of a theory carrying the symmetry and a decoupled theory of neutral objects. The parameter p labels the obstruction to gauging the

symmetry; i.e., it characterizes its 't Hooft anomaly. This understanding allowed them to consider various four-dimensional gauge theories and deduce consequences about their dynamics. They learned new facts about the long-distance behavior of these systems and the properties of interfaces in them.

With Member Clay Cordova, former Member Daniel S. Freed, and student Ho Tat Lam, Seiberg launched a detailed study of a new kind of anomalies. It is customary to couple a quantum system to external classical fields. One application is to couple the global symmetries of the system (including the Poincaré symmetry) to background gauge fields (and a metric for the Poincaré symmetry). Failure of gauge invariance of the partition function under gauge transformations of these fields reflects 't Hooft anomalies. It is also common to view the ordinary (scalar) coupling constants as background fields, i.e., to study the theory when they are spacetime dependent. These authors showed that the notion of 't Hooft anomalies can be extended naturally to include these scalar background fields. Just as ordinary 't Hooft anomalies allow them to deduce dynamical consequences about the phases of the theory and its defects, the same is true for these generalized 't Hooft anomalies.

They demonstrated these anomalies and their applications in simple pedagogical examples in one dimension (quantum mechanics) and in some two-, three-, and four-dimensional quantum field theories.

Then they extended this work to strongly coupled, four-dimensional gauge theories. Pure Yang-Mills theory (without matter), with a simple and simply connected gauge group, has a mixed anomaly between its one-form global symmetry (associated with the center) and the periodicity of its theta-parameter. This anomaly is at the root of many recently discovered properties of these theories, including their phase transitions and interfaces. They also studied some gauge theories with matter. Here they found a mixed



EDWARD WITTEN, Charles Simonyi Professor, produced a paper with Long-term Member DOUGLAS STANFORD titled “JT Gravity and the Ensembles of Random Matrix Theory,” which extended it to symmetries including the time-reversal symmetry, that which distinguishes bosons and fermions, and supersymmetry. In the same paper, they generalized some celebrated work of Maryam Mirzakhani, former Member in the School of Mathematics, to the case of super Riemann surfaces.

anomaly between the flavor symmetry group and the theta-periodicity. Again, this anomaly unifies distinct recently discovered phenomena in these theories and controls phase transitions and the dynamics on interfaces.

Charles Simonyi Professor **Edward Witten**’s most significant contribution in the last year was a paper with IAS Long-term Member Douglas Stanford “JT Gravity and the Ensembles of Random Matrix Theory.”

Previously, Stanford with Phil Saad and former Visitor Steve Shenker had related a simple model of gravity in two dimensions, known as JT gravity, to a random matrix ensemble. Stanford and Witten extended this to include additional symmetries—especially time-reversal symmetry, the symmetry that distinguishes bosons and fermions, and supersymmetry. In all cases, they were able to relate the resulting gravitational model to a random matrix ensemble. All ten of the standard random matrix ensembles—three of Wigner and Dyson, and seven more of Altland and Zirnbauer—made an appearance. Mathematically, to understand the results that come from the random matrix ensembles, it was necessary to use Reidemeister-Ray-

Singer “torsion” to construct the appropriate measure on the moduli space of possibly unorientable conformal two-manifolds. In the same paper, Stanford and Witten generalized some celebrated work of Maryam Mirzakhani, former Member in the School of Mathematics, to the case of super Riemann surfaces.

With former Member Davide Gaiotto and Theo Johnson-Freyd, Witten found a novel and illuminating sufficient condition under which a minimally supersymmetric model in two dimensions (a model with what is called (0,1) supersymmetry) can be deformed to spontaneously break supersymmetry. This work gave a partial physical interpretation to the mathematical theory of “topological modular forms.” Witten also attempted to use an orbifold method to compute entanglement entropy in open string theory. The results of that calculation have been difficult to interpret.

With former Member Kazuya Yonekura, Witten developed a non-perturbative description of “anomaly inflow,” and thereby gave a unified general description of the anomalies of fermions coupled to gauge fields and/or gravity in all dimensions. This result is a refinement and generalization

of results Witten had obtained in the 1980s.

Witten also wrote an expository set of lecture notes “Light Rays, Singularities, and All That,” on causality properties of general relativity—topics such as the Penrose singularity theorem, the Hawking area theorem for the horizon of a black hole, and other matters that rely on similar ideas. The goal was to provide an entrée to newcomers in the field, providing more intuition and less mathematical detail than in existing treatments.

Professor Emeritus **Stephen L. Adler** continued activities in three areas of research interest: particle physics, gravitation and cosmology, and quantum foundations. In quantum foundations, with Angelo Bassi, Matteo Carlesso, and Andrea Vinante, Adler calculated the rate of heating of a degenerate Fermi liquid by the noise postulated in state vector reduction models, showing that the bounds obtained from neutron star cooling are less severe than already known bounds. He also arranged a Gordon and Betty Moore Foundation Visitor Award through the American Physical Society to allow experimenter Catalina Oana Curceanu to visit the IAS for two weeks to discuss experiments to detect the postulated noise. Her visit overlapped for a week with a two-week visit by Bassi, who has a large group in Trieste working on phenomenology of reduction models, and with whom Adler has ongoing discussions and collaborations. Adler also wrote a paper analyzing the implications of non-white noise in these

models for the Conway-Kochen “Free Will Theorem.”

In particle physics, Adler continued the study of a model he introduced with spin-3/2 fields directly coupled to a spin-1/2 field. He completed the analysis of the free field structure of this model, and in collaboration with Pablo Pais recomputed the chiral anomaly in this model in an extended version, which adds an auxiliary field to achieve full fermionic gauge invariance. This gave the same answer, an anomaly of five times the standard spin-1/2 anomaly, that Adler obtained last year for the unextended model. Implications of this for the field content of grand unification schemes involving gauged spin-3/2 fields are currently under study.

In cosmology, Adler analyzed the implications of a frame-dependent dark energy action for the late-time expansion history of the universe, stimulated by reports of a discrepancy between the directly measured late-time Hubble constant and the Hubble constant inferred at decoupling by studies of the cosmic microwave background. Adler’s analysis shows novel late-time effects of possible experimental interest.

Professor Emeritus **Freeman Dyson** continued his survey of the history of ideas about evolution, as described in the 2017–18 report. This year, he enlarged the survey to include cultural evolution in addition to biological evolution. Biological evolution is driven by mutation of genes and rearrangement of genomes. Cultural evolution is driven by invention of tools and diffusion of ideas. The history of life on planet

Earth reached a major transition point about ten thousand years ago, when a single species became dominant. Cultural evolution then replaced biological evolution as the main cause of change in the planetary ecology as well as in our own society. Cultural evolution works about a thousand times faster than biological evolution. But biological evolution is also accelerating, driven by new tools arising from the human development of agriculture and medicine.

In the spring of 2019, Dyson wrote a summary of his thinking about evolution, with the title, “Biological and Cultural Evolution: Six Characters in Search of an Author.” He borrowed the subtitle from the Luigi Pirandello play, which has six actors without any script improvising a drama on an empty stage. His six characters are Charles Darwin, Motoo Kimura, and Ursula Goodenough for biological evolution, and Herbert Wells, Richard Dawkins, and Svante Pääbo for cultural evolution. Each of the six brought unexpected and divergent twists to the understanding of evolution. Three of them are still alive, and the drama that they together improvised is still evolving.

Dyson’s summary is now accessible on the Edge website hosted by John Brockman. It is an informal and provisional document, which may or may not be expanded into a book. Before it becomes a book, extensive scholarly research and careful checking of references are needed. In the meantime, Dyson welcomes comments and criticism, especially if they correct mistakes.

2018–19 MEMBERS AND VISITORS

f First Term ♦ *s* Second Term ♦ *m* Long-term Member ♦ *v* Visitor ♦ *dvp* Distinguished Visiting Professor ♦ *jvp* Junior Visiting Professor ♦ *ra* Research Associate

Ahmed Almheiri

Quantum Field Theory ♦ Institute for Advanced Study

Ben Bar-Or

Astrophysics ♦ Institute for Advanced Study
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Funding provided by the Simons Foundation

SUSAN CLARK ON INTERSTELLAR MAGNETISM



DAN KOMODA

You may have done this experiment as a child: spread a bunch of iron filings on a table, a heap of insouciant metal dust. Now place a bar magnet in their midst, and ah! The iron filings snap to attention, as if endowed with a sudden sense of purpose. They align their lengths with

the local magnetic field orientation, and suddenly an invisible presence is revealed: the curving contours of the magnetic field.

I want to pull off a similar revealing act. I want to see, and understand, the magnetic field that permeates our Milky Way galaxy. Read more at www.ias.edu/ideas/interstellar-magnetism.

MATIAS ZALDARRIAGA AND BARAK ZACKAY ON THE CURRENT STATE OF GRAVITATIONAL WAVE SEARCHES WITH LIGO/VIRGO



DAN KOMODA

In April 2019, a research team at IAS announced the discovery of six new binary black hole mergers. The team applied a unique set of signal processing techniques to data made publicly available by the LIGO-Virgo Collaboration (the same group responsible for the

first direct observation of gravitational waves in 2016), bringing external analysis to existing data to effectively double the number of results.

At the time of the announcement, two members of the team—Matias Zaldarriaga, Professor in the School of Natural Sciences, and Barak Zackay, Peter Svennilson Member in the School—described these results for an audience at IAS. Watch the video at www.ias.edu/ideas/gravitational-wave-searches-ligovirgo.

EDWARD WITTEN ON MATHEMATICS AND PHYSICS



ANDREA KANE

When I was a student, a physics graduate student would not be exposed—I was not, and I think others would not have been either—to any ideas at all in contemporary mathematics or really even in twentieth-century mathematics, practically. Now, clearly, things have changed a lot

since then.—Edward Witten, Charles Simonyi Professor in the School of Natural Sciences, in conversation with Robbert Dijkgraaf, IAS Director and Leon Levy Professor, during “The Universe Speaks in Numbers” event at IAS in May 2019. Read more by Edward Witten at www.ias.edu/ideas/edward-witten-mathematics-and-physics and watch videos of the event at www.ias.edu/ideas/videos-universe-speaks-numbers.



DAN KOMODA

SCOTT TREMAINE ON DISCOVERING AND EXPLORING THE MILKY WAY'S BLACK HOLE

On May 3, 2019, Scott Tremaine, Richard Black Professor in the School of Natural Sciences, gave a lecture on the evidence for a supermassive black hole at the core of the Milky Way galaxy, denoted Sagittarius A*. The talk focuses on what we know, what we hope to learn, and the techniques being used to study this exotic object. Watch the video at www.ias.edu/ideas/inward-bound.



LENA MURCHIKOVA ON HOW THE EVENT HORIZON TELESCOPE SHOWED US A BLACK HOLE

On April 10, 2019, we were presented with the first-ever close-up image of a black hole by the Event Horizon Telescope (EHT). This remarkable technological achievement was made possible by the collective efforts of hundreds of astrophysicists, engineers, and computer scientists. They arranged for simultaneous observations of their target with multiple telescopes around the globe and correlated the data between the instruments to effectively achieve the creation of a planet-sized telescope. The data was then processed to make the image we saw in the news.

But did we really “see” a black hole when we were shown “just” a digital image? And how is it possible to create an Earth-sized telescope? Read more at www.ias.edu/ideas/murchikova-eh- black-hole.



Member ANNE McNEVIN (left), Deborah Lunder and Alan Ezekowitz Founders' Circle Member GRETA WAGNER (right), and Member SOPHIE WAHNICH (not pictured) curated a discussion on the theme of hospitality during the School's Crisis and Critique seminar.



School of Social Science

Founded in 1973, the School of Social Science is devoted to a multidisciplinary and international approach to the analysis of societies, social change, and social problems. Every year, a theme is chosen to provide coherence to the collective work undertaken, although other areas of research are also welcome. For 2018–19, the theme was “Crisis and Critique.” In total, twenty-six Members and eight Visitors participated in the activities of the School.

ALTHOUGH IT COULD BE ARGUED that each epoch in the modern era is regarded by its contemporary as a time of crisis, the present moment seems to offer in this respect certain particular traits in terms of the quality, intensity, and spread of its crisis. In fact, crises appear to be present in many aspects of human life, whether environmental with climate change, political with the predicament of democracies, social with the increase of inequalities, economic with cycles of depression, and demographic with massive displacements of people. Among these various dimensions, two seem distinctively salient: one is moral, the other cognitive. On the one hand, the moral beliefs and convictions of the population differ to such a degree that the consent necessary for action and reform is no longer given. On the other hand, knowledge is itself challenged and destabilized both externally by the contestation of its legitimacy and internally as it can no longer rely on some shared norms and claim an impartial standpoint. In sum, both trust and truth are at stake, and critical thinking becomes more crucial than ever.

Led by **Didier Fassin**, James D. Wolfensohn Professor, and Distinguished Visiting Professor **Axel Honneth**, Jack C. Weinstein Professor for the Humanities at Columbia University, the yearly program of the School therefore addressed the complex relationships between crisis and critique. It brought together the various disciplines of the social sciences and humanities, including history, sociology, anthropology, law, economics, philosophy, political science, social theory, and media studies. It examined critical issues raised within multiple national contexts and from diverse intellectual perspectives, convening scholars from different regions of the world who belong to distinct scientific traditions and sometimes even contest the very language of crisis to interpret contemporary phenomena. It analyzed public debates and social movements, which question the explanatory framework of crises

FACULTY

Didier Fassin

James D. Wolfensohn Professor

PROFESSORS EMERITI

Joan Wallach Scott

Michael Walzer



THOMAS CLARKE



ANDREA KANE

Distinguished Visiting Professor AXEL HONNETH (left) leads a “Crisis and Critique” seminar with DIDIER FASSIN (right), James D. Wolfensohn Professor. The School’s theme year examined critical issues raised within multiple national contexts and from diverse intellectual perspectives, convening scholars from different regions of the world.

and attempt to invent new forms of critical practice. The outcome of this collective endeavor, an edited volume, is in preparation. It explores the varieties of modalities of making sense of, coping with, revolting against, and solving critical states of the world that threaten decent life, common goods, democratic institutions, individual and collective rights, even the world and its inhabitants, or simply representations of reality. In parallel, a film series on crises from an international perspective was organized with Marcia Tucker, the Historical Studies and Social Science librarian.

As part of this program, **Didier Fassin** developed a theoretical framework for his project “Crisis: An Inquiry into the Contemporary Moment” funded through his Nomis Distinguished Scientist Award, examining in particular the so-called migrant crisis in Europe. The case epitomizes the dual component of the

recognition of a situation as a crisis, objective and subjective, or factual and performative, the two being possibly dissociated, when a critical situation is not identified as a crisis or, on the contrary, when a crisis is declared without a corresponding critical situation. This dissociation leads to two series of questions, which are illustrated through various examples: Who has the authority to affirm the existence of a crisis and who is deprived of it? What does the naming of a crisis authorize and what does it symmetrically censure? Several versions of this study were presented at the Universities of Zürich, Siena, and Copenhagen, Sapienza in Rome, and at the New School for Social Research. A chapter was written for the volume *Words and Worlds* (Duke University Press) co-edited with Veena Das. The crisis unveiled by the yellow vest movement in France was discussed during a workshop at the Institute and published with Anne-Claire Defossez in the *New Left Review*.

The anthropology of punishment was the matter of lectures at the Universities of Buenos Aires, Montevideo, and Santiago, and at the Cambridge Institute of Criminology. A keynote lecture was delivered at the Academy

of Global Humanities and Critical Theory in Bologna, and several other interventions were given at public events, including at the Schaubühne in Berlin in conversation with Carolin Emcke and at the École Nationale de la Magistrature in France as part of the training of judges. In relation with this aspect of his research, Fassin participated in the Criminal Sentencing and Disposition Commission appointed by the Governor of the State of New Jersey and chaired by former Chief Justice Deborah Poritz.

The social life of objects has recently been a topic of interest in the social sciences and humanities. Based on his recently published ethnography of a French prison, Fassin has proposed to revisit this domain, arguing that things such as peepholes or tobacco, which play a major role in the carceral world, are of relevance for the social sciences not so much intrinsically but through the relations they have with human beings. This argument, which is part of a broader critique of anti-humanism, has been presented for the Melvin Tumin Lecture on Social Inequality at Princeton University as well as at the Universities of Prague and Cambridge. It has been expanded in a chapter of the volume *The Social*

FACULTY & EMERITI HONORS

Joan Wallach Scott was awarded the 2018 Edgar de Picciotto International Prize from the Graduate Institute of Geneva.



ANDREA KANE

Member EVA ILLOUZ, a sociologist and critical theorist, gives a School of Social Science lunchtime seminar on “Uncertainty, Crisis, and Negative Relationships.”

Sciences through the Looking-Glass (Oxford University Press) co-edited with George Steinmetz.

Finally, a reflection on the role of the social sciences in contemporary societies, and more specifically of ethnography as a specific mode of knowledge production, has been developed at the Universities of Vienna and San Martín in Argentina as well as during a one-week seminar at the École des Hautes Études en Sciences Sociales in Paris. It was also the source of an invitation by playwright Wajdi Maouwad for three public events at the Villa Medici in Rome.

In addition to helping to prepare with Professor Didier Fassin the weekly lunch seminar and the theme seminars of the year, Distinguished Visiting Professor **Axel Honneth** developed by readings and discussions the theoretical fundaments for a larger project on the current crisis of work. Honneth collected relevant material and developed a normative framework for determining why certain tendencies within the capitalist world of work can be seen as problematic. He took democracy as his normative reference point to develop the central premise of his research project: the chances for participation in democracies will

increase with the quality, inclusiveness, and fairness of the division of labor within society. He subsequently worked to spell out the implications of the concept of the division of labor (A. Smith, Marx, Durkheim) and to adopt it to the new developments of work in capitalist societies.

In addition, Honneth wrote a longer essay on the moral-philosophical idea, developed over the last twenty years by his colleague Stephen Darwall, that humans are transcendently required to take a “second-person standpoint” when being confronted with others in personal encounters. He also wrote the Marc Bloch lecture that he was invited to deliver at the Sorbonne in early June 2019 by invitation of the École des Hautes Études en Sciences Sociales. The lecture attempted to find another source for European solidarity, namely one that resulted from Europe’s long history of search for morally overcoming its own crimes and injustices.

Professor Emerita **Joan Wallach Scott** worked on the revisions of a series of lectures she gave first as the Natalie Zemon Davis Lecturer at the Central European University in Budapest (“In the Name of History”) and then as the Ruth Benedict Lecturer at Columbia University (“On the

Judgment of History”). Both deal with the question of how history (History) is used to offer a moral legitimation for political action in the present and the future. She examined three cases to explore the different ways in which action in the name of history operates: the International Military Tribunal at Nuremberg, Germany, in 1946; the South African Truth and Reconciliation Commission in 1996; and the ongoing movement for reparations for slavery in the United States. Central European University Press will publish “In the Name of History”; Columbia University Press will publish “On the Judgment of History.”

In addition, Scott published *Knowledge, Power, and Academic Freedom* in 2019—a collection of her essays spanning twenty years on the subject of academic freedom. Also in 2019, her 2018 book, *Sex and Secularism*, was published in French translation as *La Religion de la Laïcité*. When the book appeared last fall, Scott spent time in Paris defending her controversial argument that secularism, far from guaranteeing gender equality, rested on the inequality of the sexes.

The Geneva Graduate Institute awarded her the Edgar Picciotto



Left: Member DANIEL ALDANA COHEN (left), a political sociologist who works on climate change, with Member ROBIN CELIKATES (right), who studies civil disobedience as a response to the structural shortcomings of liberal democracies, at a Crisis and Critique seminar. Right: Member HAE YEON CHOO, whose research project examines the politics of land ownership in contemporary South Korea, in a lunchtime seminar.

International Prize for her pioneering work on gender. She noted in her acceptance speech that it was a wonderful irony to be awarded this prize for her work on gender in the city of Calvin and Rousseau.

During the academic year, Scott was an active member of the Globalization and Social Change seminar at the Graduate Center of the City University of New York. She lectured at the University of North Carolina at Chapel Hill, at Texas A&M Corpus Christi, and in London at Goldsmiths College. She continues to serve as a member of the Committee on Academic Freedom and Tenure of the American Association of University Professors, where she is now chairing a subcommittee charged with writing a report on the ways in which the current administration's attack on knowledge is putting the nation at grave risk.

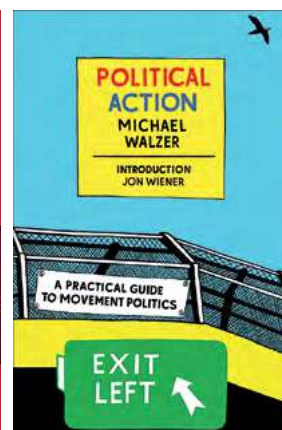
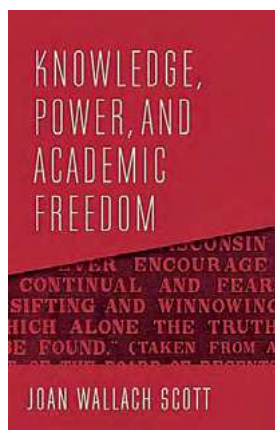
Professor Emeritus **Michael Walzer** wrote on a variety of topics in 2018–19, determined by invitations to conferences in the United States and abroad and by the School of Social Science's theme for the year: Crisis and Critique. Since he has a long-standing interest in social criticism and has written a great deal about it, Walzer

attended the theme seminar regularly, joined the discussions, and is now writing something for a possible book by seminar Members that Professor Didier Fassin and Distinguished Visiting Professor Axel Honneth will edit. Walzer has begun an article on the forms of social theory and social criticism that go along with and help to drive political and social movements like the civil rights movement and the anti-war movement of the 1960s. Years ago, Honneth and Walzer debated the value of social theory for practical criticism and political work in the "real world." They repeated the debate (and revised some of their own positions) for the theme seminar, and that is what led Walzer to the new article on theory, critique, and movement politics.

In addition, Walzer wrote a paper on immigration that was the basis for a debate on the topic at Princeton University and, subsequently, was turned into a lecture that he gave at universities in Germany and Israel. Since there were five or six Members from

Germany in the School in 2018–19, Walzer tried out the lecture on them before traveling to Germany. They were wonderfully helpful in making sure that he provoked only the right kind of disagreements.

Walzer also finished a paper on the rules of engagement for police and soldiers (and why they should be different), which was a keynote address at a conference on police ethics at Pennsylvania State University and for which Walzer had talked often with Members in 2017–18. Walzer gave two talks at Labyrinth Books—on the third volume of *The Jewish Political Tradition* and on the reissue of a book he wrote half-a-century ago on *Political Action*.



2018–19 MEMBERS AND VISITORS

f First Term ♦ *s* Second Term ♦ *v* Visitor ♦ *dvp* Distinguished Visiting Professor

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Philosophy of Communication ♦
University of Virginia
Infosys Member

Dorian Bell

Critical Race Studies, Literature ♦
University of California, Santa Cruz

Mabel Berezin

Historical, Comparative, Political, and Cultural Sociology ♦ Cornell University

David Bond

Cultural Anthropology ♦ Bennington College

Denise Brennan

Anthropology ♦ Georgetown University

Robin Celikates

Philosophy ♦ University of Amsterdam

Hae Yeon Choo

Sociology ♦ University of Toronto

Daniel Aldana Cohen

Political Sociology of Climate Change ♦ University of Pennsylvania

Rodrigo Cordero

Social Theory ♦ Universidad Diego Portales, Santiago

Anne-Claire Defossez

Sociology ♦ Institute for Advanced Study ♦ *v*

Chitrlekha Dhamija

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Gregor Dobler

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History ♦ Brown University

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Modern and Contemporary China ♦ Saint Michael's College

Dora Isabel Herrador-Valencia

Human Geography ♦ Institute for Advanced Study ♦ *v, s*

Axel Honneth

Social and Political Philosophy, Theory of Society ♦ Goethe-Universität Frankfurt and Columbia University ♦ *dvp*

Murad Idris

Political Theory ♦ University of Virginia
AMIAS Member

Eva Illouz

Sociology, Critical Theory ♦ Centre de Sociologie Européenne, Paris, and École des Hautes Études en Sciences Sociales, Paris
Funding provided by the Florence Gould Foundation Fund

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Social Philosophy ♦ Humboldt-Universität zu Berlin

Michael Kazin

History of Politics and Social Movements in the Nineteenth and Twentieth Centuries ♦ Georgetown University
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History of Economic Thought, History of Capitalism, Critical Theory ♦ The New School
Roger W. Ferguson, Jr., and Annette L. Nazareth Member

Anne McNevin

Politics, International Relations ♦ The New School

Jennifer Petersen

Media Studies ♦ University of Virginia ♦ *v*

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Economics ♦ University of Cape Town ♦ *v*

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Epidemic Disease, Critical Medical Anthropology ♦ Harvard Medical School ♦ *v*

Dieter Thomä

Philosophy ♦ Universität St. Gallen

Achim Vesper

Philosophy ♦ Goethe-Universität Frankfurt ♦ *v*

Greta Wagner

Sociology ♦ Goethe-Universität Frankfurt
Deborah Lunder and Alan Ezekowitz Founders' Circle Member

Sophie Wahnich

History of the French Revolution ♦ Centre National de la Recherche Scientifique and École des Hautes Études en Sciences Sociales, Paris

Jessica Winegar

Anthropology ♦ Northwestern University

Deborah J. Yashar

Political Science, Comparative Politics, Latin America, Political Economy of Development ♦ Princeton University ♦ *v*



THOMAS CLARKE



ANDREA KANE

Left: Member MABEL BEREZIN (left) researches challenges to democratic cohesion and solidarity in Europe and the United States. *Right:* Member RAHEL JAEGLI delivers a seminar on “Crisis, Critique, and Social Changes: Towards a Normative-Materialistic Conception.”



A roundabout near Colmar, birthplace of the sculptor Frédéric Auguste Bartholdi, designer of the Statue of Liberty, March 2018

ANNE-CLAIRE DEFOSSEZ AND DIDIER FASSIN ON THE YELLOW VESTS MOVEMENT

How could a leaderless grassroots movement, involving often quite small groups of protesters, monopolize the national news, capture the attention of the wider world, and destabilize a government that had swept to power by a landslide victory in 2017? As Jacques Rancière has suggested, it is as difficult to understand why some people mobilize when confronted with situations they regard as unacceptable, as it is to understand why others in similar or even worse circumstances do not. The *gilets jaunes* upsurge appears all the more remarkable when one considers that most of its adherents had never participated in a demonstration before and refuse any political or union affiliation. Read more at www.ias.edu/ideas/yellow-vests-movement.

MICHAEL WALZER ON POLITICAL ACTION

Written almost fifty years ago, in the immediate aftermath of the American bombing of Cambodia, *Political Action: A Practical Guide to Movement Politics* reflects a decade of intense political activity. Since I was aiming at a guide that would be helpful to citizen activists of all sorts, I avoided specific references to sixties politics; I wrote in a generalizing mode. But now I want to describe to new readers some of the concrete engagements that made me a citizen activist and led me to write *Political Action*.

Movement politics is mostly the work of the young, and I was very young, twenty-five, an unhappy graduate student, when Irving Howe, the editor of *Dissent*, asked me to fly to North Carolina and talk to and write about the black college students who were sitting in at Woolworth lunch counters. It was February 1960, and the sit-ins were the beginning of The Sixties. Read more at www.ias.edu/ideas/walzer-political-action.

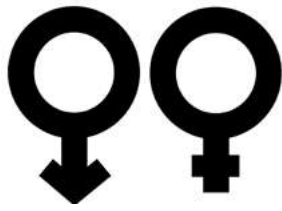


On February 13, 1960, students line the counter of a dime store in Greensboro, North Carolina, in protest of the store's refusal to serve them.



WORKSHOP CELEBRATING NATALIE ZEMON DAVIS

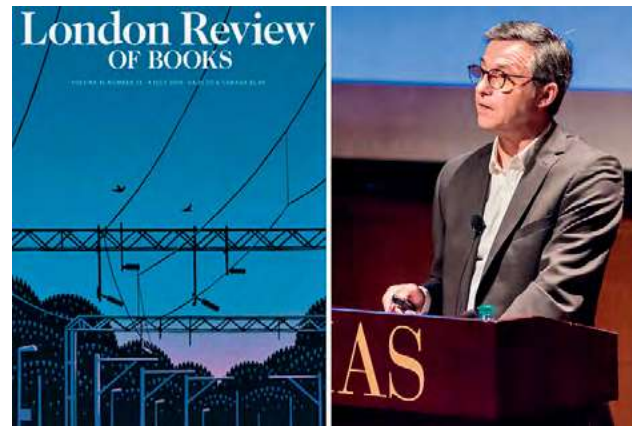
On April 26, 2019, the Institute's School of Historical Studies and the Shelby Cullom Davis Center for Historical Studies at Princeton University organized a workshop celebrating the ninetieth birthday of Natalie Zemon Davis, acclaimed early modern historian and former Member (1978) in the School of Social Science. Presenters included IAS Professors Francesca Trivellato and Joan Wallach Scott and IAS Trustee Lorraine Daston, who gathered to pay tribute to Davis's brilliant scholarship and intellectual leadership. The workshop concluded with Davis's own account of her collaboration with the Lebanese-French-Québécois playwright and director Wajdi Mouawad. Watch videos from the workshop at www.ias.edu/news/workshop-natalie-zemon-davis, and read the contributors' texts at www.ias.edu/news/in-the-media/essays-natalie-zemon-davis-90th.



JOAN WALLACH SCOTT ON THE PERSISTENCE OF GENDER INEQUALITY

Some of the reasons

usually offered to explain the persistence of gender inequality include large abstractions: patriarchy, capitalism, male self-interest, misogyny, religion. These are, of course, useful categories to work with, but none of them can account for how deep-rooted these inequalities are in our psyches, our cultures, and our politics. My alternative explanation, based on psychoanalytic and political theory, has to do with the ways in which gender and politics are interdependent: a naturalized belief in the necessary and immutable difference of the sexes provides legitimation for the organization of other social and political inequalities; in turn the legitimation invoked by politics establishes the immutability of biology. Whether taken as God's word or Nature's mandate, gender—the historically and culturally variable attempt to insist on the duality of sex difference—becomes the basis for imagining social, political, and economic orders. In this representation of things, to question the asymmetry of the sexes as a biological fact is to threaten an entire political order. Read more at www.ias.edu/ideas/scott-gender-inequality.



DIDIER FASSIN: DIVIDE AND RULE

In the *London Review of Books*, Didier Fassin, James D. Wolfensohn Professor in the School of Social Science, examines the recent European elections from a French perspective, arguing that Emmanuel Macron's representation of the democratic challenge for Europe as an alternative between “nationalists” and “progressives,” whom he would embody, is a mere rhetoric to elude the fact that his actual politics is a traditional “mix of neoliberalism and authoritarianism, projected by means of his own distinctive form of populism.” Read more at www.ias.edu/news/in-the-media/divide-and-rule.

ROWENA XIAOQING HE ON SURVIVING TIANANMEN: THE PRICE OF DISSENT IN CHINA

Since the Tiananmen massacre, activists, scholars, and regular citizens have launched a war against forgetting. Many Tiananmen veterans, both inside and outside China, including Liu Xiaobo, the late Nobel Peace Prize laureate who died a political prisoner in 2017, have devoted their lives to the unfinished cause of 1989.



Commemoration activities are organized in major cities every year. Tens of thousands of people gather in Hong Kong's Victoria Park annually to demand truth and justice for those who were violently silenced in 1989. The image of thousands of people holding candles has become as iconic as the Tank Man, reminding us that Tiananmen is not just about repression—it's about hope. Read more at www.ias.edu/news/in-the-media/he-surviving-tiananmen.



Composer and cellist ZOË KEATING (left) joins Artist-in-Residence DAVID LANG (right) for a post-performance conversation with the audience as part of the 2018–19 Edward T. Cone Concert Series.



Special Programs and Outreach

The Institute for Advanced Study is committed to the idea that science and learning transcend all geographic boundaries and scholastic disciplines, and that scholars and scientists are members of one commonwealth of the mind. It engages with the greater Princeton community through public lectures, concerts, and events, and extends its influence beyond academia through innovative programs designed to inspire and educate.

BEYOND THE WORK THAT TAKES PLACE in the four Schools, the Institute's scope is broadened and enhanced by its special programs, which contribute much to the vitality of the Institute.

The Program in Interdisciplinary Studies, directed by Professor Piet Hut, explores ways of viewing the world that span a range of disciplines from computational astrophysics, geology, and paleontology to artificial intelligence, cognitive psychology, and philosophy.

The Director's Visitor program enables the Director to invite scholars from a variety of fields, including areas not represented within the four Schools, to participate in the range of intellectual and social activities at the Institute.

The Artist-in-Residence Program was established in 1994 to create a musical presence within the Institute community, and to have in residence a person whose work could be experienced and appreciated by scholars from all disciplines. Artists-in-Residence have included Robert Taub, Jon Magnussen, Paul Moravec, Derek Bermel, Sebastian Currier, and, as of 2016, David Lang.

The Institute also engages in outreach beyond its local community. Since 1994, the IAS/Park City Mathematics Institute has integrated mathematics educators, researchers, and students through innovative programs. The Program for Women and Mathematics, sponsored jointly with Princeton University, provides substantive mathematics content as well as practical encouragement for women to pursue careers in the field of mathematics.

The School of Natural Sciences sponsors Prospects in Theoretical Physics, a two-week residential summer program held at the Institute for exceptionally promising graduate students and postdoctoral scholars.

The Summer Program in Social Science, led by Professor Didier Fassin, is an interdisciplinary initiative for early-career scholars from Africa, the Middle East, and Latin America, which aims to enrich and expand the realm of social sciences through the confrontation of different intellectual traditions and perspectives.

A Digital Scholarship@IAS initiative was formed in 2016 to accelerate the pace of research across disciplines and geographic locations by offering Faculty and Members new tools and technologies to gather and process large amounts of data, visualize the results, and make the data and results openly available.

SPECIAL PROGRAMS

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SPECIAL PROGRAMS

PROGRAM IN INTERDISCIPLINARY STUDIES



ANDREA KANE



DAN KOMODA

The current research theme of Professor **Piet Hut**, head of the Institute's Program in Interdisciplinary Studies, is a study of the origins of novelty throughout the history of the universe, specifically the origins and nature of cognition.

The three greatest forms of novelty have been the origin of the universe itself, in the Big Bang; the origin of life on Earth and likely elsewhere in the universe; and the origin of consciousness. Of these three, the first one stands out as having provided the cosmic stage on which everything else plays out, while the last one provided the means of describing the stage and the plays that are performed on it.

Hut continued to work on a book project on the origins of novelty, tentatively titled "The Innovation Circle: Emergent Order in Cognition and in the World," in collaboration with Eric Smith, a physicist at the Earth-Life Science Institute in Tokyo, a research center that Hut and colleagues founded seven years ago. Another book project, tentatively titled "Open Mind, Open World," is taking shape in a long-term collaboration between Hut and Dan Zahavi, a philosopher of phenomenology at the University of Copenhagen and Oxford University.

As the head of the Program in Interdisciplinary Studies, Hut has led the After Hours Conversations series of regular "bar talks," in which speakers from each of the four Schools give ten-minute talks, followed by informal discussions, a popular program that he started eleven years ago with Professor Emerita Caroline Walker Bynum.

Hut and his visitors hold (literally) round-table lunches during most of the first and second term, in the Simons Hall dining hall. Anyone is welcome to join these lunches, where the main topics are related to cognition, as discussed from many different angles, with rich contributions from visitors of all four Schools at IAS.

Two of Hut's visitors wrote an article about the Program in Interdisciplinary Studies for the *Newsletter of the European Mathematical Society*, Issue 112, June 2019, pp.40–42 (available at www.ias.edu/ems-pids).

Some of the invited talks given by Hut were "ALife in the Context of Origins Questions" (ALife Conference, Tokyo), "What Contains What? The Relationship between Mind and World, in Science and in Contemplation" (Columbia University, New York), "History and Future of Scientific Revolutions" (University of Wisconsin–Madison).

Left: Professor Emeritus FREEMAN DYSON (right) gives an After Hours Conversations talk on biological and cultural evolution. In the After Hours Conversations series, speakers from each of the four Schools give ten-minute talks on major open problems in their fields, followed by informal discussions.

Right: A main focus of Professor PIET HUT (right), has been a study of the origins of novelty throughout the history of the universe, specifically the origins and nature of cognition.

2018–19 VISITORS

f First Term

Ayako Fukui

Harmonic Analysis ♦ ARAYA Brain Imaging

Eiko Ikegami

Historical Sociology ♦ The New School

Yuko Ishihara

Philosophy ♦ Earth-Life Science Institute, Tokyo
Institute of Technology ♦ *f*

Barnaby Marsh

Evolutionary Dynamics ♦ Harvard University

Michael Th. Rassias

Mathematical Analysis, Analytic Number Theory ♦
Universität Zürich

Michael Solomon

Bioethics ♦ Institute for Advanced Study

Edwin Turner

Astrophysics ♦ Princeton University

Corijn van Mazijk

Philosophy ♦ University of Groningen ♦ *f*

Olaf Witkowski

Artificial Life and Complex Systems ♦ Earth-Life Science
Institute, Tokyo Institute of Technology ♦ *f*

ARTIST-IN-RESIDENCE PROGRAM



Left: Artist-in-Residence DAVID LANG answers questions from the audience as part of the Edward T. Cone Concert Series. Right: Lang (far right) joins cast onstage during the June 2019 world premiere of his opera *prisoner of the state* at Lincoln Center.

In his third season as IAS Artist-in-Residence, Pulitzer Prize–winning composer David Lang curated the 2018–19 Edward T. Cone Concert Series, the last in a three-year series titled “The Pattern Makers.” This season opened with the Grammy Award–winning Vox Clamantis Choir, which sang both Gregorian Chant and contemporary music based on Gregorian Chant. The season continued with composer and cellist Zoë Keating, who used technology to loop and superimpose long musical phrases on the spot, building up dense layers of melodies that collided dramatically on top of each other. In early 2019, Lang hosted young superstar tenor Nicholas Phan, who sang Schubert’s *Die Schöne Müllerin* accompanied by pianist Myra Huang. The season concluded with a night of performances by acclaimed film and theater actor Paul Lazar, who delivered John Cage’s *Indeterminacy*, and the Sandbox Percussion ensemble, who performed a number of Cage’s percussive pieces.

June saw the world premiere of Lang’s opera *prisoner of the state* with the New York Philharmonic at the Lincoln Center in New York City. Of the opera, an adaptation of Beethoven’s *Fidelio*, Lang told *Billboard*, “[*Fidelio*] walks up to the place where you can have a political opinion, then it backs away. I just remember thinking, I wonder what it would be like to have this piece go all the way?”

Lang begins his second three-year term as IAS Artist-in-Residence in September 2019. Learn more at www.ias.edu/air.

DIRECTOR’S VISITORS

Theoretical physicist **Curtis Callan** has recently become fascinated by the opportunities for theory that modern biology presents. At IAS, he worked to develop a deeper theoretical understanding of the adaptive immune system, and to identify other areas of biology ripe for theoretical thinking.

Paul A. Hanle is the founder of the Climate Judiciary Project, which he formed to provide the U.S. judiciary with the scientific grounding needed for science-based decision-making, particularly where climate science is central to the proceedings.

Anna Laqua has been investigating the transfer of early modern knowledge between medicine and the theater. The starting point of her research was the historical figure John Bulwer (1606–1656), a London physician and Baconian who had a special interest in theater culture.

At the IAS, **Sally Marlow**, broadcaster and Fellow of King’s College London, worked to make the documentary *Hotel Genius* about the Institute.

Science writer **George Musser** embarked on a new book project about the intersection of physics, neuroscience, and artificial intelligence, realms he explored while at the Institute.

Sarah Anna Paden worked on a large-scale project exploring the intersections between Buddhism in America and experimental music after World War II.

Iqbal Riza, Special Adviser to the Secretary-General of the United Nations, examined the historical currents and decisions that led to the emergence of Israel and Pakistan as independent states, and the political course of each in their internal governance and foreign relations.



Scientific American published “Machine Learning Gets a Bit More Humanlike” by Director’s Visitor GEORGE MUSSER in May 2019. In the article, Musser explores the question of how machines could learn simplified forms of creativity and common sense, among other human traits.

OUTREACH

IAS/PARK CITY MATHEMATICS INSTITUTE



ALL PHOTOS DAVID TITENSOR

The theme of the 2019 IAS/Park City Mathematics Institute program was “Quantum Field Theory and Manifold Invariants.” Lecture topics included low-dimensional topology (knots, three-manifold topology), and the geometric aspects of gauge theory in mathematical physics.

The IAS/Park City Mathematics Institute (PCMI) is an annual summer program held in Park City, Utah. Its intensive program incorporates activities for groups across the mathematical community, from researchers and graduate students to K–12 teachers. The program aims to promote academic excellence within each of these groups, and to promote communication between them. Founded in 1991, PCMI has been an outreach program of the IAS since 1994. It is currently funded by major grants from the National Science Foundation, the Simons Foundation, and Math for America, as well as a number of generous gifts from individuals and private foundations. Rafe Mazzeo (Stanford University) serves as PCMI Director, while Dena Vigil, a long-time program administrator, this year took on the role of Program Manager.

PCMI consists of six parallel subprograms, with the more advanced subprograms focusing on a specific research theme that changes annually. These include a program for researchers and a closely aligned program for graduate students. The graduate program centers on eight mini-courses given by leading experts in that year’s research theme. These are attended by the eighty graduate student participants, as well as many of the researchers (up to sixty participate in the program) and the more advanced undergraduate students.

PCMI’s forty-five undergraduate students participate in a program consisting of two parallel lecture courses on topics pertaining to the theme, as well as an “experimental math lab” that brings participants together to work on open-ended problems.

There is also a fifteen-person undergraduate faculty program geared toward faculty—often from undergraduate-only institutions—who are drawn to PCMI as a way to reconnect with the research community and rekindle their research programs. The last undergraduate program is a ten-person workshop on issues related to equity and inclusion in the mathematics profession and classroom.

Lastly, PCMI features a large and widely known professional development opportunity for middle and high school teachers. Approximately half of the subprogram’s sixty participants come from the New York-based Math for America program, while the rest come from school districts across the country. These teachers work on intricate problems and challenges to consolidate their mathematical knowledge and rediscover the challenges of learning rather than teaching mathematics; another part of their day is spent on reflecting on best pedagogical practices.

Well over three hundred participants attend PCMI each year, and an important goal of the program is to help these participants interact with one another. The relaxed and informal setting allows for the formation of new collaborations, mentoring relationships, and other associations. Interaction is encouraged through formal and informal social events, as well as through daily cross-program events and lectures. In 2019, cross-program activities included talks and presentations on virtual reality and mathematical imagination, quantum computation, the mathematics of square-dancing, and panel discussions on equity issues and career arcs for young researchers.

The theme of the 2019 summer program, “Quantum Field Theory and Manifold Invariants,” was organized by Dan Freed (one of PCMI’s founders, with Karen Uhlenbeck (Visiting Professor, IAS) and Herb Clemons), Sergei Gukov, Ciprian Manolescu, Constantin Teleman, and Ulrike Tillman. The two undergraduate summer school lecture series were delivered by Dan Mathews and Jessica Purcell, and Lara Anderson and Laura Fredrickson. Lecturers for the undergraduate faculty program were John Etnyre and Paul Melvin. Rochelle Gutierrez organized the Workshop on Equity and Mathematics Education.

The research theme for 2020 is “Number Theory Informed by Computation,” and will be organized by Jennifer Balakrishnan, Kristin Lauter, Bjorn Poonen, and Akshay Venkatesh (Robert and Luisa Fernholz Professor, IAS).

PROGRAM FOR WOMEN AND MATHEMATICS



The twenty-sixth annual IAS Women and Mathematics Program focused on topics in geometric analysis. Panagiota Daskalopoulos (left) delivered the Uhlenbeck Lectures, and Tatiana Toro (right) delivered the Terng Lectures. Watch videos from the program at www.ias.edu/wam2019.

The twenty-sixth annual Women and Mathematics (WAM) Program, “Topics in Geometric Analysis,” was held May 18–24, 2019, at the Institute for Advanced Study. Program activities were sponsored by IAS, Princeton University, the National Science Foundation (NSF), and a grant from Lisa Simonyi. Program organizers were Dusa McDuff (Barnard College), Margaret Readdy (University of Kentucky), Sun-Yung Alice Chang (Princeton University), and Michelle Huguenin (IAS).

The 2019 program marked the second installment of the Terng and Uhlenbeck Lectures, named in honor of Women and Mathematics cofounders Karen Uhlenbeck (Visiting Professor, IAS) and Chu-Lian Terng. Terng Lecturer Tatiana Toro (University of Washington) delivered four lectures on “Uniform Rectifiability via Perimeter Minimization,” and Uhlenbeck Lecturer Panagiota Daskalopoulos (Columbia University) delivered four lectures on “Ancient Solutions to Geometric Flows.” IAS Members Zihui Zhao and Robin Neumayer served as teaching assistants. The program included nineteen undergraduates, twenty-three graduates, and eleven postdoctoral, faculty, and industrial mathematicians from over forty universities and organizations.

The program began on May 18 with an icebreaker and tour of the Princeton University Graduate College.

On May 19, Zhao and Lu Wang (von Neumann Fellow, IAS) led the Terng and Uhlenbeck course previews. Participants Allegra Allgeier, Maxine Calle, Julia Costacurta, Hindy Drillick, Aisha Mercery, Rebecca Rechkin, and Cheng Yang assisted Margaret Readdy with an outreach program titled “Math Carnival with the Institute for Advanced Study” at the Princeton Public Library. Over 120 children and teens attended the event, which included math and magic, knot theory, and soap bubble activities. The Women-in-Science Seminar began with three talks, on tips for writing National Science Foundation grant proposals (Michelle Manes, NSF), on the gender pay gap (Michelle Issadore, NCHERM), and on professional courtesy (Evelyn Grammar).

The Women-in-Science Seminar series continued on May 20 with a career panel featuring Kirsten Lum (Johnson & Johnson), Michelle Manes, Rasha Abadir (Sayreville War Memorial High School) and Alina Bucur (von Neumann Fellow, IAS), moderated by Readdy. The graduate/postdoc research seminar, organized by Rosa Fuster Aguilera and Rong Tang, included talks by Betül Orcan-Ekmekci, Paula Burkhardt-Guim, Raquel Perales, Alice Lim, Lisa Naples, and Liangbing Luo.

The next day, participants watched a live broadcast of Karen Uhlenbeck receiving the 2019 Abel Prize, honoring her pioneering work in mathematics, from King Harald V in Norway. Later, Michelle Issadore ran a “#MeToo” lunch seminar on sexual harassment in the workplace and related federal protections. Daniela De Silva gave a colloquium that evening.

On May 22, participants visited Princeton University to hear faculty Casey Kelleher, Otis Chodosh (Veblen Research Instructor, IAS), and Fernando Coda Marques (Distinguished Visiting Professor, IAS). Sigurd Angenent gave a computer workshop lecture on Python, assisted by Princeton graduate student Linda Cook. The day was punctuated with many opportunities for the participants to meet Princeton faculty during a lunch, tea, and dinner hosted by the university’s mathematics department.

Thanks to a generous grant from Lisa Simonyi, the WAM Ambassador Program concluded its second year of building support and outreach networks across the country. The Ambassador Program funds up to three postdoctoral or advanced graduate ambassadorships and up to six graduate ambassadors per year. Funded activities for 2018–2019 included a one-on-one graduate/undergraduate mentoring program, career panels, a public talk on challenges faced by African-American women pursuing higher education in STEM, a Wikipedia edit-a-thon to edit and write women mathematician biographies, and regional and state-wide conferences. Participants listened to one representative from each funded group and were able to ask questions about organizing similar activities in their own region.

PROSPECTS IN THEORETICAL PHYSICS



ALL PHOTOS DAN KOMODA

PiTP 2019, “Great Problems in Biology for Physicists,” covered topics ranging from virology, cancer, and immunology to machine learning and neural networks. ARNOLD J. LEVINE (top, center) spoke on “Cancer Origins and Overview,” and Raúl Rabadán (middle) spoke on “Some Quantitative Problems in Evolution and Heterogeneity of Human Cancers.” Watch videos from the program at www.ias.edu/ideas/videos-pitp-2019.

Prospects in Theoretical Physics (PiTP) is an intensive two-week summer program geared specifically to graduate students and postdoctoral scholars. First held at the Institute in 2002, PiTP has covered topics ranging from cosmology to the Large Hadron Collider, to string theory, to computation and biology, to insights into quantum matter, and to computational plasma astrophysics.

“Great Problems in Biology for Physicists” was the theme of PiTP 2019, which was held July 15–26, 2019, on the Institute campus. The program was organized with collaboration and generous support from the Paul G. Allen Frontiers Group, and with further support from the National Science Foundation’s Cancer Convergence Education Network grant.

Registration for the 2019 program included a core group of sixty participants, who attended the full program, augmented by another group of twenty-five participants from area institutions (Princeton University, Columbia University, Mount Sinai, New York University, and Rutgers, the State University of New Jersey), who attended multiple lectures and discussions on particular topics. Graduate and postdoctoral programs of forty-six institutions were represented, and over half of the registrants came from outside of the United States, representing twenty-two different countries. More than twenty percent of participants were women. The backgrounds of the participants ranged from quantum physics to theoretical biochemistry, to systems and computational biology, to immunology. Over forty percent of the participants were postdoctoral researchers.

“Great Problems in Biology for Physicists” provided an opportunity for participants to meet and interact with senior lecturers from many different research and academic institutions. Over the two weeks of the program, twenty-eight lecturers gave talks (generally ninety minutes in length). Beginning with lectures designed to build background on the genome, molecular, and evolutionary biology, the program continued with lectures addressing cancer-related aspects of several topics, including virology, immunology, aging, epigenetics, and machine learning, as well as some non-cancer-specific subjects. The structure of the lectures provided participants with unparalleled access to top scientists in their fields, as participants were encouraged to ask questions and engage in follow-up discussions. Each day had a central theme and, on average, three lectures. Open blocks of time for discussion, following the afternoon tea break, enabled the program’s organizers and lecturers to create targeted discussion and working groups based on the lectures and the main questions of the day. Evening activities included discussion of career issues of general interest to both graduate students and postdocs (led by one of the senior lecturers), open workshops on problem sets, and informal discussions over dinner on topics ranging from the day’s lectures to research papers and projects, and more specific career advice, as well as time for Convergence team graduate students and postdocs to interact with each other and with the other graduate students and postdocs in attendance.

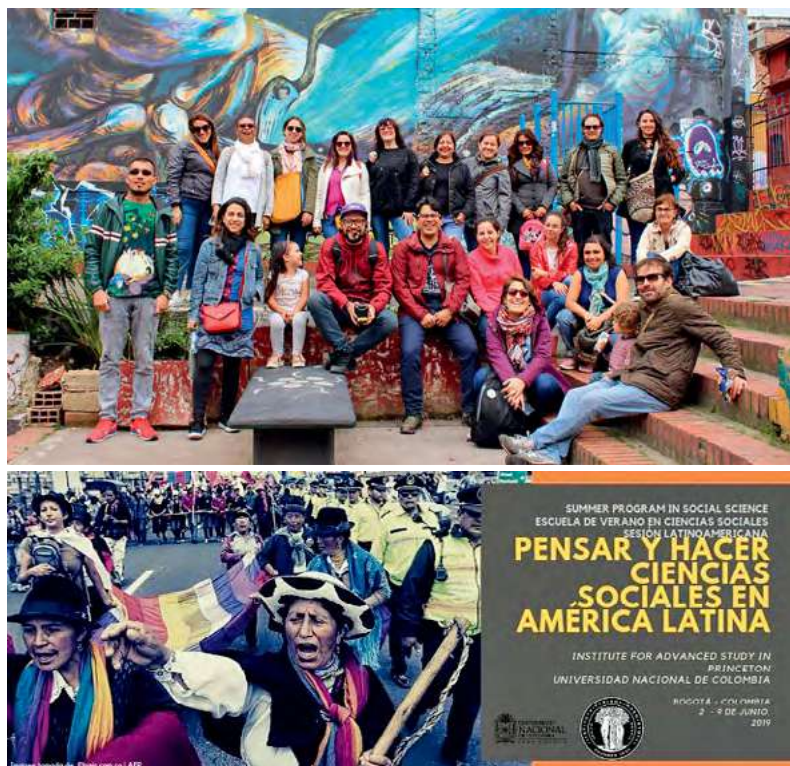
SUMMER PROGRAM IN SOCIAL SCIENCE

Designed to bring together twenty early-career scholars from Africa, the Middle East, and Latin America, the Summer Program in Social Science aims to enrich and expand the realm of the social sciences through the confrontation of different intellectual traditions and perspectives; to facilitate and enhance the dialogue between various scientific disciplines and communities; and to strengthen international networks across continents. Special attention is paid to local contexts of production and global modalities of circulation of knowledge, and the participants are invited to exchange their research experiences with their constraints, challenges, and expectations.

Organized by the School of Social Science and developed by Didier Fassin, James D. Wolfensohn Professor, the program is conducted in collaboration with the Wits Institute for Social and Economic Research at the University of the Witwatersrand in Johannesburg, and the Escuela de Estudios de Género and Centro de Estudios at the Universidad Nacional de Colombia in Bogotá. Funded by the Mellon Foundation, it is composed of three two-year cycles. The first cycle started in June 2018, with a two-week session at the Institute, and was further developed in May and June 2019 via one-week workshops at the two collaborating institutions in South Africa and Colombia. A three-year pilot initiative organized by the Institute in collaboration with the École des Hautes Études en Sciences Sociales in Paris and the Swedish Collegium for Advanced Study in Uppsala took place from 2015 to 2017.



The 2019 Summer Program in Social Science, developed by DIDIER FASSIN (far left), convened twenty early-career scholars from Africa, the Middle East, and Latin America, with disciplines in history, anthropology, sociology, geography, economics, law, political science, and literary studies.

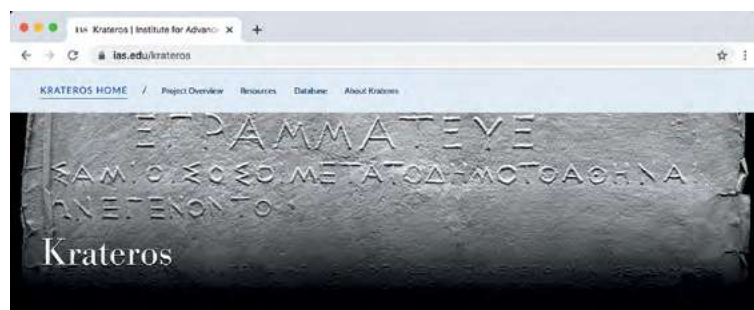


Participants' research topics include the care of disabled persons in Brazil, the transportation infrastructure in Colombia, the everyday life under an authoritarian regime in Angola, the public life of secret societies in Cameroon, the experience of Palestinian women imprisoned in Israel, the Arab uprising seen from the perspective of farmers in Egypt, and the humanitarian approach to migrant working children in Mexico and India.

The scholars invited to participate in the current cycle have gone through a selection process. Their disciplines are history, anthropology, sociology, geography, economics, law, political science, and literary studies. Their research topics include the care of disabled persons in Brazil, the discourse on indigenous people in Argentina, the transportation infrastructure in Colombia, the resistance to extractive industries in Latin America, the everyday life under an authoritarian regime in Angola, the violence of mafias in Nigeria, the public life of secret societies in Cameroon, the social life of mining communities in Zimbabwe, the experience of Palestinian women imprisoned in Israel, the resilience of the population during the Syrian crisis in Lebanon, the Arab uprising seen from the perspective of farmers in Egypt, the ethics and politics of Sufi shrines in Pakistan, and the humanitarian approach to migrant working children in Mexico and India.

The program has given birth to several "South-South" initiatives, such as a collaborative course between the American University of Beirut and the University of Johannesburg, and a collective panel presented to the Latin American Studies Association annual meeting.

DIGITAL SCHOLARSHIP@IAS



Left: The Krateros website, which hosts the digital collections of epigraphic squeezes at IAS Right: Shawn Hill of Fordham University spoke about digital pedagogy tools as part of the Digital Scholarship Conversations series.

Albert: The Institute's Digital Repository

The 2018–2019 academic year was a banner year for the Albert repository project (see <https://albert.ias.edu>). Albert is an open access repository, intended to preserve and publish scholarly materials from the Institute's current and former Faculty, Members, Research Associates, and Visitors, as well as to provide modern publishing resources for born-digital projects, datasets, and collaborative efforts. The repository, which is constantly growing, currently boasts over 8,000 items in its collections, and as of this year, serves as the platform hosting the Shelby White and Leon Levy Archives Digital Collections (see <https://library.ias.edu/archives>), as well as Krateros, the digital collections of epigraphic squeezes at IAS (see <https://www.ias.edu/krateros>).

Beyond those projects, and the growing collection of Faculty publications, this past year Albert was strategically linked with major open access platforms, including ORCID.org and ArXiv.org. Plans for the future include a major software upgrade and improvements to the user interface and analytical engine.

Digital Projects

IAS Faculty and staff continued to support a number of ongoing digital scholarship projects, as well as beginning to plan for future projects and collaborations. Projects currently underway include:

- **The Zaydi Manuscript Tradition.** Supported by funding from the Carnegie Corporation of New York, the Charles and Lisa Simonyi Fund for Arts and Sciences, the National Endowment for the Humanities, the Middle East Center at Penn University, the Gerard B. Lambert Foundation, the Ruth Stanton Foundation, and Sherwin Seligsohn (this donation is part of an unrestricted gift to the School of Historical Studies), and in partnership with the Hill Museum and Manuscript Library, Professor Sabine Schmidtke's Zaydi Manuscript Tradition: A Digital Portal continued to grow. It will contain 5,000 manuscripts by the end of 2019, and it is planned that by 2020, some 10,000 to 15,000 manuscripts (mainly from Yemen, but also from European and North American libraries and other places in the Middle East) will be uploaded to the repository and the portal (see www.ias.edu/digital-scholarship/zaydi_manuscript_tradition).
- **Krateros: Squeezes of Greek Inscriptions at the IAS.** Supported by funding from Annette Merle Smith and by the Charles and Lisa Simonyi Fund for Arts and Sciences, the effort to digitize the Institute's unique collection of squeezes of ancient Greek inscriptions, led by Angelos Chaniotis, Professor in the School of Historical Studies, continues. To date, 15,538 squeezes have been scanned, representing about 50% of the total collection. Of these, 2,683 have been made available through open access as part of the Albert repository.
- **A New Business History of Early Modern Tuscany.** Francesca Trivellato, Professor in the School of Historical Studies, continues to develop a tailor-made relational database for the analysis of ca. 5,000 limited partnerships registered in Florence, but operating elsewhere as well, from 1445 to 1808. Currently hosted on a password-protected web platform, this resource will eventually be made available through open access. This novel tool mines an unusually large dataset to address a central issue in business history and the history of Renaissance Florence, namely, the role of social ties versus institutional innovations in the early development of capitalism.

Digital Scholarship Working Group

Strategic direction for the Institute's support of digital scholarship is provided by the Digital Scholarship Working Group, currently comprised of Jeff Berliner, Emma Moore, Marcia Tucker, María Mercedes Tuyá, and Sabine Schmidtke. In addition to curating the Digital Scholarship Conversations series (see sidebar), this year the group completed a draft of the Institute's forthcoming policy on Open Access, expected to be enacted in the coming year.

September 27

Digital Scholarship Conversations ♦ *The Archaeology of Reading: Building a Digital Research Environment* ♦ **Dr. Jaap Geraerts**, University College London

December 13

Digital Scholarship Conversations ♦ Film Screening: *Paywall: The Business of Scholarship* ♦ **Jason Schmitt**, Clarkson University

March 1

Lunch and Learn Workshops ♦ *ORCID and IAS: Connecting Researchers and Research* ♦ **Jeff Berliner**, Institute for Advanced Study; **Sabine Schmidtke**, Professor, School of Historical Studies; representatives of ORCID

March 22

Digital Scholarship Conversations ♦ *Fast, Free, and Fun: 3 Great New Digital Pedagogy Tools* ♦ **Shawn Hill**, Faculty Technology Services, Fordham University

May 7

Staff Training ♦ *How to Use and Work with Albert* ♦ **María Mercedes Tuyá**, Institute for Advanced Study

RECORD OF EVENTS

School of Historical Studies

September 26

Modern International Relations Seminar ♦
Informal Group Discussion

September 27

Lunchtime Colloquia Series ♦ *First Term Introductions* ♦ **Angelos Chaniotis**, Professor, School of Historical Studies

October 1

Art History Seminar ♦ *First Term Introductions* ♦ **Yve-Alain Bois**, Professor in the School of Historical Studies

October 2

Medieval Studies Seminar ♦ *First Term Introductions* ♦ **Patrick J. Geary**, Andrew W. Mellon Professor, School of Historical Studies

October 3

Near Eastern Studies Seminar ♦ *Reading the Quran Backwards: Some Hypotheses on a Seventeenth-Century Manuscript* ♦ **Pier Mattia Tommasino**, Columbia University; Member, School of Historical Studies

Modern International Relations Seminar ♦
Informal Group Discussion

October 4

Lunchtime Colloquia Series ♦ *The Mao Badge Fad: How a State-Supported Consumer Fad Undermined a Revolution* ♦ **Karl Gerth**, University of California, San Diego; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *The Medieval/Early Modern Divide along the Franco-Spanish Border* ♦ **Francesca Trivellato**, Professor, School of Historical Studies

October 8

Art History Seminar ♦ *On Duccio's Maesta* ♦ **Eric Palazzo**, Université de Poitiers; Member, School of Historical Studies

Brown Bag Lunch Series, Department and Program in Near Eastern Studies, Princeton University ♦ *Qadi Ja'far and the Revival of Zaydi Islam in Sixth/Twelfth-Century Yemen* ♦ **Scott Lucas**, The University of Arizona; Member, School of Historical Studies

October 9

Ancient Studies Seminar ♦ *Many Funny Things Happened on the Way to the Forum: Graffiti from the City Park of Aphrodisias* ♦ **Angelos Chaniotis**, Professor, School of Historical Studies

October 10

Near Eastern Studies Seminar ♦ *Medinan Verses in a Meccan Sura or Exegetical Glosses? The Case of Quran 91* ♦ **Tommaso Tesei**, Van Leer Jerusalem Institute; Member, School of Historical Studies

Modern International Relations Seminar ♦
Informal Group Discussion

October 11

Lunchtime Colloquia Series ♦ *Why Gibbon Was Wrong; The Case for 472 and the "Fall" of Rome* ♦ **Michele Salzman**, University of California, Riverside; Member, School of Historical Studies

October 12

IAS Friends Talk ♦ *Uncovering Eighty Years of Research into the Near and Middle East at the Institute for Advanced Study* ♦ **Sabine Schmidtke**, Professor, School of Historical Studies

October 15

East Asian Studies Seminar ♦ *Another Monetary Economy: A History of Chinese Currencies* ♦ **Akinobu Kuroda**, The University of Tokyo; Member, School of Historical Studies

October 16

Ancient Studies Seminar ♦ *Aristotle on Dramatic Katharsis* ♦ **Pierre Destrée**, Seeger Center for Hellenic Studies, Princeton University

October 17

Art History Public Seminar ♦ *The Unbearable Lightness of Whiteness: Racism and Medievalism in the Architecture of Prewar Los Angeles* ♦ **Alison Perchuk**, The California State University, Channel Islands; Member, School of Historical Studies

Near Eastern Studies Seminar ♦ *Shi'izing Iran— with Sunni Occult Science* ♦ **Matthew Melvin-Koushki**, University of South Carolina; Visitor, School of Historical Studies

Modern International Relations Seminar ♦
Informal Group Discussion

October 18

Lunchtime Colloquia Series ♦ *Landscapes of St. Gregory: Topography and Hagiography in Medieval Central Italy* ♦ **Alison Perchuk**, The California State University, Channel Islands; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Shared Burdens: Mutuality, Governance Constructs, and Third-Party Enforcement in Early Modern Europe; The Case of General Averages in the Netherlands (Sixteenth and Seventeenth Centuries)* ♦ **Sabine Go**, Vrije Universiteit Amsterdam; Member, School of Historical Studies

October 22

Art History Seminar ♦ *On The Concept of the "Tragic" Image in Byzantine Illustrated Manuscripts* ♦ **Benjamin Anderson**, Cornell University; Member, School of Historical Studies

October 24

Modern International Relations Seminar ♦
Informal Group Discussion

October 25

Lunchtime Colloquia Series ♦ *Rameau's "Sensationalist Conversion" Revisited* ♦ **Nathan Martin**, University of Michigan; Member, School of Historical Studies

Near Eastern Studies Seminar ♦ *A Little Bit More than Just Bindings* ♦ **Nuria de Castilla**, École Pratique des Hautes Études, Paris

October 29

East Asian Studies Seminar ♦ *Reading, Rhyming, and Recursion: Considering the Function of Print in Fourteenth-Century Japan* ♦ **Brian Steininger**, Princeton University; Member, School of Historical Studies

October 30

Medieval Studies Seminar ♦ *Experiencing Sanctity and Community in Byzantine North Africa* ♦ **Ralf Bockmann**, Deutsches Archäologisches Institut, Rome; Member, School of Historical Studies

October 31

Near Eastern Studies Seminar ♦ *Making the Self: Death and Individuality in Early Modern Ottoman Society* ♦ **Nükhet Varlık**, Rutgers University in Newark and New Jersey Institute of Technology; Member, School of Historical Studies

Modern International Relations Seminar ♦
Informal Group Discussion

November 1

Lunchtime Colloquia Series ♦ *Historical Reading Practices and the Limitations of Evidence* ♦ **Earle Havens**, Johns Hopkins University; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Catalunya and Beyond: Sex and Priestly Masculinities in Late Medieval Europe* ♦ **Michelle Armstrong-Partida**, The University of Texas at El Paso; Member, School of Historical Studies

November 5

Art History Seminar ♦ *On The Evolution of Church Buildings in the Byzantine North* ♦ **Ralf Bockmann**, Deutsches Archäologisches Institut, Rome; Member, School of Historical Studies

East Asian Studies Seminar ♦ *Buddhism and the Chinese Discovery of Religion* ♦ **Stephen R. Bokenkamp**, Arizona State University; Member, School of Historical Studies

November 6

Near Eastern Studies Seminar ♦ *How Many Laws Are in the Quran? Answers from Zaydi Yemen* ♦ **Scott Lucas**, The University of Arizona; Member, School of Historical Studies

November 7

Modern International Relations Seminar ♦ Informal Group Discussion

November 8

Lunchtime Colloquia Series ♦ *The Protection of Socialist Property under Stalin: The Voices of "Thieves"* ♦ **Juliette Cadiot**, École des Hautes Études en Sciences Sociales, Paris; Member, School of Historical Studies

Seminar (in cooperation with Princeton University) ♦ *The Arid Negev Highlands (Southern Israel) in the Iron Age: The Impact of the Exact and Life Sciences* ♦ **Israel Finkelstein**, Tel Aviv University

November 9

Lecture ♦ *Jerusalem in Biblical Times (ca. 1350–100 B.C.E.): Comments on Archaeology and History* ♦ **Pierre Destrée**, Seeger Center for Hellenic Studies, Princeton University; **Israel Finkelstein**, Tel Aviv University

Medieval Studies Seminar ♦ *The Old English Genesis, the Cotton Genesis, and the Tournian Bibles* ♦ **Seiichi Suzuki**, Kansai Gaidai University; Member, School of Historical Studies

November 12

East Asian Studies Seminar ♦ 仁: *The Question of the One and the Many in Historical Analysis* ♦ **Lydia Liu**, Columbia University; Member, School of Historical Studies

November 13

Ancient Studies Seminar ♦ *The Organization of the Construction Industry in Classical Athens* ♦ **Cristina Carusi**, The University of Texas at Austin; Member, School of Historical Studies

November 14

Modern International Relations Seminar ♦ Informal Group Discussion

November 15

Lunchtime Colloquia Series ♦ *Great Expectations: Genealogy, History, and Eschatology in the European Middle Ages* ♦ **Hans Hummer**, Wayne State University; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Hernando Colón's Cosmography* ♦ **Seth Kimmel**, Columbia University; Member, School of Historical Studies

November 20

Medieval Studies Seminar ♦ *Workshop on Genealogical Images* ♦ **Hans Hummer**, Wayne State University; Member, School of Historical Studies

November 26

Art History Seminar ♦ *On Freud's Misreading of Leonardo's Ego* ♦ **Johannes Endres**, University of California, Riverside

November 29

Lunchtime Colloquia Series ♦ *Empire, Ecology, and Plague: Rethinking the Second Pandemic (ca. 1340s–ca. 1840s)* ♦ **Nükhet Varlık**, Rutgers University in Newark and New Jersey Institute of Technology; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Reading Readers Writing about Reading: The Information Cultures of John Dee and Gabriel Harvey* ♦ **Earle Havens**, Johns Hopkins University; Member, School of Historical Studies

December 3

Art History Seminar ♦ *On "Metapainting" in Byzantium and Trecento Italy* ♦ **Giulia Puma**, Université de Nice Sophia Antipolis, Université Côte d'Azur; **Maria Alessia Rossi**, Princeton University

East Asian Studies Seminar ♦ *Rethinking Japanese Imperialism, 1930s–1970s: Lessons from Imperial and Post-imperial Japan* ♦ **Louise Young**, University of Wisconsin–Madison; Member, School of Historical Studies

December 4

Ancient Studies Seminar ♦ *Auditory Culture, Music, and Rhetoric in Dionysius of Halicarnassus* ♦ **Sean Gurd**, University of Missouri–Columbia; Member, School of Historical Studies

The Historical Studies–Social Science Library Book Conversation ♦ *Salvaging the Zaydi Manuscript Tradition: The Fate of Private and Family Libraries in Twentieth-Century Yemen* ♦ **Sabine Schmidtke**, Professor, School of Historical Studies

Medieval Studies Seminar ♦ **Cosmin Alin Popa-Gorjanu**, University of Alba Iulia; Member, School of Historical Studies

December 5

Near Eastern Studies Seminar ♦ *Reading and Refinement: Arabic Conduct Pedagogy, 1870s–1920s* ♦ **Marilyn Booth**, University of Oxford; Member, School of Historical Studies

Modern International Relations Seminar ♦ Informal Group Discussion

December 6

Lunchtime Colloquia Series ♦ *Heraclius's War Propaganda and the Quran's Promise of Reward for Dying in Battle* ♦ **Tommaso Tesei**, Van Leer Jerusalem Institute; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Reading the Quran Backwards: Orientalism, Science, and Philology in Seventeenth-Century Florence* ♦ **Pier Mattia Tommasino**, Columbia University; Member, School of Historical Studies

December 6–7

Shii Studies Research Program Conference: Yemeni Manuscript Collections and Zaydi Studies ♦ Opening Remarks ♦ **Hassan Farhang Ansari**, Long-term Member, School of Historical Studies; **Sabine Schmidtke**, Professor, School of Historical Studies ♦ *The Origins of the Adhān: Reports from the Family of 'Alī* ♦ **Nebil A. Husayn**, University of Miami ♦ *Abraham and the Search for Charisma and Legitimacy in Zaydi Discourses* ♦ **Maher Jarrar**, American University of Beirut ♦ *Al-Imām al-Rassī's Theory of the Imamate* ♦ **Rodrigo Adem**, El Colegio de México ♦ *New Sources for the History of Zaydism in Iran* ♦ **Hassan Farhang Ansari**, Long-term Member, School of Historical Studies ♦ *New Zaydi Manuscripts in Berlin and Their Traces of Ownership* ♦ **Christoph Rauch**, Staatsbibliothek zu Berlin–Preussischer Kulturbesitz ♦ *Towards a History of Libraries in Yemen* ♦ **Sabine Schmidtke**, Professor, School of Historical Studies ♦ *Their Hands before Our Eyes: Strategies of Mise en Texte in Yemeni Manuscripts* ♦ **Valentina Sagaria-Rossi**, Biblioteca dell'Accademia Nazionale dei Lincei e Corsiniana, Rome ♦ *A Tiny and Forgotten Library of Zaydi Manuscripts* ♦ **Anne Regourd**, Centre National de la Recherche Scientifique, UMR 7192, Associée, Paris ♦ *Arguing over the Boundaries of the Interpretive Community in al-Mujzi fī Usul al-Fiqh* ♦ **Devin J. Stewart**, Emory University ♦ *Islamic Theology in Thirty Topics: A Yemeni-Zaydi Tradition Preserved in the Biblioteca Ambrosiana* ♦ **Scott Lucas**, The University of Arizona; Member, School of Historical Studies ♦ *Humayd b. Ahmad al-Muḥallī's Framing of Theology in al-Kawākib al-durriyya* ♦ **Jan Thiele**, Consejo Superior de Investigaciones Científicas, Madrid ♦ *A Contribution to the Question: Was Ibn al-Wazīr the Founder of a School that Set off the "Summation of Zaydism"? Muḥammad b. Ibrāhīm al-Wazīr (d. 840/1436) and Sālih b. Mahdī al-Maqbālī (d. 1108/1696) on Theological and Legal Diversity* ♦ **Damaris Wilmers**, National Records and Archives Authority, Muscat, Oman ♦ *Imam al-Qasim b. Muhammad's (d. 1029) Polemical Response to a Sufi Attack (K. Half anf al-afik fī jawābihi 'ala al-Kamil al-mutadarik)* ♦ **Bernard Haykel**, Princeton University ♦ *Interpretive and Governing Authority in the Zaydi imāma* ♦ **Brinkley M. Messick**, Columbia University ♦ *Qasimi Yemen, a View from the Red Sea Coast* ♦ **Nancy Um**, Binghamton University, The State University of New York ♦ *Shifting Positions on the Ḥadawī Family Waqf: Yemeni Zaydi Fiqh*,

Polemics, and Decrees since al-Hādī until Today ♦ **Eirik Hovden**, University of Bergen, Norway ♦ *Zaydī Arguments against Muḥammad b. ‘Alī al-Shawkānī’s Fatwa on the Worldly Judgment of Jewish Orphans and the Legitimacy of the Late Qāsimī Imamate* ♦ **Kerstin Hünefeld**, Freie Universität Berlin and Herbert D. Katz Center for Advanced Judaic Studies, University of Pennsylvania ♦ *Borders in Arabia: Hijazi Responses to Zaydī Politics and Doctrine* ♦ **Zacky Khairul Umam**, Freie Universität Berlin and Johns Hopkins University

December 10

Art History Seminar ♦ *On Marble Bust Portraits of the Renaissance* ♦ **Jeanette Kohl**, University of California, Riverside; Member, School of Historical Studies

East Asian Studies Seminar ♦ *Illustrating Knowledge: Mundane Reading in Late Ming China* ♦ **Yuming He**, University of California, Davis; Member, School of Historical Studies

December 11

Ancient Studies Seminar ♦ *How Rome Survived the Gothic Wars* ♦ **Michele Salzman**, University of California, Riverside; Member, School of Historical Studies

Art History Lecture Series ♦ *The Barbarian Invasions: A Genealogy of the History of Art* ♦ **Eric Michaud**, Ecole des Hautes Études en Sciences Sociales

December 12

Near Eastern Studies Seminar ♦ *Sultan al-Ghawri’s Salons and the Question of Confessional Ambiguity at the Mamluk Court* ♦ **Christian Mauder**, Universität Leipzig; Member, School of Historical Studies

Modern International Relations Seminar ♦ Informal Group Discussion

December 13

Lunchtime Colloquia Series ♦ *Orphans of History: Religious Minorities in Southern Ireland, 1922–68* ♦ **Eugenio Biagini**, University of Cambridge; Member, School of Historical Studies

December 17

Art History Seminar ♦ *Second Report on The Concept of the “Tragic” Image in Byzantine Illustrated Manuscripts* ♦ **Benjamin Anderson**, Cornell University; Member, School of Historical Studies

Near Eastern Studies ♦ Project Presentation ♦ *The Intellectual, Social, and Cultural History of the Arab and Islamic World in Transregional Perspective, Sixteenth to Eighteenth Centuries* ♦ **Christian Mauder**, Universität Leipzig; Member, School of Historical Studies

December 18

Medieval Studies Seminar ♦ *The Concept of Energy in Liturgy and Art* ♦ **Eric Palazzo**, Université de Poitiers; Member, School of Historical Studies

December 19

Modern International Relations Seminar ♦ Informal Group Discussion

December 20

Lunchtime Colloquia Series ♦ *Death from Laughter, Female Hysteria, and Early Cinema* ♦ **Maggie Hennefeld**, University of Minnesota, Twin Cities; Member, School of Historical Studies

January 17

Lunchtime Colloquia Series ♦ *Second Term Introductions* ♦ **Angelos Chaniotis**, Professor, School of Historical Studies

Medieval Studies Seminar ♦ *Second Term Introductions* ♦ **Patrick J. Geary**, Andrew W. Mellon Professor, School of Historical Studies

January 22

Medieval Studies Seminar ♦ **Warren Brown**, California Institute of Technology; Member, School of Historical Studies

January 24

Lunchtime Colloquia Series ♦ *Francesco Redi’s Experiments on the Generation of the Insects (1668)—a New Reading* ♦ **Pier Mattia Tommasino**, Columbia University; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *A Missed Encounter: Burckhardt and Economic Historians* ♦ **Francesca Trivellato**, Professor, School of Historical Studies

January 28

Art History Seminar ♦ *Second Term Introductions* ♦ **Yve-Alain Bois**, Professor in the School of Historical Studies

East Asian Studies Seminar ♦ *Unending Capitalism: State Consumerism and the Negation of the Chinese Socialist Revolution* ♦ **Karl Gerth**, University of California, San Diego; Member, School of Historical Studies

January 29

Medieval Studies Seminar ♦ **Eric Palazzo**, Université de Poitiers; Member, School of Historical Studies

January 30

Art History Public Seminar ♦ *Hic Est Homo Platonis: Embodied Platonism in Renaissance Art* ♦ **Jeanette Kohl**, University of California, Riverside; Member, School of Historical Studies

Modern International Relations Seminar ♦ Informal Group Discussion

January 31

Lunchtime Colloquia Series ♦ *Melkite Christians between Byzantium, Muslims, and Crusaders* ♦ **Johannes Pahlitzsch**, Johannes Gutenberg-Universität Mainz; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Marketing and Social Structure in Premodern Xinjiang (East Turkestan)* ♦ **Eric Schluessel**, University of Montana; Member, School of Historical Studies

February 5

Ancient Studies Seminar ♦ *The Sound of Greek Religion* ♦ **Angelos Chaniotis**, Professor, School of Historical Studies

Medieval Studies Seminar ♦ **Noa Turel**, University of Alabama at Birmingham; Member, School of Historical Studies

History of Science Lecture Series ♦ *Twenty Years Is a Long Time* ♦ **Sophia Roosth**, Harvard University

February 6

Near Eastern Studies Seminar ♦ *“Akhbar al-fakhkh,” a Forged Text for Propaganda Purposes* ♦ **Hassan Farhang Ansari**, Long-term Member, School of Historical Studies

Modern International Relations Seminar ♦ Informal Group Discussion

February 7

Lunchtime Colloquia Series ♦ *The Affairs of Mr. Apollonius: Papyrus Documents from Second-Century C.E. Egypt* ♦ **Thomas Kruse**, Österreichische Akademie der Wissenschaften; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Humanist Republicanism: Toward a New Paradigm* ♦ **Gabriele Pedullà**, Università degli Studi Roma Tre; Member, School of Historical Studies

February 11

Art History Seminar ♦ *On the Iconology of Kairos* ♦ **Barbara Baert**, Katholieke Universiteit Leuven; Member, School of Historical Studies

East Asian Studies Seminar ♦ *Marketing and Social Structure in Qing Xinjiang* ♦ **Eric Schluessel**, University of Montana; Member, School of Historical Studies

February 12

Medieval Studies Seminar ♦ *Low-Cost Charters and Micro-politics: Documenting the Political Everyday between France and the Empire (Twelfth to Fifteenth Centuries)* ♦ **Paul Bertrand**, Université Catholique de Louvain; Member, School of Historical Studies

February 13

Modern International Relations Seminar ♦ Informal Group Discussion

February 14

Lunchtime Colloquia Series ♦ *The Return of the Owl: The Renaissance Rediscovery of Athenian Democracy* ♦ **Gabriele Pedullà**, Università degli Studi Roma Tre; Member, School of Historical Studies

February 19

Ancient Studies Seminar ♦ “*A Gift to the Goddess*”: *Worship, Law, and Economy at the Sanctuaries of Roman Macedonia* ♦ **Maria Youni**, Democritus University of Thrace; Member, School of Historical Studies

Medieval Studies Seminar ♦ *Andronikos II and an-Nāṣir Muḥammad: Byzantine-Mamluk Relations and the Situation of Orthodox Christians under Mamluk Rule at the Beginning of the Fourteenth Century* ♦ **Johannes Pahlitzsch**, Johannes Gutenberg-Universität Mainz; Member, School of Historical Studies

February 20

Modern International Relations Seminar ♦ Informal Group Discussion

February 21

Lunchtime Colloquia Series ♦ *Alas! Commemoration of the Dead in Roman Palmyra* ♦ **Rubina Raja**, Aarhus University; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Sites of Antiquarianism: Between Seville and San Lorenzo* ♦ **Seth Kimmel**, Columbia University; Member, School of Historical Studies

February 25

East Asian Studies Seminar ♦ *Twisted and Reeled: Silk in the Premodern World—a Comparison between China and Italy* ♦ **Dagmar Schaefer**, Max-Planck-Institut für Wissenschaftsgeschichte; Member, School of Historical Studies

February 26

Medieval Studies Seminar ♦ *More than Just Sex: Concubinous Unions in the Late Medieval Mediterranean* ♦ **Michelle Armstrong-Partida**, The University of Texas at El Paso; Member, School of Historical Studies

History of Science Lecture Series ♦ *After Math: Reasoning, Proving, and Computing in the Postwar United States* ♦ **Stephanie A. Dick**, University of Pennsylvania

February 27

Near Eastern Studies Seminar ♦ *Alexander's Gate against Gog and Magog and the Sixth-Century Byzantine-Sasanian Wars* ♦ **Tommaso Tesei**, Van Leer Jerusalem Institute; Member, School of Historical Studies

Modern International Relations Seminar ♦ Informal Group Discussion

February 28

Lunchtime Colloquia Series ♦ *Bad Money Does Not Drive Out Good Money: Complementarity among Monies in Global History* ♦ **Akinobu Kuroda**, The University of Tokyo; Member, School of Historical Studies

March 1

Art History Lecture Series ♦ *Fluidity and Sedimentation in Rembrandt's "Christ Carrying the Cross"* ♦ **Nicola Suthor**, Yale University

March 4

East Asian Studies Seminar ♦ *Considering Citizenship in Imperial Chinese History* ♦ **Hilde De Weerd**, Universiteit Leiden; Member, School of Historical Studies

March 5

Medieval Studies Seminar ♦ *Consent and Affection: Problems for Medieval People and for Medievalists (Late Antiquity and Early Middle Ages)* ♦ **Sylvie Joye**, Université de Lorraine, Nancy; Member, School of Historical Studies

History of Science Lecture Series ♦ *Robocon Is Zazen: Psychology and Buddhism in Mori Masahiro's Robotics* ♦ **Yulia Frumer**, Johns Hopkins University

March 6

Modern International Relations Seminar ♦ Informal Group Discussion

March 7

Lunchtime Colloquia Series ♦ *Al-Makin's Metamorphoses between Mamluk Egypt and Early Modern Europe* ♦ **Martino Diez**, Università Cattolica del Sacro Cuore, Milan; Member, School of Historical Studies

Early Modern Europe Seminar ♦ *Popular Politics in Early Modern Venice: The Arsenalotti's Protest of 1569* ♦ **Maartje van Gelder**, University of Amsterdam; Member, School of Historical Studies

March 11

Art History Seminar ♦ *On the Concept of Energy in Medieval Art* ♦ **Eric Palazzo**, Université de Poitiers; Member, School of Historical Studies

March 12

Medieval Studies Seminar ♦ *Ecclesiastical Architecture in Byzantine North Africa—Community, Liturgy, Veneration of Saints* ♦ **Ralf Bockmann**, Deutsches Archäologisches Institut, Rome; Member, School of Historical Studies

March 13

Art History Public Seminar ♦ *Matrix as Ornament: The Medieval Afterlife of Intaglios and the Retrospection of Function* ♦ **Catherine Fernandez**, Princeton University

March 14

Lunchtime Colloquia Series ♦ *Master of Love and Food: Fatherhood, Care, and Coercion in Late Antique and Early Medieval West* ♦ **Sylvie Joye**, Université de Lorraine, Nancy; Member, School of Historical Studies

March 15

Epigraphic Friday ♦ *Krateros: The IAS Squeeze Digitization Project* ♦ **Aaron Hershkowitz**, Institute for Advanced Study ♦ *The Evolving Format of Building Accounts* ♦ **Cristina Carusi**, The University of Texas at Austin; Member, School of Historical Studies ♦ *A New Greek Epigram from Teos and "Theognidea"* ♦ **Andrej Petrovic**, University of Virginia, with **Mustafa Adak**, Antalya University ♦ *Allusions to Greek Literature in Lycian Verse Inscriptions (CEG 177 and 888)* ♦ **Brett Evans**, University of Virginia ♦ *The Historian Philippos of Pergamon* ♦ **Christopher Jones**, Harvard University and Institute for Advanced Study ♦ *Ἀναγκαιότατος καιρός: The Greek Concept of "Crisis"* ♦ **Angelos Chaniotis**, Professor, School of Historical Studies ♦ *Aemilius Paulus and Roman Politics in Greece: Notes on an Inscription from Gonnoi* ♦ **Maria Youni**, Democritus University of Thrace; Member, School of Historical Studies ♦ *The Honorable Decree for Karzoazos from Olbia* ♦ **Emyr Dakin**, The Graduate Center, The City University of New York ♦ *A New Epitaph from Aphrodisias* ♦ **Giorgos Tsolakis**, Institute for the Study of the Ancient World, New York University ♦ *A Hydreion for the Erythraean Sibyl—a New Reading of IK Erythrai II 225* ♦ **Saskia Kerschbaum**, Ludwig-Maximilians-Universität München ♦ *Stranded in Lycia: A Vow for Neptune* ♦ **Sophia Bönisch-Meyer**, Kommission für Alte Geschichte und Epigraphik ♦ *Inscriptions from Jerash* ♦ **Rubina Raja**, Aarhus University; Member, School of Historical Studies ♦ *A New Greek Inscription from South Arabia* ♦ **Glen W. Bowersock**, Professor Emeritus, School of Historical Studies

March 19

Ancient Studies Seminar ♦ *Priests in Roman Palmyra* ♦ **Rubina Raja**, Aarhus University; Member, School of Historical Studies

March 21

Lunchtime Colloquia Series ♦ *Easter 1475: A Bloodbath, a Boy, and a Bust* ♦ **Jeanette Kohl**, University of California, Riverside; Member, School of Historical Studies

March 26

Ancient Studies Seminar ♦ *The Archive of the Strategos Apollonios and Some Peculiar Features of Letter Writing in Roman Egypt* ♦ **Thomas Kruse**, Österreichische Akademie der Wissenschaften; Member, School of Historical Studies

Medieval Studies Seminar ♦ **Cosmin Alin Popa-Gorjanu**, University of Alba Iulia; Member, School of Historical Studies

March 27

Modern International Relations Seminar +
Informal Group Discussion

March 28

Lunchtime Colloquia Series + “*Your Rulers Are Slaves, the Sons of Unbelievers*”: *Genealogical Competition in the Eastern Mediterranean of the Sixteenth Century* + **Christian Mauder**, Universität Leipzig; Member, School of Historical Studies

March 29

Art History Lecture Series + *Titan's Bride Stripped Bare* + **Maria Loh**, City University of New York

April 1

East Asian Studies Seminar + *Lawmaking in China: From the End of the Cultural Revolution to the Present* + **Ji Li**, Rutgers Law School; Member, School of Social Science

April 2

History of Science Lecture Series + *Race by Numbers: Statistics and Race in Interwar British India* + **Projit Bihari Mukharji**, University of Pennsylvania

April 3

Near Eastern Studies Seminar + *Melkites under the Rule of Sultan an-Nāṣir Muḥammad and an-Nuwayrī's Account of the Fire of Cairo in 721/1321* + **Johannes Pahlitzsch**, Johannes Gutenberg-Universität Mainz; Member, School of Historical Studies

Modern International Relations Seminar +
Informal Group Discussion

April 4

Lunchtime Colloquia Series + *The Color of Moral Thought: How Self-Determination Was Written into Human Rights* + **Lydia Liu**, Columbia University; Member, School of Historical Studies

Early Modern Europe Seminar + *Europa Virgo, the Indies, and an Early Modern Family Romance* + **Carina Johnson**, Pitzer College; Member, School of Historical Studies

April 4–5

S. T. Lee Public Lecture + *Stalin at War* + **Stephen Kotkin**, Princeton University + S. T. Lee Workshop + *Informal Discussion on the Topic of the Lecture* + **Jonathan Haslam**, George F. Kennan Professor, School of Historical Studies + **John Barber**, University of Cambridge + **Stephen Kotkin**, Princeton University + **Hiroaki Kuromiya**, Indiana University + **Charles S. Maier**, Harvard University + **Marie Mendras**, School of International Affairs, Sciences Po and Centre National de la Recherche Scientifique, Paris + **Rachel Polonsky**, University of Cambridge + **Silvio Pons**, Scuola Normale Superiore, Rome + **Edward A. Rees**, University of Birmingham + **Jane Taubman**, Amherst

College + **William Taubman**, Amherst College + **Amir Weiner**, Stanford University + **Valery T. Youngblood**, Vyatka State University, Kirov

April 8

East Asian Studies Seminar + *Chinese Theories of Literary Creativity* + **Wendy Swartz**, Rutgers, The State University of New Jersey

April 9

Ancient Studies Seminar + *Plutarch and the Periclean Erga* + **Cristina Carusi**, The University of Texas at Austin; Member, School of Historical Studies

Medieval Studies Seminar + *Landscape Sanctified: Topographic Miracles and Monasticism in Medieval Italy; Two Case Studies from the “Dialogues” of Gregory the Great* + **Alison Perchuk**, The California State University, Channel Islands; Member, School of Historical Studies

April 10

Near Eastern Studies Seminar + *Al-Andalus and Reconquista in Current Spanish Political and Academic Context* + **Alejandro García-Sanjuán**, Universidad de Huelva; Member, School of Historical Studies

Modern International Relations Seminar +
Informal Group Discussion

April 11

Lunchtime Colloquia Series + *Imagining Machines, Reimagining Europe in the World, 1300–1600* + **Noa Turel**, University of Alabama at Birmingham; Member, School of Historical Studies

Early Modern Europe Seminar + *Orientalism, Science, and Linguistics in Seventeenth-Century Florence: Chapter 1, Reading the Quran Backwards* + **Pier Mattia Tommasino**, Columbia University; Member, School of Historical Studies

April 16

History of Science Lecture Series + *The Restless Machinery of Life* + **Jessica Riskin**, Stanford University

April 23–24

Muslims & Manuscripts + April 23, Princeton University + *The Message and the Messengers* + **Tehseen Thaver**, Princeton University + April 24, Institute for Advanced Study + *The Praiseworthy One*, a Book Talk with Author Christiane Gruber + **Christiane Gruber**, University of Michigan

April 23

Medieval Studies Seminar + *King Lists and Genealogy* + **Hans Hummer**, Wayne State University; Member, School of Historical Studies

April 24

Art History Lecture Series + *Moroni's Gray Grounds* + **David Young Kim**, University of Pennsylvania

April 25

Early Modern Europe Seminar + *Land and Conversion: New Frameworks for Colonial American Hymnody* + **Glenda Goodman**, University of Pennsylvania; Member, School of Historical Studies

May 10–11

Near Eastern Studies Workshop: Scribal Habits in Middle Eastern Manuscripts Workshop + Opening Remarks + **Sabine Schmidtke**, Professor, School of Historical Studies, and George A. Kiraz, Senior Research Associate, School of Historical Studies + *Connecting the Dots: Using Diaeresis as a Source of Information about Scribal Practices in Greek Papyri in Sixth-Century Egypt* + **Elizabeth Buchanan**, University of Findlay, Ohio + *Direct Copies as Test Cases in the Quest for Scribal Habits* + **Alan Taylor Farnes**, Brigham Young University + *The Niqqud in Medieval Judeo-Greek Manuscripts: Research Expectations vs. Scribal Practice* + **Julia G. Krivoruchko**, University of Cambridge + *The Second-Hand Scribe: A Unique Tosefta Fragment from the Levant, Its Intellectual Environment, and Its Influence* + **Binyamin Katzoff**, Bar-Ilan University + *Scribes and Their Habits in Eighth-Century Syria* + **Jonathan Loopstra**, University of Northwestern–St. Paul + *Organizing 1 Clement in Syriac and Coptic: Text Dividers in University Library Cambridge Add. MSS 1700, Berlin Staatsbibliothek Ms. or. fol. 3065, and Strasbourg Université copte 362–385* + **Dan Batovici**, Katholieke Universiteit Leuven + *Scribes and the Book of Revelation in Eastern New Testaments* + **T. C. Schmidt**, Yale University + “*We Are the Sum of Our Habits*”: Aggregate Scribal Habits of Whole Bible Manuscripts + **Michael Dormandy**, University of Cambridge + *Scribal Practice in Arabic Literary Papyri* + **Ursula Bsees**, University of Cambridge + *Manuscripts of Arabic Popular Epics and Sīrat Sayf ibn Dhī Yazan* + *Scholarly Practices in Twelfth-Century Kashan: Fadl Allāh al-Rawandī and His Role in the Transmission of al-Sharīf al-Murtada's Ghurār al-fawa'id* + **Sabine Schmidtke**, Professor, School of Historical Studies, and **Hassan Farhang Ansari**, Long-term Member, School of Historical Studies + **Zuzana Gažáková**, Comenius University in Bratislava + *Presentation of Projects* + **Tommaso Tesei**, Van Leer Jerusalem Institute; Member, School of Historical Studies + **George A. Kiraz**, Senior Research Associate, School of Historical Studies + *Manuscript Production and Scribal Work-Rate in Fifteenth-Century Iran* + **Mihan Shiva**, Harvard Art Museums + *Inscribing Authority on the Books of Jurisprudence: Fatwās, Scribes, and Chief Jurisprudents in the Early Modern Ottoman Empire, Fifteenth–Eighteenth Centuries* + **H. Evren Sünnetçioğlu**, Central European University

May 14

Medieval Studies Seminar ♦ *Of Parchment and Pollen: Tracing Agricultural, Economic, and Environmental Change in the Paleoeological and Historical Records of Medieval Italy* ♦ **Ned Schoolman**, University of Nevada, Reno; Visitor, School of Historical Studies

May 30–31

Medievalist Renunion: Discussion of Past, Current, and Future Projects ♦ **Patrick J. Geary**, Andrew W. Mellon Professor, School of Historical Studies ♦ **Robert Bartlett**, University of St. Andrews ♦ **Ottó S. Gecser**, Eötvös Loránd University ♦ **Sara McDougall**, City University of New York ♦ **Edward M. Schoolman**, University of Nevada, Reno ♦ **Vlada Stankovic**, University of Belgrade ♦ **Andrea Sterk**, University of Minnesota ♦ **Vincent Debais**, École des Hautes Études en Sciences Sociales, Paris

School of Mathematics

September 11

Vladimir Voevodsky Memorial Conference ♦ *The Mathematical Work of Vladimir Voevodsky* ♦ **Dan Grayson**, University of Illinois at Urbana-Champaign ♦ *What Do We Mean by “Equal”* ♦ **Pierre Deligne**, Professor Emeritus, School of Mathematics ♦ *A¹-Algebraic Topology: Genesis, Youth, and Beyond* ♦ **Fabien Morel**, Mathematisches Institut, Ludwig-Maximilians-Universität München ♦ *On Voevodsky’s Univalence Principle* ♦ **André Joyal**, Université du Québec à Montréal

September 12

Vladimir Voevodsky Memorial Conference ♦ *Galois, Grothendieck, and Voevodsky* ♦ **George Shabat**, Russian State University for the Humanities ♦ *Univalent Foundations and the Equivalence Principle* ♦ **Benedikt Ahrens**, University of Birmingham ♦ *The Synthetic Theory of ∞ -Categories vs. the Synthetic Theory of ∞ -Categories* ♦ **Emily Riehl**, Johns Hopkins University ♦ *Voevodsky Proof of Milnor and Bloch-Kato Conjectures* ♦ **Alexander Merkurjev**, University of California, Los Angeles ♦ *Isotropic Motivic Category* ♦ **Alexander Vishik**, University of Nottingham

September 13

Vladimir Voevodsky Memorial Conference ♦ *Towards Elementary Infinity-Toposes* ♦ **Michael Shulman**, University of San Diego ♦ *Even Spaces and Motivic Resolutions* ♦ **Michael Hopkins**, Harvard University ♦ *Universal Chow Group of 0-Cycle and Nilpotence* ♦ **Claire Voisin**, Collège de France ♦ *A Search for an Algebraic Equivalence Analogue of Motivic Theories* ♦ **Eric Friedlander**, University of Southern California

September 14

Vladimir Voevodsky Memorial Conference ♦ *Univalence from a Computer Science Point-of-View* ♦ **Dan Licata**, Wesleyan University ♦ *Algebraic*

K-Theory, Combinatorial K-Theory, and Geometry ♦ **Inna Zakharevich**, Cornell University ♦ *On the Proof of the Conservativity Conjecture* ♦ **Joseph Ayoub**, Universität Zürich ♦ *Perverse Schemers and Semi-orthogonal Decompositions* ♦ **Mikhail Kapranov**, Kavli Institute for the Physics and Mathematics of the Universe, University of Tokyo; Visiting Professor, School of Mathematics

September 20

Joint IAS/Princeton University Number Theory Seminar ♦ *Eisenstein Ideal with Squarefree Level* ♦ **Preston Wake**, Member, School of Mathematics
Working Seminar in Algebraic Number Theory

September 24

Computer Science/Discrete Mathematics Seminar I ♦ *Four and a Half Proofs of a Product-Measure Version of the Erdős-Ko-Rado Theorem* ♦ **Ehud Friedgut**, Weizmann Institute of Science

September 25

Variational Methods in Geometry Seminar ♦ *Extremal Eigenvalue Problems and Free Boundary Minimal Surfaces in the Ball* ♦ **Ailana Fraser**, The University of British Columbia; Member, School of Mathematics

Short talks by Postdoctoral Members ♦ *Caustics of Fronts and the Arborealization Conjecture* ♦ **Daniel Alvarez-Gavela**, Member, School of Mathematics ♦ *The Min-Max Width of Unit Volume Three-Spheres* ♦ **Lucas Coelho Ambrozio**, Member, School of Mathematics ♦ *Invertible Objects in Chromatic Homotopy Theory* ♦ **Irina Bobkova**, Member, School of Mathematics ♦ *Min-Max Construction for Constant Mean Curvature Surfaces* ♦ **Xin Zhou**, University of California, Santa Barbara; Member, School of Mathematics ♦ *Analyticity Results for the Euler and Navier-Stokes Equations* ♦ **Guher Camliyurt**, Member, School of Mathematics ♦ *Comparing Measures of Complexity for Minimal Subvarieties* ♦ **Alessandro Carlotto**, Eidgenössische Technische Hochschule Zürich; Member, School of Mathematics

September 26

Symplectic Dynamics Working Group ♦ Orientation Meeting

Short talks by Postdoctoral Members ♦ *The Modern Application of Separation of Variables* ♦ **Gao Chen**, Member, School of Mathematics ♦ *Geometry and Topology of Isoperimetric and Index One Minimal Surfaces* ♦ **Celso dos Santos Viana**, Member, School of Mathematics ♦ *Ramanujan Graphs and Golden Gates* ♦ **Shai Evra**, Member, School of Mathematics ♦ *Adventures in Monotone Complexity* ♦ **Mika Göös**, Member, School of Mathematics ♦ *The Optimal Transport Problem* ♦ **Yash Jhaveri**, Eidgenössische Technische Hochschule Zürich; Member, School of Mathematics ♦ *Homological Projective Geometry* ♦ **Qingyuan Jiang**, Member, School of Mathematics

September 27

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Towards a p -adic Deligne-Lusztig Theory* ♦ **Charlotte Chan**, Princeton University
Working Seminar in Algebraic Number Theory

September 28

Allen-Cahn/Ginzburg-Landau Reading Group
Reception to Honor Akshay Venkatesh

Short talks by Postdoctoral Members ♦ *Renormalized Volume for Hyperbolic 3-Manifolds* ♦ **Franco E. Vargas Pallete**, Member, School of Mathematics ♦ *What I Learned about Pseudoholomorphic Quilts in the IAS Cafeteria (But Not at the Math Table)* ♦ **Nathaniel Bottman**, Member, School of Mathematics ♦ *Logarithmic Riemann-Hilbert Correspondences* ♦ **Clemens Koppensteiner**, Member, School of Mathematics ♦ *Minimal Surfaces and Geometry of the Space of Cycles* ♦ **Yevgeny Liokumovich**, Member, School of Mathematics ♦ *Minimal Surfaces and Geometry of the Space of Cycles* ♦ **Yevgeny Liokumovich**, Massachusetts Institute of Technology; Member, School of Mathematics ♦ *Monodromy Representations and Arithmetic* ♦ **Daniel Litt**, Member, School of Mathematics

October 1

Computer Science/Discrete Mathematics Seminar I ♦ *Oracle Separation of Quantum Polynomial Time and the Polynomial Hierarchy* ♦ **Avishay Tal**, University of California, Berkeley

Seminar on Theoretical Machine Learning ♦ *Structured Learning with Parsimony in Measurements and Computations: Theory, Algorithms, and Applications* ♦ **Xingguo Li**, Princeton University

Short talks by Postdoctoral Members ♦ *Pointwise Monotonicity of Heat Kernels* ♦ **Ángel D. Martínez Martínez**, Member, School of Mathematics ♦ *Singular Hodge Theory of Matroids* ♦ **Jacob Matherne**, Member, School of Mathematics ♦ *Minimal Hypersurfaces and Phase Transitions* ♦ **Marco Aurelio Méndez Guaraco**, Member, School of Mathematics ♦ *Probabilistically Checkable Proofs and the Graph Coloring Problem* ♦ **Dor Yosef Minzer**, Member, School of Mathematics ♦ *Regularity Lemmas and Other Extremal Results* ♦ **Guy Moshkovitz**, Member, School of Mathematics ♦ *Stability for Functional and Geometric Inequalities* ♦ **Robin Neumayer**, Member, School of Mathematics ♦ *Invariant Theory and Complexity* ♦ **Viswambhara Makam**, Member, School of Mathematics

October 2

Variational Methods in Geometry Seminar ♦ *Prescribing Scalar Curvature in High Dimension* ♦ **Andrea Malchiodi**, Scuola Normale Superiore di Pisa ♦ *On the Existence of Minimal*

Heegaard Splittings ♦ **Daniel J. Ketover**, Princeton University; Member, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ **Tensor Rank** ♦ **Avi Wigderson**, Herbert H. Maass Professor, School of Mathematics

October 3

Short talks by Postdoctoral Members ♦ *Proofs from Algorithms, Algorithms from Proofs* ♦ **Pravesh Kothari**, Member, School of Mathematics ♦ *Intrinsic Diophantine Approximation on S^3* ♦

Raphael Sebastian Steiner, Member, School of Mathematics ♦ *Contact Hypersurfaces and Mirror Symmetry* ♦ **Saraswathi Venkatesh**, Member, School of Mathematics ♦ *Zimmer's Conjecture for Co-compact Lattices in Simple Complex Lie Groups* ♦ **Zhiyuan Zhang**, KTH Royal Institute of Technology, Stockholm; Member, School of Mathematics ♦ *Getting Information from Higher-Dimensional Moduli Spaces in Floer Theory* ♦ **Zhengyi Zhou**, Member, School of Mathematics

October 4

Princeton/IAS Symplectic Geometry Seminar ♦ *Quantum Footprints of Symplectic Rigidity* ♦ **Leonid Polterovich**, Tel Aviv University

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Spacing and a Large Sieve-Type Inequality for Roots of a Cubic Congruence* ♦ **Matthew Welsh**, Rutgers, The State University of New Jersey

October 5

Allen-Cahn/Ginzburg-Landau Reading Group

Short talks by Postdoctoral Members ♦ *Quantifying Eisenstein Congruences* ♦ **Preston Wake**, Member, School of Mathematics ♦ *Modeling Adaptive Communication Games* ♦ **Sida Wang**, Member, School of Mathematics ♦ *Classification of Algebraic Varieties* ♦ **Jakub Witaszek**, Member, School of Mathematics ♦ *Elliptic/Harmonic Measures and the Geometry of Domains* ♦ **Zihui Zhao**, Member, School of Mathematics ♦ *Morse Theory on Ellipsoids* ♦ **Daniel J. Ketover**, Member, School of Mathematics ♦ *The Asymptotic Spectrum of Tensors* ♦ **Jeroen Zuiddam**, Member, School of Mathematics

October 8

Seminar on Theoretical Machine Learning

Members' Seminar ♦ *Existence Theory of Minimal Hypersurfaces* ♦ **Fernando Codá Marques**, Princeton University; Distinguished Visiting Professor, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Semitoric Families* ♦ **Joseph Palmer**, Rutgers, The State University of New Jersey

October 9

Variational Methods in Geometry Seminar ♦ *Singularity and Comparison Theorems for Metrics with Positive Scalar Curvature* ♦ **Chao Li**, Stanford University; Visitor, School of Mathematics ♦ *Construction of Hypersurfaces of Prescribed Mean Curvature* ♦ **Jonathan Julian Zhu**, Harvard University; Visitor, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ *Asymptotic Spectra and Their Applications I and II* ♦ **Jeroen Zuiddam**, Member, School of Mathematics

October 10

Mathematical Conversations ♦ *Stirring Efficiently* ♦ **Camillo De Lellis**, Professor, School of Mathematics
Short talks by Postdoctoral Visitors ♦ *Front Propagation in a Nonlocal Reaction-Diffusion Equation* ♦ **Olga Turanova**, University of California, Los Angeles; Visitor, School of Mathematics ♦ *Harmonic Maps between Singular Spaces* ♦ **Brian Freidin**, Brown University; Visitor, School of Mathematics ♦ *The Geometry of Neural Networks (aka Deep Learning for Mathematicians)* ♦ **Yaim Cooper**, Visitor, School of Mathematics

Informal Group Action Seminar ♦ *Thin Groups and Their Dynamics* ♦ **Simion Filip**, Harvard University; Visitor, School of Mathematics

Symplectic Dynamics Working Group

October 11

Venkatesh Working Group ♦ *Introduction to Perverse Sheaves* ♦ **Mark Goresky**, Visitor, School of Mathematics

Joint IAS/Princeton University Number Theory Seminar ♦ *Explicit Formulae for Stark Units and Hilbert's Twelfth Problem* ♦ **Samit Dasgupta**, Duke University

Working Seminar in Algebraic Number Theory

October 12

Allen-Cahn/Ginzburg-Landau Reading Group

October 15

Computer Science/Discrete Mathematics Seminar I ♦ *Breaking the Circuit-Size Barrier in Secret Sharing* ♦ **Vinod Vaikuntanathan**, Massachusetts Institute of Technology

Emerging Topics Working Group ♦ *Introduction to Scalar Curvature and Convergence* ♦ **Christina Sormani**, The City University of New York; Visitor, School of Mathematics

Seminar on Theoretical Machine Learning ♦ *On the Dynamics of Gradient Descent for Training Deep Neural Networks* ♦ **Wei Hu**, Princeton University

Members' Seminar ♦ *Critical Hölder Exponents* ♦ **Camillo De Lellis**, Professor, School of Mathematics

Informal Group Action Seminar ♦ *Rigidity for Slowly Growing Representations of $SL(n, \mathbb{Z})$* ♦ **Mikael de la Salle**, École Normale Supérieure de Lyon

Symplectic Dynamics/Geometry Seminar ♦ *Structures in the Floer Theory of Symplectic Lie Groupoids* ♦ **James Pascaleff**, University of Illinois at Urbana-Champaign

October 16

Emerging Topics Working Group ♦ *Notions of Scalar Curvature* ♦ **Mikhail Gromov**, Institut Des Hautes Études Scientifiques and New York University ♦ *Positive Mass Theorem in All Dimensions* ♦ **Richard Schoen**, University of California, Irvine; Member, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ *Asymptotic Spectra and Their Applications I and II* ♦ **Jeroen Zuiddam**, Member, School of Mathematics

October 17

Emerging Topics Working Group ♦ *Stability of the Positive Mass Theorem* ♦ **Lan-Hsuan Huang**, University of Connecticut; von Neumann Fellow, School of Mathematics ♦ *Untitled Talk* ♦ **Raquel Perales**, Universidad Nacional Autónoma de México

Mathematical Conversations ♦ *Mathematical Structures in the Jungles of Life* ♦ **Mikhail Gromov**, Institut Des Hautes Études Scientifiques and New York University

Symplectic Dynamics Working Group ♦ *Billiard Dynamics—a Symplectic Point of View* ♦ **Yaron Ostrover**, Tel Aviv University; von Neumann Fellow, School of Mathematics

October 18

Venkatesh Working Group

Emerging Topics Working Group ♦ *Index Theory and Flexibility in Positive Scalar Curvature* ♦ **Bernhard Hanke**, Universität Augsburg

Joint IAS/Princeton University Number Theory Seminar ♦ *Honda-Tate Theory for Shimura Varieties* ♦ **Mark Kisin**, Harvard University

Working Seminar in Algebraic Number Theory

October 19

Emerging Topics Working Group ♦ *Tori of Almost Nonnegative Scalar Curvature* ♦ **Brian Allen**, The City University of New York ♦ *Conjectures for Intrinsic Flat Convergence and Scalar Curvature* ♦ **Christina Sormani**, The City University of New York; Visitor, School of Mathematics ♦ *Smooth Convergence Away from Singularities* ♦ **Sajjad Lakzian**, Fordham University ♦ *Formation of Research Teams*

Analysis Seminar ♦ *Some Recent Results Related to the Strong Openness Property of Multiplier Ideal Sheaves* ♦ **Qi'an Guan**, Peking University; Member, School of Mathematics

October 22

Computer Science/Discrete Mathematics Seminar I ♦ *Approximating the Edit Distance to within a Constant Factor in Truly Subquadratic Time* ♦ **Mike Saks**, Rutgers, The State University of New Jersey

Seminar on Theoretical Machine Learning ♦ *Learning in Non-convex Games with an Optimization Oracle* ♦ **Alon Gonen**, Princeton University

Members' Seminar ♦ *New and Old Results in the Classical Theory of Minimal and Constant Mean Curvature Surfaces in Euclidean 3-Space \mathbb{R}^3* ♦ **William H. Meeks III**, The University of Massachusetts; Member, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *A Local Systolic Inequality in Contact and Symplectic Geometry* ♦ **Gabriele Benedetti**, Universität Heidelberg

October 23

Variational Methods in Geometry Seminar ♦ *Existence of Infinitely Many Minimal Hypersurfaces in Closed Manifolds* ♦ **Antoine Song**, Princeton University

Symplectic Dynamics Working Group ♦ *A Rudimentary Introduction to Some Questions on Zero Entropy Conservative Surface Dynamics* ♦ **Zhiyuan Zhang**, Member, School of Mathematics

Hermann Weyl Lectures ♦ *Point-Counting and Diophantine Applications* ♦ **Jonathan Pila**, University of Oxford

Computer Science/Discrete Mathematics Seminar II ♦ *Small-Set Expansion on the Grassmann Graph* ♦ **Dor Yosef Minzer**, Member, School of Mathematics

October 24

Mathematical Conversations ♦ *What Is a Central Limit Theorem for Random Groups?* ♦ **Melanie Wood**, University of Wisconsin–Madison

Hermann Weyl Lectures ♦ *O-Minimality and Ax-Schanuel Properties* ♦ **Jonathan Pila**, University of Oxford

October 25

Venkatesh Working Group ♦ *Decomposition Theorem, Springer Representations, and the Iwahori-Hecke Algebra* ♦ **Mark Goresky**, Visitor, School of Mathematics

Joint IAS/Princeton University Number Theory Seminar ♦ *Irreducible Components of Affine Deligne-Lusztig Varieties and Orbital Integrals* ♦ **Rong Zhou**, Member, School of Mathematics

Working Seminar in Algebraic Number Theory

October 26

Allen-Cahn/Ginzburg-Landau Reading Group

Analysis Seminar

Hermann Weyl Lectures ♦ *The Zilber-Pink Conjecture* ♦ **Jonathan Pila**, University of Oxford

October 29

Computer Science/Discrete Mathematics Seminar I ♦ *2-Universality of Random Graphs* ♦ **Gal Kronenberg**, Tel Aviv University

Members' Seminar ♦ *On Measures Invariant under the Diagonal Group—a New Approach* ♦ **Elon Lindenstrauss**, The Hebrew University of Jerusalem; Member, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *A Simplicial Construction of G-Equivariant Floer Homology* ♦ **Kristen Hendricks**, Michigan State University

Computer Science/Discrete Mathematics Seminar ♦ *X-Ramanujan Graphs: Ex Uno Plures* ♦ **Ryan O'Donnell**, Carnegie Mellon University

October 30

Variational Methods in Geometry Seminar ♦ *Analysis of Some Conformally Invariant Problems* ♦ **Paul Laurain**, Université Paris Diderot ♦ *Recent Progress on Overdetermined Elliptic Problems* ♦ **Jose Espinar**, Instituto Nacional de Matemática Pura e Aplicada, Rio de Janeiro

Computer Science/Discrete Mathematics Seminar II ♦ *On the NP-Hardness of 2-to-2 Games* ♦ **Dor Yosef Minzer**, Member, School of Mathematics

October 31

Informal Group Action Seminar ♦ *The Difference between Lagrange and Markov after Hausdorff* ♦ **Carlos Matheus Santos**, Centre National de la Recherche Scientifique, Paris

November 1

Venkatesh Working Group

Symplectic Dynamics Working Group ♦ *Generic Dynamics: A Phenomenon/Mechanism Correspondence* ♦ **Enrique Pujals**, The City University of New York

November 2

Allen-Cahn/Ginzburg-Landau Reading Group

November 5

Computer Science/Discrete Mathematics Seminar I ♦ *Sunflowers and Friends* ♦ **Shachar Lovett**, University of California, San Diego

Seminar on Theoretical Machine Learning ♦ *Scalable Natural Gradient Training of Neural Networks* ♦ **Roger Grosse**, University of Toronto

Workshop on Mean Curvature and Regularity ♦ *Spacetime Aspects of Mean Curvature in General Relativity* ♦ **Richard Schoen**, University of California, Irvine; Member, School of Mathematics ♦ *Weyl Law for the Phase Transition Spectrum and Density of Limit-Interfaces* ♦ **Marco Aurelio Mendez Guaraco**, Member, School of Mathematics ♦ *Some Minimal Submanifolds Generalizing the Clifford Torus* ♦ **Jaigyoung Choe**, Korea Institute for Advanced Study

November 6

Symplectic Dynamics Working Group ♦ *Hamiltonian Pseudo-rotations of Projective Spaces* ♦ **Zhengyi Zhou**, Member, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ *The GM-MDS Conjecture* ♦ **Shachar Lovett**, University of California, San Diego

Workshop on Mean Curvature and Regularity ♦ *Boundary Regularity for Area Minimizing Currents and a Question of Almgren* ♦ **Camillo De Lellis**, Professor, School of Mathematics ♦ *Topological Uniqueness of Self-Expanders of Small Entropy* ♦ **Lu Wang**, University of Wisconsin–Madison; von Neumann Fellow, School of Mathematics ♦ *A Priori Estimates for Einstein Manifolds* ♦ **Aaron Naber**, Northwestern University

November 7

Mathematical Conversations ♦ *Hodge-Riemann Relations for Potts-Model Partition Functions* ♦ **June Huh**, Visiting Professor, School of Mathematics

Workshop on Mean Curvature and Regularity ♦ *Progress on Existence of Minimal Surfaces* ♦ **André Neves**, Member, School of Mathematics ♦ *A Plateau Problem at Infinity in $\mathbb{H}^2 \times \mathbb{R}$* ♦ **Magdalena Rodriguez**, Universidad de Granada ♦ *Sinh-Gordon Equation and Application to the Geometry of CMC Surfaces* ♦ **Laurent Hauswirth**, Université Paris–Est Marne-la-Vallée ♦ *Recent Gluing Constructions in Geometry and the Gluing Methodology* ♦ **Nicolaos Kapouleas**, Brown University; Member, School of Mathematics

November 8

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Epsilon Dichotomy for Linear Models* ♦ **Hang Xue**, The University of Arizona

Working Seminar in Algebraic Number Theory

Workshop on Mean Curvature and Regularity ♦ *Locating Minimal Surfaces in Geomestatic Manifolds* ♦ **Christina Sormani**, The City University of New York; Member, School of Mathematics ♦ *Generic Uniqueness of Expanders with Vanishing Relative Entropy* ♦ **Felix**

Schulze, University College London ♦ *The Embedded Calabi-Yau Problem for Minimal Surfaces of Finite Genus* ♦ **Joaquin Perez**, Universidad de Granada

November 9

Allen-Cahn/Ginzburg-Landau Reading Group

Workshop on Mean Curvature and Regularity ♦ *Free Boundary Minimal Möbius Bands* ♦ **Ailana Fraser**, The University of British Columbia; Member, School of Mathematics ♦ *Progress in the Theory of CMC Surfaces in Locally Homogeneous 3-Manifolds X* ♦ **William H. Meeks III**, University of Massachusetts; Member, School of Mathematics

November 12

Seminar on Theoretical Machine Learning ♦ *Generalized Framework for Nonlinear Acceleration* ♦ **Damien Scieur**, Princeton University
Members' Seminar ♦ *Invertible Objects in Stable Homotopy Theory* ♦ **Irina Bobkova**, Member, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Distinguishing Fillings via Dynamics of Fukaya Categories* ♦ **Yusuf Baris Kartal**, Massachusetts Institute of Technology

November 13

Variational Methods in Geometry Seminar ♦ *Translators for Mean Curvature Flow* ♦ **David Hoffman**, Stanford University ♦ *Morse-Theoretic Aspects of the Willmore Energy* ♦ **Alexis Michelat**, Eidgenössische Technische Hochschule Zürich

Symplectic Dynamics Working Group ♦ *Celestial Mechanics and Holomorphic Curves* ♦ **Umberto Leone Hryniewicz**, Universidade Federal do Rio de Janeiro; von Neumann Fellow, School of Mathematics

November 14

Mathematical Conversations ♦ *The Stability of Atoms and the Ionization Conjecture* ♦ **Ian Jauslin**, Princeton University

Informal Group Action Seminar ♦ *Dimension of Self-Affine Measures and Additive Combinatorics* ♦ **Michael Hochman**, The Hebrew University of Jerusalem; von Neumann Fellow, School of Mathematics

Symplectic Dynamics Working Group

November 15

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Hyperfields, Ordered Blueprints, and Moduli Spaces of Matroids* ♦ **Matt Baker**, Georgia Institute of Technology

Working Seminar in Algebraic Number Theory

November 16

Allen-Cahn/Ginzburg-Landau Reading Group

Analysis Seminar ♦ *Some Recent Results Related to the Strong Openness Property of Multiplier Ideal Sheaves* ♦ **Qi'an Guan**, Peking University; Member, School of Mathematics

November 19

Seminar on Theoretical Machine Learning ♦ *Prediction with a Short Memory* ♦ **Sham Kakade**, University of Washington and Google Brain

Members' Seminar ♦ *A Tale of Two Conjectures: From Mahler to Viterbo* ♦ **Yaron Ostrover**, Tel Aviv University; von Neumann Fellow, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Lyapunov Exponents for Small Random Perturbations of Predominantly Hyperbolic Two-Dimensional Volume-Preserving Diffeomorphisms, Including the Standard Map* ♦ **Alex Blumenthal**, University of Maryland

November 20

Variational Methods in Geometry Seminar ♦ *Almgren's Isomorphism Theorem and Parametric Isoperimetric Inequalities* ♦ **Yevgeny Liokumovich**, Massachusetts Institute of Technology; Member, School of Mathematics ♦ *The Min-Max Width of Unit Volume Three-Spheres* ♦ **Lucas Coelho Ambrozio**, University of Warwick; Member, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ *Introduction to Query-to-Communication Lifting* ♦ **Mika Göös**, Member, School of Mathematics

November 22

Venkatesh Working Group

November 23

Allen-Cahn/Ginzburg-Landau Reading Group

November 26

Computer Science/Discrete Mathematics Seminar I ♦ *Classical Verification of Quantum Computations* ♦ **Urmila Mahadev**, University of California, Berkeley

Seminar on Theoretical Machine Learning ♦ *à la Carte Embedding: Cheap but Effective Induction of Semantic Feature Vectors* ♦ **Nikunj Saunshi**, Princeton University

Members' Seminar ♦ *Effective Sato-Tate under GRH* ♦ **Alina Ioana Bucur**, University of California, San Diego; von Neumann Fellow, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Some Developments in the Legendrian Grid Invariants* ♦ **C.-M. Michael Wong**, Louisiana State University

November 27

Joint IAS/Princeton University Number Theory Seminar ♦ *Good and Semi-stable Reductions of Shimura Varieties* ♦ **Michael Rapoport**, Universität Bonn

Variational Methods in Geometry Seminar ♦ *Homotopical Effects of K-Dilation* ♦ **Larry Guth**, Massachusetts Institute of Technology ♦ *Bubbling Theory for Minimal Hypersurfaces* ♦ **Ben Sharp**, University of Warwick

Symplectic Dynamics Working Group ♦ *Holomorphic Curves and Celestial Mechanics* ♦ **Umberto Leone Hryniewicz**, Universidade Federal do Rio de Janeiro; von Neumann Fellow, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ *Monotone Circuit Lower Bounds from Resolution* ♦ **Mika Göös**, Member, School of Mathematics

November 28

Mathematical Conversations ♦ *The Isoperimetric Inequality* ♦ **Robin Neumayer**, Member, School of Mathematics

Informal Group Action Seminar ♦ *Characterizing Locally Symmetric Spaces by Their Lyapunov Spectra* ♦ **Clark W. Butler**, Princeton University; Veblen Research Instructor, School of Mathematics

November 29

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *The Lucky Logarithmic Derivative* ♦ **Will Sawin**, Columbia University

Working Seminar in Algebraic Number Theory

November 30

Allen-Cahn/Ginzburg-Landau Reading Group

Analysis Seminar ♦ *Branched Conformal Structures and the Dyson Superprocess* ♦ **Govind Menon**, Brown University; Member, School of Mathematics

December 3

Members' Seminar ♦ *Recent Progress on Zimmer's Conjecture* ♦ **David M. Fisher**, Indiana University; Member, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Mean Action of Periodic Orbits of Area-Preserving Annulus Diffeomorphisms* ♦ **Morgan Weiler**, University of California, Berkeley

December 4

Joint IAS/Princeton University Number Theory Seminar ♦ *p-adic Cohomology of the Drinfeld Half-Space* ♦ **Wiesława Nizioł**, École Normale Supérieure de Lyon

Variational Methods in Geometry Seminar ♦ *Global Results Related to Scalar Curvature and Isoperimetry* ♦ **Otis Chodosh**, Princeton University; Veblen Research Instructor, School of Mathematics

Symplectic Dynamics Working Group ♦ *Coarse Geometry of the Group of Hamiltonian Diffeomorphisms via the Theory of Persistence Modules* ♦ **Daniel Álvarez-Gavela**, Member, School of Mathematics

December 5

Mathematical Conversations ♦ *Two Short Stories on Mathematical Uncertainty Principle* ♦ **Eugenia Malinnikova**, Norwegian University of Science and Technology; von Neumann Fellow, School of Mathematics

Informal Group Action Seminar ♦ *New Techniques for Zimmer's Conjecture* ♦ **David M. Fisher**, Indiana University; Member, School of Mathematics ♦ *An Application of Margulis's Inequality to Effective Equidistribution* ♦ **Asaf Katz**, The University of Chicago

December 6

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Slopes in Eigenvarieties for Definite Unitary Groups* ♦ **Lynnette Ye**, Harvard University

Working Seminar in Algebraic Number Theory

December 7

Allen-Cahn/Ginzburg-Landau Reading Group

December 10

Computer Science/Discrete Mathematics Seminar I ♦ *A Matrix Expander Chernoff Bound* ♦ **Ankit Garg**, Microsoft Research

Seminar on Theoretical Machine Learning ♦ *On Expressiveness and Optimization in Deep Learning* ♦ **Nadav Cohen**, Member, School of Mathematics

Members' Seminar ♦ *Schubert Polynomials via Triangulations of Flow Polytopes* ♦ **Karola Mészáros**, Cornell University; von Neumann Fellow, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Upper Bounds on the Lagrangian Spectral Norm* ♦ **Egor Shelukhin**, Université de Montréal

December 11

Variational Methods in Geometry Seminar ♦ *Density and Equidistribution of Minimal Hypersurfaces* ♦ **André Neves**, The University of Chicago; Member, School of Mathematics ♦ *Harmonic Maps into Singular Spaces* ♦ **Brian Freidin**, Brown University; Visitor, School of Mathematics

Symplectic Dynamics Working Group ♦ *Hamiltonian Pseudo-rotations of Projective Spaces* ♦ **Zhengyi Zhou**, Member, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ *An Invitation to Tensor Networks* ♦ **Michael Walter**, University of Amsterdam

December 12

Mathematical Conversations ♦ *How to Detect a Projective Space?* ♦ **Jakub Witaszek**, Member, School of Mathematics

Informal Group Action Seminar ♦ *Non-accumulation of Periodic Torus Orbits* ♦ **Ilya Khayutin**, Princeton University; Veblen Research Instructor, School of Mathematics

December 13

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Nearby Cycles over General Bases and Duality* ♦ **Weizhe Zheng**, Morningside Center of Mathematics, Chinese Academy of Sciences, Beijing

Working Seminar in Algebraic Number Theory

December 14

Allen-Cahn/Ginzburg-Landau Reading Group

Analysis Seminar ♦ *Two Questions of Landis and Their Applications* ♦ **Eugenia Malinnikova**, Norwegian University of Science and Technology; von Neumann Fellow, School of Mathematics

December 17

Symplectic Dynamics/Geometry Seminar ♦ *Barcodes and C^0 Symplectic Topology* ♦ **Sobhan Seyfaddini**, École Normale Supérieure, Paris

December 18

Variational Methods in Geometry Seminar ♦ *Bounds in Renormalized Volume for Hyperbolic 3-Manifolds* ♦ **Franco E. Vargas Pallete**, University of California, Berkeley; Member, School of Mathematics

Symplectic Dynamics Working Group ♦ *Celestial Mechanics and Holomorphic Curves II* ♦ **Umberto Leone Hryniewicz**, Universidade Federal do Rio de Janeiro; von Neumann Fellow, School of Mathematics

January 9

Mathematics Seminar ♦ *Distribution of the Integral Points on Quadrics* ♦ **Naser Talebi Zadeh Sardari**, University of Wisconsin-Madison ♦ *The Sup-Norm Problem on S^3* ♦ **Raphael Sebastian Steiner**, Member, School of Mathematics ♦ *Ramanujan Complexes and Golden Gates in $PU(3)$* ♦ **Shai Evra**, Member, School of Mathematics

January 15

Variational Methods in Geometry Seminar ♦ *Regularity of Weakly Stable Codimension 1 CMC Varifolds* ♦ **Neshan Wickramasekera**, University of Cambridge; Member, School of Mathematics ♦ *Minimal Surfaces with Index One in Spherical Space Forms* ♦ **Celso dos Santos Viana**, Member, School of Mathematics

January 16

Working Group on Geometric Applications of the Langlands Correspondence ♦ *Untitled Talk* ♦ **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

January 22

Joint IAS/Princeton University Number Theory Seminar ♦ *The Eigencurve at Eisenstein Weight One Points* ♦ **Alice Pozzi**, University College London

Variational Methods in Geometry Seminar ♦ *Symplectic Methods for Sharp Systolic Inequalities* ♦ **Umberto Leone Hryniewicz**, Universidade Federal do Rio de Janeiro; Member, School of Mathematics ♦ *(Non)Uniqueness Questions in Mean Curvature Flow* ♦ **Lu Wang**, University of Wisconsin-Madison; Member, School of Mathematics

Computer Science/Discrete Mathematics Seminar II ♦ *New Results on Projections* ♦ **Guy Moshkovitz**, Member, School of Mathematics

January 23

Mathematical Conversations ♦ *Bourgain and the Sum-Product Phenomena* ♦ **Avi Wigderson**, Herbert H. Maass Professor, School of Mathematics

BYOP@Lunch Working Group

Working Group on Geometric Applications of the Langlands Correspondence ♦ *Untitled Talk* ♦ **Raju Krishnamoorthy**, University of Georgia

January 24

Venkatesh Working Group

Analysis Seminar ♦ *Multiplicity of Eigenvalues for the Circular Clamped Plate Problem* ♦ **Dan Mangoubi**, The Hebrew University of Jerusalem

January 28

Computer Science/Discrete Mathematics Seminar I ♦ *PCP and Delegating Computation: A Love Story* ♦ **Yael Tauman Kalai**, Microsoft Research

Members' Seminar ♦ *Minimal Hypersurfaces in Manifolds of Finite Volume* ♦ **Yevgeny Liokumovich**, Massachusetts Institute of Technology; Member, School of Mathematics

Symplectic Dynamics/Geometry Seminar + *Vortex Equation and Gauged Sigma Model* + **Guangbo Xu**, Simons Center for Geometry and Physics, Stony Brook University, The State University of New York

January 29

Variational Methods in Geometry Seminar + *Min-Max Minimal Surfaces in Arbitrary Codimension* + **Tristan Rivière**, Eidgenössische Technische Hochschule Zürich; Member, School of Mathematics + *The Systole of Large Genus Minimal Surfaces in Positive Ricci Curvature* + **Henrik Matthiesen**, The University of Chicago

Computer Science/Discrete Mathematics Seminar II + *A Regularity Lemma with Modifications* + **Guy Moshkovitz**, Member, School of Mathematics

January 30

Mathematical Conversations + *A Mathematical Conjecture about Crumpling Paper* + **Francesco Maggi**, The University of Texas at Austin; Member, School of Mathematics

BYOP@Lunch Working Group

Working Group on Geometric Applications of the Langlands Correspondence + *Untitled Talk* + **Daniel Litt**, University of Georgia; Member, School of Mathematics

January 31

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar + *Upper Bounds for Constant Slope p -adic Families of Modular Forms* + **John Bergdall**, Bryn Mawr College

Analysis Seminar + *Analyticity Results for the Navier-Stokes Equations* + **Guher Camliyurt**, Member, School of Mathematics

February 4

Computer Science/Discrete Mathematics Seminar I + *Near-Optimal Strong Dispersers* + **Dean Doron**, The University of Texas at Austin

Members' Seminar + *The Sample Complexity of Multireference Alignment* + **Philippe Rigollet**, Massachusetts Institute of Technology; Visiting Professor, School of Mathematics

Symplectic Dynamics/Geometry Seminar + *A Sheaf-Theoretic $SL(2, \mathbb{C})$ Floer Homology for Knots* + **Laurent Cote**, Stanford University

Joint IAS/Princeton University Algebraic Geometry Seminar + *Drinfeld's Lemma for Schemes* + **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

February 5

Variational Methods in Geometry Seminar + *Spacetime Positive Mass Theorem* + **Lan-Hsuan Huang**, University of Connecticut; von Neumann Fellow, School of Mathematics + *On the Topology and Index of Minimal Surfaces* + **Davi Maximo**, University of Pennsylvania; Member, School of Mathematics

Symplectic Dynamics Working Group + *Quasiconformality and the Lyapunov Spectrum* + **Clark W. Butler**, Princeton University; Veblen Research Instructor, School of Mathematics

Computer Science/Discrete Mathematics Seminar II + *Noncommutative Rank* + **Viswambhara Makam**, University of Michigan; Member, School of Mathematics

February 6

Mathematical Conversations + *How to Efficiently Check Proofs* + **Dor Yosef Minzer**, Member, School of Mathematics

Working Group on Geometric Applications of the Langlands Correspondence

February 7

Joint IAS/Princeton University Number Theory Seminar + *p -adic Integration and Geometric Stabilization* + **Dimitry Wyss**, Sorbonne Université

Working Seminar in Algebraic Number Theory + *Introduction* + **Preston Wake**, Member, School of Mathematics

Analysis Seminar + *Positive Canonical Bundle under Negative Holomorphic Curvature* + **Damin Wu**, University of Connecticut; Member, School of Mathematics

February 11

Computer Science/Discrete Mathematics Seminar I + *Interactive Coding over the Noisy Broadcast Channel* + **Gillat Kol**, Princeton University

Seminar on Theoretical Machine Learning + *Online Control with Adversarial Disturbances* + **Naman Agarwal**

Members' Seminar + *Quantum Jacobi Forms and Applications* + **Amanda L. Folsom**, Amherst College; von Neumann Fellow, School of Mathematics

Symplectic Dynamics/Geometry Seminar + *Getting a Handle on Contact Manifolds* + **Kevin Sackel**, Massachusetts Institute of Technology

Joint IAS/Princeton University Algebraic Geometry Seminar + *On the Algebraic Sato-Tate Conjecture for Abelian Varieties* + **Victoria Cantoral-Farfán**, International Centre for Theoretical Physics, Trieste, Italy

February 12

Variational Methods in Geometry Seminar + *Min-Max Solutions of the Ginzburg-Landau Equations on Closed Manifolds* + **Daniel Stern**, Princeton University + *Isoperimetry and Boundaries with Almost Constant Mean Curvature* + **Francesco Maggi**, The University of Texas at Austin; Member, School of Mathematics

Symplectic Dynamics Working Group

Computer Science/Discrete Mathematics Seminar II + *Why Can't We Prove Tensor Rank and Waring Rank Lower Bounds?* + **Viswambhara Makam**, University of Michigan; Member, School of Mathematics

February 13

Mathematical Conversations + *Harmonic Measure and Boundary Regularity* + **Zihui Zhao**, Member, School of Mathematics

BYOP@Lunch Working Group

Seminar on Theoretical Machine Learning + *Understanding and Rewiring SGD for Practically Effective ML* + **Rahul Kidambi**, University of Washington

Working Group on Geometric Applications of the Langlands Correspondence

February 14

Venkatesh Working Group + *The Equivariant Derived Category* + **Mark Goresky**, School of Mathematics

Joint IAS/Princeton University Number Theory Seminar + *An Application of a Conjecture of Mazur-Tate to Supersingular Elliptic Curves* + **Emmanuel Lecouturier**, Tsinghua University

Working Seminar in Algebraic Number Theory + *Modular Symbols and L -Values of Modular Forms* + **Eric Chen**, Princeton University

Analysis Seminar + *Elliptic Measures and the Geometry of Domains* + **Zihui Zhao**, Member, School of Mathematics

February 18

Seminar on Theoretical Machine Learning + *Curiosity, Intrinsic Motivation, and Provably Efficient Maximum Entropy Exploration* + **Karan Singh**, Princeton University

Joint IAS/Princeton University Algebraic Geometry Seminar + *An Example of Liftings with Different Hodge Numbers* + **Shizhang Li**, Columbia University

February 19

Variational Methods in Geometry Seminar + *On Minimizers and Critical Points for Anisotropic Isoperimetric Problems* + **Robin Neumayer**, Member, School of Mathematics + *Invariant*

Metrics and the Greene-Wu Conjectures ♦ **Damin Wu**, University of Connecticut; Member, School of Mathematics

Symplectic Dynamics Working Group ♦ *Entropy and Dynamical Systems in Dimension 2* ♦ **Fabio Tal**, Universidade de São Paulo

Computer Science/Discrete Mathematics Seminar II ♦ *Lorentzian Polynomials* ♦ **June Huh**, Visiting Professor, School of Mathematics

February 20

Mathematical Conversations ♦ *Finite Fields and the Ax-Grothendieck Theorem* ♦ **Remy van Dobben de Bruyn**, Princeton University; Veblen Research Instructor, School of Mathematics

BYOP@Lunch Working Group

Working Group on Geometric Applications of the Langlands Correspondence

February 21

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Automorphy of Mod 3 Representations over CM Fields* ♦ **Patrick Allen**, University of Illinois at Urbana-Champaign

Working Seminar in Algebraic Number Theory ♦ *Class Groups and Galois Cohomology* ♦ **Shilin Lai**, Princeton University

Analysis Seminar ♦ *Plateau's Problem as a Capillarity Problem* ♦ **Francesco Maggi**, The University of Texas at Austin; Member, School of Mathematics

February 22

Deep Learning: Alchemy or Science?

February 25

Computer Science/Discrete Mathematics Seminar I ♦ *Strongly Log Concave Polynomials, High-Dimensional Simplicial Complexes, and an FPRAS for Counting Bases of Matroids* ♦ **Shayan Oveis Gharan**, University of Washington

Members' Seminar ♦ *Positive Geometries* ♦ **Thomas Lam**, University of Michigan; von Neumann Fellow, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Higher Symplectic Capacities* ♦ **Kyler Siegel**, Columbia University

Joint IAS/Princeton University Algebraic Geometry Seminar ♦ *Vertex Algebras and Moduli of Curves* ♦ **Nicola Tarasca**, Rutgers, The State University of New Jersey

February 26

Variational Methods in Geometry Seminar ♦ *Geodesic Nets: Examples and Open Problems* ♦ **Alexander Nabutovsky**, University of

Toronto; Member, School of Mathematics ♦ *Ancient Gradient Flows of Elliptic Functionals* ♦ **Christos Mantoulidis**, Massachusetts Institute of Technology

Computer Science/Discrete Mathematics Seminar II ♦ *Lorentzian Polynomials* ♦ **June Huh**, Visiting Professor, School of Mathematics

February 27

Mathematical Conversations ♦ *Hodge Theory: Matrices and Differential Equations* ♦ **Simon Filip**, Harvard University; Visitor, School of Mathematics

BYOP@Lunch Working Group

Symplectic Dynamics Working Group ♦ *Diffusion Process in the Three-Body Problem* ♦ **Marian Gidea**, Yeshiva University

Emerging Topics on Scalar Curvature and Convergence ♦ *Techniques for Proving Intrinsic Flat Limits Are Not the Zero Space* ♦ **Christina Sormani**, The City University of New York; Visitor, School of Mathematics

Working Group on Geometric Applications of the Langlands Correspondence

February 28

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Derived Structures Controlling Representations* ♦ **Carl Wang-Erickson**, Imperial College London

Working Seminar in Algebraic Number Theory ♦ *Cup Products and K-Groups* ♦ **Francisc Fité**, Member, School of Mathematics

Analysis Seminar ♦ *Global Well-Posedness and Scattering for the Radially Symmetric Cubic Wave Equation with a Critical Sobolev Norm* ♦ **Benjamin G. Dodson**, Johns Hopkins University; von Neumann Fellow, School of Mathematics

March 1

Workshop on New Ideas and Tools in Turbulence ♦ *Remarks on Turbulence* ♦ **Katepalli Sreenivasan**, New York University; Member, School of Mathematics ♦ *3-Point Function of Vorticity in 2D Turbulence* ♦ **Alexander Polyakov**, Princeton University ♦ *Emergence of Multiscaling in a Flow Driven by a Random Force* ♦ **Victor Yakhot**, Boston University ♦ *Latest and Most Exciting Theories of Hydrodynamic Turbulence* ♦ **Peter Constantin**, Princeton University ♦ *For What It's Worth: An Analyst's Hunt for Asymptotic Heat Transport in Rayleigh-Bénard Convection* ♦ **Charlie Doering**, University of Michigan ♦ *Application of Machine Learning to Turbulence Modeling* ♦ **Weinan E**, Princeton University ♦ *Cascades in Vortex*

Collisions ♦ **Ryan McKeown**, Harvard University ♦ *Voluntary Thoughts on Turbulence* ♦ Multiple speakers

March 2

Workshop on New Ideas and Tools in Turbulence ♦ *Nonuniqueness of Weak Solutions to the Navier-Stokes Equations* ♦ **Tristan Buckmaster**, Princeton University ♦ *Spontaneously Stochastic Solutions in Dynamical Systems with Singularities* ♦ **Theo Drivas**, Princeton University ♦ *Lagrangian Chaos and Passive Scalar Turbulence* ♦ **Jacob Bedrossian**, University of Maryland ♦ *Statistical Mechanics and the Isometric Embedding Problem* ♦ **Govind Menon**, Brown University; Member, School of Mathematics

March 4

Computer Science/Discrete Mathematics Seminar I ♦ *Local and Global Expansion of Graphs* ♦ **Yuval Peled**, New York University

Seminar on Theoretical Machine Learning ♦ *FFJORD: Free-Form Continuous Dynamics for Scalable Reversible Generative Models* ♦ **Will Grathwohl**, University of Toronto

Symplectic Dynamics/Geometry Seminar ♦ *Gysin Sequences and Cohomology Ring of Symplectic Fillings* ♦ **Zhengyi Zhou**, Member, School of Mathematics

Joint IAS/Princeton University Algebraic Geometry Seminar ♦ *Volumes and Intersection Theory on Moduli Spaces of Abelian Differentials* ♦ **Dawei Chen**, Boston College; Member, School of Mathematics

Workshop on Geometric Functionals: Analysis and Applications ♦ *Compactness of Conformally Compact Einstein Manifolds in Dimension 4* ♦ **Alice Chang**, Princeton University ♦ *Singularities of Teichmüller Harmonic Map Flow* ♦ **Melanie Rupflin**, University of Oxford ♦ *Self-Similar Solutions of Mean Curvature Flow and Entropy* ♦ **Jacob Bernstein**, Johns Hopkins University; Member, School of Mathematics ♦ *Kähler Constant Scalar Curvature Metrics on Blow Ups and Resolutions of Singularities* ♦ **Claudio Arezzo**, International Centre for Theoretical Physics, Trieste, Italy

March 5

Workshop on Geometric Functionals: Analysis and Applications ♦ *L^p Curvatures: Some Analysis Questions from Gauge Theory* ♦ **Tristan Riviere**, Eidgenössische Technische Hochschule Zürich; Member, School of Mathematics ♦ *Spacetime Positive Mass Theorem* ♦ **Lan-Hsuan Huang**, University of Connecticut; von Neumann Fellow, School of Mathematics ♦ *Periodic Geodesics and Geodesic Nets on Riemannian Manifolds* ♦ **Regina Rotman**, University of Toronto; Member, School of Mathematics ♦ *Liouville Equations and Functional Determinants* ♦ **Andrea Malchiodi**, Scuola Normale Superiore di Pisa

Computer Science/Discrete Mathematics Seminar II ♦ *Improved List-Decoding and Local List-Decoding Algorithms for Polynomial Codes* ♦ **Swastik Kopparty**, Rutgers, The State University of New Jersey; Member, School of Mathematics

March 6

Mathematical Conversations ♦ *From Celestial Mechanics to the Arnold Conjectures* ♦ **Umberto Leone Hryniewicz**, Universidade Federal do Rio de Janeiro; von Neumann Fellow, School of Mathematics
Seminar on Theoretical Machine Learning ♦ *Exponentiated Gradient Meets Gradient Descent* ♦ **Will Grathwohl**, University of Toronto

Workshop on Geometric Functionals: Analysis and Applications ♦ *Normalized Harmonic Map Flow* ♦ **Michael Struwe**, Eidgenössische Technische Hochschule Zürich ♦ *Loop Products, Closed Geodesics, and Self-Intersections* ♦ **Nancy Hingston**, The College of New Jersey ♦ *Nature of Some Stationary Varifolds near Multiplicity 2 Tangent Planes* ♦ **Neshan Wickramasekera**, University of Cambridge; Member, School of Mathematics ♦ *Existence and Uniqueness of Green's Function to a Nonlinear Yamabe Problem* ♦ **Yanyan Li**, Rutgers, The State University of New Jersey

Working Group on Geometric Applications of the Langlands Correspondence ♦ *Untitled Talk* ♦ **Daniel Litt**, University of Georgia; Member, School of Mathematics

March 7

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Special Cycles on Orthogonal Shimura Varieties* ♦ **Eugenia Rosu**, The University of Arizona

Working Seminar in Algebraic Number Theory

Workshop on Geometric Functionals: Analysis and Applications ♦ *Compactness and Finiteness Theorems (Almost) without Curvature* ♦ **Gerard Besson**, Université de Grenoble ♦ *One-Cycle Sweepout Estimates of Essential Surfaces in Closed Riemannian Manifolds* ♦ **Stéphane Sabourau**, Université Paris-Est Créteil ♦ *L^2 Curvature for Surfaces in Riemannian Manifolds* ♦ **Ernst Kuwert**, Albert-Ludwigs-Universität Freiburg

March 8

Workshop on Geometric Functionals: Analysis and Applications ♦ *Ricci Flows That Attain Their Initial Data Weakly* ♦ **Peter Topping**, University of Warwick ♦ *Filling Metric Spaces* ♦ **Alexander Nabutovsky**, University of Toronto; Member, School of Mathematics

March 11

Computer Science/Discrete Mathematics Seminar I ♦ *Near Log-Convexity of Measured Heat in (Discrete) Time and Consequences* ♦ **Mert Sağlam**, University of Washington

Seminar on Theoretical Machine Learning ♦ *A Theoretical Analysis of Contrastive Unsupervised Representation Learning* ♦ **Orestis Plevrakis**, Princeton University

Members' Seminar ♦ *Geometry of Two-Dimensional Riemannian Disks and Spheres* ♦ **Regina Rotman**, University of Toronto; Member, School of Mathematics

Joint IAS/Princeton University Algebraic Geometry Seminar ♦ *A Non-Archimedean Ax-Lindemann Theorem* ♦ **Antoine Chambert-Loir**, Université Paris Diderot

March 12

Variational Methods in Geometry Seminar ♦ *Macroscopically Minimal Hypersurfaces* ♦ **Hannah Alpert**, The Ohio State University

Computer Science/Discrete Mathematics Seminar II ♦ *Halting Problems for Sandpiles and Abelian Networks* ♦ **Lionel Levine**, Cornell University; von Neumann Fellow

March 13

Mathematical Conversations ♦ *Wiggling and Wrinkling* ♦ **Daniel Álvarez-Gavela**, Member, School of Mathematics

BYOP@Lunch Working Group

March 14

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Local Aspects of Venkatesh's Thesis* ♦ **Yiannis Sakellaris**, Rutgers, The State University of New Jersey

Working Seminar in Algebraic Number Theory ♦ *The Map to K_2 without Symbols* ♦ **Akshay Venkatesh**, Professor, School of Mathematics

Analysis Seminar ♦ *Gradient Gibbs Models and Homogenization* ♦ **Scott Armstrong**, New York University

March 15

Analysis Seminar ♦ *Localization and Delocalization for Interacting 1D Quasiperiodic Particles* ♦ **Ilya Kachkovskiy**, Michigan State University

March 18

Computer Science/Discrete Mathematics Seminar I ♦ *An Application of the Universality Theorem for Tverberg Partitions* ♦ **Imre Barany**, Alfréd Rényi Institute of Mathematics, Hungarian Academy of Sciences, Budapest, and University College London

Members' Seminar ♦ *Tracking Trajectories in Hamiltonian Systems Using Holomorphic Curve Tools* ♦ **Barney Bramham**, Ruhr-Universität Bochum; von Neumann Fellow, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *Minimal Sets and Properties of Feral Pseudoholomorphic Curves* ♦ **Joel Fish**, University of Massachusetts, Boston

March 19

Variational Methods in Geometry Seminar ♦ *Gap and Index Estimates for Yang-Mills Connections in 4D* ♦ **Matthew Gursky**, University of Notre Dame ♦ *Multiplicity One Conjecture in Min-Max Theory* ♦ **Xin Zhou**, University of California, Santa Barbara; Member, School of Mathematics

Symplectic Dynamics Working Group ♦ *Properties of Feral Pseudoholomorphic Curves* ♦ **Joel Fish**, University of Massachusetts, Boston

Computer Science/Discrete Mathematics Seminar II ♦ *A Brief Tour of Proof Complexity: Lower Bounds and Open Problems* ♦ **Toniann Pitassi**, University of Toronto; Visiting Professor, School of Mathematics

March 20

Mathematical Conversations ♦ *From Dynamics to Contact Topology and Back* ♦ **Jo Nelson**, Rice University

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Symplectic Dynamics/Geometry Seminar ♦ *Equivariant and Nonequivariant Contact Homology* ♦ **Jo Nelson**, Rice University

March 21

Analysis Seminar ♦ *Front Propagation in a Nonlocal Reaction-Diffusion Equation* ♦ **Olga Turanova**, University of California, Los Angeles; Visitor, School of Mathematics

LMFDB

March 22

LMFDB

March 25

Computer Science/Discrete Mathematics Seminar I ♦ *On the Approximation Resistance of Balanced Linear Threshold Functions* ♦ **Aaron Potechin**, The University of Chicago

Members' Seminar ♦ *The General Case?* ♦ **Amie Wilkinson**, The University of Chicago

Joint IAS/Princeton University Algebraic Geometry Seminar ♦ *Singular Hodge Theory of Matroids* ♦ **Jacob Matherne**, Member, School of Mathematics

March 26

Variational Methods in Geometry Seminar ♦ *a-Harmonic Maps between Spheres* ♦ **Tobias Lamm**, Karlsruher Institut für Technologie ♦ *A Mountain Pass Theorem for Minimal Hypersurfaces with Fixed Boundary* ♦ **Rafael Montezuma**, Princeton University

Computer Science/Discrete Mathematics Seminar II ♦ *Factors of Sparse Polynomials: Structural Results and Some Algorithms* ♦ **Shubhangi Saraf**, Member, School of Mathematics

Emerging Topics Working Group ♦ *Coherence, Planar Boundaries, and the Geometry of Subgroups* ♦ **Genevieve Walsh**, Tufts University ♦ *One-Relator Groups, Nonpositive Immersions, and Coherence* ♦ **Henry Wilton**, University of Cambridge

March 27

Mathematical Conversations ♦ *A Curious Family of Curves* ♦ **Amie Wilkinson**, The University of Chicago

Variational Methods in Geometry Seminar ♦ *Multiplicity One Conjecture in Min-Max Theory (continued)* ♦ **Xin Zhou**, University of California, Santa Barbara; Member, School of Mathematics

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Emerging Topics Working Group ♦ *Coherence and Lattices* ♦ **Matthew Stover**, Temple University

Working Group on Geometric Applications of the Langlands Correspondence ♦ *Untitled Talk* ♦ **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

March 28

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Stronger Arithmetic Equivalence* ♦ **Andrew Sutherland**, Massachusetts Institute of Technology

Working Seminar in Algebraic Number Theory ♦ *Hida Theory and Ohta's Canonical Comparison Map* ♦ **Giada Grossi**, University College London

April 1

Computer Science/Discrete Mathematics Seminar I ♦ *Fooling Polytopes* ♦ **Li-Yang Tan**, Stanford University

Members' Seminar ♦ *A Recent Perspective on Invariant Theory* ♦ **Viswambhara Makam**, Member, School of Mathematics

Symplectic Dynamics/Geometry Seminar ♦ *The Arnold Conjecture via Symplectic Field Theory Polyfolds* ♦ **Ben Filippenko**, University of California, Berkeley

Joint IAS/Princeton University Algebraic Geometry Seminar ♦ *Motivic Euler Products and Motivic Height Zeta Functions* ♦ **Margaret Bilu**, New York University

April 2

Variational Methods in Geometry Seminar ♦ *Stable Hypersurfaces with Prescribed Mean Curvature* ♦ **Costante Bellettini**, Princeton University; Member, School of Mathematics ♦ *Constrained Deformations of Positive Scalar Curvature Metrics* ♦ **Alessandro Carlotto**, Eidgenössische Technische Hochschule Zürich; Member, School of Mathematics

Symplectic Dynamics Working Group

Computer Science/Discrete Mathematics Seminar II ♦ *A High-Dimensional Littlewood-Offord Inequality* ♦ **Li-Yang Tan**, Stanford University

April 3

Mathematical Conversations ♦ *A Glamorous Movie Star, the "Bad Boy" of Music, and the Development of Spread Spectrum Communications* ♦ **Mark Goresky**, School of Mathematics

Working Group on Geometric Applications of the Langlands Correspondence ♦ *Untitled Talk* ♦ **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

April 4

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Singular Moduli for Real Quadratic Fields* ♦ **Jan Vonk**, University of Oxford

Working Seminar in Algebraic Number Theory ♦ *p-adic L-Functions in One and Two Variables* ♦ **Kim Tuan Do**, Princeton University

Analysis Seminar ♦ *Higher Regularity of the Singular Set in the Thin Obstacle Problem* ♦ **Yash Jhaveri**, Member, School of Mathematics

April 5

Analysis Seminar ♦ *Two-Dimensional Random Field Ising Model at Zero Temperature* ♦ **Jian Ding**, The Wharton School, University of Pennsylvania

April 8

Computer Science/Discrete Mathematics Seminar I ♦ *Collective Coin-Flipping Protocols and Influences of Coalitions* ♦ **Hamed Hatami**, McGill University

Seminar on Theoretical Machine Learning ♦ *Fast Minimization of Structured Convex Quartics* ♦ **Brian Bullins**, Princeton University

Symplectic Dynamics/Geometry Seminar ♦ *Constructions in Symplectic and Contact Topology via H-Principles* ♦ **Oleg Lazarev**, Columbia University

Joint IAS/Princeton University Algebraic Geometry Seminar ♦ *Macaulayfication of Noetherian Schemes* ♦ **Kęstutis Česnavičius**, Université Paris-Sud and Mathematical Sciences Research Institute

Marston Morse Lectures ♦ *Disorder Increases Almost Surely* ♦ **Laure Saint-Raymond**, Université Pierre et Marie Curie and Ecole Normale Supérieure

April 9

Variational Methods in Geometry Seminar ♦ *The Energy Functional on Besse Manifolds* ♦ **Marco Radeschi**, University of Notre Dame ♦ *Bifurcating Conformal Metrics with Constant Q-Curvature* ♦ **Renato Bettiol**, The City University of New York

Marston Morse Lectures ♦ *Space-Time Correlations at Equilibrium* ♦ **Laure Saint-Raymond**, Université Pierre et Marie Curie and Ecole Normale Supérieure

Computer Science/Discrete Mathematics Seminar II ♦ *Flow Polytopes* ♦ **Karola Mészáros**, Cornell University; von Neumann Fellow, School of Mathematics

April 10

Mathematical Conversations ♦ *How Do Computers Do Arithmetic, and Should We Believe the Answers?* ♦ **Scott Tremaine**, Richard Black Professor, School of Natural Sciences

Working Group on Geometric Applications of the Langlands Correspondence ♦ *Untitled Talk* ♦ **Joe Kramer-Miller**, University of California, Irvine

April 11

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar ♦ *Sato-Tate Groups of Abelian Threefolds* ♦ **Francesc Fité**, Member, School of Mathematics

Working Seminar in Algebraic Number Theory ♦ *Overview of the Work of Fukaya-Kato* ♦ **Preston Wake**, Member, School of Mathematics

Marston Morse Lectures ♦ *Fluctuations Look Like White Noise* ♦ **Laure Saint-Raymond**, Université Pierre et Marie Curie and Ecole Normale Supérieure

April 15

Computer Science/Discrete Mathematics Seminar I ♦ *On the Possibility of an Instance-Based Complexity Theory* ♦ **Boaz Barak**, Harvard University

Seminar on Theoretical Machine Learning + *Is Optimization/ERM the Right Metaphor for Deep Learning?* + **Sanjeev Arora**, Princeton University; Visiting Professor, School of Mathematics

Members' Seminar + *Étale and Crystalline Companions* + **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

Symplectic Dynamics/Geometry Seminar + *Augmentations and Immersed Exact Lagrangian Cobordisms* + **Yu Pan**, Massachusetts Institute of Technology

Joint IAS/Princeton University Algebraic Geometry Seminar + *The p -Curvature Conjecture in Families* + **Ananth Shankar**, Massachusetts Institute of Technology

April 17

Analysis Seminar + *Loops in Hydrodynamic Turbulence* + **Katepalli Sreenivasan**, New York University; Member, School of Mathematics

Working Group on Geometric Applications of the Langlands Correspondence + *Untitled Talk* + **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

April 18

Venkatesh Working Group
Joint IAS/Princeton University Number Theory Seminar + *How Does the Rank of an Elliptic Curve Grow in Towers of Number Fields?* + **Florian Sprung**, Arizona State University

Working Seminar in Algebraic Number Theory + *The Galois Side of Fukaya-Kato* + **Gyu Jin Oh**, Princeton University

Analysis Seminar + *Dimension of the Stationary Measure for Random Matrix Products in $SL_2(\mathbf{R})$* + **Michael Hochman**, Einstein Institute of Mathematics, The Hebrew University of Jerusalem

April 22

Joint IAS/Princeton University Algebraic Geometry Seminar + *Chow Motives, L -Functions, and Powers of Algebraic Hecke Characters* + **Laure Flapan**, Northeastern University and Mathematical Sciences Research Institute

April 24

Working Group on Geometric Applications of the Langlands Correspondence + *Construction of Crystalline Companions I* + **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

April 25

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar + *Jensen-Polya Program for the Riemann Hypothesis and Related Problems* + **Ken Ono**, Emory University

Variational Methods in Geometry Seminar + *Infinite Solutions of the Singular Yamabe Problem in Spheres via Teichmüller Theory* + **Paolo Piccione**, Universidade de São Paulo

Working Seminar in Algebraic Number Theory + *Galois Side of Fukaya-Kato (continued)* + **Gyu Jin Oh**, Princeton University

April 29

Joint IAS/Princeton University Algebraic Geometry Seminar + *Nearby Cycles for Parity Sheaves and the Affine Hecke Category* + **Laura Rider**, University of Georgia

April 30

Variational Methods in Geometry Seminar + *The Geometry of Constant Mean Curvature Surfaces in Euclidean Space* + **Giuseppe Tinaglia**, King's College London

May 1

Working Group on Geometric Applications of the Langlands Correspondence + *Construction of Crystalline Companions II* + **Kiran Kedlaya**, University of California, San Diego; Visiting Professor, School of Mathematics

May 2

Venkatesh Working Group

Joint IAS/Princeton University Number Theory Seminar + *Singularities in Reductions of Shimura Varieties* + **Thomas Haines**, University of Maryland

Working Seminar in Algebraic Number Theory + *Galois Side of Fukaya-Kato (continued)* + **Gyu Jin Oh**, Princeton University

May 6

Analysis Seminar + *Singularity Formation for Some Incompressible Euler Flows* + **Tarek Elgindi**, University of California, San Diego

Joint IAS/Princeton University Algebraic Geometry Seminar + *Hecke Orbits and Foliations* + **Frans Oort**, Universiteit Utrecht

May 9

Joint IAS/Princeton University Number Theory Seminar + *Generalized Hasse-Herbrand Functions* + **Isabel Leal**, New York University

Working Seminar in Algebraic Number Theory + *Applications to Iwasawa Theory of Modular Forms* + **Shilin Lai**, Princeton University

May 16

Informal Group Action Seminar + *A Probabilistic Takens Theorem* + **Yonatan Gutman**, Institute of Mathematics of the Polish Academy of Sciences, Warsaw

May 19

2019 Women and Mathematics + *Terng Course Preview* + **Zihui Zhao**, University of Washington; Member, School of Mathematics + *Uhlenbeck Course Preview* + **Lu Wang**, University of Wisconsin-Madison; Member, School of Mathematics

May 20

2019 Women and Mathematics + *Uniform Rectifiability via Perimeter Minimization* + **Tatiana Toro**, University of Washington + *Terng Lecture Review Session* + *Ancient Solutions to Geometric Flows* + **Panagiotas Daskalopoulos**, Columbia University + *Uhlenbeck Lecture Review Session* + *Research Seminars*

May 21

2019 Women and Mathematics + *Uniform Rectifiability via Perimeter Minimization* + **Tatiana Toro**, University of Washington + *Ancient Solutions to Geometric Flows* + **Panagiotas Daskalopoulos**, Columbia University + *Viewing of the Presentation of the Abel Prize to Karen Uhlenbeck* + *Terng/Uhlenbeck Lectures Review Session* + *Viscosity Solutions Approach to Variational Problems* + **Daniela de Silva**, Columbia University

May 23

2019 Women and Mathematics + *Uniform Rectifiability via Perimeter Minimization* + **Tatiana Toro**, University of Washington + *Terng Lecture Review Session* + *Ancient Solutions to Geometric Flows* + **Panagiotas Daskalopoulos**, Columbia University + *Uhlenbeck Lecture Review Session* + *Research Seminars* + *Ambassador Program Introduction* + **Margaret Readdy**, University of Kentucky + *Ambassador Program Results*

May 24

2019 Women and Mathematics + *Uniform Rectifiability via Perimeter Minimization* + **Tatiana Toro**, University of Washington + *Ancient Solutions to Geometric Flows* + **Panagiotas Daskalopoulos**, Columbia University

May 30

Analysis Seminar + *The Inviscid Limit for the Navier-Stokes Equations with Data Analytic Only near the Boundary* + **Fei Wang**, University of Maryland

June 13

Scalar Curvature Seminar + *Stability of the Spacetime Positive Mass Theorem in Spherical Symmetry* + **Marcus Khuri**, Stony Brook University, The State University of New York + *Symmetries of Cosmological Cauchy Horizons with Non-closed Orbits* + **Jim Isenberg**, University

of Oregon ♦ *Symmetries of Cosmological Cauchy Horizons with Non-closed Orbits* ♦ **Jared Speck**, Massachusetts Institute of Technology

School of Natural Sciences

ASTROPHYSICS ACTIVITIES

September 6

Astrophysics Informal Seminar ♦ *Three-Dimensional Cluster Lensing* ♦ **Charles Keeton**, Rutgers, The State University of New Jersey

September 13

Astrophysics Informal Seminar ♦ *Formation of Black Hole Mergers in Dense Stellar Systems* ♦ **Johan Samsing**, Princeton University

September 18

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *Radiation-Dominated Black Hole Accretion Flows* ♦ **James Stone**, Princeton University

September 20

Astrophysics Informal Seminar ♦ *A New Wavelength Window into Atmospheric Escape in Exoplanets* ♦ **Antonija Oklopčič**, Harvard-Smithsonian Center for Astrophysics

September 24–25

Modern Inflation Cosmology–2018 ♦ *dS/dS and TT* ♦ **Eva Silverstein**, Stanford University ♦ *The Kreuzer-Skarke Axiverse* ♦ **Liam McAllister**, Cornell University ♦ *Holography and the Space of Inflationary Models* ♦ **Daniel Green**, University of California, San Diego ♦ *Cosmological Correlators from the Boundary* ♦ **Daniel Baumann**, University of Amsterdam ♦ *Cosmological Correlators and Scattering Amplitudes from Combinatorial Geometry at Infinity* ♦ **Nima Arkani-Hamed**, Professor, School of Natural Sciences ♦ *The Hyperinflation Attractor* ♦ **David Marsh**, University of Cambridge ♦ *Nonperturbative Potentials in Real Time* ♦ **John Stout**, University of Amsterdam ♦ *Swampland, Emergence of Infinite Field Distances, and Inflation* ♦ **Irene Valenzuela**, Utrecht University ♦ *Is it λ or M_{Pl} ?* ♦ **Sergei Dubovsky**, New York University ♦ *Cosmological Aspects of a Shift Symmetry* ♦ **Enrico Pajer**, University of Cambridge ♦ *Light Particles with Spin in Inflation* ♦ **Paolo Creminelli**, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy ♦ *Double Soft Gravitons and Asymptotic Symmetries* ♦ **Bart Horn**, Manhattan College ♦ *The Landscape, the Swampland, and the Era of Precision Cosmology* ♦ **Andrei Linde**, Stanford University ♦ *Planck 2018 and dS from 10d* ♦ **Renata Kallosh**, Stanford University ♦ *Uplifts and Flattening* ♦ **Alexander Westphal**, Deutsches Elektronen-Synchrotron (DESY), Universität Hamburg ♦ *Topology of Cosmological Black Holes* ♦ **Mehrdad Mirbabayi**, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, and Stanford University ♦ *$\lambda\lambda\varphi^4$ in de Sitter* ♦ **Leonardo**

Senatore, Stanford University, and Victor Gorbenko, Member, School of Natural Sciences ♦ *Improving fNL Constraints with Velocity Field and Lensing Measurements* ♦ **Moritz Münchmeyer**, Perimeter Institute for Theoretical Physics ♦ *Action Principle and Vacuum Decay in General Relativity* ♦ **Thomas Bachlechner**, University of California, San Diego ♦ *A Real-Time Semiclassical Description of Vacuum Decay* ♦ **Jonathan Braden**, University College London ♦ *Intermittent Non-Gaussianity in Reheating* ♦ **Andrei Frolov**, Simon Fraser University ♦ *Beyond Stochastic Inflation during Classical Transverse Instabilities* ♦ **J. Richard Bond**, Canadian Institute for Theoretical Astrophysics, University of Toronto

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *B-Modes from the Early Universe and the Milky Way* ♦ **Raphael Flauger**, University of California, San Diego

September 27

Astrophysics Informal Seminar ♦ *Harnessing Machine Learning to Study Stellar Feedback* ♦ **Stella Offner**, The University of Texas at Austin

October 1

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion ♦ *Massive Neutrinos Leave Fingerprints on Cosmic Voids* ♦ **Christina Kreisch**, Princeton University

October 2

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *The Dynamic Milky Way in the Gaia Era* ♦ **Adrian Price-Whelan**, Princeton University

October 4

Astrophysics Informal Seminar ♦ *DAVs: Red Edge and Outbursts* ♦ **Jing Luan**, Member, School of Natural Sciences

October 9

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *Imaging All the Sky All the Time in Search of Radio Exoplanets* ♦ **Gregg Hallinan**, California Institute of Technology

October 11

Astrophysics Informal Seminar ♦ *Looking for Light Relics and Missing Baryons with Cosmological Data* ♦ **Julián Muñoz**, Harvard University

October 16

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *Proto-neutron Star Winds: Supernova Diversity, Magnetars, and Heavy Element Nucleosynthesis* ♦ **Todd Thompson**, The Ohio State University; Junior Visiting Professor, School of Natural Sciences

October 18

Astrophysics Informal Seminar ♦ *Gravitational Lenses as High-Resolution Telescopes* ♦ **Anna Barnacka**, Harvard-Smithsonian Center for Astrophysics

October 22

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion ♦ *Cluster Mass Calibration with ACT and KiDS* ♦ **Naomi Robertson**, University of Oxford

October 23

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *New Results in Tests of Gravity with Radio Pulsars* ♦ **Michael Kramer**, Max-Planck-Institut für Radioastronomie

October 25

Astrophysics Informal Seminar ♦ *Searching for New Physics with Gravitational Waves* ♦ **Victor Gorbenko**, Member, School of Natural Sciences

November 1

Astrophysics Informal Seminar ♦ *Simulations of Structure Formation Beyond CDM* ♦ **Simeon Bird**, University of California, Riverside

November 5

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion ♦ *An Astrometric Search Method for Gravitational Waves with Arbitrary Polarization Modes Using Data from Gaia* ♦ **Deyan Mihaylov**, University of Cambridge

November 6

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *Entering an Era of Precision Stellar Astrophysics (or, Fun with Stellar Radii)* ♦ **Keivan Stassun**, Vanderbilt University

November 8

Astrophysics Informal Seminar ♦ *Gravitational Wave Data: Analysis Techniques and Future Prospects* ♦ **Miriam Cabero Müller**, Princeton University

November 13

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium ♦ *Probing Behind the Man in the Moon: Results from NASA's GRAIL Mission* ♦ **Jay Melosh**, Purdue University

November 15

Astrophysics Informal Seminar ♦ *Rare Views of Galaxy Cluster Laboratories* ♦ **Brenda Frye**, The University of Arizona

November 19

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion ♦ *Massive Neutrinos Leave Fingerprints on Cosmic Voids* ♦ **Marco Raveri**, The

University of Chicago + *Exploring a Novel Probe for Cosmology: Cosmic Voids* + **Elena Massara**, Center for Computational Astrophysics, Flatiron Institute

November 20

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium + *The Dark History of the Early Universe: Seeking Imprints of Dark Matter Interactions on the Cosmic Dawn* + **Tracy Slatyer**, Massachusetts Institute of Technology; Junior Visiting Professor, School of Natural Sciences

November 26

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Galaxy Clusters in the Dark Energy Survey* + **Tom McClintock**, Brookhaven National Laboratory

November 27

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium + *Kinematics of Circumgalactic Gas* + **Crystal Martin**, University of California, Santa Barbara

November 29

Astrophysics Informal Seminar + *The Milky Way's Stellar Streams and Its Galactic Bar* + **Sarah Pearson**, Center for Computational Astrophysics, Flatiron Institute

December 3

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Gas Contents in the Low- Z Universe* + **Seunghwan Lim**, University of Massachusetts

December 4

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium + *On the Origin of Life: Major Hurdles on the Path from Organic Chemistry to Biochemistry* + **Andrei Lupas**, Max-Planck-Institut für Entwicklungsbiologie

December 6

Astrophysics Informal Seminar + *The Lyman Alpha Forest, DLAs, and Other Absorption Systems as Tracers of Large-Scale Structure* + **Jordi Miralda-Escude**, Universitat de Barcelona; Member, School of Natural Sciences

December 11

Institute for Advanced Study/Princeton University Joint Astrophysics Colloquium + *Machine Learning for the Universe: Steps Towards Opening the Black Box* + **Shirley Ho**, Center for Computational Astrophysics, Flatiron Institute

December 13

Astrophysics Informal Seminar + *Minimoons to Planet X: Mapping Solar System Populations with ZTF and LSST* + **Mario Jurić**, University of Washington

December 17

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Neutrinos and Other Light Relics Beyond Their Masses* + **Benjamin Wallisch**, Member, School of Natural Sciences

January 14

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Weak Singularities in Large-Scale Structure: Identification and Workaround* + **Cornelius Rampf**, Observatoire de la Côte d'Azur

February 4

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Multiwavelength Confirmation of Unconfirmed Planck Clusters* + **Steven Boada**, Rutgers, The State University of New Jersey

February 13

Astrophysics Informal Seminar + *A Statistical Solution to the Chaotic, Nonhierarchical Three-Body Problem* + **Nicholas C. Stone**, Columbia University

February 25

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Clarifying the Hubble Constant Tension* + **Stephen Feeney**, Center for Computational Astrophysics, Flatiron Institute

February 28

Astrophysics Informal Seminar + *Dense Regions in Supersonic Isothermal Turbulence* + **Brant Robertson**, University of California, Santa Cruz; Junior Visiting Professor, School of Natural Sciences

March 7

Astrophysics Informal Seminar + *Halometry from Astrometry* + **Ken Van Tilburg**, New York University; Member, School of Natural Sciences

March 14

Astrophysics Informal Seminar + *Conversion Measure of Faraday Rotation-Conversion with FRB Applications* + **Andrei Gruzinov**, New York University

March 21

Astrophysics Informal Seminar + *Black Hole Accretion* + **Charles Gammie**, University of Illinois at Urbana-Champaign

March 28

Astrophysics Informal Seminar + *Signatures of the Early Universe in the BAO Spectrum* + **Benjamin Wallisch**, Member, School of Natural Sciences

April 1

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *The Universe as Seen through a Pulsar Timing Array* + **Tristan Smith**, Swarthmore College

April 4

Astrophysics Informal Seminar + *The Growing Field of Post-Main-Sequence Planetary System Science* + **Dimitri Veras**, University of Warwick

April 11

Astrophysics Informal Seminar + *Planets Big and Small* + **Eve J. Lee**, California Institute of Technology

April 12

Astrophysics Informal Seminar + *Dynamics of Planets Orbiting in the Alpha Centauri AB Stellar System* + **Jack Lissauer**, Ames Research Center, National Aeronautics and Space Administration

April 15

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Are We Ready for Precision Cosmology? General Relativistic Effects and Gauge-Invariant Formalism* + **Jaiyul Yoo**, Center for Theoretical Astrophysics and Cosmology, Institute for Computational Science, Universität Zürich + *Investigating Galactic Thermal Dust Emission* + **Daniel Herman**, University of Oslo

April 18

Astrophysics Informal Seminar + *Prophets of Doom and the Doom of Prophecy: Long-Term Planetesimal Dynamics in the Solar System* + **William Isaac Newman**, University of California, Los Angeles; Member, School of Natural Sciences

April 25

Astrophysics Informal Seminar + *Time-Domain Approaches to Investigating the Tension in H_0* + **Danny Goldstein**, California Institute of Technology

April 29

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion + *Inhomogeneous Initial Conditions and the Start of Inflation* + **Patrick John Fitzpatrick**, Massachusetts Institute of Technology

May 2

Astrophysics Informal Seminar + *The Black Hole Shadow in the M87 Galaxy* + **Dimitrios Psaltis**, Steward Observatory, The University of Arizona

May 3

Astrophysics Informal Seminar + *MUSE and GRAVITY* + **Tim de Zeeuw**, Sterrewacht Leiden; Max-Planck-Institut für Extraterrestrische Physik

May 9

Astrophysics Informal Seminar + *Unfolding the Dynamical and Colorful Lives of Neutron Star Mergers* + **Wen-fai Fong**, Northwestern University

May 13

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion ♦ *The Neutrino Puzzle: Anomalies, Interactions, and Cosmological Tensions* ♦ **Christina Kreisch**, Princeton University

May 14

Astrophysics Informal Seminar ♦ *What Can We Expect from SRG/eRosita and ART-XC/and Ground-Based Microwave Telescopes Sky Surveys* ♦ **Rashid Sunyaev**, Max-Planck-Institute für Astrophysik; Distinguished Visiting Professor, School of Natural Sciences

May 16

Astrophysics Informal Seminar ♦ *Probing Dark Energy with CHIME* ♦ **Richard Shaw**, The University of British Columbia

May 23

Astrophysics Informal Seminar ♦ *New Opportunities with Future CMB Observations* ♦ **Joel Meyers**, Southern Methodist University

May 30

Astrophysics Informal Seminar ♦ *Black Hole Spin Misalignments in Microquasars* ♦ **Greg Salvesen**, University of California, Santa Barbara

June 3

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion ♦ *Cosmology with Cosmic Voids: Status and Recent Results* ♦ **Alice Pisani**, Princeton University

June 10

Princeton University/Institute for Advanced Study Early Universe/Cosmology Lunch Discussion ♦ *Quasi-isotropic Cycles and Bounces in a Mixmaster Cosmology* ♦ **Chandrima Ganguly**, Dartmouth College

June 20

Astrophysics Informal Seminar ♦ *The Scientific Potential of Third-Generation Gravitational Wave Detectors* ♦ **Salvatore Vitale**, Massachusetts Institute of Technology

HIGH ENERGY THEORY ACTIVITIES

September 12

Physics Group Meeting ♦ *Introduction to “Fractons” and the Haah Code* ♦ **Brian Swingle**, University of Maryland; Junior Visiting Professor, School of Natural Sciences

September 17

High Energy Theory Seminar ♦ *Higher-Form Symmetries in Magnetohydrodynamics, Effective Field Theory, and Holography* ♦ **Saso Grozdanov**, Massachusetts Institute of Technology

September 19

Physics Group Meeting ♦ *Discussion on the OPE Inversion Formula and Related Topics* ♦ **Petr Kravchuk**, Member, School of Natural Sciences

September 21

High Energy Theory Seminar ♦ *d-dimensional SYK, AdS Loops, and 6j Symbols* ♦ **Vladimir Rosenhaus**, Member, School of Natural Sciences

September 26

Physics Group Meeting ♦ *T \bar{T} Deformation* ♦ **Shu-Heng Shao**, Long-term Member, School of Natural Sciences

October 1

High Energy Theory Seminar ♦ *Entanglement Branes and Extended Topological Quantum Field Theory* ♦ **William Donnelly**, Perimeter Institute for Theoretical Physics

October 10

Physics Group Meeting ♦ *Review of the KKLT Construction of de-Sitter Vacua of String Theory* ♦ **Juan Maldacena**, Carl P. Feinberg Professor, School of Natural Sciences

Informal Physics Discussion ♦ *Lorentz Covariant Theories with Causality Violation* ♦ **Harvey Reall**, University of Cambridge

October 11

Informal High Energy Theory Seminar ♦ *Weak Gravity Conjecture from Black Hole Entropy* ♦ **Grant Remmen**, University of California, Berkeley

October 15

High Energy Theory Seminar ♦ *Tree Amplitudes for Some Supersymmetric Theories in Six Dimensions* ♦ **John Schwarz**, California Institute of Technology

October 17

Physics Group Meeting ♦ *Soft Particles and Symmetry* ♦ **Daniel Steven Kapec**, Member, School of Natural Sciences

October 19

High Energy Theory Seminar ♦ *Continuous 2-group Symmetry of 6d N=(1,0) LST and T-dualities* ♦ **Kantaro Ohmori**, Member, School of Natural Sciences

October 24

Physics Group Meeting ♦ *Information Geometry and Machine Learning as Tools for Phenomenology* ♦ **Kyle Cranmer**, New York University; Junior Visiting Professor, School of Natural Sciences

October 29

High Energy Theory Seminar ♦ *The Chiral Algebra Program for 4d Superconformal Field Theories* ♦ **Leonardo Rastelli**, Stony Brook University, The State University of New York

October 31

Physics Group Meeting ♦ *Relative Entropy and Energy Conditions in QFT* ♦ **Nima Lashkari**, Member, School of Natural Sciences

November 2

High Energy Theory Seminar ♦ *T \bar{T} Deformation and Topological Gravity* ♦ **Victor Gorbenko**, Member, School of Natural Sciences

November 7

Physics Group Meeting ♦ *Boundary Entropy in Integrable QFTs* ♦ **Shota Komatsu**, Member, School of Natural Sciences

November 12

High Energy Theory Seminar ♦ *Energy is Entanglement* ♦ **Arvin Shahbazi Moghaddam**, University of California, Berkeley

November 14

Physics Group Meeting ♦ *Nonsupersymmetric D-branes* ♦ **Edward Witten**, Charles Simonyi Professor, School of Natural Sciences

November 16

High Energy Theory Seminar ♦ *M-theory in 4d, N=1 Superspace* ♦ **Katrin Becker**, Texas A&M University; Member, School of Natural Sciences

November 26

High Energy Theory Seminar ♦ *Stringy ER=EPR* ♦ **Daniel Jafferis**, Harvard University

November 28

Physics Group Meeting ♦ *Mapping the Swampland* ♦ **Thomas Rudelius**, Member, School of Natural Sciences

November 30

High Energy Theory Seminar ♦ *Falling Toward Charged Black Holes* ♦ **Ying Zhao**, Member, School of Natural Sciences

December 4–5

Quantum Information and the Structure of Spacetime Workshop ♦ *Flat Entanglement Spectra in Fixed-Area Eigenstates of Quantum Gravity* ♦ **Don Marolf**, University of California, Santa Barbara ♦ *Entanglement Entropy Relations via Holography* ♦ **Veronika Hubeny**, University of California, Davis ♦ *Entanglement as a Connection for Holographic Spacetimes* ♦ **Lampros Lamprou**, Massachusetts Institute of Technology ♦ *Scrambling Time and Causal Structure in a Schwarzschild Black Hole* ♦ **Peter Shor**, Massachusetts Institute of Technology ♦ *A Toy Model of the Information Paradox in Empty Space* ♦ **Suvrat Raju**, International Centre for Theoretical Sciences, Bangalore, India ♦ *Nonperturbative Effects in Jackiw-Teitelboim Gravity* ♦ **Phil Saad**, Stanford University ♦ *Symmetry in QFT and Gravity* ♦ **Hiroshi Ooguri**, Walter Burke Institute for Theoretical Physics, California Institute of Technology, and Kavli Institute for the Physics and Mathematics of the

Universe, The University of Tokyo + *Open Strings on the Rindler Horizon* + **Edward Witten**, Charles Simonyi Professor, School of Natural Sciences + *Comments about $T\bar{T}$ and SYK* + **Herman Verlinde**, Princeton University + *Quantum Chaos and Effective Field Theory* + **Felix Haehl**, The University of British Columbia + *Recovering the QNEC from the ANEC* + **Thomas Faulkner**, University of Illinois at Urbana-Champaign + *Black Hole Entropy and Soft Hair* + **Andrew Strominger**, Harvard University + *Entanglement Wedge Reconstruction and the Hayden-Preskill Protocol* + **Ahmed Almheiri**, Member, School of Natural Sciences + *Constraining Correlation Functions Using Modular Theory* + **Nima Lashkari**, Member, School of Natural Sciences

December 10

High Energy Theory Seminar + *'t Hooft Anomalies, High- T , and Low- T Domain Walls in Adjoint Fermion Theories with (or without) Supersymmetry* + **Erich Poppitz**, University of Toronto

December 12

Physics Group Meeting + *Introduction to Four-Dimensional Chern-Simons Theory* + **Masahito Yamazaki**, Kavli Institute for the Physics and Mathematics of the Universe, The University of Tokyo

December 14

High Energy Theory Seminar + *Higgs Parity, Strong CP Problem, and Unification* + **Keisuke Harigaya**, Member, School of Natural Sciences

December 19

Physics Group Meeting + *Elementary Positive Geometry of Causal Diamonds, Particles, and Strings* + **Nima Arkani-Hamed**, Professor, School of Natural Sciences

January 28

High Energy Theory Seminar + *Under Construction: A Progress Report on a Theory of SUSY Representations* + **S. James Gates, Jr.**, Brown University

January 30

Physics Group Meeting + *Light-Ray Operators in CFT* + **Petr Kravchuk**, Member, School of Natural Sciences

February 6

Physics Group Meeting + *Recovering the QNEC from the ANEC* + **Nima Lashkari**, Member, School of Natural Sciences

February 8

High Energy Theory Seminar + *Gauge Theories for the Cuprates Near Optimal Doping* + **Subir Sachdev**, Harvard University

February 22

High Energy Theory Seminar + *Bridging the Gap between Lattice Models and TQFT* + **Michael Levin**, The University of Chicago

February 25

High Energy Theory Seminar + *Twisted Holography for the $N=4$ Chiral Algebra* + **Kevin Costello**, Perimeter Institute for Theoretical Physics

February 27

Physics Group Meeting + *6d Spinor-Helicity and Superamplitudes* + **Yvonne Geyer**, Member, School of Natural Sciences

March 4

High Energy Theory Seminar + *The Fuzzball Paradigm for Black Holes and Its Possible Implications for Cosmology* + **Samir Mathur**, The Ohio State University

March 13

Physics Group Meeting + *Formation of Compact Structures with Axion Dark Matter* + **Ken Van Tilburg**, New York University; Member, School of Natural Sciences

March 18

High Energy Theory Seminar + *The Interior of Dynamic Vacuum Black Holes and the Strong Cosmic Censorship Conjecture in General Relativity* + **Mihalis Dafermos**, Princeton University

March 20

Physics Group Meeting + *Aspects of One-Matrix Integrals* + **Douglas Stanford**, Long-term Member, School of Natural Sciences

March 22

High Energy Theory Seminar + *Nonperturbative and Doubly Nonperturbative Effects in JT Gravity* + **Douglas Stanford**, Long-term Member, School of Natural Sciences

March 27

Physics Group Meeting + *Supersymmetry, Self-Force, and the Swampland* + **Thomas Rudelius**, Member, School of Natural Sciences

April 1

High Energy Theory Seminar + *The Kreuzer-Skarke Axiverse* + **Liam McAllister**, Cornell University

April 3

Informal High Energy Theory Seminar + *Some Arithmetic Path Integrals* + **Minhyong Kim**, University of Oxford

April 5

High Energy Theory Seminar + *Hydrodynamic Charge Transport: Fluctuating Stripes and Magnetophonons* + **Anna Karlsson**, Member, School of Natural Sciences

April 15

High Energy Theory Seminar + *Quantum Epidemiology: Operator Growth, Thermal Effects, and SYK* + **Alexandre Streicher**, University of California, Santa Barbara

April 19

High Energy Theory Seminar + *Anyonic-String/Brane Träumerei: Quantum 4d Yang-Mills Gauge Theories and Time-Reversal Symmetric 5d TQFT* + **Juven Chun-Fan Wang**, Member, School of Natural Sciences

April 24

Physics Group Meeting + *The Current State of Gravitational Wave Searches with LIGO/VIRGO* + **Matias Zaldarriaga**, Professor, School of Natural Sciences

April 26

High Energy Theory Seminar + *Anomalies in the Space of Couplings and Dynamical Applications* + **Clay Cordova**, Long-term Member, School of Natural Sciences

April 29

High Energy Theory Seminar + *Globally Consistent Three-Family Standard Models in F-Theory* + **Mirjam Cvetič**, University of Pennsylvania

May 15

Physics Group Meeting + *Two Important Milestones in the History of the Universe: The Last Scattering Surface, the Black Body Photosphere of the Universe, and Distortions of the CMB Spectrum* + **Rashid Sunyaev**, Max-Planck-Institute für Astrophysik and Space Research Institute, Moscow; Distinguished Visiting Professor, School of Natural Sciences

June 4

Gordon & Betty Moore Foundation Seminar + *Challenging the Pauli Exclusion Principle by Hunting “Impossible” Atoms in the Cosmic Silence* + **Catalina Oana Curceanu**, Laboratori Nazionali di Frascati, Istituto Nazionale di Fisica Nucleare

June 5

Physics Group Meeting + *Geometric Extremization for Supersymmetric AdS_3 and AdS_2 Solutions* + **Jerome Gauntlett**, Imperial College London

June 7

Gordon & Betty Moore Foundation Seminar + *Testing Collapse Models Underground by Searching the Spontaneous Radiation (How To Go from “To Be AND Not To Be” to “To Be OR Not To Be”)* + **Catalina Oana Curceanu**, Laboratori Nazionali di Frascati, Istituto Nazionale di Fisica Nucleare

June 12

Physics Group Meeting + *The Entanglement Wedge of an Evaporating Black Hole* + **Ahmed Almheiri**, Member, School of Natural Sciences

THE SIMONS CENTER FOR SYSTEMS BIOLOGY ACTIVITIES

September 10

Joint Laboratory Meeting + *Spectrum and Mutational Landscape of LFS Tumors* + **Chang Chan**, Rutgers Cancer Institute of New Jersey

October 23

Convergence Cancer Research Meeting + *Ecology of the Tumor Microenvironment* + **Peter Lee**, City of Hope + *Using RNA Seq to Study Tumor Evolution* + **Mickey Atwal**, Cold Spring Harbor Laboratory + *Neoadjuvant Treatment to Drive in Situ Vaccination in Breast Cancers* + **Nitasha Bennett**, Massachusetts Institute of Technology +

October 29

The Simons Center for Systems Biology Informal Talks on Abstract/Conceptual/Quantitative Aspects of Biology + *Scaling Law of Human Memory Recall* + **Misha Tsodyks**, Weizmann Institute of Science

November 2

Joint Laboratory Meeting on p53 + *Mutant p53 Protein Accumulation Promoted by MDM2 Isoforms and BAG Proteins in Cancer* + **Zhaohui Feng**, Rutgers Cancer Institute of New Jersey

December 14

The Simons Center for Systems Biology Informal Talks on Abstract/Conceptual/Quantitative Aspects of Biology + *To Catch and Reverse a Quantum Jump Mid-flight* + **Michel Devoret**, Yale University

January 9

Convergence Cancer Research Meeting + *Deep Learning of the Immune Synapse* + **John-William Sidhom**, Johns Hopkins University

January 11

Joint Laboratory Meeting + *Sexual Dimorphism of SNPs in the Human Population* + **Katya Khramatsova**, The University of Chicago

February 7

The Simons Center for Systems Biology Informal Talks on Abstract/Conceptual/Quantitative Aspects of Biology + *TOPIC: Microbial Communities, Evolution without Species, etc.* + **Mikhail Tikhonov**, Washington University in St. Louis

March 1

Joint Laboratory Meeting + *Applying Methods of Random Matrix Theory to De-noising Biological Data* + **Raúl Rabadán**, Columbia University

March 6

Joint Laboratory Meeting + *Mutant p53 Activates Small GTPase Rac1 as a Novel Mechanism to Promote Tumorigenesis* + **Wenwei Hu**, Rutgers Cancer Institute of New Jersey

April 9

The Simons Center for Systems Biology Informal Talks on Abstract/Conceptual/Quantitative Aspects of Biology + **Rogier Braakman**, Massachusetts Institute of Technology

April 10

The Simons Center for Systems Biology Informal Talks on Abstract/Conceptual/Quantitative Aspects of Biology + **Clement Mouhot**, University of Cambridge

April 11

Governor's Conference on Effective Partnering in Cancer Research + *Utilizing the Totality of Mutagenesis for Clinical Purposes* + **Serena Nik-Zainal**, University of Cambridge + *Connecting TCRs to Antigens* + **Harlan Robins**, Fred Hutchinson Cancer Research Center + *Immune Interactions Predict Cancer Evolution* + **Marta Łuksza**, Icahn School of Medicine at Mount Sinai + *Specificity in Natural and Synthetic Protein Circuits* + **Michael B. Elowitz**, California Institute of Technology + *Probing Metabolic Heterogeneity in Tumors Using Imaging Mass Spectrometry* + **Shawn M. Davidson**, Princeton University

June 19

The Simons Center for Systems Biology Informal Talks on Abstract/Conceptual/Quantitative Aspects of Biology + *Self-Assembly of Multivalent Droplets* + **Jasna Brujic**, New York University

June 25

Convergence Cancer Research Meeting + *Computational Analysis of the Role and Transcriptional Landscape of Nonimmune Stroma in the Progression of Breast Tumor Microenvironment* + **Mickey Atwal**, Cold Spring Harbor Laboratory + *Fractal Dimension, Occupancy, and Hotspot Analyses of B Cell Spatial Distribution in Breast Cancer* + **Claire Yu**, University of California, Irvine + *The Spatial Profile of CD8⁺ T Cells in Triple-Negative Breast Cancer* + **Xuefei Li**, Rice University + *Combination Therapies Using Ivermectin Targeting Multiple Components of the Breast Cancer Tumor Microenvironment* + **Peter Lee**, City of Hope

Prospects in Theoretical Physics 2019 + *Great Problems in Biology for Physicists* + Organizers and lecturers: **Uri Alon**, Weizmann Institute of Science; **Regina Barzilay**, Massachusetts Institute of Technology; **Shelley Berger**, University of Pennsylvania; **Ed Boyden**, Massachusetts Institute of Technology; **Curtis Callan**, Princeton University; Director's Visitor: **Navdeep S. Chandel**, Northwestern University; **Shawn M. Davidson**, Princeton University; **Michael M. Desai**, Harvard University; **Stephen P. Goff**, Columbia University; **Benjamin Greenbaum**, Mount Sinai; **Clyde A. Hutchison, III**, J. Craig Venter Institute; **Edo Kussell**, New York University; **Titia de Lange**, Rockefeller University; **Arnold J. Levine**, Professor

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School of Social Science

September 14

Social Science Orientation Session

Social Science Welcome Party

September 17

Social Science Seminar + *Crisis and Critique: A Discourse on the Method* + **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science

September 24

Social Science Seminar + *The Role of Troublemakers in Times of Crisis* + **Dieter Thomä**, Universität St. Gallen; Member, School of Social Science

September 26

Crisis and Critique Seminar + Introductory Session I

October 1

Social Science Seminar + *The Party of Which People?: The Evolution of the Democrats from Jackson to Obama* + **Michael Kazin**, Georgetown University; Member, School of Social Science

October 8

Social Science Seminar + *Security Crises: Populism, Nationalism, and Threats to Democracy in Europe* + **Mabel Berezin**, Cornell University; Member, School of Social Science

October 9

Crisis and Critique Film Series + *Inside Job*, directed by Charles Ferguson; post-screening discussion led by **Clara Elisabetta Mattei**, The New School; Member, School of Social Science

October 10

Crisis and Critique Seminar + Introductory Session II

October 15

Social Science Seminar ♦ *From Slavery to Precarity? African Labor History and the History of Work in Africa since the Late Nineteenth Century* ♦ **Andreas Eckert**, Humboldt-Universität zu Berlin; Member, School of Social Science

October 17

Colonial Crisis and Anti-colonial Critique ♦ Planning Meeting organized by **Beshara Doumani**, Brown University; Member, School of Social Science

October 19

Academic Mixer, sponsored jointly by the Schools of Social Science and Historical Studies

October 22

Social Science Seminar ♦ *The Power Logic of Justice in China* ♦ **Ji Li**, Rutgers Law School; Member, School of Social Science

October 24

Crisis and Critique Seminar ♦ *Colonial Crisis and Anti-colonial Critique* ♦ Session curated by **Hector Amaya**, University of Virginia, and **Beshara Doumani**, Brown University; Members, School of Social Science

October 29

Social Science Seminar ♦ *The Dictatorship of Capital: Urban Redevelopment and the Question of Violence in Post-authoritarian South Korea* ♦ **Hae Yeon Choo**, University of Toronto; Member, School of Social Science

October 31

Critical Conversations ♦ Introductory Meeting

November 5

Social Science Seminar ♦ *Inequality, Empathy Gulfs, and Social Critique* ♦ **Martin Hartmann**, Universität Luzern; Member, School of Social Science

November 7

Crisis and Critique Seminar ♦ *Political Crises and Street Politics as Critique* ♦ Session curated by **Robin Celikates**, University of Amsterdam, and **Jessica Winegar**, Northwestern University; Members, School of Social Science

Crisis and Critique Film Series ♦ *Clash*, directed by Mohamed Diab; post-screening discussion led by **Munira Khayyat**, The American University in Cairo, and **Jessica Winegar**, Northwestern University; Members, School of Social Science

November 9–10

The Social Sciences in a Changing World Workshop ♦ Organized by **George Steinmetz**, University of Michigan, and **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science

November 12

Social Science Seminar ♦ *Publicity, Violence, and Technological Mediation* ♦ **Hector Amaya**, University of Virginia; Member, School of Social Science

November 14

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Robin Celikates**, University of Amsterdam; Member, School of Social Science

November 19

Social Science Seminar ♦ *Environment: A Disastrous History of the Hydrocarbon Present* ♦ **David Bond**, Bennington College; Member, School of Social Science

November 20

Crisis and Critique Seminar ♦ *The Environmental Crisis* ♦ Session curated by **David Bond**, Bennington College, and **Daniel Aldana Cohen**, University of Pennsylvania; Members, School of Social Science

November 26

Social Science Seminar ♦ *Democracy and the Division of Labor: Outline of a Research Project* ♦ **Axel Honneth**, Goethe-Universität Frankfurt and Columbia University; Distinguished Visiting Professor, School of Social Science

November 28

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Jessica Winegar**, Northwestern University; Member, School of Social Science

December 3

Social Science Seminar ♦ *Crisis, Critique, and Social Change: Towards a Normative-Materialistic Conception* ♦ **Rahel Jaeggi**, Humboldt-Universität zu Berlin; Member, School of Social Science

December 5

Crisis and Critique Seminar ♦ *Hospitality* ♦ Session curated by **Anne McNevin**, The New School; **Sophie Wahnich**, Centre National de la Recherche Scientifique and École des Hautes Études en Sciences Sociales, Paris; and **Greta Wagner**, Goethe-Universität Frankfurt; Members, School of Social Science

Crisis and Critique Film Series ♦ *A Touch of Sin*, directed by Jia Zhang-ke; post-screening discussion led by **Rowena Xiaoqing He**, Saint Michael's College, and **Ji Li**, Rutgers Law School; Members, School of Social Science

December 10

Social Science Seminar ♦ *Uncertainty, Crisis, and Negative Relationships* ♦ **Eva Illouz**, Centre de Sociologie Européenne, Paris, and École des Hautes Études en Sciences Sociales, Paris; Member, School of Social Science

January 23

Crisis and Critique Seminar ♦ *Two Views on Social Criticism* ♦ Curated by **Eva Illouz**, Centre de Sociologie Européenne, Paris, and École des Hautes Études en Sciences Sociales, Paris, **Rahel Jaeggi**, Humboldt-Universität zu Berlin, and **Dieter Thomä**, Universität St. Gallen; Members, School of Social Science

January 28

Conversation on the Yellow Vests ♦ Discussion organized by **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science, **Sophie Wahnich**, Centre National de la Recherche Scientifique and École des Hautes Études en Sciences Sociales, Paris; Member, School of Social Science, and **Anne-Claire Defosse**, Visitor, School of Social Science

Social Science Seminar ♦ *Democratizing Disobedience: Outline of a Critical Theory of Protest* ♦ **Robin Celikates**, University of Amsterdam; Member, School of Social Science

February 4

Social Science Seminar ♦ *Islam: Three Genealogies* ♦ **Murad Idris**, University of Virginia; Member, School of Social Science

February 5

Crisis and Critique Film Series ♦ *Snowpiercer*, directed by Bong Joon-Ho; post-screening discussion led by **David Bond**, Bennington College, and **Daniel Aldana Cohen**, University of Pennsylvania; Members, School of Social Science

February 6

Crisis and Critique Seminar ♦ *Legitimation Crisis* ♦ Curated by **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science, and **Axel Honneth**, Goethe-Universität Frankfurt and Columbia University; Distinguished Visiting Professor, School of Social Science

February 11

Social Science Seminar ♦ *In Face of Crisis, Responsibility of Human and Social Sciences: A Detour by Way of the Eighteenth Century and the French Revolution* ♦ **Sophie Wahnich**, Centre National de la Recherche Scientifique and École des Hautes Études en Sciences Sociales, Paris; Member, School of Social Science

February 13

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Denise Brennan**, Georgetown University, and **Michael Kazin**, Georgetown University; Members, School of Social Science

February 25

Social Science Seminar ♦ *Capitalism and Crisis: On the Origins and Rationality of Austerity* ♦ **Clara Elisabetta Mattei**, The New School; Member, School of Social Science

February 27

Crisis and Critique Seminar ♦ *Collective Volume Discussion*

February 28

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Beshara Doumani**, Brown University; Member, School of Social Science

March 4

Social Science Seminar ♦ *Implicated: World-Making and Border Politics* ♦ **Anne McNevin**, The New School; Member, School of Social Science

March 6

Crisis and Critique Seminar ♦ *Moral Economy* ♦ Curated by **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science

Crisis and Critique Film Series ♦ *Fire at Sea*, directed by Gianfranco Rosi; post-screening discussion led by **Anne McNevin**, The New School, and **Greta Wagner**, Goethe-Universität Frankfurt; Members, School of Social Science

March 11

Social Science Seminar ♦ *Aesthetics, Politics, and Revolution in Egypt* ♦ **Jessica Winegar**, Northwestern University; Member, School of Social Science

March 13

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Munira Khayyat**, The American University in Cairo; Member, School of Social Science

March 18

Social Science Seminar ♦ *Viral Populism: Antisemitism, Islamophobia, and the Refugee Crisis* ♦ **Dorian Bell**, University of California, Santa Cruz; Member, School of Social Science

March 20

Crisis and Critique Seminar ♦ *Black Radicalism* ♦ Curated by **Robin Celikates**, University of Amsterdam, **Hae Yeon Choo**, University of Toronto, **Anne McNevin**, The New School, and **Jessica Winegar**, Northwestern University; Members, School of Social Science

March 25

Social Science Seminar ♦ *Giving Society a Form: Authoritarian Traces, Neoliberal Threads, and the Force of Concepts* ♦ **Rodrigo Cordero**, Universidad Diego Portales, Santiago; Member, School of Social Science

March 27

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Chitralekha Dhamija**, Jawaharlal Nehru University; Visitor, School of Social Science

April 1

Social Science Seminar ♦ *"Look at the Stones": Towards a Modern History of the Palestinians* ♦ **Beshara Doumani**, Brown University; Member, School of Social Science

April 3

Crisis and Critique Film Series ♦ *Timbuktu*, directed by Abderrahmane Sissako; post-screening discussion led by **Andreas Eckert**, Humboldt-Universität zu Berlin; Member, School of Social Science

April 8

Social Science Seminar ♦ *Follow the Carbon: Climate Change and Inequality in the Twenty-First-Century City* ♦ **Daniel Aldana Cohen**, University of Pennsylvania; Member, School of Social Science

April 9

Crisis and Critique Seminar ♦ *Black Radicalism* ♦ **Charles W. Mills**, The Graduate Center, The City University of New York

April 10

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **David Bond**, Bennington College; Member, School of Social Science

April 15

Social Science Seminar ♦ *China since Tiananmen: History, Memory, and Nationalism* ♦ **Rowena Xiaoqing He**, Saint Michael's College; Member, School of Social Science

April 18

Crisis and Critique Seminar ♦ *Collective Volume Discussion*

April 22

Social Science Seminar ♦ *Helping Refugees: The Moral Economy of Volunteers in Rural Germany* ♦ **Greta Wagner**, Goethe-Universität Frankfurt; Member, School of Social Science

April 24

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Rodrigo Cordero**, Universidad Diego Portales, Santiago; Member, School of Social Science

April 29

Social Science Seminar ♦ *Confronting Carceral State-Making: Undocumented Life in the Era of Mass Deportation* ♦ **Denise Brennan**, Georgetown University; Member, School of Social Science

May 1

Crisis and Critique Seminar ♦ *Collective Volume Discussion*

Crisis and Critique Film Series ♦ *Searching for Lin Zhao's Soul*, directed by Hu Jie ♦ Post-screening discussion led by filmmaker **Hu Jie**

May 6

Social Science Seminar ♦ *The Life of War: Ecologies of Resistance and Survival* ♦ **Munira Khayyat**, The American University in Cairo; Member, School of Social Science

May 8

Colonial Crisis and Anti-colonial Critique ♦ Critical Conversation led by **Hae Yeon Choo**, University of Toronto; Member, School of Social Science

May 13

Social Science Seminar ♦ *An Intellectual and Political History of Urban Poverty in Uruguay (1943–2010): A Global History from a Local Perspective* ♦ **Aldo Marchesi**, Universidad de la República, Uruguay; Member, School of Social Science

May 15

Crisis and Critique Seminar ♦ *Collective Volume Discussion*

May 27–June 1

Summer Program in Social Science Session in Bogotá, Colombia ♦ Organized by **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science, and **Mara Viveros Vigoya**, Universidad Nacional de Colombia

June 3–9

Summer Program in Social Science Session in Johannesburg, South Africa ♦ Organized by **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science, and **Sarah Nuttall**, University of the Witwatersrand

Director's Office

September 24

Member Welcome Reception

September 29

Member Family Barbeque

October 2

Princeton Symphony Orchestra Concert ♦ **Daniel Rowland**, **Maja Bogdanović**

October 10

Impact of the Past Lecture ♦ *Applying History in Real Time: A Tale of Two Crises* ♦ **Niall Ferguson**, Stanford University

October 12

Friends Talk ♦ *Uncovering 80 Years of Research into the Near and Middle East at the Institute for Advanced Study* ♦ **Sabine Schmidtke**, Professor, School of Historical Studies

October 17

Friends Dessert with a Member ♦ *How to Test String Theory* ♦ **Thomas Rudelius**, Member, School of Natural Sciences

October 19

Edward T. Cone Concert Series ♦ **Vox Clamantis Choir**

October 20

Edward T. Cone Concert Series and Talk ♦ **Vox Clamantis Choir**

October 26

Public Lecture ♦ *Genes, Patents, and Race: The History of Science as a Bridge Between Disciplines* ♦ **Myles W. Jackson**, Professor, School of Historical Studies; and **Arnold J. Levine**, Professor Emeritus, School of Natural Sciences

November 2

Impact of the Past Lecture ♦ *Policing the Past: The CIA and the Landscape of Secrecy* ♦ **Richard J. Aldrich**, University of Warwick

November 4

Princeton Symphony Orchestra Concert ♦ **Basia Danilow and Colleagues**

November 9

AMIAS Public Lecture ♦ *Jerusalem in Biblical Times: Comments on the Archaeology and History ca. 1350–100 B.C.E.* ♦ **Israel Finkelstein**, Tel Aviv University

November 16

Friends Lunch with a Member ♦ *Our Magnetic Milky Way* ♦ **Susan E. Clark**, Member, School of Natural Sciences

November 30

Edward T. Cone Concert Series ♦ **Zoë Keating**

December 1

Edward T. Cone Concert Series and Talk ♦ **Zoë Keating**

December 6

Friends Breakfast with a Member ♦ *Does Socialism Have a Future in the United States—or Anywhere?* ♦ **Michael Kazin**, Georgetown University; Member, School of Social Science

December 20

Institute Community Holiday Party

January 11

Friends Lunch with a Member ♦ *Deep Learning: A Scientific Perspective* ♦ **Nadav Cohen**, Member, School of Mathematics

February 1

Edward T. Cone Concert Series ♦ **Nicholas Phan**

February 2

Edward T. Cone Concert Series and Talk ♦ **Nicholas Phan**

February 6

Impact of the Past Lecture ♦ *China's Past in its Present and Future: War and the Making of a New Order in Asia, 1937 to the Present* ♦ **Rana Mitter**, University of Oxford

February 8

Friends Talk ♦ *What is Gravitas? The Feminist Quest for Inclusivity in the Arts* ♦ **Judy Brodsky**, Rutgers, the State University of New Jersey; and **Ferris Olin**, Rutgers, the State University of New Jersey

February 22

Friends Lunch with a Member ♦ *Reading Ibn Tufayl in the Modern Middle East: Philosophy, Colonialism, and Political Fantasies* ♦ **Murad Idris**, University of Virginia; Member, School of Social Science

Public Workshop ♦ *Deep Learning: Alchemy or Science?* ♦ **Michael Collins**, Columbia University; **Yann LeCun**, New York University; **Joelle Pineau**, McGill University; **Zachary Lipton**, Carnegie Mellon University; and **Shai Shalev-Shwartz**, Hebrew University of Jerusalem

March 8

Edward T. Cone Concert Series ♦ **Paul Lazar and Sandbox Percussion**

March 9

Edward T. Cone Concert Series and Talk ♦ **Paul Lazar and Sandbox Percussion**

March 14

IAS Einstein Gala

March 15

Friends Lunch with a Member ♦ *Landscapes of St. Gregory: Toward an Ecoarthistory of Medieval Italy* ♦ **Alison Locke Perchuk**, The California State University, Channel Islands; Member, School of Historical Studies

March 17

Princeton Symphony Orchestra Concert ♦ **Verona Quartet**

March 19

Reception for Karen Uhlenbeck in Honor of Her Abel Prize

March 20

Friends Talk ♦ *A Party for Which People? The Democrats from Andrew Jackson to Barack Obama and Beyond* ♦ **Michael Kazin**, Georgetown University; Member, School of Social Science

March 27

Impact of the Past Lecture ♦ *Brexit: "Jolly Old Storm Clouds," Britain and Europe, 1919–2019* ♦ **Patricia Clavin**, University of Oxford

April 4

S.T. Lee Public Lecture ♦ *Stalin at War* ♦ **Stephen Kotkin**, Princeton University

April 7

Princeton Symphony Orchestra Concert ♦ **Chamber Music for Winds**

April 12

Friends Lunch with a Member ♦ *Reinterpreting Political Violence in 20th-Century Europe: A Comparative Perspective* ♦ **Julian Casanova**, Universidad de Zaragoza; Member, School of Historical Studies

Author's Talk ♦ *Louisa Hall in Conversation with Pia de Jong—A Portrait of J. Robert Oppenheimer: Icon and Enigma* ♦ **Louisa Hall** and **Pia de Jong**

April 25

A Conversation on the Intersection of Music, Architecture, and Design ♦ **Gustavo Dudamel** and **Frank Gehry**

Member End of Term Party

April 26

Remembering Irving Lavin 1927–2019

May 3

Public Lecture ♦ *Inward Bound: Discovering and Exploring the Milky Way's Black Hole* ♦ **Scott Tremaine**, Richard Black Professor, School of Natural Sciences

May 4

Public Lecture ♦ *The Power of Self-Learning Systems* ♦ **Demis Hassabis**, DeepMind

May 8

Friends Public Lecture ♦ *Critique of Punitive Reason* ♦ **Didier Fassin**, James D. Wolfensohn Professor, School of Social Science

May 15

Friends Talk ♦ *Nuclear Weapons Policy in the Age of Putin and Xi* ♦ **Walter B. Slocombe**, Under Secretary of Defense for Policy (1994–2001)

May 29

Public Workshop ♦ *The Universe Speaks in Numbers* ♦ **Nima Arkani-Hamed**, Professor, School of Natural Sciences; **Kyle Cranmer**, New York University; Junior Visiting Professor, School of Natural Sciences; **Freeman Dyson**, Professor Emeritus, School of Natural Sciences; **Graham Farmelo**, Director's Visitor; **Thomas Lam**, von Neumann Fellow, School of Mathematics; **Gregory Moore**, Rutgers, the State University of New Jersey; **Karen Uhlenbeck**, Visiting Professor, School of Mathematics; **Edward Witten**, Charles Simonyi Professor in the School of Natural Sciences; **Natalie Wolchover**; and **Robbert Dijkgraaf**, Director and Leon Levy Professor.

May 30

Friends Annual Meeting and Picnic

May 31–June 1

Honoring the Life and Work of Jean Bourgain

ACKNOWLEDGMENTS

(for the year ended June 30, 2019)

Each year researchers from around the world come to the Institute for Advanced Study to interact, explore, take risks, share, build, and discover. This is only possible with the vision and support of a worldwide network of philanthropists. We thank our donors for their contributions. In Fiscal Year 2018–19, new commitments to the endowment and IAS Fund totaled more than \$13 million.

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Left: Friends of the Institute for Advanced Study have many opportunities to interact with the Institute's distinguished Faculty and Members, like Alison Perchuk (right), Friends of the Institute for Advanced Study Member in the School of Historical Studies. Center: Charles Simonyi (left) and Robbert Dijkgraaf (right) present Jim Simons (center) with the inaugural IAS Bamberger Medal, which recognizes visionary philanthropy in the spirit of IAS founders Louis Bamberger and Caroline Bamberger Fuld. Right: The late Professor Irving Lavin (left), who, with his wife Marilyn Aronberg Lavin (right), continues to generously support the Institute through a planned gift.

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[Nancy B. Peretsman](#)

Managing Director
Allen & Company LLC
New York, New York

[Sandra E. Peterson](#)

Operating Partner, Clayton, Dubilier & Rice
Former Group Worldwide Chairman, Johnson
& Johnson
New York, NY

[Jörn Rausing](#)

Non-Executive Director
Tetra Laval Group Board
London, United Kingdom
From May 4, 2019

[Martin Rees](#)

Professor Emeritus of Cosmology
and Astrophysics
Astronomer Royal and Fellow of
Trinity College
University of Cambridge
Cambridge, England

[David M. Rubenstein](#)

Co-Founder and Co-Executive Chairman
The Carlyle Group
Washington, D.C.

[Eric E. Schmidt](#)

Technical Advisor
Alphabet Inc.
Mountain View, California

[Charles Simonyi](#)

Technical Fellow
Microsoft Corporation
Redmond, Washington

[Peter Svennilsson](#)

Founder and Managing Partner
The Column Group
San Francisco, California

[Shirley M. Tilghman](#)

President Emerita
Professor of Molecular Biology and Public
Affairs
Princeton University
Princeton, New Jersey

[Ewine F. van Dishoeck](#)

Professor of Molecular Astrophysics
Leiden University
Leiden, The Netherlands

[Brian F. Wruble](#)

Chairman, New York Board of Trustees,
The Oppenheimer Funds
Chairman Emeritus, The Jackson Laboratory
Key West, Florida
Through May 4, 2019

Trustees Emeriti

[Richard B. Black](#)

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[Michel L. Vaillaud](#)

[Shelby White](#)

[Marina v.N. Whitman](#)

[James D. Wolfensohn](#), *Chair Emeritus*

ADMINISTRATION, 2018–2019

Robbert Dijkgraaf

Director and Leon Levy Professor

Nadine M. S. Thompson

Executive Assistant to the Director
Through November 30, 2018

Carolyn Pritchett

Executive Assistant to the Director
From December 1, 2018

Josephine S. Faass

Director of Academic Affairs
Through May 2, 2019

Janine M. Purcaro

Chief Operating Officer and Associate
Director for Finance and Administration

Mark Baumgartner

Chief Investment Officer

Michael Ciccone

Chief Administrative Operations Officer

William Grip

Chief Facilities Officer

Michael Klompus

Chief Human Resources Officer

Mary Mazza

Comptroller and Chief Fiscal Officer

Michel Reymond

Chef

Elizabeth Boluch Wood

Chief Development Officer and Associate
Director for Development and
Communications

Mary Boyajian

Senior Director of Principal and Planned Giving

Karla Cosgriff

Director of Annual Giving

Kelly Devine Thomas

Director of Editorial and Content Strategy

Pamela Hughes

Director of Friends and Stewardship Programs

Susan Olson

Director of Events

Maurie Perl

Senior Director of External Relations and
Strategic Communications

Library Administration

Emma Moore

Librarian, Mathematics and Natural Sciences

Marcia Tucker

Librarian, Historical Studies and Social
Science (also Coordinator of Information
Access for Computing, Telecommunications,
and Networking Administration)

Casey Westerman

Archivist
Through March 7, 2019

School Administration

Nicole Maldonado

Administrative Officer
School of Mathematics

Donne Petito

Administrative Officer
School of Social Science

Michelle Sage

Administrative Officer
School of Natural Sciences

Suzanne P. Christen

Executive Director and Administrator
The Simons Center for Systems Biology
School of Natural Sciences

Marian Gallagher Zelazny

Administrative Officer
School of Historical Studies
Through June 3, 2019

Programs

Beth Brainard

Program Officer
IAS/Park City Mathematics Institute
Through March 31, 2019

Dena Vigil

Program Officer
IAS/Park City Mathematics Institute
From April 1, 2019

Arlen K. Hastings

Director of External Projects

Michelle Huguenin

Administrative Program Manager
Women and Mathematics

David Lang

Artist-in-Residence

Rafe Mazzeo

Director
IAS/Park City Mathematics Institute

Margaret Readdy

Academic Program Manager
Women and Mathematics

Computing, Telecommunications, and Networking Administration

Jeffrey Berliner

Chief Information Officer

Brian Epstein

Computer Manager
Network and Security

Kevin Kelly

Computer Manager
School of Mathematics

Jonathan Peele

Computer Manager
Information Technology Group

James Stephens

Computer Manager
School of Natural Sciences

Edna Wigderson

Manager of Databases and Integration

PRESENT AND PAST DIRECTORS

(in order of service as of June 30, 2019)

Abraham Flexner · Frank Aydelotte
J. Robert Oppenheimer · Carl Kaysen · Harry Woolf
Marvin L. Goldberger · Phillip A. Griffiths · Peter Goddard · Robbert Dijkgraaf

PRESENT AND PAST FACULTY

(2018–19 Faculty and Faculty Emeriti are in black)

Stephen L. Adler · James W. Alexander · Andrew E. Z. Alföldi · Danielle Allen
Nima Arkani-Hamed · Michael F. Atiyah · John N. Bahcall · Arne K. A. Beurling · Yve-Alain Bois
Enrico Bombieri · Armand Borel · Jean Bourgain · Glen W. Bowersock
Caroline Walker Bynum · Luis A. Caffarelli · Angelos Chaniotis · Harold F. Cherniss · Marshall Clagett
Giles Constable · Patricia Crone · José Cutileiro · Roger F. Dashen · Camillo De Lellis · Pierre Deligne
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Didier Fassin · Patrick J. Geary · Clifford Geertz · Felix Gilbert · James F. Gilliam · Peter Goddard
Kurt Gödel · Hetty Goldman · Peter Goldreich · Oleg Grabar · Phillip A. Griffiths · Christian Habicht
Harish-Chandra · Jonathan Haslam · Ernst Herzfeld · Albert O. Hirschman · Helmut Hofer · Lars V. Hörmander
Piet Hut · Jonathan Israel · Myles W. Jackson · Ernst H. Kantorowicz · George F. Kennan · Robert P. Langlands
Irving Lavin · Tsung-Dao Lee · Stanislas Leibler · Arnold J. Levine · Elias A. Lowe · Robert MacPherson
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Benjamin D. Meritt · John W. Milnor · David Mitrany · Deane Montgomery · Marston Morse
J. Robert Oppenheimer · Abraham Pais · Erwin Panofsky · Peter Paret · Tullio E. Regge
Winfield W. Riefler · Dani Rodrik · Marshall N. Rosenbluth · Peter Sarnak · Sabine Schmidtke
Joan Wallach Scott · Nathan Seiberg · Atle Selberg · Kenneth M. Setton · Carl L. Siegel · Thomas Spencer
Walter W. Stewart · Bengt G. D. Strömberg · Richard Taylor · Homer A. Thompson · Scott Tremaine
Francesca Trivellato · Kirk Varnedoe · Oswald Veblen · Akshay Venkatesh · Vladimir Voevodsky
John von Neumann · Heinrich von Staden · Michael Walzer · Robert B. Warren · André Weil · Hermann Weyl
Morton White · Hassler Whitney · Avi Wigderson · Frank Wilczek · Edward Witten
Ernest Llewellyn Woodward · Chen Ning Yang · Shing-Tung Yau · Matias Zaldarriaga

Institute for Advanced Study—
Louis Bamberger and Mrs. Felix Fuld Foundation

Financial Statements
June 30, 2019 and 2018

(With Independent Auditors' Report Thereon)

Independent Auditors' Report

The Board of Trustees

Institute for Advanced Study—Louis Bamberger and Mrs. Felix Fuld Foundation:

We have audited the accompanying financial statements of the Institute for Advanced Study—Louis Bamberger and Mrs. Felix Fuld Foundation, which comprise the statements of financial position as of June 30, 2019 and 2018, and the related statements of activities and cash flows for the years then ended, and the related notes to the financial statements.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with U.S. generally accepted accounting principles; this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility

Our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of the Institute for Advanced Study—Louis Bamberger and Mrs. Felix Fuld Foundation as of June 30, 2019 and 2018, and the changes in its net assets and its cash flows for the years then ended, in accordance with U.S. generally accepted accounting principles.

Emphasis of Matter

As discussed in Note 1(b)(xv) to the financial statements, the Institute for Advanced Study—Louis Bamberger and Mrs. Felix Fuld Foundation adopted Accounting Standards Update 2016-14, *Not-for-Profit Entities (Topic 958): Presentation of Financial Statements of Not-for-Profit Entities*, during the year ended June 30, 2019. Our opinion is not modified with respect to this matter.

KPMG LLP

October 28, 2019

STATEMENTS OF FINANCIAL POSITION
JUNE 30, 2019 AND 2018

Assets	2019	2018
Cash and cash equivalents	\$ 5,129,094	2,046,757
Accounts receivable and other assets	2,958,222	3,457,752
Grants receivable	2,406,574	2,092,063
Contributions receivable, net	15,951,133	24,106,193
Mortgages receivable	5,806,101	5,407,378
Funds held by bond trustee	872,355	852,322
Beneficial interest in remainder trust	1,968	1,066,466
Land, buildings and improvements, equipment, and rare book collection, net	130,257,646	122,170,708
Investments	790,125,348	809,182,814
Total assets	<u>\$ 953,508,441</u>	<u>970,382,453</u>
Liabilities and Net Assets		
Liabilities:		
Accounts payable and accrued expenses	\$ 9,433,853	10,949,189
Deferred revenue	7,353,781	9,522,988
Liabilities under split-interest agreements	1,516,049	1,819,942
Postretirement benefit obligation	19,584,782	18,308,952
Asset retirement obligation	1,172,363	1,142,036
Bond swap liability	2,788,944	2,316,450
Long-term debt, net	88,020,789	92,039,675
Total liabilities	<u>129,870,561</u>	<u>136,099,232</u>
Net assets:		
Net assets without donor restrictions:		
Undesignated	223,454,839	235,900,368
Designated for specific purposes	132,573,325	131,472,898
Total net assets without donor restrictions	<u>356,028,164</u>	<u>367,373,266</u>
Net assets with donor restrictions:		
Purpose restricted	208,663,563	213,273,544
Endowment fund corpus	258,946,153	253,636,411
Total net assets with donor restrictions	<u>467,609,716</u>	<u>466,909,955</u>
Total net assets	<u>823,637,880</u>	<u>834,283,221</u>
Total liabilities and net assets	<u>\$ 953,508,441</u>	<u>970,382,453</u>

See accompanying notes to financial statements.

STATEMENT OF ACTIVITIES
YEAR ENDED JUNE 30, 2019

	Without donor restrictions	With donor restrictions	Total
Operating revenues, gains, and other support:			
Private contributions and grants	\$ 52,000	19,897,538	19,949,538
Government grants	—	6,563,183	6,563,183
Investment income, net	14,644,933	17,452,485	32,097,418
Auxiliary activity	4,402,459	—	4,402,459
Net assets released from restrictions— satisfaction of program restrictions	43,213,445	(43,213,445)	—
Total operating revenues, gains, and other support	62,312,837	699,761	63,012,598
Operating expenses:			
School of Mathematics	11,266,618	—	11,266,618
School of Natural Sciences	12,163,326	—	12,163,326
School of Historical Studies	9,787,655	—	9,787,655
School of Social Science	3,703,414	—	3,703,414
Libraries and other academic	6,241,792	—	6,241,792
Administration and general	18,591,030	—	18,591,030
Auxiliary activity	10,696,058	—	10,696,058
Total operating expenses	72,449,893	—	72,449,893
Change in net assets from operating activities	(10,137,056)	699,761	(9,437,295)
Nonoperating activities:			
Change in fair value of bond swap liability	(472,494)	—	(472,494)
Gain on sale of plant assets	(259,957)	—	(259,957)
Other components of net periodic pension cost	(475,595)	—	(475,595)
Total nonoperating activities	(1,208,046)	—	(1,208,046)
Change in net assets	(11,345,102)	699,761	(10,645,341)
Net assets—beginning of year	367,373,266	466,909,955	834,283,221
Net assets—end of year	\$ 356,028,164	467,609,716	823,637,880

See accompanying notes to financial statements.

STATEMENT OF ACTIVITIES
YEAR ENDED JUNE 30, 2018

	Without donor restrictions	With donor restrictions	Total
Operating revenues, gains, and other support:			
Private contributions and grants	\$ 91,245	37,489,668	37,580,913
Government grants	—	6,770,907	6,770,907
Investment income, net	26,719,615	30,223,024	56,942,639
Auxiliary activity	5,789,947	—	5,789,947
Net assets released from restrictions— satisfaction of program restrictions	38,589,054	(38,589,054)	—
Total operating revenues, gains, and other support	71,189,861	35,894,545	107,084,406
Operating expenses:			
School of Mathematics	11,899,313	—	11,899,313
School of Natural Sciences	11,707,757	—	11,707,757
School of Historical Studies	8,278,431	—	8,278,431
School of Social Science	3,737,858	—	3,737,858
Libraries and other academic	6,408,272	—	6,408,272
Administration and general	16,684,044	—	16,684,044
Auxiliary activity	9,963,625	—	9,963,625
Total operating expenses	68,679,300	—	68,679,300
Change in net assets from operating activities	2,510,561	35,894,545	38,405,106
Nonoperating activities:			
Change in fair value of bond swap liability	1,130,869	—	1,130,869
Gain on sale of plant assets	2,518,055	—	2,518,055
Other components of net periodic pension cost	323,192	—	323,192
Total nonoperating activities	3,972,116	—	3,972,116
Change in net assets	6,482,677	35,894,545	42,377,222
Net assets—beginning of year	360,890,589	431,015,410	791,905,999
Net assets—end of year	\$ 367,373,266	466,909,955	834,283,221

See accompanying notes to financial statements.

STATEMENTS OF CASH FLOWS
YEARS ENDED JUNE 30, 2019 AND 2018

	2019	2018
Cash flows from operating activities:		
Change in net assets	\$ (10,645,341)	42,377,222
Adjustments to reconcile change in net assets to net cash used in operating activities:		
Depreciation	6,528,737	5,769,778
Contributions restricted for endowment and plant	(11,281,481)	(9,761,994)
Net appreciation on investments	(34,259,323)	(59,732,183)
Change in fair value of bond swap liability	472,494	(1,130,869)
Gain on sale of plant assets	(259,957)	(2,518,055)
Amortization of debt issuance costs	62,253	60,729
Amortization of bond discount	23,861	26,693
Changes in assets/liabilities:		
Receivables and other assets	(213,704)	382,550
Contributions receivable	8,155,060	(17,428,206)
Beneficial interest in remainder trust	1,064,498	(5,063)
Accounts payable and accrued expenses	(1,515,336)	(456,867)
Deferred revenue	(2,169,207)	(94,066)
Postretirement benefit obligation	1,275,830	476,309
Asset retirement obligation	30,327	25,922
Net cash used in operating activities	(42,731,289)	(42,008,100)
Cash flows from investing activities:		
Proceeds from sale of plant assets	973,386	3,453,425
Purchase of plant assets	(15,329,104)	(26,324,852)
Proceeds from sale of investments	258,562,949	312,370,302
Purchase of investments	(205,246,160)	(284,301,248)
Net cash provided by investing activities	38,961,071	5,197,627
Cash flows from financing activities:		
Contributions restricted for endowment and plant	11,281,481	14,761,994
Decrease in liabilities under split-interest agreements	(303,893)	(80,324)
Proceeds from issuance of long-term debt	—	24,724,503
Principal payments on long-term debt	(4,105,000)	(3,160,000)
(Increase) decrease in funds held by bond trustee	(20,033)	1,605,148
Net cash provided by financing activities	6,852,555	37,851,321
Net increase in cash and cash equivalents	3,082,337	1,040,848
Cash, cash equivalents—beginning of year	2,046,757	1,005,909
Cash, cash equivalents—end of year	\$ 5,129,094	2,046,757
Supplemental data:		
Interest paid	\$ 3,271,097	3,006,937

See accompanying notes to financial statements.

NOTES TO FINANCIAL STATEMENTS
JUNE 30, 2019 AND 2018

(1) **Organization and Summary of Significant Accounting Policies**

(a) ***Organization***

The Institute for Advanced Study—Louis Bamberger and Mrs. Felix Fuld Foundation (the Institute), an independent, private institution devoted to the encouragement, support, and patronage of learning, was founded in 1930 as a community of scholars where intellectual inquiry could be carried out in the most favorable circumstances.

Focused on mathematics and classical studies at the outset, the Institute today consists of the School of Historical Studies, the School of Mathematics, the School of Natural Sciences, and the School of Social Science. Each school has a small permanent faculty, and some 190 fellowships are awarded annually to members visiting the Institute from other research institutions and universities throughout the world.

The Founders' original letter to the first trustees described the objectives of the Institute as follows: "The primary purpose is the pursuit of advanced learning and exploration in fields of pure science and high scholarship to the utmost degree that the facilities of the institution and the ability of the faculty and students will permit."

(b) ***Summary of Significant Accounting Policies***

Basis of Presentation

The accompanying financial statements, which are presented on the accrual basis of accounting, have been prepared to focus on the Institute as a whole and to present net assets and revenues, expenses, gains, and losses based on the existence or absence of donor-imposed restrictions. Accordingly, net assets and changes therein are classified as follows:

- Without Donor Restrictions—Net assets not subject to donor-imposed stipulations. Net assets without donor restrictions may be designated for specific purposes by action of the Board of Trustees.
- With Donor Restrictions—Net assets subject to donor-imposed restrictions that will be met either by actions of the Institute or the passage of time. Also included in this category are net assets subject to donor-imposed restrictions to be maintained permanently by the Institute, including gifts and pledges wherein donors stipulate that the corpus of the gift be held in perpetuity and that only the income be made available for specific purposes. Other restricted items in this net asset category include annuity and life income gifts for which the ultimate purpose of the proceeds is subject to donor-imposed restrictions.

Revenues are reported as increases in net assets without donor restrictions unless use of the related asset is limited by donor-imposed restrictions. Expenses are reported as decreases in net assets without donor restrictions. Expiration of donor-imposed restrictions that simultaneously increase net assets without donor restrictions and decrease net assets with donor restrictions are reported as net assets released from restrictions.

In the statements of activities, the Institute includes in operations all revenue and expenses that are an integral part of its program and supporting activities. Change in the fair value of bond swap liability, gain on sale of plant assets and other components of net periodic pension cost are recognized as nonoperating activities.

(i) ***Cash and Cash Equivalents***

Cash and cash equivalents consist of cash on hand and all highly liquid investments with an original maturity of three months or less, except for those managed as a component of the Institute's investment portfolio.

(ii) ***Mortgages Receivable***

The Institute regularly offers first mortgages on primary residences to full-time faculty and senior administrative employees who have met certain requirements stipulated by the Board of Trustees.

(iii) ***Investments***

Investments in marketable securities are reported in the financial statements at fair value based on published market quotations. Investments in limited partnerships and hedge funds are reported in the financial statements at estimated fair value using net asset value (NAV) or its equivalent as a practical expedient, based upon values provided by external investment managers or general partners, unless it is probable that all or a portion of the

investment will be sold for an amount different from NAV. The Institute reviews and evaluates the values provided by external investment managers and general partners and agrees with the valuation methods and assumptions used in determining the fair value of funds. These estimated fair values may differ significantly from the values that would have been used had a ready market for these securities existed. As of June 30, 2019 and 2018, the Institute had no plans or intentions to sell investments at amounts different from NAV.

The statements of activities recognize unrealized gains and losses on investments as increases and decreases, respectively, in net assets without donor restrictions unless their use restricted by explicit donor stipulation or law. Gains and losses on the sale of investment securities are calculated using the specific-identification method.

(iv) Fair Value Measurements

Fair value is defined as the exchange price that would be received for an asset or paid to transfer a liability (an exit price) in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants on the measurement date. The fair value hierarchy requires an entity to maximize the use of observable inputs and minimize the use of unobservable inputs when measuring fair value. A financial instrument's level within the fair value hierarchy is based on the lowest level of any input that is significant to the fair value measurement. The three levels of inputs used to measure fair value are as follows:

- Level 1: Quoted prices in active markets for identical assets or liabilities
- Level 2: Observable inputs other than Level 1 prices, such as quoted prices for similar assets or liabilities, quoted prices in markets that are not active, or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the assets or liabilities
- Level 3: Unobservable inputs that are supported by little or no market activity and that are significant to the fair value of the asset or liabilities.

Fair value estimates are made at a specific point in time based on available market information and judgments about the financial asset, including estimates of timing, amount of expected future cash flows, and the credit standing of the issuer. In some cases, the fair value estimates cannot be substantiated by comparison to independent markets. In addition, the disclosed fair value may not be realized in the immediate settlement of the financial asset and does not reflect any premium or discount that could result from offering for sale at one time an entire holding of a particular financial asset. Potential taxes and other expenses that would be incurred in an actual sale or settlement are not reflected in amounts disclosed.

NAV is used as a practical expedient for certain commingled funds, privately held investments, and securities held in partnership format for which a readily determinable fair value is not available, unless the Institute believes such NAV calculation is not measured in accordance with fair value. These values may differ significantly from values that would have been used had a readily available market existed for such investments, and that difference could be material to the change in net assets of the Institute.

(v) Plant Assets and Depreciation

Proceeds from the sale of plant assets, if there are no donor-imposed restrictions, are transferred to operating funds or, if subject to donor-imposed restrictions, to amounts with donor restrictions for plant acquisitions. Depreciation is provided over the estimated useful lives of the respective assets on a straight-line basis (buildings and capital improvements 20–40 years, equipment 3–6 years).

(vi) Split-Interest Agreements

The Institute is the beneficiary of various unitrusts, a pooled income fund, and a gift annuity fund. The Institute's interest in these split-interest agreements is reported as a contribution in the year received and is calculated as the difference between the fair value of the assets contributed to the Institute and the estimated liability to the beneficiary. This liability is computed using actuarially determined rates and is adjusted annually to reflect changes in the life expectancy of the donor or annuitant, amortization of the discount, and other changes in the estimates of future payments. The assets held by the Institute under these arrangements are recorded at fair value as determined by quoted market prices and are included as a component of investments.

(vii) Unamortized Debt Issuance Costs

Debt issuance costs represent costs incurred in connection with debt financing. Amortization of these costs is provided on the effective interest method extending over the remaining term of the applicable indebtedness.

(viii) Asset Retirement Obligation

The Institute recognizes the fair value of a liability for legal obligations associated with asset retirements in

the period in which the obligation is incurred if a reasonable estimate of the fair value of the obligation can be made. When the liability is initially recorded, the Institute capitalizes the cost of the asset retirement obligation by increasing the carrying amount of the related long-lived asset. The liability is accreted to its present value each period and the capitalized cost associated with the retirement obligation is depreciated over the useful life of the related asset. Upon settlement of the obligation, any difference between the cost to settle the asset retirement obligation and the liability recorded is recognized as a gain or loss in the statements of activities.

(ix) Contributions

Contributions, including unconditional promises to give, are recognized initially at fair value as revenues in the period received. Conditional promises to give are not recognized until they become unconditional, that is when the conditions on which they depend are met. Contributions of assets other than cash are recorded at their estimated fair value. Pledges of contributions to be received after one year are discounted at a risk-adjusted discount rate. The discount rates range from 1.74% to 2.81%. Amortization of discount is recorded as additional contribution revenue in accordance with donor-imposed restrictions, if any, on the contributions. The inputs to the fair value estimate are considered Level 3 in the fair value hierarchy.

Contributions of long-lived assets are reported as unconditional contribution revenue. Contributions restricted for the acquisition of grounds, buildings, and equipment are reported as revenue with donor restrictions. These contributions are reclassified to net assets without donor restrictions when the associated long-lived asset is placed in service.

Included in contributions are gifts from members of the Board of Trustees which are received in the normal course of business.

(x) Grants

The Institute receives grants from a number of sources including corporations, foundations and governmental agencies. Grants are evaluated as to whether they qualify as contributions or exchange transactions as defined by U.S. GAAP and to determine if there are any donor restrictions.

Based on the Institute's review of grants received, the granting agency does not receive commensurate value for the grant and therefore grant income is considered a voluntary, nonreciprocal transaction that meets the definition of a contribution. Each grant also has one or more barriers, which must be overcome which therefore categorize them as conditional contributions for the Institute. Grant revenue with donor imposed conditions is recorded initially as deferred revenue (if the funds are received in advance) and is reported as revenue as the conditions are satisfied. At the same time, the Institute records net assets released from restrictions to match the expenses incurred in satisfying the donor restrictions.

(xi) Auxiliary Activity

The Institute receives income and incurs expenses relating to the operations of a dining services facility and a housing complex on campus for the use by our community of scholars. The income and expenses are displayed on the statement of activities as Auxiliary Activity.

The revenue streams include income from the sale of food and beverages, rental income, laundry income and pet registration fees. These revenue streams, except for rental income, are recognized at the point in time in which the service is provided. Rental income is recognized over a period of time since the tenants are simultaneously receiving and consuming the benefit of the service provided. Auxiliary income is recognized in the fiscal year in which the service is delivered.

(xii) Functional Allocation of Expenses

The costs of providing program services and support services of the Institute have been summarized on a functional basis in the statements of activities. These costs include direct and indirect costs that have been allocated, on a consistent basis, among the programs and administrative expenses. Natural expenses are accounted for on a direct cost basis to the school or department upon which the expenses is incurred.

There are certain indirect costs that cannot be charged on a direct basis. The Institute allocates these costs (academic building expenses including costs to maintain the academic buildings, interest and depreciation) to the schools and supporting departments reported in the accompanying statement of activities on a square footage basis. Note 10 shows the relationship between the functional and natural classifications of expenses.

Fundraising expenses incurred by the Institute amounted to \$3,131,077 and \$1,958,071 for the years ended June 30, 2019 and 2018, respectively. This amount is included in administration and general expenses in the accompanying statements of activities.

(xiii) Tax Status

The Institute is exempt from federal income taxes pursuant to Section 501(c)(3) of the Internal Revenue Code (the Code) and is listed in the Internal Revenue Service Publication 78. The Institute has been classified as a public charity under Section 509(a) of the Code.

There are certain transactions that could be deemed unrelated business income and would result in a tax liability. Management reviews transactions to estimate potential tax liabilities using a threshold of more likely than not. It is management's estimation that there are no material tax liabilities that need to be recorded.

(xiv) Use of Estimates

The preparation of financial statements in conformity with U.S. generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements. Estimates also affect the reported amounts of revenues and expenses during the reported period. Actual results could differ from those estimates.

(xv) New Accounting Standards Adopted

In fiscal year 2019, the Institute adopted the provisions of the applicable Accounting Standards Updates (ASU), as follows;

ASU 2014-09, *Revenue from Contracts with Customers (Topic 606)*: This ASU requires that "an entity recognize revenue to depict the transfer of promised goods or services to customers in an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services," which replaces most existing revenue recognition guidance in U.S. GAAP. The Institute performed an analysis of the provisions of the ASU and concluded that the adoption of this ASU did not significantly impact the Institute's financial statements.

ASU 2016-14, *Not-for-Profit Entities (Topic 958): Presentation of Financial Statements of Not-for-Profit Entities*. This guidance which is intended to improve the net asset classification requirements and the information presented in the financial statements and notes about a not-for-profit entity's liquidity, financial performance, and cash flows. The Institute adopted the main provisions of this guidance which includes (1) Presentation of two classes of net assets rather than the previously required three. Net assets without donor restrictions, previously reported as unrestricted net assets of \$367,373,266, and net assets with donor restrictions, previously reported as temporarily restricted net assets of \$211,062,206 and permanently restricted net assets of \$255,847,749, in 2018; (2) Recognition of capital gifts for construction as a net asset without donor restrictions when the associated long-lived asset is placed in service, and (3) Recognition of underwater funds as a reduction in net assets with donor restrictions. This guidance also enhances disclosures for board designated amounts, composition of net asset without donor restrictions, liquidity (note 3), and requires the reporting of expenses by both natural and functional classification (note 10).

ASU 2017-07, *Compensation-Retirement Benefits (Topic 715): Improving the Presentation of Net Periodic Cost and Net Periodic Postretirement Benefit Cost*. This ASU requires the Institute to present the service cost component of net periodic benefit cost in the line items where compensation is reported. All other cost components of net periodic benefit cost are presented on the statement of activities outside of operating income. The Institute applied these changes retrospectively.

ASU 2018-08, *Not-for-Profit Entities (Topic 958): Clarifying the Scope and the Accounting Guidance for Contributions Received and Contributions Made*. This ASU clarifies (1) whether transactions should be accounted for as contributions (nonreciprocal transactions) within the scope of Topic 958, *Not-for-Profit Entities*, or as exchange (reciprocal) transactions subject to other guidance and (2) determining whether a contribution is conditional. The Institute performed an analysis of the provisions of this ASU and concluded that the adoption of this ASU did not significantly impact the Institute's financial statements.

(xvi) Reclassifications

Certain reclassifications have been made to prior year amounts to conform with the current year presentation and as a result of the adoption of the new accounting standards.

(xvii) Future Accounting Standards

The FASB issued ASU 2016-02, *Leases (Topic 842)*: which requires all lessees to recognize all leases, including operating leases, on-balance sheet via a right of use asset and lease liability, unless the lease is a short term lease. The Institute is currently evaluating the impact of this ASU and plans to adopt ASU 2016-02 for the year ending June 30, 2020.

The FASB issued ASU 2016-15, *Statement of Cash Flows (Topic 230): Classification of Certain Cash Receipts and Cash Payments*, which changes how not-for-profit entities report specific cash flow issues. The significant requirements of the future ASU relate to (1) debt prepayment or extinguishment costs, (2) proceeds from the settlement of insurance claims, and (3) distributions received from equity method investees. The Institute is currently evaluating the impact of this ASU and plans to adopt ASU 2016-15 for the year ending June 30, 2020.

The FASB issued ASU 2016-18, *Statement of Cash Flows: Restricted Cash*, which requires that the statement of cash flows explains the change in the total of cash, cash equivalents and amounts generally described as restricted cash or restricted cash equivalents for the fiscal year. The Institute is currently evaluating the impact of this ASU and plans to adopt ASU 2016-18 for the year ended June 30, 2020.

(2) Contributions Receivable

Contributions receivable at June 30, 2019 and 2018 were as follows:

	2019	2018
Amounts expected to be collected:		
Less than one year	\$ 5,450,000	10,175,180
One to five years	11,719,901	16,869,901
	17,169,901	27,045,081
Discount for present value (1.74%–2.81%)	(1,218,768)	(2,938,888)
Total	\$ 15,951,133	24,106,193

At June 30, 2019 and 2018, 97% and 78% of gross contributions receivable and 21% and 43% of contributions revenue are from four donors, respectively.

During fiscal year 2011, the Institute received two conditional pledges totaling \$100 million to enhance the Institute's endowment fund. The pledges were conditioned on the Institute raising an additional \$100 million in cash or pledges from third-party donors in the period January 1, 2011 through June 30, 2015, which have been met. The conditional pledge payments began in June 2011 and will continue through June 30, 2022. As of June 30, 2019 and 2018, the Institute has recorded revenue totaling approximately \$100.5 million and \$97.8 million, respectively, relating to these conditional pledges.

(3) Liquidity and Availability of Resources

Resources available to the Institute to fund general expenditures have seasonal variations during the year attributable to a concentration of contributions received at calendar and fiscal year-end and transfers from the endowment. The Institute actively manages its resources to align its cash inflows with anticipated outflows, including approving the endowment draw rate in accordance with policies approved by its Board of Trustees. As further described in note 8, the Institute has lines of credit which may be drawn on, if needed, to manage cash flows.

Financial assets and liquidity resources available within one year for general expenditures, such as operating expenses, scheduled principal and interest payments on debt, and capital constructions costs not financed with debt, at June 30, 2019 and 2018 were as follows:

	2019	2018
Financial assets:		
Cash and cash equivalents	\$ 5,129,094	2,046,757
Accounts receivable due less than 1 year, net	69,949	250,685
Mortgages receivable due less than 1 year, net	561,260	579,277
Contributions receivable due less than 1 year	5,450,000	10,175,180
Endowment appropriated for expenditure—operations	47,557,100	44,626,900
Total financial assets available within one year	58,767,403	57,678,799
Liquidity resources:		
Lines of credit	50,000,000	50,000,000
Total financial assets and liquidity resources available within one year	\$ 108,767,403	107,678,799

(4) Investments, Funds Held by Bond Trustee, and Beneficial Interest in Remainder Trust

(a) Overall Investment Objective

The overall investment objective of the Institute is to invest its assets in a prudent manner that will achieve a long-term rate of return sufficient to fund a portion of its annual operating activities and capital preservation. The Institute diversifies its investments among various managers and investment opportunities. Substantially all of the investments are pooled with each individual fund subscribing to or disposing of units on the basis of the market value per unit, determined on a quarterly basis. Major investment decisions are authorized by the Board's Investment Committee, which oversees the Institute's investment program in accordance with established guidelines.

(b) Allocation of Investment Strategies

The Institute may hold shares or units in traditional institutional funds, traditional stocks and fixed-income securities, as well as in alternative investment funds involving hedged strategies, private equity, and real asset strategies. Hedged strategies involve funds whose managers have the authority to invest in various asset classes at their discretion, including the ability to invest long and short. Funds with hedged strategies generally hold securities or other financial instruments for which a ready market exists and may include stocks, bonds, put or call options, swaps, currency hedges, and other instruments and are valued accordingly. Private equity funds employ buyout and venture capital strategies and focus on investments in turn-around situations. Real asset funds generally hold interests in public real estate investment trusts or commercial real estate through sole-member entities. Private equity and real asset strategies therefore often require the estimation of fair values by the fund managers in the absence of readily determinable market values. Because of the inherent uncertainties of valuation, these estimated fair values may differ significantly from values that would have been used had a ready market existed, and the differences could be material. Such valuations are determined by fund managers and generally consider variables such as operating results, comparable earnings multiples, projected cash flows, recent sales prices, and other pertinent information and may reflect discounts for the illiquid nature of certain investments held.

The following tables summarize the Institute's investments and other assets at fair value by major category in the fair value hierarchy as of June 30, 2019 and 2018, as well as related strategy, liquidity, and funding commitments:

June 30, 2019					
	Total	Level 1	Level 2	Level 3	Investments at NAV
Investments:					
Long-term investment strategies:					
Hedge funds—onshore:					
Emerging markets	\$ 494,770	—	—	—	494,770
Multiple strategies	45,728,879	—	—	—	45,728,879
Total	46,223,649	—	—	—	46,223,649
Hedge funds—offshore:					
Structured credit	16,218,967	—	—	—	16,218,967
Distressed/high-yield	990,139	—	—	—	990,139
Emerging markets	10,934	—	—	—	10,934
Equities—long bias	17,934,730	—	—	—	17,934,730
Equities—long/short	31,279,081	—	—	—	31,279,081
Fixed income arbitrage	25,040,305	—	—	—	25,040,305
Multiple strategies	194,744,214	—	—	—	194,744,214
Quantitative/CTA	70,983,674	—	—	—	70,983,674
Insurance	35,780,986	—	—	—	35,780,986
Bio tech/healthcare	32,841,186	—	—	—	32,841,186
Discretionary macro	16,280,036	—	—	—	16,280,036
Energy trading	152,313	—	—	—	152,313
Total	\$ 442,256,565	—	—	—	442,256,565
Limited partnerships	216,388,962	—	—	—	216,388,962
Exchange-traded funds	9,882,000	9,882,000	—	—	—
Cash and cash equivalents	71,685,551	71,685,551	—	—	—

June 30, 2019					
	Total	Level 1	Level 2	Level 3	Investments at NAV
Other investments:					
Assets held under split-interest agreements:					
Cash and cash equivalents	\$ 55,761	55,761	—	—	—
Fixed income securities	3,632,860	—	—	3,632,860	—
Total investments	\$ 790,125,348	81,623,312	—	3,632,860	704,869,176
Other assets:					
Beneficial interest in remainder trust	\$ 1,968	1,968	—	—	—
Funds held by bond trustee:					
U.S. government obligations	872,355	—	872,355	—	—
Total other assets	\$ 874,323	1,968	872,355	—	—
June 30, 2018					
	Total	Level 1	Level 2	Level 3	Investments at NAV
Investments:					
Long-term investment strategies:					
Hedge funds—onshore:					
Emerging markets	\$ 525,853	—	—	—	525,853
Multiple strategies	46,377,701	—	—	—	46,377,701
Total	46,903,554	—	—	—	46,903,554
Hedge funds—offshore:					
Structured credit	15,778,348	—	—	—	15,778,348
Distressed/high-yield	1,095,899	—	—	—	1,095,899
Emerging markets	25,332	—	—	—	25,332
Equities—long bias	19,569,096	—	—	—	19,569,096
Equities—long/short	56,970,468	—	—	—	56,970,468
Fixed income arbitrage	23,512,649	—	—	—	23,512,649
Multiple strategies	192,052,446	—	—	—	192,052,446
Quantitative/CTA	88,291,229	—	—	—	88,291,229
Quantitative equity long/short	11,523,826	—	—	—	11,523,826
Insurance	32,702,355	—	—	—	32,702,355
Bio tech/healthcare	30,308,671	—	—	—	30,308,671
Discretionary macro	18,065,459	—	—	—	18,065,459
Energy trading	1,016,895	—	—	—	1,016,895
Total	\$ 490,912,673	—	—	—	490,912,673
Limited partnerships	196,847,254	—	—	—	196,847,254
Cash and cash equivalents	70,648,379	70,648,379	—	—	—

June 30, 2018					
	Total	Level 1	Level 2	Level 3	Investments at NAV
Other investments:					
Assets held under split-interest agreements:					
Cash and cash equivalents \$	73,647	73,647	—	—	—
Fixed income securities	3,797,307	—	—	3,797,307	—
Total investments	\$ 809,182,814	70,722,026	—	3,797,307	734,663,481
Other assets:					
Beneficial interest in remainder trust	\$ 1,066,466	—	—	1,066,466	—
Funds held by bond trustee:					
U.S. government obligations	852,322	—	852,322	—	—
Total other assets	\$ 1,918,788	—	852,322	1,066,466	—

The following tables present the Institute's activities for the years ended June 30, 2019 and 2018 for investments classified in Level 3:

2019			
Level 3 roll forward	Assets held under split-interest agreement	Beneficial interest in remainder trust	Total
	Fixed income securities		
Fair value at June 30, 2018	\$ 3,797,307	1,066,466	4,863,773
Dispositions	(267,729)	(1,025,173)	(1,292,902)
Net appreciation (realized and unrealized)	103,282	(41,293)	61,989
Fair value at June 30, 2019	\$ 3,632,860	—	3,632,860

2018			
Level 3 roll forward	Assets held under split-interest agreement	Beneficial interest in remainder trust	Total
	Fixed income securities		
Fair value at June 30, 2017	\$ 3,748,875	1,061,403	4,810,278
Dispositions	(276,218)	—	(276,218)
Net appreciation (realized and unrealized)	324,650	5,063	329,713
Fair value at June 30, 2018	\$ 3,797,307	1,066,466	4,863,773

The Institute's accounting policy is to recognize transfers between levels of the fair value hierarchy on the date of the event or change in circumstances that caused the transfer. There were no transfers between investments classified as Level 1 and Level 2 for the years ended June 30, 2019 or 2018. For the year ended June 30, 2019, the beneficial interest in remainder trust investment transferred out of Level 3 and into Level 1. There were no transfers in or out of investments classified as Level 3 for the years ended June 30, 2018.

Private equity and venture capital investments are generally made through limited partnerships. Under the terms of such agreements, the Institute may be required to provide additional funding when capital or liquidity calls are made by fund managers. These partnerships have a limited existence, and they may provide for annual extensions for the purpose of disposing portfolio positions and returning capital to investors. However, depending on market conditions, the inability to execute the fund's strategy or other factors, a manager may extend the terms of a fund beyond its originally anticipated existence or may wind the fund down prematurely. The Institute cannot anticipate such changes because they generally arise from unforeseeable events, but should they occur, they could reduce liquidity or originally anticipated investment returns. Accordingly, the timing and amount of future capital or liquidity calls in any particular future year are uncertain. As of June 30, 2019, the Institute is obligated under certain limited partnership agreements to advance additional funding in the amount of \$126,688,129, which is anticipated to be called over the next 10 years.

Investment liquidity as of June 30, 2019 is aggregated below based on redemption or sale period:

	Investment fair values
Investment redemption or sale period:	
Daily	\$ 71,685,551
Monthly	85,237,588
Quarterly	105,189,114
Semiannually	70,370,603
Annually	84,932,156
Subject to rolling lock ups or other restrictions	149,380,261
Illiquid	223,330,075
	<hr/>
Total as of June 30, 2019	\$ 790,125,348
	<hr/> <hr/>

(c) Funds Held by Bond Trustee

Funds held by bond trustee represent funds held for debt service payments to be made for the various bond indentures. These funds are being held in trust by U.S. Bank.

(d) Redemption Restrictions—Hedge Funds

At June 30, 2019, the Institute had hedge fund investments of approximately \$488,480,000, of which approximately \$67,692,350 was restricted from redemption for lock-up periods. At June 30, 2018, the Institute had hedge fund investments of approximately \$537,816,000, of which approximately \$75,963,700 was restricted from redemption for lock-up periods. Some of the investments with redemption restrictions allow early redemption for specified fees. The terms and conditions upon which an investor may redeem an investment vary, usually with the majority requiring 30 to 180 days' notice after the initial lock-up period.

The expirations of redemption lock-up periods are summarized in the table below:

	Amount
Fiscal year:	
2020	\$ 38,966,420
2021	25,473,440
2022 and thereafter	3,252,490
	<hr/>
Total	\$ 67,692,350
	<hr/> <hr/>

(e) **Redemption Restrictions—Limited Partnerships**

At June 30, 2019 and 2018, the Institute had limited partnership investments of approximately \$216,389,000 and \$196,847,300, respectively, which were restricted from redemption for lock-up periods. Some of the investments with redemption restrictions allow early redemption for specified fees. The terms and conditions upon which an investor may redeem an investment vary, usually with the majority requiring 30 to 180 days' notice after the initial lock-up period.

The expirations of redemption lock-up periods are summarized in the table below:

	Amount
Fiscal year:	
2020	\$ 28,738,500
2021	4,008,930
2022	34,636,600
2023	12,122,710
2024	15,542,670
2025 and thereafter	121,339,590
Total	<u>\$ 216,389,000</u>

(5) **Investment Return and Endowment Spending Policy**

Investment return consists of interest, dividends, and realized and unrealized gains and losses on investments. Each year, the Institute includes a portion of its endowment return in its operating budget, with the amount of such planned support determined using its spending policy. The policy of the Institute is to distribute for current spending a percentage of the fair value of pooled investments, which is determined by the Board of Trustees annually. The budgeted spending rate for operating and capital purposes was 6.84% and 6.16% for 2019 and 2018, respectively. The actual spending rate for operating and capital purposes was 5.96% and 5.75% for 2019 and 2018, respectively.

The following tables summarize the investment return and its classification in the statements of activities for the years ended June 30, 2019 and 2018:

	2019		
	Without donor restrictions	With donor restrictions	Total
Investment income, net of investment expenses	\$ (791,049)	(1,370,856)	(2,161,905)
Net appreciation (realized and unrealized)	15,435,982	18,823,341	34,259,323
	<u>\$ 14,644,933</u>	<u>17,452,485</u>	<u>32,097,418</u>
	2018		
	Without donor restrictions	With donor restrictions	Total
Investment income, net of investment expenses	\$ (1,066,685)	(1,722,859)	(2,789,544)
Net appreciation (realized and unrealized)	27,786,300	31,945,883	59,732,183
	<u>\$ 26,719,615</u>	<u>30,223,024</u>	<u>56,942,639</u>

(6) **Endowment**

The Institute's endowment consists of approximately 120 individual funds established for a variety of purposes including both donor-restricted endowment funds and funds designated by the Board of Trustees to function as endowments. Net assets associated with endowments, including funds designated by the Board of Trustees to function as endowments, are classified and reported based on the existence or absence of donor-imposed restrictions.

(a) *Interpretation of Relevant Law*

The Institute has interpreted the New Jersey-enacted version of the Uniform Prudent Management of Institutional Funds Act (UPMIFA) as allowing the Institute to appropriate for expenditure or accumulate so much of a donor-restricted endowment fund as the Institute determines is prudent for the uses, benefits, purposes, and duration for which the endowment fund is established, subject to the intent of the donor as expressed in the gift instrument. Unless stated otherwise in the gift instrument, the assets in a donor-restricted endowment fund are donor-restricted assets until appropriated for expenditure by the Board of Trustees of the Institute. As a result of applicable accounting guidance, the Institute classifies as net assets with donor restrictions (a) the original value of gifts donated to the permanent endowment, (b) the original value of subsequent gifts to the permanent endowment, and (c) the accumulations to the permanent endowment made in accordance with the direction of the applicable donor gift instrument at the time the accumulation is added to the fund. The remaining portion of the donor-restricted endowment fund that is not classified as endowment fund corpus within the net assets with donor restrictions is classified as net assets with donor purpose restrictions until those amounts are appropriated for expenditure in a manner consistent with the standard of prudence prescribed by UPMIFA.

From time to time, the fair value of assets associated with individual donor-restricted endowments may fall below the original corpus the fund included in net assets with donor restrictions due to unfavorable market fluctuations subsequent to the investment of the gift. Under the provisions of UPMIFA, spending from such endowment funds with deficiencies would be permitted. Deficiencies of this nature, which are reported in net assets with donor restrictions, totaled approximately \$2,086,000 and \$1,952,000 at June 30, 2019 and 2018, respectively. Subsequent gains that restore the fair value of the assets of the donor-purpose restricted endowment fund are classified as an increase in net assets with donor restrictions.

Below is a schedule which represents the composition of the Institute's endowment funds and funds designated by the Board of Trustees to function as endowments by type of fund as of June 30, 2019 and 2018:

2019				
	Without donor restrictions	With donor restrictions		Total
		Original gift	Accumulated gains	
Undesignated	\$ 207,880,560	—	—	207,880,560
Specific purpose designated funds	132,573,325	—	—	132,573,325
Donor—purpose restricted funds	—	10,836,804	166,145,736	176,982,540
Endowment fund corpus	—	258,946,153	—	258,946,153
	<u>\$ 340,453,885</u>	<u>269,782,957</u>	<u>166,145,736</u>	<u>776,382,578</u>
2018				
	Without donor restrictions	With donor restrictions		Total
		Original gift	Accumulated gains	
Undesignated	\$ 220,599,374	—	—	220,599,374
Specific purpose designated funds	131,472,898	—	—	131,472,898
Donor-restricted funds	—	8,336,803	171,021,471	179,358,274
Endowment fund corpus	—	253,636,411	—	253,636,411
	<u>\$ 352,072,272</u>	<u>261,973,214</u>	<u>171,021,471</u>	<u>785,066,957</u>

Changes in the Institute's endowment funds and funds designated by the Board of Trustees to function as endowments for the fiscal years ended June 30, 2019 and 2018 were as follows:

	Without donor restrictions	With donor restrictions		Total
		Original gift	Accumulated gains	
Net assets, June 30, 2017	\$ 345,616,287	256,078,368	161,944,422	763,639,077
Investment returns:				
Investment income, net	(1,368,357)	—	(1,587,839)	(2,956,196)
Net appreciation (realized and unrealized)	27,786,300	—	31,769,170	59,555,470
Total investment return	26,417,943	—	30,181,331	56,599,274
Contributions	137,000	5,894,846	—	6,031,846
Appropriation for expenditure— operations	(20,098,958)	—	(21,104,282)	(41,203,240)
Net assets, June 30, 2018	352,072,272	261,973,214	171,021,471	785,066,957
Investment returns:				
Investment income, net	(1,075,587)	—	(1,343,894)	(2,419,481)
Net appreciation (realized and unrealized)	15,435,982	—	18,842,518	34,278,500
Total investment return	14,360,395	—	17,498,624	31,859,019
Contributions	52,000	7,809,743	—	7,861,743
Appropriation for expenditure— operations	(26,030,782)	—	(22,374,359)	(48,405,141)
Net assets, June 30, 2019	\$ 340,453,885	269,782,957	166,145,736	776,382,578

(b) Funds with Deficiencies

From time to time, the fair value of assets associated with individual donor restricted “true” endowment funds may fall below the level of the donor or UPMIFA requires to be retained as a fund of perpetual duration. Deficiencies of this nature are reported in net assets with donor restrictions. As of June 30, 2019 and 2018, funds with an original gift of \$3,087,675 and \$2,987,675 were “underwater” by \$2,086,798 and \$1,952,195, respectively.

(c) Return Objectives and Risk Parameters

The Institute has adopted investment and spending policies for endowment assets that attempt to provide a predictable stream of funding to programs supported by its endowment while seeking to maintain the purchasing power of the endowment assets.

(d) Strategies Employed for Achieving Objectives

The Institute manages its investments in accordance with a total return concept and the goal of maximizing returns within acceptable levels of risk. The Institute relies on a total return strategy in which investment returns are achieved through both capital appreciation (realized and unrealized) and current yield (dividends and interest). The Institute's spending policy is designed to provide a stable level of financial support and to preserve the real value of its endowment.

(7) Physical Plant

Physical plant and equipment are stated at cost at date of acquisition, less accumulated depreciation.

A summary of plant assets at June 30, 2019 and 2018 is as follows:

	2019	2018
Land	\$ 373,738	373,738
Land improvements	3,013,115	2,983,905
Buildings and improvements	188,798,187	175,816,514
Equipment	38,261,197	37,229,054
Rare book collection	203,508	203,508
Joint ownership property	5,131,177	4,728,370
	235,780,922	221,335,089
Accumulated depreciation	(105,523,276)	(99,164,381)
Net book value	\$ 130,257,646	122,170,708

(8) Long-Term Debt

A summary of long-term debt at June 30, 2019 and 2018 is as follows:

	2019	2018
2006 Series B—NJEFA	\$ 19,500,000	21,100,000
2006 Series C—NJEFA	14,300,000	14,900,000
2008 Series C—NJEFA	1,420,000	2,090,000
2012 Taxable	14,915,000	15,325,000
2015 Taxable	14,355,000	14,675,000
2017 Taxable	24,495,000	25,000,000
Long-term debt	88,985,000	93,090,000
Less:		
Unamortized bond discount	(274,115)	(297,976)
Unamortized debt issuance costs	(690,096)	(752,349)
Total long-term debt	\$ 88,020,789	92,039,675

Interest expense on long-term debt for the years ended June 30, 2019 and 2018 was \$3,207,818 and \$2,946,063, respectively.

(a) 2006 Series B

In July 2006, the Institute received proceeds of the New Jersey Educational Facilities Authority (the Authority) offering of \$29,600,000 Revenue Bonds, 2006 Series B of the Institute for Advanced Study Issue. The 2006 Series B Bonds were issued to finance the advance refunding of the outstanding 1997 Series G Bonds, the partial advance refunding of the 2001 Series A Bonds, and to pay a portion of certain costs incidental to the sale and issuance of the 2006 Series B Bonds.

(b) 2006 Series C

In March 2007, the Institute received proceeds of the Authority offering of \$20,000,000 Revenue Bonds, 2006 Series C of the Institute for Advanced Study Issue. Proceeds are being used to finance the costs of construction, renovating, and equipping certain educational facilities of the Institute to fund capitalized interest on the 2006 Series C Bonds during the renovation and construction and to pay certain costs incidental to the sale and issuance of the 2006 Series C Bonds.

(c) 2008 Series C

In March 2008, the Institute received proceeds of the Authority offering of \$11,255,000 Revenue Bonds, 2008 Series C of the Institute for Advanced Study Issue. The 2008 Series C Bonds were issued to finance the advance refunding

of outstanding 1997 Series F Bonds, the advance refunding of outstanding 1997 Series G, and to pay a portion of certain costs incidental to the sale and issuance of the 2008 Series C Bonds.

(d) 2012 Taxable

In December 2012, the Institute received proceeds of \$17,320,000 Taxable Bonds, 2012 Series of the Institute for Advanced Study Issue, which were issued at a discount of approximately \$92,000. The 2012 Taxable Bonds were used to finance the advance refunding of outstanding 2001 Series A Bonds, to fund renovations to the Members Housing facility and the costs of renovation and equipping certain educational facilities of the Institute and to pay certain costs incidental to the sale and issuance of the 2012 Taxable Bonds.

(e) 2015 Taxable

In November 2015, the Institute received proceeds of \$15,300,000 Taxable Bonds, 2015 Series of the Institute for Advanced Study Issue, which were issued at a discount of approximately \$80,000. The 2015 Taxable Bonds were used to fund capital projects at the Institute and for other corporate purposes of the Institute and to pay certain costs incidental to the sale and issuance of the 2015 Taxable Bonds.

(f) 2017 Taxable

In November 2017, the Institute received proceeds of \$25,000,000 Taxable Bonds, 2017 Series of the Institute for Advanced Study Issue, which were issued at a discount of approximately \$84,000. The 2017 Taxable Bonds were used to fund capital projects at the Institute and for other corporate purposes of the Institute and to pay certain costs incidental to the sale and issuance of the 2017 Taxable Bonds.

(g) Interest Rates

The 2006 Series B and C Bonds bear interest at variable rates. The bonds were issued in the weekly mode with weekly rates determined by Lehman Brothers Inc., as a Remarketing Agent and paid monthly. The maximum interest rate on the 2006 Bonds shall be twelve percent (12%) per annum. The 2006 bonds are subject to redemption at various prices and require principal payments and sinking fund installments through July 1, 2031 (Series B) and July 1, 2036 (Series C). The obligation to pay the Authority on a periodic basis, in the amounts sufficient to cover principal and interest due on the bonds, is a general obligation of the Institute. On September 18, 2008, the Institute entered into a contract with JPMorgan Chase Bank to take over as a remarketing agent, replacing Lehman Brothers Inc.

The 2008 Series C Bonds bear interest at rates ranging from 3% to 5% per annum, payable semiannually, are subject to redemption at various prices and require principal payments and sinking fund installments through July 1, 2021. The obligation to pay the Authority on a periodic basis, in the amounts sufficient to cover principal and interest due on the bonds, is a general obligation of the Institute.

The 2012 Taxable bonds bear interest at rates ranging from 0.388% to 3.892% per annum, payable semiannually, are subject to redemption at various prices and require principal payments and sinking fund installments through December 1, 2042. The obligation to make the interest payments on a periodic basis, in the amounts sufficient to cover principal and interest due on the bonds, is a general obligation to the Institute.

The 2015 Taxable bonds bear interest at rates ranging from 0.906% to 4.394% per annum, payable semiannually, are subject to redemption at various prices and require principal payments and sinking fund installments through December 1, 2045. The obligation to make the interest payments on a periodic basis, in the amounts sufficient to cover principal and interest due on the bonds, is a general obligation to the Institute.

The 2017 Taxable bonds bear interest at rates ranging from 1.713% to 3.732% per annum, payable semiannually, are subject to redemption at various prices and require principal payments and sinking fund installments through November 1, 2047. The obligation to make the interest payments on a periodic basis, in the amounts sufficient to cover principal and interest due on the bonds, is a general obligation to the Institute.

(h) Bond Swap Agreement

On December 22, 2008, the Institute entered into a swap agreement with Wells Fargo Bank covering \$28,900,000 of outstanding 2006 Series B Bonds that required the Institute to pay a fixed rate of 3.7702% to Wells Fargo Bank in exchange for Wells Fargo Bank agreeing to pay the Institute a variable rate equal to 67% of the USD-LIBOR-BBA rate with a term of three months, payable monthly, on an identical notional amount. The notional value of the 2006 Series B Bond is \$22,300,000. The effective date of the swap was December 22, 2008, and the termination date of the swap agreement coincides with the maturity of the bonds, which is July 1, 2031.

The Institute entered into this swap agreement with the intention of lowering its effective interest rate. At June 30, 2019 and 2018, the fair value of the interest rate swap was (\$2,788,944) and (\$2,316,450), respectively. The unrealized

gain recognized during the years ended June 30, 2019 and 2018 in the amount of (\$472,494) and \$1,130,869, respectively, is reported in the statements of activities in change in fair value of bond swap liability. The swap agreement utilizes Level 2 inputs to measure fair value. The fair value of the interest rate swap was determined using pricing models developed based on the LIBOR swap rate and other market data. Under the swap agreement, the Institute may be required to post collateral to the counterparty if certain triggering events (rates and dollar thresholds) are met. As of June 30, 2019 and 2018, there was no requirement to post collateral imposed by the swap counterparty.

The bonds are repayable as follows at June 30, 2019:

	Amount
Year ending June 30:	
2020	\$ 4,275,000
2021	4,325,000
2022	3,735,000
2023	3,965,000
2024	4,105,000
2025 through 2048	68,580,000
Total	<u>\$ 88,985,000</u>

The 2006 Series B, 2006 Series C, and 2008 Series C bonds are secured by a pledge of revenues pursuant to the respective Loan Agreements.

(i) Lines of Credit

As of June 30, 2019 and 2018, the Institute had unsecured loan agreements representing a line of credit. As of June 30, 2019 and 2018, the agreements provide for borrowings up to \$50,000,000, of which \$30,000,000 is available through June 2020 and \$20,000,000 is available through March 2022. Interest payments are due on demand and interest accrues for the \$20,000,000 line of credit at the LIBOR rate plus 90 basis points, which was 3.18% as of June 30, 2019 and for the \$30,000,000 line of credit at LIBOR rate plus 50 basis points, which is 2.78% as of June 30, 2019. There were no borrowings in fiscal year 2019 or 2018 against the lines of credit. No interest expense was incurred for the years ended June 30, 2019 and 2018.

(j) Standby Bond Purchase Agreement

On July 17, 2017, in connection with the substitution of the Standby Bond Purchase Agreements, the 2006 Bonds were subject to mandatory tender for purchase and were remarketed with an alternate liquidity facility on July 17, 2017. The 2006 Bonds continue to be in the Weekly Mode, with J.P. Morgan Securities LLC serving as a Remarketing Agent for the Bonds. Each Series of the 2006 Bonds are secured by a new Standby Bond Purchase Agreement issued by TD Bank, N.A.

(9) Pension Plans and Other Postretirement Benefits

Separate voluntary defined-contribution retirement plans are in effect for faculty members and eligible staff personnel, both of which provide for annuities, which are funded, to the Teachers Insurance and Annuity Association and/or the College Retirement Equities Fund. Contributions are based on the individual participant's compensation in accordance with the formula set forth in the plan documents on a nondiscriminatory basis. Contributions for the years ended June 30, 2019 and 2018 totaled approximately \$2,666,000 and \$2,389,000, respectively.

In addition to providing pension benefits, the Institute provides certain health care and life insurance benefits for retired employees and faculty. Substantially, all of the Institute's employees may become eligible for these benefits if they meet minimum age and service requirements. The Institute accrues these benefits over a period in which active employees become eligible under existing benefit plans.

The components of net periodic postretirement benefit cost other than the service cost component are included in a line item in the nonoperating activities section of the statement of activities.

The following table provides a reconciliation of the change in benefit obligation of the plan at June 30, 2019 and 2018. There are no plan assets at June 30, 2019 or 2018.

	2019	2018
Postretirement benefit obligation:		
Retirees	\$ 6,494,495	6,508,512
Fully eligible active plan participants	3,012,837	3,014,814
Other active plan participants	10,077,450	8,785,626
Postretirement benefit obligation	<u>\$ 19,584,782</u>	<u>18,308,952</u>
Change in benefit obligation:		
Benefit obligation at beginning of year	\$ 18,308,952	17,832,643
Service cost	800,235	799,501
Interest cost	745,173	680,320
Benefits paid	(450,870)	(437,552)
Actuarial gain	181,292	(565,960)
Benefit obligation at end of year	<u>\$ 19,584,782</u>	<u>18,308,952</u>
Components of net periodic benefit cost:		
Service cost	\$ 800,235	799,501
Interest cost	745,173	680,320
Amortization of net gain	181,292	(565,960)
Net periodic postretirement benefit cost	<u>\$ 1,726,700</u>	<u>913,861</u>

	2019	2018
Benefit obligation weighted average assumptions at June 30, 2019 and 2018:		
Discount rate	3.50 %	4.13%
Periodic benefit cost weighted average assumptions for the years ended June 30, 2019 and 2018:		
Discount rate	4.13 %	3.87%

The healthcare trend rate is assumed to be 6.5% in fiscal 2019 and 6.0% in fiscal 2018, trending to an ultimate rate of 5.0% in 2028 and thereafter.

The effects of a 1% increase or decrease in trend rates on total service and interest cost and the postretirement benefit obligation are as follows:

	2019		2018	
	Increase	Decrease	Increase	Decrease
Effect on total service and interest cost	\$ 465,436	(334,858)	461,657	(323,423)
Effect on the postretirement benefit obligation	4,924,714	(3,542,289)	4,236,423	(3,129,519)

Projected payments for each of the next five fiscal years and thereafter through 2029 are as follows:

	<u>Amount</u>
Year ending June 30:	
2020	\$ 493,000
2021	502,000
2022	518,000
2023	541,000
2024	574,000
2025 through 2029	3,467,000

The Institute funds claims as they are incurred. The Institute does not expect to contribute any amounts in fiscal year 2019 or 2018, except as needed to provide for benefit payments.

(10) Natural Allocation of Expenses

The costs of providing program services and support services of the Institute have been summarized on a functional basis in the statement of activities. The following chart shows the relationship between the functional and natural classifications of expenses. Certain operating costs have been allocated among the functional categories as disclosed in note 1(b).

Expenses by natural classification for the year ended June 30, 2019 consist of the following:

		2019							
		Schools of				Library and other Academic	Administration and general	Auxiliary Activity	Total
		Mathematics	Natural Sciences	Historical Studies	Social Science				
Salaries	\$	2,663,909	3,597,476	3,576,217	1,952,821	1,614,822	9,669,899	1,947,108	24,113,162
Salaries		5,069,737	3,612,469	2,451,392	1,328,841	138,950			12,601,389
Employee benefits and taxes		1,057,075	1,389,777	1,355,750	385,194	545,894	3,454,253	588,689	8,776,632
Materials and supplies		39,831	98,981	40,315	44,193	84,766	817,788	455,854	1,581,728
Conferences and travel		506,039	535,660	493,234	152,048	1,809,252	1,112,078	653,273	5,261,584
Insurance, legal and professional fees		34,488	369,590	379,405	8,900	755,894	2,923,323	211,354	4,682,954
Occupancy (inc. utilities and real estate taxes)							850,000	1,402,842	2,252,842
Interest expense							1,699,559	1,517,259	3,207,818
Books and periodicals		127	3,533	1,396	333	741,664	10,904	794	758,754
Other expenses		644,251	882,720	388,021	193,394	410,863	129,432	35,615	2,684,296
Depreciation		14,484	89,462	36,990	4,042	139,687	2,360,802	3,883,270	6,528,737
Subtotal		10,029,941	10,579,668	8,722,720	3,169,766	6,241,792	23,009,948	10,696,058	72,449,893
Academic building allocation		1,236,677	1,583,658	1,064,935	533,648	—	(4,418,918)	—	—
	\$	11,266,618	12,163,326	9,787,655	3,703,414	6,241,792	18,591,030	10,696,058	72,449,893

Expenses by natural classification for the year ended June 30, 2018 consist of the following:

		2018							
		Schools of				Library	Administration	Auxiliary	
		Mathematics	Natural Sciences	Historical Studies	Social Science	and other Academic	and general	Activity	Total
Salaries	\$	3,271,580	3,513,247	2,639,523	903,476	1,607,712	9,033,173	1,975,882	22,941,193
Stipends		4,412,930	3,236,985	2,489,233	1,413,776	91,300			11,644,224
Employee benefits and taxes		1,663,230	1,703,428	1,373,816	507,626	580,806	3,127,934	594,766	9,551,606
Materials and supplies		34,494	46,180	39,335	39,371	85,734	676,351	377,313	1,248,668
Conferences and travel		537,269	530,977	374,454	188,021	1,552,742	1,161,446	611,155	4,956,064
Insurance, legal and professional fees		110,352	367,271	119,192	18,475	398,448	2,458,341	178,433	3,650,512
Occupancy (rent, utilities and real estate taxes)		—	—	—	—	—	773,773	1,331,123	2,104,896
Interest expense		—	—	—	—	—	1,470,640	1,475,422	2,946,062
Books and periodicals		94	3,569	8,280	—	847,127	18,485	1,324	878,879
Other expenses		680,064	749,023	210,525	168,941	1,107,970	43,430	24,465	2,981,418
Depreciation		43,001	89,151	36,963	4,025	136,443	2,016,453	3,443,742	5,769,778
Subtotal		10,753,014	10,239,831	7,291,321	3,243,211	6,408,272	20,780,026	9,963,625	68,679,300
Academic building allocation		1,146,299	1,467,926	987,110	494,647	—	(1,995,982)	—	—
	\$	11,899,313	11,707,757	8,278,431	3,737,858	6,408,272	16,684,044	9,963,625	68,679,300

(11) Net Assets

Net assets are comprised of the following at June 30, 2019 and 2018:

	2019	2018
Net assets without donor restrictions:		
Undesignated	\$ 223,454,839	235,900,368
Designated for specific purpose funds:		
School of Mathematics	16,308,145	15,974,456
School of Natural Sciences	21,936,096	22,233,177
School of Historical Studies	17,251,781	17,143,252
School of Social Science	1,505,873	1,445,076
Libraries and other academic	70,895,415	70,207,753
Administration and general	4,676,015	4,469,184
Designated for specific purpose funds	132,573,325	131,472,898
Total net assets without donor restrictions	<u>\$ 356,028,164</u>	<u>367,373,266</u>
Net assets with donor restrictions and appropriation through endowment spending policy:		
Subject to expenditure for specific purpose:		
School of Mathematics	\$ 28,787,317	30,227,248
School of Natural Sciences	21,646,276	20,939,995
School of Historical Studies	36,675,554	38,004,769
School of Social Science	58,140,108	59,192,260
Libraries and other academic	6,624,038	6,595,422
Administration and general	56,790,270	58,313,850
Net assets with donor-purpose restrictions	208,663,563	213,273,544
Net assets held as endowed fund corpus to generate income for specified purposes	258,946,153	253,636,411
Total net assets with donor restrictions	<u>\$ 467,609,716</u>	<u>466,909,955</u>

(12) Subsequent Events

The Institute evaluated events subsequent to June 30, 2019 through October 28, 2019, the date on which the financial statements were issued, and determined there were no subsequent events required to be disclosed.

Let $D = d + A$ be a covariant derivative
 $F = D^2 = (d + A)^2 = dA + \frac{1}{2}[A, A]$ be it

We are interested in questions in

minima of $\int F^2$. These are



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Yang-Mills equations.