

IAS

INSTITUTE FOR
ADVANCED STUDY

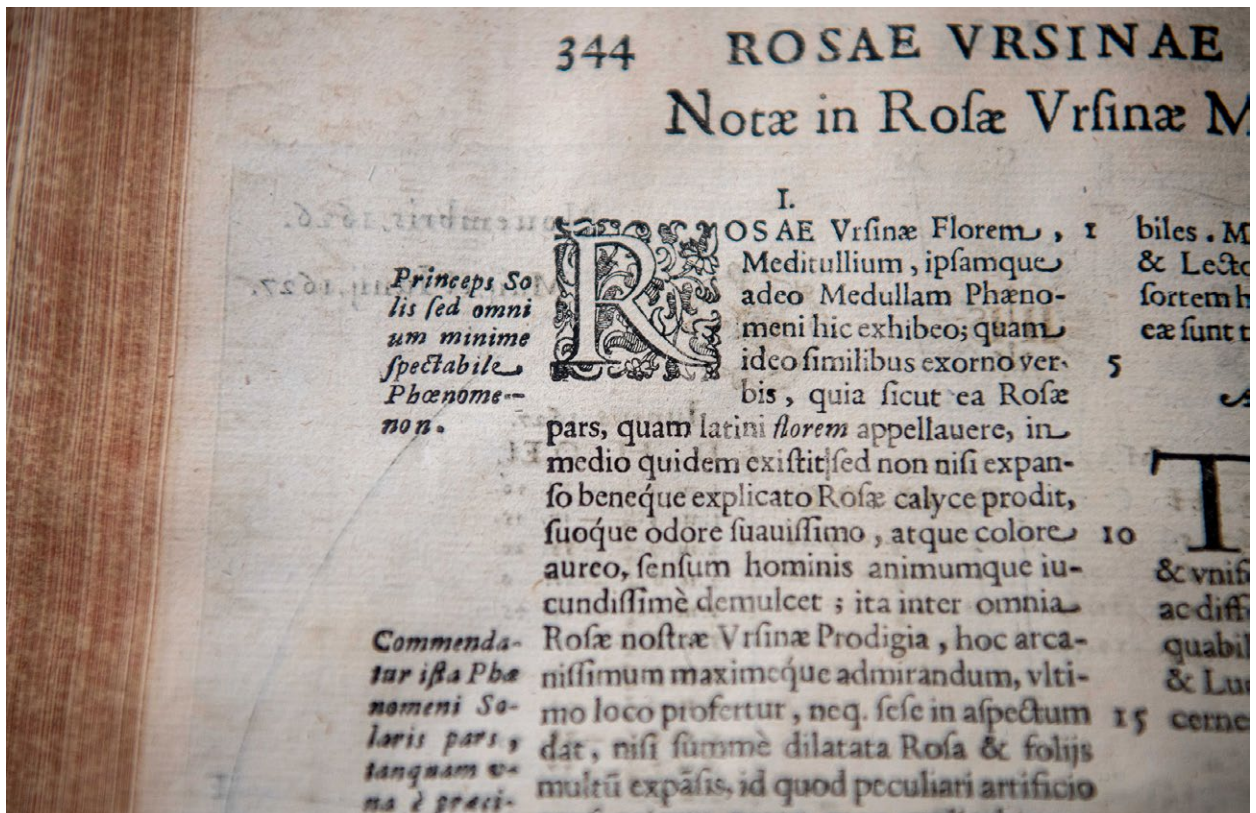


Report for the Academic Year
2022–2023

Cover: The first of the Institute's regularly scheduled Happy Hours to take place in 2023 also saw scholars and their families gather for the first time in the newest building to open on campus: Rubenstein Commons. Nana Osei-Opore, Andrew W. Mellon Foundation Fellow in the School of Historical Studies, spoke to a packed audience about his research.

Opposite: A page from German Jesuit Christoph Scheiner's seventeenth-century book *Rosa Ursina sive Sol ex admirando facularum & macularum suarum phoenomeno varius*, which is part of the Historical Studies-Social Science Library's rare book collection. The book focuses on sunspots, namely dark, planet-sized regions that appear on the surface of the sun. Scheiner argued with his contemporary Galileo about their nature, with Scheiner eventually adopting Galileo's assertion that sun spots were not solar satellites. His book became a standard treatise on sunspots for over a century. Scholars had the opportunity to browse this title, among others, as part of the 2023 Founders Day celebrations.

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Report of the Chair



ANDREA KANE

AFTER 15 YEARS AS CHAIR OF THE BOARD OF TRUSTEES, I am honored to share my final report on behalf of this remarkable institution, which I joined in 1997, and continue to serve, as Trustee and Chair Emeritus. To this day, the Institute remains a place of wonder and unique potential. Working alongside my fellow Trustees, four Directors (three as Chair), and distinguished Faculty, our community has accomplished much together to fortify and advance an enduring mission of foundational discovery. I have taken great care to both steward growth and preserve tradition. As such, our collective work has helped to sustain IAS as a leading global center for independent, field-shaping research.

I am also delighted to be a part of the Institute's next chapter under the leadership of John A. Overdeck, philanthropist, business leader, and IAS Trustee, who was elected Chair in May 2023. Mathematically minded and dedicated to the power of ideas and discovery, John embodies the values and talent to lead the Institute into its second century.

As Chair, I was pleased to contribute to the academic excellence and financial sustainability of IAS, building on the success of my predecessors. In the past 15 years, we advanced numerous important projects for the Institute, including the construction of new academic and residential facilities, a campus-wide renewable energy system, the expansion of School programs and enrollment, and the establishment of the Shelby White and Leon Levy Archives Center. Within the Schools, the Simons Center for Systems Biology, a three-year Theoretical Machine Learning program, the annual Summer Program in Social Science, and the award-winning Women and Mathematics program have continued to foster a global network of collaboration and intellectual mentorship. Many fruitful exchanges have likewise been sparked through the open and intersective spaces at IAS, from the Woods to Rubenstein Commons which opened its doors in November 2022. It has also been my distinct honor to welcome to our campus community nineteen Faculty appointees and thirty-four new Trustees to the Board and oversee the endowment of six professorships across three Schools.

In 2011, the Charles and Lisa Simonyi Fund for Arts and Sciences, with the Simons Foundation, initiated a \$100 million challenge grant "to strengthen the Institute's endowment and ensure the freedom needed for fundamental research for future generations." Exceeding the original goal, it was announced in 2015 that \$212 million had been raised for the endowment and IAS Fund. In 2021, the endowment exceeded \$1 billion for the first time.

This past year, the Board elected Eve Marder, University Professor and Victor and Gwendolyn Beinfeld Professor of Neuroscience at Brandeis University, as Academic Trustee in the School of Natural Sciences during its May 2023 meeting. Ewine van Dishoeck represented the School on the Board since 2018, contributing greatly to the discussions and function of the Board, lending her expertise as a scientist, administrator, and global collaborator. After eight years, Afsaneh Beschloss concluded her work on the Board. Afsaneh has served on various committees and as Co-Chair of the Finance Committee. She was a key partner during the early days of the pandemic and endlessly generous interlocutor throughout her IAS tenure. For Ewine and Afsaneh's support of the Institute's purpose and mission, I am most grateful. The accolades received by IAS scholars during my chairmanship have been vast and varied. Among past and present Faculty and Members, awards have included 3 Nobel Prizes in Physics, 15 Abel Prizes, 10 Fields Medals, 24 Break-through Prizes, numerous MacArthur fellowships and Wolf Prizes, and various appointments to domestic and international learned societies.

In recognition of the Institute's visionary supporters, I was proud to co-chair the inaugural IAS Einstein Gala held in 2019, honoring Trustee Emeritus James Simons, who received the first Bamberger Medal. This honor was subsequently received by former Board Chair Sir James Wolfensohn and Trustee Emerita Shelby White. I am deeply honored to have served alongside such incredible and generous leaders during my time as Chair and believe as strongly as ever in our collective capacity to unlock new frontiers of knowledge here at IAS.

Charles Simonyi
Chair of the Board

Report of the Director

THE INSTITUTE HAS LONG ATTRACTED INDIVIDUALS whose spirit of inquiry is as free as their understanding is deep. Among these is our Board Chair, Charles Simonyi, whose own work has transformed human capacities for thought and expression, and whose leadership of our Board has greatly expanded the possibilities for intellectual and campus life of the Institute.

Charles's term as Chair began in the aftermath of a global financial crisis and concluded fifteen years later after a global pandemic. During this time and thanks in large part to his support and guidance, the Institute not only endured, but continued to develop an ever-greater faculty of discovery. Charles's counsel—his depth of experience, suppleness of perspective, and astounding communicative courtesy that edifies as well as inspires—has contributed immeasurably to maintaining the Institute as a precious gathering point for the global community of knowledge. It is a testament to his work that this year, his last one as Chair, Charles welcomed 281 scholars to campus, hailing from 36 countries and representing approximately 107 academic institutions.

There is little in the cosmos that Charles is not interested in, and his generosity has made possible our work in all of our fields of inquiry. He has not only made all of us at the Institute feel the possibilities of discovery, but he has also helped us blaze the trails, and walked them with us.

These paths, like the ones in our Institute Woods, are winding, moving within and across diverse intellectual topographies. At every stage, Charles has exhorted us both to deepen our specialized knowledge, and to look across disciplines and domains in search of approaches to our most challenging questions. In Homer's Greek, Charles would be referred to as *polytropos*, meaning "skilled in all ways of contending," or, more literally, "of many turns." Those skills have guided the Institute for almost two decades, and guided me for my first years as Director. I am happy to report that they will continue to be at our disposal, for Charles will still serve on the Board, still share his wisdom, and still accompany us on these paths into the future, exploring them alongside us.

Charles will be succeeded by yet another Board Chair of extraordinary depth and breadth, John A. Overdeck. John brings to the role a boundless curiosity, experienced leadership, an understanding of the conditions necessary for discovery, and a passionate commitment to intellectual freedom. I very much look forward to working with him to preserve and expand the Institute's ability to keep open the doors to independent inquiry and transformational discovery, at a time when throughout the world these feel as vulnerable and as necessary as they ever have.

David Nirenberg
Director and Leon Levy Professor

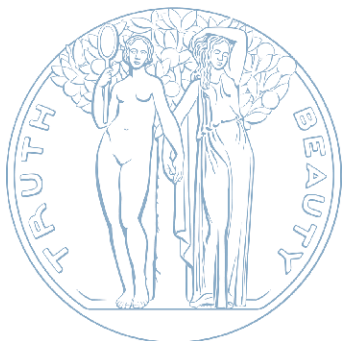


ANDREA KANE

IAS scholars and staff enjoying a game of soccer as part of the 2023 Founders Day celebrations.



The Institute for Advanced Study



The Institute's mission, which has remained constant from the time of founding Director Abraham Flexner, is "to assemble a group of scientists and scholars who with their pupils and assistants 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."

THE INSTITUTE FOR ADVANCED STUDY (IAS) is one of the world's leading international centers for theoretical research and intellectual inquiry. Each year, IAS assembles more than 250 visiting researchers capable of generating—through their talent, proximity, collaboration, critique, and conversation—insights and discoveries that could not otherwise have been produced. The Institute's academic community is drawn from more than 100 institutions around the world and is composed of scholars from postdoctoral fellows at the beginning of their research careers to distinguished senior academics who continue to shape fields of inquiry. Research spans four Schools—Historical Studies, Mathematics, Natural Sciences, and Social Science—and is focused on curiosity-driven exploration and fundamental discovery.

The IAS campus provides the material conditions for discovery by furnishing exceptional minds with an environment free of external pressures and academic restraints. Enabled by the generosity of the Institute's founders and subsequent benefactors, IAS catalyzes the generation and transmission of knowledge. The Institute creates time and space for individual work as well as dialogue and partnership among its scholars through organized collaborative networks and serendipitous interactions.

Counted among the Institute's past and present Faculty and Members are thirty-five Nobel Laureates, forty-four of the sixty-two Fields Medalists, and twenty-two of the twenty-five Abel Prize Laureates, and many winners of the Wolf and MacArthur prizes. 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 scholars to deepen understanding across the sciences and humanities.

In the words of current IAS Director and Leon Levy Professor, historian and author David Nirenberg, "The Institute has also served the nation and the world through the constant performance of its founding values: that discriminations by gender and race are inimical to excellence, that scholars and ideas must move freely if fundamental knowledge is to flourish, and that when knowledge flourishes, humanity benefits. Both these tasks—discovery and the defense of these values—feel as urgent today as they were at the Institute's founding."

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, embraces a historical approach to research throughout the humanistic disciplines and supports all learning for which historical methods are appropriate. Uniquely positioned to sponsor work that crosses departmental and professional boundaries, the School actively promotes interdisciplinary research and the cross-fertilization of ideas, thereby encouraging the creation of new historical enterprises.

FACULTY

Suzanne Conklin Akbari

Angelos Chaniotis

Nicola Di Cosmo

*Luce Foundation Professor
in East Asian Studies*

Myles W. Jackson

*Albers-Schönberg Professor in
the History of Science*

Sabine Schmidtke

Francesca Trivellato

Andrew W. Mellon Professor

PROFESSORS EMERITI

Yve-Alain Bois

Glen W. Bowersock

Caroline Walker Bynum

Patrick J. Geary

Jonathan Israel

Heinrich von Staden

In March 2023, Catherine M. Jackson of Oxford University treated IAS scholars to a lecture and practical demonstration of scientific glassblowing as part of the History of Science Lecture Series convened by Albers-Schönberg Professor Myles W. Jackson.



In the 2022–23 academic year, the School of Historical Studies Faculty explored questions (among others) of the role of the humanities in engineering curricula, how emotions were used to construct political and cultural fictions in ancient Greece, and the relationship of the global and the local. Among all scholars, 53 Members and 15 Visitors joined the School during the year, working on topics ranging from the development of customary law in medieval England; to fascist paramilitary organizations in colonial India; to the theory, practice, and scientific knowledge of Tibetan healing rites. Throughout the year, the School hosted, among others, a series of lectures on ‘Oriental Studies’ (in conjunction with Digital Scholarship @IAS), and a workshop (jointly organized with the Shelby Cullom Davis Center for Historical Studies at Princeton University) on new directions in the study of economic history.

Professor **Suzanne Conklin Akbari**’s work centers on the global Middle Ages, especially the relationship of the global and the local. She is interested in how our research emerges from the particular land that we live and work on, the role of IAS in fostering collaborations and possible future directions of disciplinary realignment. Akbari is a founding member of NAISIP, the Native American and Indigenous Studies Initiative at Princeton, and is Language Director for Land, Language, and Art (LLA), a Global Initiative from the Humanities Council at Princeton University.* She coordinated the second annual Munsee Language and History Symposium in October 2022 and the inaugural Lunaape Language Camp* at Princeton in July 2023. Akbari delivered the opening plenary of the annual meeting of the Medieval Academy of America on the topic “Language, Sovereignty, and Nation: ‘Medieval’ Vernaculars on Native Lands” (February 2023). In June 2023, she was a short-term research fellow at the Freie Universität Berlin working on her current project “Aanihkwaachiimuwak lunaapahkiing: Rethinking Medieval Studies on Indigenous Lands.”

Akbari’s recent publications include *Practices of Commentary: Medieval Traditions and Transmissions* (co-edited with Amanda Goodman; De Gruyter, 2023); “Huluniixsuwaakan: The Role of the Library in Munsee Delaware Language Revitalization and the Development of Community Relationships on Lunaape Land,” co-written with Ian McCallum, Melissa Moreton, and Anu Vedantham, to appear in *Library Trends*; “Alexander the Great’s Encounters with the Sacred in Medieval History Writing, from the *Shahnameh* to the *Histoire ancienne jusqu’à César*,” in *Out of Bounds: Exploring the Limits of Medieval Art* (2023); and “Automated Transcription of Gə’əz Manuscripts Using Deep Learning,” in *Digital Humanities Quarterly* 17.3 (2023) (with Samuel Grieggs et al.).* She is co-PI on “The Book and the Silk Roads,” a Mellon-funded research project based at the University of Toronto which seeks to map connections between regions of the premodern world by describing the technology of the book. This project (2019–22) has been funded for a second phase, “Hidden Stories: New Approaches to the Local and Global” (2023–26).* The Medieval Studies seminar for 2022–23 met regularly to share work in progress by current members; it also hosted the Late Antique and Early Medieval History Graduate Student Seminar, co-organized with Princeton University and Eberhard Karls Universität Tübingen (March 29), and sponsored

the annual meeting of the Delaware Valley Medieval Association (April 26).

The main focus of Professor **Angelos Chaniotis**’s work is the study of inscriptions and the information they provide for Greek social, cultural, and religious history. He continued working on the corpus of the inscriptions of Aphrodisias. He also co-directed together with Associate Professor Antonis Kotsonas (ISAW/NYU) the excavation of the city of Lyktos on Crete, where he is unearthing a building complex used for the imperial cult and for meetings of the council. The digitization of squeezes of Greek inscriptions at IAS is nearly completed, with generous grants by the Fowler Merle-Smith Family Trust and the National Endowment for the Humanities.

The Ancient Studies Seminar (October 2022–April 2023) took place in a hybrid form; the online option made it possible for former Members to attend. Subjects related to Greek archaeology and art, Greek literature, Roman history, Greek epigraphy, and the archaeology of the Near East were treated by Members and former Members from Australia, Denmark, Germany, the United Kingdom, and the U.S. The annual workshop ‘Epigraphic Friday’ took place online and lasted for two days (March 3–4, 2023). The lectures by 15 scholars from Denmark, France, Germany, Greece, Israel, Serbia, Switzerland, Turkey, the United Kingdom, and the U.S. were attended by approximately 80 scholars and graduate students from the U.S., Europe, and Israel.

Chaniotis gave 24 lectures in Austria, Germany, Greece, Italy, and the U.S., most of them online, and taught online the course “Ancient Greece After Sunset: Histories, History, and Perceptions of the Night” at the Northeast Normal University, Changchun (China). His lectures presented various aspects of nightlife in the Greek world (fourth century B.C.E. to fourth century C.E.).

His most recent book, *Emotionen und Fiktionen: Gefühle in Politik, Gesellschaft und Kultur der griechischen Antike* (Darmstadt 2023), presented to a general audience the results of his research on emotions in ancient Greece. The book shows how emotions

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(fear, hope, love, affection, indignation, sorrow, compassion, and disgust) were used in order to construct political and cultural fictions, and to enhance values.

In Greece, Chaniotis continued his work as a member of the Council of Higher Education, responsible for the strategic planning and the evaluation of Greek universities, and in March he joined the National Council for Research, Innovation, and Technology. In April, he was elected Chairman of the non-profit organization “Komvos-Node: Networks of Global Hellenism.” He was also elected member of the American Philosophical Society and Corresponding Member of the Royal Academy of Belgium.

During the past academic year, **Nicola Di Cosmo**, Henry Luce Foundation Professor in East Asian Studies, continued to be engaged in interdisciplinary work with climate scientists and archaeologists. He played a leading role as a member of the core group of the “Volcanoes, Climate and History” research project at the Zentrum für Interdisziplinäre Forschung (ZiF), Universität Bielefeld. Two meetings were convened: Workshop III – Model Simulations (November 21/22–24/25, 2022) and Workshop IV – Historical Interpretations (April 24–28, 2023). This group has planned several publications currently in

progress. The work undertaken last year with funding from the Tang Research Foundation by a team led by Di Cosmo, which includes environmental historians and climate scientists, focusing on the effects of East Asian Monsoon variability on Chinese history, has made further progress and is expected to meet again to finalize research results next year.

His publications include the monograph *Venezia e i Mongoli: diplomazia e commercio sulle vie della seta*, co-authored with Lorenzo Pubblici (December 2022). The English translation has now been contracted with Princeton University Press. Other publications cover the fields of ancient and medieval East Asia and historical climatology: “Die Zügel der Macht: Die Herausbildung berittener nomadischer Eliten in der Eurasischen Steppen” in *Reiter-Nomaden in Europa: Hunnen, Awaren, Ungarn* (Halle 2022); “Beyond Boom and Bust: Climate in the History of Medieval Steppe Empires (C. 550–1350 C.E.)” in *Perspectives on Public Policy in Societal-Environmental Crises*. Ed. by A. Izdebski, J. Haldon, P. Filipkowski (Springer 2022). He was an author in Mackay et al., “The 852/3 CE Mount Churchill eruption: examining the potential climatic and societal impacts and the timing of the Medieval Climate Anomaly

in the North Atlantic region” which appeared in *Climate of the Past* 18 (2022). He participated also in a discussion on “Was There a Medieval ‘State?’” published in *Medieval Worlds* 18 (2023). His previous book *Ancient China and Its Enemies* (2002) was translated into Turkish as *Antik Çin ve Düşmanları: Doğu Asya Tarihinde Göçebe Gücün Yükselişi* (Kronik Kitap, 2022).

In terms of public engagement, he was invited to present a series of lectures, mostly on methodological problems related to the use of climate proxies in historical research, at various venues such as Rice University (Kalb Lecture), the University of Padua, and as keynote at NYU-Florence. He was Visiting Professor at the University of Venice (May–July 2023), where his lectures focused on historical research within Environmental Humanities. At IAS, he was engaged in the development of the East Asian collection at the HS-SS Library, by organizing, together with Librarian Marcia Tucker, the donation of the personal library of the late Professor Giovanni Stary. He continues to mentor doctoral students at Columbia, Princeton, and the University of Naples.

This past academic year, Albers-Schönberg Professor in the History of Science **Myles W. Jackson** published an article on genetic ownership in *Ownership of Knowledge: Beyond Intellectual Property* (MIT Press, 2023). He signed a contract with Princeton University Press to publish his manuscript, tentatively titled “Engineering Fidelity: German Radio, the Trautonium and Electronic Music,” hopefully appearing in late 2024/early 2025.

He ran a panel for the German Academic Exchange Service (DAAD) in NYC on the role of the humanities in engineering curricula and organized a conference titled “Science Policy: US vs. Germany” in March 2023 at the American Academy of Berlin (AAB). Jackson also gave a lecture at the AAB on his forthcoming book. In October 2022, he was inducted into the German National Academy of Science and Engineering (acatech).

Other activities included Jackson’s hosting of a reading group in the history of science at IAS: scholars’ works were circulated and discussed every two weeks.



DAN KOMODA

Esther Liberman Cuenca, the recipient of a Andrew W. Mellon Foundation Fellowship for Assistant Professors at IAS, spent her time at the Institute writing a book on urban identity and the development of customary law from the twelfth to the sixteenth centuries.

The group included Members in the history of science, East Asian studies, contemporary history, as well as scholars from Princeton University, including Davis Center postdoctoral fellows and graduate students from the Department of History. Jackson also resumed his lecture series in the history of science at IAS: the first since the pandemic. Steven Shapin (Department of the History of Science at Harvard), one of the world's leading historians and sociologists of science, lectured on "Social Sciences are Better than the Natural Sciences, Explain." Catherine Jackson (no relation!) from Oxford offered a lecture entitled, "Microheterotopias: Chemistry Meets Glassblowing." The lecture was accompanied by demonstrations from Tracy Drier, a professional glassblower from the Department of Chemistry of the University of Wisconsin, Madison. Andrew Warwick, also from Oxford, delivered a talk and led a discussion on the history of late nineteenth- and early twentieth-century mathematics and mathematical physics. This was part of a seminar series arranged by the School of Mathematics.

In the future, he hopes to continue collaborating with the School of Mathematics as well as the Schools of Natural Sciences and Social Science. He is also working on another book manuscript that deals with the relationship between science and society from the eighteenth century to the present aimed at educated laypersons. Jackson is also collaborating with scholars from the Max-Planck-Institut für Wissenschaftsgeschichte in Berlin and the Friedrich-Schiller-Universität Jena. Finally, he is working with Andrew W. Mellon Professor Francesca Trivellato and scholars from the Davis Center of Princeton University: the Institute will host two postdoctoral fellows a year in conjunction with the Davis Center.

In 2022–23, Professor **Sabine Schmidtke** focused on *Wissenschaft des Judentums* at the turn of the twentieth century, the history of Oriental Islamic studies, Twelver-Shi'i legal and doctrinal thought, and the Zaydi Shi'i tradition of Yemen and Northern Iran.

Analyzing the crossroads of Islamic Studies and the "Science of Judaism" at



While at IAS, Nana Osei-Opare, Andrew W. Mellon Foundation Fellow, worked on a book titled "Socialist De-Colony: Black and Soviet Entanglements in Ghana's Cold War and Decolonization Projects, 1957–66."

MARIA O'LEARY

the turn of the twentieth century, Schmidtke completed a monograph on Martin Schreiner (1863–1926), a former student of Ignaz Goldziher (1850–1921), who played a pioneering role in the scholarly exploration of the Mu'tazila and other Islamic strands of thought. This work is currently in press (Tübingen: Mohr Siebeck). In parallel, an edition of Schreiner's correspondence (in Arabic, Hebrew, Hungarian, and German) is in preparation (with Dora Zsom). Schmidtke further studied the legacy of some related figures, including Ignaz Goldziher, Eugen Mittwoch (1876–1942), and Israel Friedlaender (1876–1920). While Mittwoch's legacy needs to be pieced together on the basis of what can be found in the archives of others, Friedlaender's legacy is largely preserved at the JTSA in New York. A study on the fate of Mittwoch's library was published in 2023* and a second study focusing on Mittwoch's position between Jewish and Islamic studies is currently in press.* An annotated edition and study of Friedlaender's correspondence with Ignaz Goldziher is presently in preparation (with Camilla Adang). Another study on Goldziher's correspondence with Walter Gottschalk (1891–1974) revolves around Goldziher's work on oaths and his edition

of the *K. al-Aymān* by the fourth/tenth-century author Abū Is'āq Ibrāhīm b. 'Abd Allāh al-Najīramī that was never published.

Within the area of the history of Near Eastern and Islamic studies, Schmidtke published a monograph on Rudolf Strothmann (1877–1960), the founder of Shi'i studies in Europe (Transactions of the American Philosophical Society in 2023,* as well as several papers on Strothmann's Middle East trip in 1929/30*). A critical edition of his travel diary is currently in preparation (with Gaby Strothmann). Together with colleagues in Göttingen and Budapest, Schmidtke prepared a volume revolving around Ignaz Goldziher and his correspondents, entitled "Building Bridges: Ignaz Goldziher and His Correspondents. Islamic and Jewish Studies around the Turn of the Twentieth Century," which will be sent to the press shortly. Together with two Italian colleagues, Valentina Sagaria Rossi and Roberto Tottoli, she is further working on a collective volume on the life and work of Paul Kahle (1875–1964). Schmidtke also began preparations for a collaborative research project entitled "Scholarly Correspondences: The Case of 'Oriental Studies' During the Late Nineteenth and Early Twentieth Century." For

this purpose, she convened, together with Digital Scholarship @IAS, a series of lectures on the topic, reflecting on contents and digital strategies to explore the material.* In view of the series's success, a continuation is planned for spring 2024. During the fall of 2022, Schmidtke consulted the archive(s) of Carl Rathjens (1887–1966) in Hamburg, resulting in a collaborative project with Marieke Brandt on aspects of the intellectual history of twentieth-century Yemen. During December 2022 and January 2023, Schmidtke consulted various archives of European Orientalists, in Berlin and in Leiden, resulting in various publications including a study involving Christiaan Snouck Hurgronje (1857–1936).* In February and March 2023, Schmidtke was able to gather the scholarly *Nachlass* of Wilferd Madelung (1930–2023), one of the most important scholars of Shi'i Islam, from his former residences in Oxford and Chicago, and the material is currently being sorted and inventoried.* The next step will be the analysis of the material, which promises to yield new insights into the evolution of the study of Shi'ism in the West.

In the field of Shi'i Studies, she completed, with Visiting Professor Hassan Farhang Ansari and Amin Ehteshami, the seventh volume of the peer-reviewed journal, *Shii Studies Review*,* which will be published in fall 2023. In it, Schmidtke, together with Iranian colleagues, published an *editio princeps* of a section of the otherwise lost work, *K. al-Minhāj*, by the twelfth-century Twelver Shi'i theologian Sālim b. Maḥfūẓ Ibn 'Uzayza (of 'Azīza). Critical editions of several other doctrinal works by Twelver Shi'i authors are currently in preparation. Schmidtke also completed a study on the Shi'i source materials that were available to Carl Brockelmann (1868–1956) during the preparation of his seminal *Geschichte der arabischen Literatur*. This study is currently in press.*

In the realm of Zaydi studies, a so-far unknown multitext codex was discovered in the Malik 'Abd al-'Azīz library in Riyadh, copied by al-Ḥasan b. Muḥammad b. Aḥmad b. 'Alī Ibn Abī l-'Ashīra in 552/1157 in Ṣa'da and consisting of

doctrinal texts by Zaydī and Mu'tazilī authors, invariably Iranian. With the exception of one text, the codex is the only known extant witness of the tracts it includes, and two tracts are not even attested in the relevant bio-bibliographical sources. Together with Iranian colleagues, Schmidtke wrote a study on the codex that includes critical editions of four of its tracts. Critical editions of all remaining tracts included in the codex are in preparation. She also catalogued the David Thomas Gochenour Collection of Zaydi Yemeni Manuscripts that was donated to the Institute in 2022 and is now accessible to scholars through the HS-SS library.*

Two other edited volumes were finalized over the course of the past year and are currently in press, namely *Religious and Intellectual Diversity in the Islamicate World and Beyond* (with Omer Michaelis, published by Brill), and *Literary Snippets: Colophons across Space and Time* (with Senior Research Associate George A. Kiraz, published by Gorgias Press).

Over the course of the year, Schmidtke organized a number of online events and in-person meetings. These included the aforementioned lecture series “Scholarly Correspondences.” In collaboration with Gorgias Press and IAS Professor Angelos Chaniotis, Schmidtke continued to convene a series of online talks, “The Author's Voice,” featuring new publications in the field of NES. Four conferences were held,

namely “Medieval (and Premodern) Muslim Scholars at Work: A Symposium in Honor of Etan Kohlberg” (with former Member Joseph Witztum), “Yemen under the rule of Imam Yahya, 1904 through 1948: A critical assessment of the sources,” (with Marieke Brandt, Research Associate Valentina Sagaria Rossi, and Jan Thiele), “Multilingual Manuscripts in Middle Eastern Manuscript Traditions,” (with George A. Kiraz), and “Second Mainz-Princeton Symposium: Reflections on Byzantium from a Global Perspective” (with Zachary Chitwood and former Member Johannes Pahlitzsch).

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 U.K., Germany, Israel, Italy, Iran, and the U.S. Over the course of the year, the Members regularly met in a lively bi-weekly online seminar which was also frequented by Princeton University graduate students and faculty, former IAS Members, as well as occasional visitors.

Andrew W. Mellon Professor **Francesca Trivellato** remains interested in expanding the boundaries of economic history and uncovering the manifold traditions that inform this field of study. For the second time since joining IAS in 2018, she hosted a workshop jointly



Art historian Ewa Lajer-Burcharth returned to IAS for a second Membership in 2022–23. During her time at the Institute, she researched the transformation of drawing in the eighteenth century.

ANDREA KANE

organized with the Shelby Cullom Davis Center for Historical Studies at Princeton University. Held in March 2023, this one was titled “New Directions in Economic History” and featured scholars from many disciplinary tracks. She also spoke at two events on the Princeton campus: a dialogue with Jan de Vries (UC-Berkeley) on microhistory and global history and a roundtable on the work of Carlo Ginzburg at the School of Architecture.

In July 2022, Trivellato delivered the closing keynote at the World Economic History Congress in Paris, where she also organized one session with papers on the business history of pre-modern Eurasia and one showcasing the periodical that she co-edits, *Capitalism: A Journal of History and Economics*. In May and June 2023, she was Fernand Braudel Visiting Professor at the European University Institute in Florence, where she delivered a talk titled “The Ghosts of Max Weber in the Economic History of Pre-Industrial Europe.”

The “Early Modern Europe Plus” seminar met in person (with a hybrid option) throughout the academic year, gathering historians, literary scholars, and art historians of Europe and its empires as well as specialists of Africa and Islam. The titles of all the papers that were discussed can be found online.* Trivellato received valuable feedback from the seminar participants on her work-in-progress on the idea of economic justice and the meaning of inequality in pre-industrial Europe.

After a conference in Cambridge, U.K. in July 2022, she revised and submitted for consideration an article on the law of shipwreck and the contested eighteenth-century concept of “civilization,” co-written with former Member Guillaume Calafat.

In 2022–23, she published a volume that had been long in the making, *Classic Essays on Jews in Early Modern Europe*, co-edited with Jonathan Karp (Routledge, 2003), as well as three articles, all available in open access: with Tommaso Munari, “Gino Luzzatto and the Contested Place of Jews in the Economic History of Mediterranean Europe,” *Mediterranean Historical Review* (2022); with Claire Lemerrier, “1751 and Thereabout: A Quantitative and Comparative Approach to Notarial



Angelos Chaniotis, Professor in the School of Historical Studies, speaking as part of a panel discussion hosted by the Association of Members of the Institute for Advanced Study (AMIAS).

Records,” *Social Science History* (2022); and “Political Theories of Money and the Politics of Contextualization,” *European Law Open* (2022), which engages with the work of Stefan Eich, Member in the School of Social Science.

The French translation of her 2019 book *The Promise and Peril of Credit* appeared as *Juifs et capitalisme: Aux origines d'une légende* (Seuil, 2023) and was widely reviewed in French media.

In 2022–23, Professor Emerita **Caroline Walker Bynum** published reviews of Eugene Reynolds’s *Blood Theology* and Inbar Graiver’s *Asceticism of the Mind*. A lengthy interview with her appeared in *L’Homme. Europäische Zeitschrift für Feministische Geschichtswissenschaft* 33.1 (2022). She wrote a “retrospective review” of Marie-Dominique Chenu’s *La théologie au douzième siècle* (first published 1957; English translation 1968) for a new series in *Common Knowledge*. Her article on growing up in the American South, which first appeared in *Common Knowledge* in 2021, appeared in German translation in *Historische Anthropologie* in summer 2023.

In fall 2022, she spoke at a symposium at Rutgers University that celebrated the twentieth anniversary of the appearance of Susan Neiman’s *Evil in Modern Thought* and lectured at Hunter College and The New School in New York City.

In January, she received a Distinguished Career Award at the meeting of the American Catholic Historical Association, held in conjunction with the American Historical Association in Philadelphia. In the fall of 2022, she began a three-year term as a vice president for the American Philosophical Society, for which she organized a spring meeting panel on “the new autobiography,” at which IAS Professor Emeritus Yve-Alain Bois spoke. Currently, she is revising for publication an article on the vision of the hazelnut in Julian of Norwich’s *Showings*.

Professor Emeritus **Patrick J. Geary** returned to the Institute in October to give a lecture on genetic data as historical evidence for the “Evidence and Error” series organized by Myles W. Jackson, Akshay Venkatesh, Helmut Hofer, Nathan Seiberg, and Didier Fassin. Together with collaborators Krishna Veeramah, Yijie Tian, Deven Vyas, and István Koncz, he also held a workshop at Princeton University to explain his ongoing HistoGenes project.* The goal of the workshop was to explain how humanists and natural scientists can collaborate to understand the deep past. In October, he also delivered the plenary lecture at the HistoGenes annual plenary meeting in Budapest.*

The project, now in its third year, is producing detailed micro-studies of

different areas of the Carpathian basin in the early Middle Ages which will be appearing in a variety of scientific journals. In the next three years of the project, the HistoGenes team will weave these focused contributions together into a comprehensive study of the region's population from the fourth to tenth centuries. In May, he joined his co-Principal Investigator Walter Pohl and other team members in Ljubljana, Slovenia to present the preliminary results of his team's work on the transformation of what is today Slovenia to local archaeologists who are

collaborating on the project.

In June, he spoke at a conference in Cluj-Napoca Romania on the dangers and seductions of public history.

Two of his long-delayed articles appeared, one a tour d'horizon of Western Europe ca. 1000, during the lifetime of Oliba, Count of Berga, Abbot of Ripoll, and Bishop of Vic. The second assessed the place of music in Carolingian monastic culture from an historical perspective. In May, he gave the opening address at a conference hosted by the Central European University (CEU),

"Community, Identity, Individuals: Shaping the (Political) Nation in Premodern Europe." Finally, for the twenty-seventh and final time, he chaired M.A. defenses at that same university and gave the keynote lecture at the thirtieth and final anniversary of the founding of the Department of Medieval Studies at the CEU. The department is being dissolved and incorporated with the Department of History into a new Department of Historical Studies, a name taken from our own School of Historical Studies.

2022–23 MEMBERS AND VISITORS

f First Term ♦ *s* Second Term ♦ *m* Long-term Member ♦ *v* Visitor ♦ *vp* Visiting Professor ♦ *ra* Research Associate

Hassan Farhang Ansari

Islamic Law and Theology ♦ Institute for Advanced Study ♦ *vp*

Kyoungjin Bae

History of Early Modern China ♦ Kenyon College ♦ *f*

The Andrew W. Mellon Foundation Fellowship for Assistant Professors

Emily Baum

History of China, History of Medicine ♦ University of California, Irvine
George F. Kennan Member

Elizabeth B. Bearden

Renaissance Studies, Disability Studies ♦ University of Wisconsin-Madison

Funding provided by the Fund for Historical Studies; Felix Gilbert Member

Rebecca Benefiel

Classics, Roman Archaeology, Epigraphy ♦

Washington and Lee University

Friends of the Institute for Advanced Study Member

Joel Blecher

Islamic History, History of Capitalism ♦ The George Washington University ♦ *s*

Elizabeth and J. Richardson Dilworth Fellow

Susanne Bobzien

Philosophy ♦ University of Oxford

Funding provided by the Hetty Goldman Membership Fund and the Fund for Historical Studies

Christopher Bonura

Medieval Mediterranean and Global Middle Ages

Funding provided by the Fund for Historical Studies and the Herodotus Fund

Rosie Bsheer

History ♦ Harvard University ♦ *f*

Cemil Bülbül

Ancient History ♦ *v*

Pinar Bülbül

Anatolian History ♦ Kahramanmaraş Sütçü İmam Üniversitesi ♦ *v*

Ilaria Bultrighini

Ancient History, Epigraphy ♦ University College London ♦ *s*

Funding provided by the Fund for Historical Studies

Howard Chiang

History of Science ♦ University of California, Davis ♦ *f*

Funding provided by the Fund for Historical Studies

Joan Breton Connelly

Classical Archaeology ♦ New York University ♦ *s*

Funding provided by The Andrew W. Mellon Foundation

Esther Liberman Cuenca

Urban History, Legal History, Medievalism ♦

University of Houston–Victoria

The Andrew W. Mellon Foundation Fellowship for Assistant Professors

Anne Dunlop

History of Art ♦ The University of Melbourne

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Patrick J. Finglass

Classical Studies ♦ University of Bristol ♦ *f*

Elizabeth and J. Richardson Dilworth Fellow;

Funding provided by the Fund for Historical Studies

Yulia Frumer

History of Science and Technology ♦ Johns Hopkins University

Founders' Circle Member, in recognition of Deborah Lunder and Alan Ezekowitz

Paul Galvez

Art History ♦ *v*

Vincent Gayon

International Sociological History ♦ Université Paris-Dauphine

Funding provided by the Florence Gould Foundation Fund

Paul R. Goldin

Chinese History and Philosophy ♦ University of Pennsylvania

Funding provided by the Fund for Historical Studies; Roger E. Covey Member in East Asian Studies

Jeffrey L. Gould

Modern History, Latin America ♦ Indiana University ♦ *dvp*

Simcha Gross

Ancient History, Late Antiquity, Frontiers ♦

University of Pennsylvania

The Andrew W. Mellon Foundation Fellowship for Assistant Professors

Charles George Häberl

Linguistics and History of Religions ♦ Rutgers, The State University of New Jersey ♦ *f*

Funding provided by the Fund for Historical Studies; Willis F. Doney Member

Evan Haefeli

History of Religion, Atlantic World ♦ Texas A&M University ♦ *s*

Funding provided by The Gladys Krieble Delmas Foundation

Bruce Stewart Hall

History of Africa ♦ University of California, Berkeley

Hans Kohn Member

Yasmin Annabel Haskell

Neo-Latin, History of Emotion, Jesuits ♦ University of Western Australia

Funding provided by the Fund for Historical Studies; Martin L. and Sarah F. Leibowitz Member

Guy Hedreen

Art, Literature and Culture of Ancient Greece ♦
Williams College ♦ *f*
*Funding provided by The Andrew W. Mellon
Foundation Fund*

Christopher P. Jones

Classical Philology and History ♦ Harvard
University ♦ *ra*

Elizabeth Kassler-Taub

History of Architecture ♦ Dartmouth College ♦ *s*
Funding provided by the Herodotus Fund

David Kennedy

Archaeology, History of the Roman Near East ♦
University of Western Australia ♦ *v/s*

Juliette Kennedy

Foundations of Mathematics ♦ University of
Helsinki ♦ *v/f*

Mansoor Khallilzand

Islamic Philosophy ♦ Westphalian Wilhelm
University of Münster ♦ *v/f*

George A. Kiraz

*Ottoman History of Religious Minorities, Syriac
Studies* · Beth Mardutho: The Syriac Institute · *ra*

Thiago Nascimento Krause

Early Modern History, Brazil in the World ♦
Universidade Federal do Rio de Janeiro
Funding provided by the Herodotus Fund

Verena Krebs

Medieval History, Ethiopian History ♦ Ruhr-
Universität Bochum
Gerda Henkel Stiftung Member

Derek Krueger

Religion in Late Antiquity and Byzantium ♦ The
University of North Carolina at Greensboro
George William Cottrell, Jr. Member; *Funding provided
by the Fund for Historical Studies*

Thomas Kruse

Ancient History ♦ Austrian Academy of Sciences ♦
v/s

Ewa Lajer-Burcharth

History of Art ♦ Harvard University
*Funding provided by the Fund for Historical Studies
and the Ruth Stanton Foundation Fund*

Christopher Lakey

History of Art, Medieval Studies ♦ Independent
Scholar ♦ *f*
*Funding provided by the Fund for Historical Studies;
William D. Loughlin Member*

Georg Leube

Islamic Studies ♦ Universität Bayreuth
*Funding provided by the Fund for Historical Studies
and the Alexander von Humboldt Foundation*

Ari Daniel Levine

Chinese History, History of Knowledge ♦ University
of Georgia
*Funding provided by the Fund for Historical Studies;
Starr Foundation East Asian Studies Member*

Renee Levine Melammed

*Jewish History, Women's Studies, and Sephardic
Jewry* ♦ Schechter Institute of Jewish Studies ♦ *v*

Sara Lipton

History of Religion, Cultural History ♦ Stony Brook
University, The State University of New York ♦ *f*
Elizabeth and J. Richardson Dilworth Fellow

Manling Luo

Premodern Chinese Literature and Culture ♦ Indiana
University ♦ *s*
Starr Foundation East Asian Studies Member

Elizabeth McGowan

Ancient Art ♦ Williams College ♦ *v*

Uri Melammed

Yemenite Jewry, Semitic Languages ♦ The Hebrew
University ♦ *s*
Patricia Crone Member

Emily Mokros

Chinese History ♦ University of Kentucky ♦ *s*
Funding provided by the Herodotus Fund

Melissa Moreton

History of the Book, Global Middle Ages · *ra*

Philipp Nothaft

History of Science ♦ University of Oxford ♦ *s*
AMIAS Member

Nana Osei-Opare

Africa, the Cold War, Black Political Thought ♦
Fordham University
*The Andrew W. Mellon Foundation Fellowship for
Assistant Professors*

Arnaud Pelletier

Early Modern Philosophy ♦ Université Libre de
Bruxelles ♦ *f*
Funding provided by the Fund for Historical Studies

Susan Dabney Pennybacker

Modern British and Transnational History ♦ The
University of North Carolina at Chapel Hill ♦ *s*
George F. Kennan Member

Meron Martin Piotrkowski

Ancient Jewish History and Jewish Papyrology ♦
Seeger Center for Hellenic Studies ♦ *f*
Funding provided by the Herodotus Fund

Pamela Maxine Potter

Music History, German Cultural History ♦
University of Wisconsin–Madison ♦ *s*
Infosys Member

Reza Pourjavady

Islamic Intellectual History ♦ Otto-Friedrich-
Universität Bamberg
Patricia Crone Member

Leila Rahimi Bahmany

*Comparative Literature, Persian Literature, Azeri
Turkish Literature* ♦ *v*

Christopher Ratté

Classical Archaeology ♦ University of Michigan ♦ *s*
*Funding provided by The Andrew W. Mellon
Foundation Fund*

Ali Raza

South Asia, Internationalism, Decolonization ♦
Lahore University of Management Sciences
Willis F. Doney Member

Valentina Sagaria Rossi

Zaydi Manuscript Tradition, Arabic Codicology ♦
Accademia Nazionale dei Lincei ♦ *ra*

Michele Renee Salzman

Roman History ♦ University of California,
Riverside ♦ *v/f*

Anna Sehnalova

Asian Studies, Anthropology ♦ University of
Oxford ♦ *f*
Funding provided by the Herodotus Fund

Sharon Therese Strocchia

European History, Social History of Medicine ♦
Emory University ♦ *f*
*Funding provided by The Andrew W. Mellon
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Luke Sunderland

Medieval Literature and Culture ♦ Durham
University ♦ *s*
*Funding provided by the Fund for Historical Studies
and the Patrons' Endowment Fund*

Judith Surkis

Modern European History ♦ Institute for Advanced
Study

Maria Theodoropoulou

Linguistics ♦ Aristotle University of
Thessaloniki ♦ *v/s*

Anicia C. Timberlake

Musicology ♦ Peabody Institute of the Johns
Hopkins University ♦ *f*
Edward T. Cone Member in Music Studies

Stephen V. Tracy

Greek History and Epigraphy ♦ The American
School of Classical Studies at Athens ♦ *ra*

Allan A. Tulchin

French History ♦ Shippensburg University ♦ *s*
Willis F. Doney Member

Alla Vronskaya

History of Modern Architecture ♦ University of
Kassel ♦ *v*

Alicia Walker

Medieval Art and Architectural History ♦ Bryn
Mawr College
Agnes Gund and Daniel Shapiro Member

David Wilton

Linguistics, Medieval Literature ♦ *v*

Helmut Zander

Religion and Politics in Christianity and Islam ♦
Albert-Ludwigs-Universität Freiburg ♦ *v/s*

Mantha Zarmakoupi

Classical Archaeology, History of Architecture ♦
University of Pennsylvania ♦ *s*
Edwin C. and Elizabeth A. Whitehead Fellow

Peter Zarrow

Modern China, Intellectual and Cultural History ♦
Institute of Modern History, Academia Sinica
*Funding provided by the Hetty Goldman Membership
Fund*

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 remains an international center for mathematics and theoretical computer science research. Each year, the School appoints Members from all mathematical subject areas and career levels. This includes around 20 memberships for those participating in the annual special year program.

FACULTY

Bhargav Bhatt

Fernholz Joint Professor

Camillo De Lellis

IBM von Neumann Professor

Helmut Hofer

Hermann Weyl Professor

Jacob Lurie

Frank C. and Florence S. Ogg Professor

Peter Sarnak

Gopal Prasad Professor

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 MacPherson

Thomas Spencer

Each week, the School of Mathematics gathers for informal Mathematical Conversations, during which a scholar presents their latest work for discussion, accompanied by snacks and refreshments. In March 2023, Visitor Or Zamir took to the blackboard to share a crash course in cryptography.

In addition to activities surrounding the special year on dynamics, additive number theory, and algebraic geometry, Faculty in the School worked on translating problems in algebra to potentially more tractable questions in topology, investigating the nature of singularities for area-minimizing integral currents, examining the spectra of locally uniform geometries, and more. Visiting scholars who joined the School for the year, including 60 Members and 14 Visitors, worked on topics such as the efficiency of quantum proofs and bridges between symplectic geometry and the field of hyperbolic dynamics. Events hosted by the School included conferences to honor the contributions of Distinguished Visiting Professor Karen Uhlenbeck and to celebrate 100 years of Noetherian Rings, as well as an interdisciplinary seminar on the theme of “Evidence and Error,” in conjunction with Faculty from the other three Schools.

During the 2022–23 academic year, the School hosted a **special year** titled “Dynamics, Additive Number Theory, and Algebraic Geometry.” Tamar Ziegler of The Hebrew University of Jerusalem was the Distinguished Visiting Professor. Participants included Karim Adiprasito, Vitaly Bergelson, Jan Draisma, James Maynard, Sarah Peluse, and Terence Tao. The year focused on (still-evolving) interfaces between ergodic theory, additive combinatorics, multiplicative number theory, and algebraic geometry.

In the past 20 years, there have been spectacular interlacing advancements in ergodic theory, analytic number theory, and additive combinatorics, leading to the resolution of long standing conjectures. A well-known example is the Green-Tao theorem on arithmetic progressions in primes. A more recent example is the proof of the logarithmic Sarnak conjecture for uniquely ergodic systems; this proof combines structure theorems from dynamics and additive combinatorics with the recent understanding of the behavior of multiplicative functions in short intervals. One focus of the special year was to further advance the interaction between these fields.

Another goal of the program was to advance the interplay between additive combinatorics, theoretical computer science, and algebraic geometry over rings with many variables. In recent years, there is growing interest in stability phenomena in algebraic geometry, specifically in properties of polynomial rings that are stable in the number of variables (e.g., Stillman conjecture). Problems of a similar nature were independently studied by researchers in additive combinatorics in relation to Ramsey questions in finite field geometry. The two contexts are linked via model theory. The program brought together researchers on both sides to explore this connection further.

In his first year, **Bhargav Bhatt**, Fernholz Joint Professor, investigated arithmetic and algebraic geometry in a p -adic world.

Motivated by applications to the cohomology of Shimura varieties (suggested by Lue Pan at Princeton University), Bhatt recently obtained a fairly optimal integral form of Kodaira’s vanishing theorem in mixed characteristic, refining the work he reported at the Institute’s Noether conference in June 2023.

The previous work relies on leveraging the p -adic Riemann-Hilbert correspondence to translate problems in algebra to potentially more tractable questions in topology. A simpler and more complete instance of this translation, in positive characteristic,

was the subject of Bhatt’s recently concluded joint work with Manuel Blickle, Gennady Lyubeznik, Anurag K. Singh, and Wenliang Zhang.

In the fall of 2022, Bhatt gave a course at Princeton University on his ongoing joint work with Jacob Lurie on prismatic F -gauges; these are recently discovered objects in p -adic geometry, analogous to variations of Hodge structures in complex geometry. This course, aimed at advanced graduate students and postdocs, first built up to the definition of F -gauges in a leisurely fashion; it then explained some of the main currently known results about them, including a crystalline refinement of the classical local Tate duality theorem.

Member Bogdan Zavyalov delved deeply into sheaf theoretic questions in arithmetic algebraic geometry and obtained results on nearby cycles of IC-sheaves in nonarchimedean geometry, on axiomatic Poincaré duality in a wide range of contexts, and on non-abelian Hodge theory in positive characteristic via stacks.

With Pan and Zavyalov, Bhatt began a new joint arithmetic geometry seminar between IAS and Princeton University in 2023. In its first semester, the seminar featured talks on a variety of topics at the boundary of algebraic geometry and number theory, such as motivic homotopy theory, moduli of local systems, geometric Langlands over a p -adic field, and the arithmetic minimal model program.

The activities in geometric analysis and partial differential equations at IAS, led by IBM von Neumann Professor **Camillo De Lellis**, have witnessed some important breakthroughs in two areas of geometric analysis: the interaction between topology and curvature conditions in smooth Riemannian manifolds and the theory of singularities for solutions to geometric variational problems.

Elia Bruè, Member of the School in the fall semester, together with Aaron Naber and Daniela Semola, disproved a conjecture by Milnor dating back to 1968. Milnor conjectured that the fundamental group of a complete manifold with nonnegative Ricci curvature is always finitely generated. On the contrary, Bruè, Naber, and Semola found a striking counterexample, namely a 7-dimensional manifold with nonnegative Ricci curvature whose fundamental group is homomorphic to the quotient of the rational numbers with the integer numbers. The work of the three authors contains some striking new ideas, in particular a new topological



In October 2022, a celebration was held in recognition of the work of Member (1968–69) Andrew P. Ogg, who endowed the Frank C. and Florence S. Ogg Professorship in the School of Mathematics. At the event, Winnie Li, Distinguished Professor of Mathematics at Penn State University, discussed the impact of Ogg’s work on modular forms through personal encounters.

construction which builds manifolds with infinitely generated fundamental groups (and which can be interpreted as a smooth version of the classical fractal snowflake) and a careful analysis of the mapping class group of diffeomorphisms of the product of two 3-dimensional spheres.

De Lellis, together with his Ph.D. student Anna Skorobogatova and Veblen Research Instructor Paul Minter, has spent most of the year investigating the nature of singularities for one of the most common examples of orientable minimizers of the area, called area-minimizing integral currents. In three joint papers posted in the spring on the arXiv preprint server, De Lellis, Minter, and Skorobogatova solved a 40-year open problem in the area, proving that the singular set of an m -dimensional area-minimizing integral current is always an $(m-2)$ -dimensional “rectifiable” set. It was shown by Federer in the 1960s that such singularities can indeed form an $(m-2)$ -dimensional set, as he provided, among many others, examples of two-dimensional area-minimizing oriented surfaces in the four-dimensional Euclidean space with point singularities. A celebrated result of Almgren at the end of the seventies showed that the dimension of the singularities can never exceed the one of Federer’s examples. At the time of its completion, Almgren’s monograph

consisted of 1728 typewritten pages, but his regularity theory was greatly simplified around 10 years ago, paving the way to a considerable amount of activity in the area. The rectifiability question has been a pivotal open problem: in a nutshell an $(m-2)$ -rectifiable set has a structure which resembles much more what we intuitively understand as an $(m-2)$ -dimensional surface. For instance, the theorem by De Lellis, Minter, and Skorobogatova excludes that the singular set can be an $(m-2)$ -dimensional fractal. On the other hand, this is essentially the optimal structural result without additional information on the geometry of the minimizer: in 2021, Zhenhua Liu (Ph.D. student at Princeton University, advised by Camillo De Lellis) found examples with singularities which form lower-dimensional fractals.

Helmut Hofer, Hermann Weyl Professor, led the research in symplectic geometry and dynamics at IAS. The research group consisted of Members Alexey Balitskiy, Ipsita Datta, Agustin Moreno, Jo Nelson, Shira Tanny, and von Neumann Fellow Vinicius Gripp Barros Ramos. The group organized, with Princeton University, the “Joint Symplectic Geometry Seminar” and the international “Symplectic Zoominar” jointly with Université de Montréal, Université de Paris-Saclay, Princeton University, and Tel Aviv University.

A large part of the broad activity focused on the understanding of the dynamics of Hamiltonian systems by developing new analytical and geometric tools.

In collaboration with Oleg Lazarev, Thomas Massoni, and former Member Kai Cieliebak, Moreno has explored a novel bridge between symplectic geometry and the well-established field of hyperbolic dynamics. On the applied side, Moreno continued his collaboration with Dayung Koh (JPL-NASA) and Urs Frauenfelder, with the addition of Cengiz Aydin. Using the new ideas, they have produced numerical studies of periodic orbits for satellites in the Jupiter-Europa system, by deformation of the classical Hill lunar problem.

Nelson, jointly with Morgan Weiler, finished a paper succeeding in the notoriously difficult computation of torus knot filtered embedded contact homology of the tight contact 3-sphere in a large class of cases. Datta continued her work with former Member Joshua Sabloff on defining invariants for Lagrangian tangles. She profited from Nelson’s expertise on obstruction bundle gluing—a powerful technical tool—which will be important for the technical part of her project with Sabloff.

Ramos, in joint work with Daniele Sepe and former von Neumann Fellow

Yaron Ostrover, studied connections between billiards in simplices and symplectic equivalences using the Toda lattice. Balitskiy, motivated by discussions with Ramos, studied the behavior of symplectic balls in symplectic vector spaces. He was particularly interested in the characterization of all symplectic balls which are Lagrangian products of polytopes. The new results by Ramos and Balitskiy provide more evidence for the well-known fundamental Viterbo conjecture (2000) and the classical Mahler conjecture (1939). (Mahler and Viterbo are former Members.)

Member Shira Tanny and Visitor Julian Chaidez continued their work on the smooth closing lemma, which implies a generic property of Hamiltonian flows, and developed a more direct approach that significantly extends the class of flows for which their strong version applies. Together with Lev Buhovsky, Tanny proved a dichotomy for solutions to the Floer equation that cross a given distance. Either their energy is bounded below (as for holomorphic curves) or they follow the direction of gradient flow lines. This established dichotomy is important in understanding generic properties of Hamiltonian flows by Floer-theoretic methods.

Jacob Lurie, Frank C. and Florence S. Ogg Professor, is primarily interested in the interplay between homotopy theory and algebraic geometry. Broadly speaking, the goal of homotopy theory is to study topological spaces by means of algebraic



ANDREA KANE

While at IAS, Member Agustin Moreno continued his work into the well-known restricted 3-body problem from a theoretical standpoint, with a view towards practical applications such as space mission design.

invariants, such as singular cohomology with coefficients in a field. Generally, these invariants are more powerful (and subtle) when the coefficient field has positive characteristic. In this case, they carry a rich structure given by Steenrod operations, which have no counterpart for rational cohomology. Understanding these operations has played an important role in resolving many important questions (for example, the proofs of the Segal and Sullivan conjectures in the 1980s).

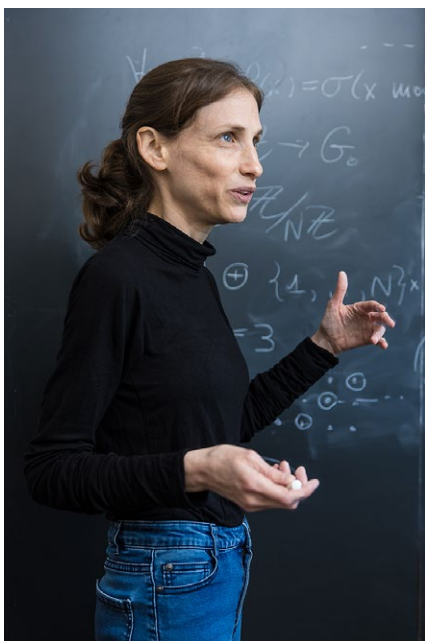
These ideas have begun to penetrate the world of algebraic geometry. In

the 1990s, past IAS Professor Vladimir Voevodsky initiated the study of motivic homotopy theory, which uses concepts from classical topology to study algebraic varieties. Within this framework, he constructed an analogue of singular cohomology (called motivic cohomology) and showed that, in characteristic zero, there are motivic counterparts of Steenrod operations. This led to important advances in algebra: most notably, Voevodsky's proofs of conjectures of Milnor and Bloch-Kato. His ideas were extremely influential and have directly impacted the work of



ANDREA KANE

Scholars from the School of Mathematics engage in teatime discussions with colleagues from other Schools.



During her time at IAS, AMIAS Member Rachel Greenfeld combined Fourier analysis and combinatorial techniques with ergodic theory and number theory tools to study problems of tilings and orthogonal systems of exponentials.

several current Members, including Hana Jia Kong (who has applied ideas from motivic homotopy theory to simplify calculations in classical topology), Piotr Pstragowski and Peter James Haine (who jointly discovered a new interpretation of the stable version of Voevodsky's theory), and Toni Mikael Annala (who has extended Voevodsky's ideas to settings without homotopy-invariance). For this reason, the School of Mathematics ran a seminar on this circle of ideas (led by Professors Bhatt, Lurie, and Venkatesh).

Recently, there has been a significant progress in applying topological ideas to the study of algebraic geometry in mixed characteristic, culminating in the introduction (by Bhatt and Peter Scholze) of a new invariant called prismatic cohomology. Unlike motivic cohomology, prismatic cohomology is not homotopy-invariant, and therefore does not fall within the purview of Voevodsky's theory. Over the past year, Lurie has been working to understand the counterparts of Steenrod operations in the prismatic setting. Blending earlier joint work with Bhatt (on the geometry of prismatic F -gauges) with ideas from chromatic homotopy theory, he has formulated (and

partially proved) some conjectures about their existence and expected behavior.

Gopal Prasad Professor **Peter Sarnak** and some of his long-term collaborators and current students continued their investigations of the spectra of locally uniform geometries.

Such spectra are closely related to central problems in number theory when the geometric object is defined arithmetically. More generally, they have varied applications in problems of optimal design in engineering and in physics.

A unifying picture that emerged recently is that the inverse problem of prescribing spectral gaps for large such geometries in the Euclidean setting reduces to fundamental (and mostly unresolved) problems of Mahler in the classical geometry of numbers, while in the non-Euclidean setting it amounts to a rich and challenging continuation and extension of the much studied "Bass Note Spectrum." This viewpoint led naturally to revisiting these classical problems with modern tools and vice-versa, and it has resulted in a number of advances and uncovered some surprising

new connections. The expectation is that this unified viewpoint will bring us closer to a complete understanding of these spectral problems.

Sarnak and his students were also regular and active participants in the seminars and workshops of the special year program.

For the past few years, **Akshay Venkatesh**, Robert and Luisa Fernholz Professor, has been working on a project with David Ben-Zvi and Yiannis Sakellaridis to elaborate "relative Langlands duality." This can be viewed as a certain extension of the Langlands program. The larger context of this project, however, is the surprising parallel between phenomena in number theory and 3-dimensional geometry, and Venkatesh hopes that the lessons learned from the study of relative Langlands duality will clarify some aspects of this relationship.

Herbert H. Maas Professor **Avi Wigderson** and the members of his Computer Science and Discrete Mathematics (CSDM) group were engaged in research on a diverse set of topics, each representing significant



At IAS, Member Ipsita Datta explored applications of holomorphic curve techniques to the study of Lagrangians.



ANDREA KANE

During the celebration held in honor of the Frank C. and Florence S. Ogg Professorship, John Duncan of Emory University and Academia Sinica explained how Andrew P. Ogg's works have guided the maturation of moonshine from its inception to the present, and continue to shape its future perspective.

progress. Members Fernando Granha Jeronimo and Pei Wu studied the efficiency of quantum proofs (where quantum computers verify “entangled” proofs). Member Roei Tell and his collaborators worked on the long-standing challenge of understanding the power of randomness in efficient algorithms. Visitor Orit Raz and collaborators researched the elusive notion of structural rigidity of graphs. Past von Neumann Fellow Ronen Eldan and Wu, in collaboration with Wigderson, studied topics in the analysis of Boolean functions, of particular interest to the power of coalitions of voters to influence voting schemes. Veblen Fellow Matija Bucic and collaborators worked on new notions of expander graphs (sparse but fault-tolerant networks) and their

applications. Members Leonardo Coregliano and Jeronimo found new methods for approaching the central coding theory question of the trade-off between redundancy and noise-tolerance of error-correcting codes. Visiting Professor Toniann Pitassi and collaborators defined and explored notions of reproducibility in machine learning.

Professor Emeritus **Phillip Griffiths** gave several talks on his research in algebraic geometry at various institutions including Rutgers University, University of Miami, Stony Brook University, and Tsinghua University. Griffiths also organized several conferences at the Institute of the Mathematical Sciences of the Americas at the University of Miami. He also had a paper published, “Differential of a period mapping at a

singularity,” with his co-author Mark Green in *Pure and Applied Mathematics Quarterly*. Together with former Director's Visitor Robert Bryant and former Member Jeff Cheeger, Griffiths organized and contributed to a memorial issue for Isadore Singer for the *Notices of the American Mathematical Society*.

2022–23 MEMBERS AND VISITORS

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

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Ergodic Theory, Combinatorics ♦ Institute for Advanced Study
 Funding provided by the National Science Foundation

Karim Alexander Adiprasito

Combinatorics, Algebra, Geometry ♦ Einstein Institute for Mathematics ♦ *s*
 Funding provided by The Ambrose Monell Foundation

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

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 Funding provided by the National Science Foundation

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 Funding provided by the National Science Foundation

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 Funding provided by the Charles Simonyi Endowment

Jacob Bernstein

Geometry ♦ Johns Hopkins University
 Funding provided by the Charles Simonyi Endowment

Arthur Bik

Algebraic Geometry, Representation Theory ♦ Institute for Advanced Study
 Funding provided by the Simons Foundation

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Partial Differential Equations ♦ Institute for Advanced Study ♦ *v*

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 Funding provided by the National Science Foundation

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 Funding provided by the National Science Foundation

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Number Theory ♦ Institute for Advanced Study
 Funding provided by the National Science Foundation

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 Funding provided by the National Science Foundation

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Algebra ♦ Universität Bern ♦ *f*

Sergio Fenley

Low-Dimensional Topology, Dynamical Systems ♦ Florida State University

Nikos Frantzikinakis

Mathematics ♦ *s*
 Ralph E. and Doris M. Hansmann Member

Alexander Gamburd

Mathematics ♦ University of California, Santa Cruz ♦ *f*

Federico Glaudo

Mathematics ♦ Institute for Advanced Study
 Funding provided by the National Science Foundation

Mark Goresky

Geometry, Automorphic Forms ♦ Institute for Advanced Study ♦ *v*

Fernando Granha Jeronimo

Theoretical Computer Science ♦ Institute for Advanced Study
 Funding provided by the National Science Foundation

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 AMLAS Member

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

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Michael Harrison

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 Funding provided by the National Science Foundation

Wei Ho

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D. Dominique Kemp

Harmonic Analysis ♦ Institute for Advanced Study
 Shiing-Shen Chern Member

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 Funding provided by the National Science Foundation

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 Funding provided by the National Science Foundation

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Algebra ♦ Indiana University ♦ *f*

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Mathematics ♦ Nicolaus Copernicus University in Toruń
 Funding provided by the Giorgio and Elena Petronio Fellowship II Fund

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Representation Theory ♦ Institute for Advanced Study
 Funding provided by the National Science Foundation and the University of Melbourne

Noam Lifshitz

Combinatorics ♦ The Hebrew University of Jerusalem ♦ *v/f*
 Bell System Fellowship

Hans Lindblad

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Ayelet Lindenstrauss

Algebraic Topology + Indiana University + v/f

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Friends of the Institute for Advanced Study Member

Paul Minter

Geometric Analysis + Institute for Advanced
Study + vri

Mariusz Mirek

Fourier Analysis, Ergodic Theory + Universität Bonn

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Supported by Eric and Wendy Schmidt

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Geometric Group Theory + Institute for Advanced
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Mathematics + Rice University + s
Stacy and James Sarvis Founders' Circle Member

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Computational Complexity, Proof Theory +
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Funding provided by the National Science Foundation

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Probability, Mathematical Physics + Institute for
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Funding provided by the James D. Wolfensohn Fund

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Probability, Machine Learning + Institute for
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Patrick Shafto

Machine and Human Learning + Rutgers
University–Newark + v

Or Shalom

Mathematics + Institute for Advanced Study
Funding provided by the National Science Foundation

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Technology + vp

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Or Zamir

Algorithms, Data Structures, Graph Theory,
Combinatorics + Institute for Advanced Study + v

Bogdan Zavyalov

Mathematics + Institute for Advanced Study
Funding provided by the Charles Simonyi Endowment

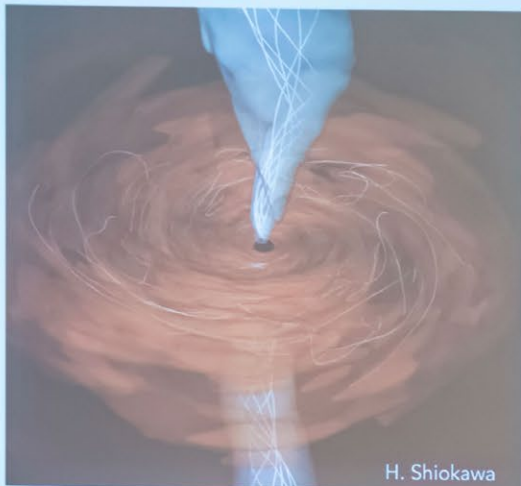
Tamar Ziegler

Mathematics + Technion–Israel Institute of
Technology + dvp

School of Natural Sciences

The School of Natural Sciences, established in 1966, supports research in broad areas of astrophysics, systems biology, and theoretical physics. Each year, the School 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 in the School's many scientific areas and among scholars in the Institute's School of Mathematics, Princeton University, and the larger scientific community.

Blandford & Znajek 1977



4/10

FACULTY

Nima Arkani-Hamed

Stanislas Leibler

Juan Maldacena

Carl P. Feinberg Professor

Nathan Seiberg

Charles Simonyi Professor

James Stone

Michail Tsodyks

C.V. Starr Professor

Matias Zaldarriaga

Richard Black Professor

PROFESSORS EMERITI

Stephen L. Adler

Peter Goddard

Peter Goldreich

Arnold J. Levine

Scott Tremaine

Edward Witten

George Nathaniel Wong, Frank and Peggy Taplin Member, presented a "Big Ideas" talk at Founders Day 2023. Wong uses numerical methods and analytic modeling to study high-energy astrophysical phenomena.

This academic year, the Faculty of the School of Natural Sciences investigated questions which include but are not limited to how “dark energy” drives the accelerated expansion of the universe, the role of wormholes in violating global symmetries in gravity theories, and how recognition and recall relate to each other in the context of human memory. Many scholars, including 60 Members and 9 Visitors, joined the School during the year, working on topics ranging from galaxy formation and scattering amplitudes in quantum field theory to the dynamics of ecological systems. The School hosted numerous events that included a workshop on spacetime and quantum information and a meeting on flares and bursts in galactic nuclei.

Astrophysics

Professor **James Stone** has been continuing his work to investigate the gas dynamics of accretion flows onto black holes. Having developed novel numerical algorithms for general relativistic radiation transport and magnetohydrodynamics (MHD) running on modern exascale supercomputers, Stone—along with current and former Members Elias Most, Patrick Mullen, and George Nathaniel Wong—is investigating the radiation-dominated regime of accretion, where the radiation field produced by the accreting flow dominates the dynamics. The goal is to model theoretically the observed luminosity and variability of observed systems such as quasars and X-ray binaries. This work has been enabled by an allocation of over 4M hours per year on supercomputers hosted by the Department of Energy (DOE) through the highly competitive INCITE program. In addition, along with collaborators at the Pennsylvania State University, Stone and physics graduate student Hengrui Zhu have implemented numerical methods to solve Einstein’s equations on supercomputers in order to study the dynamics of matter in regimes where spacetime is also evolving rapidly, such as mergers of neutron stars, or accretion flows around binary black holes. The excellent performance of this new numerical relativity code on the world’s largest computers will enable calculations in heretofore inaccessible regimes, such as mergers involving large mass ratios or highly elliptical orbits.

Stone is also working with Members and visiting graduate students to apply these numerical methods to a variety of other problems. This includes the properties of MHD turbulence in astrophysical accretion disks (with Member Tomohiro Ono), the feeding of black holes from the intergalactic medium (with Minghao Guo and Eliot Quataert), the growth of magnetic fields via dynamo action in accretion disks (with visiting graduate student Goni Halevi and Elias Most), and the properties of MHD turbulence in special relativistic flows (with Most).

Over the past year, Richard Black Professor **Matias Zaldarriaga**, in collaboration with both current and former colleagues, has delved into various research areas, enhancing our understanding of cosmic phenomena.

In one study, Member Giovanni Cabass and former Member Marko Simonović joined forces with Zaldarriaga to explore the potential of perturbative forward modeling for constraining cosmological parameters. Their analysis revealed how perturbative

methods might provide a unique perspective, particularly when examining the field-level posterior distribution. This research marks a significant stride towards creating simpler yet more effective tools for grasping the universe’s dynamics. These tools are expected to extract additional cosmological insights from forthcoming galaxy surveys.

Another endeavor involved Members Mikhail M. Ivanov and Cabass, former Member Simonović, and other contributors, visiting graduate student Oliver H. E. Philcox and Takahiro Nishimichi. Collectively, they formulated a comprehensive framework for analyzing the full bispectrum of the galaxy distribution, accounting for redshift space distortions. Their pioneering work, which includes a new algorithm and meticulous testing across different datasets, enriches the suite of tools the community relies on to study vast cosmic structures. When applied to existing data, it yielded enhanced constraints on cosmological parameters. The data and tools resulting from this research are now accessible to the public.

On another front, former Members Barack Zackay and Tejaswi Venumadhav Nerella partnered with Javier Roulet, Hang You, and others for the IMRPhenomXODE project. Their objective was to forge a more precise model for gravitational-wave signals originating from precessing binary black holes (BBHs). The results represent a considerable enhancement, particularly concerning the model’s precision for specific black hole configurations.

Members Horng Sheng Chia and Digvijay Wadekar collaborated with Venumadhav and Zackay. Thomas D. P. Edwards, Aaron Zimmerman, and Seth Olsen also contributed to this endeavor. Their research initiated an innovative search in gravitational wave data, emphasizing binaries with members exhibiting pronounced tidal deformabilities. This search has established the groundwork for inventive methods in gravitational wave data analysis, introducing a novel perspective for uncovering distinct celestial events.

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 different organizational levels of biological systems.

In 2022–23, Leibler continued his studies of nonequilibrium

aspects of biological phenomena. In particular, he finalized his collaborative work on nonlinear elastic theory of proteins, and on a dynamical systems theory for the phenomenon of genetic assimilation, discovered and described 70 years ago by C. H. Waddington. This research was done in collaboration with two former IAS Members: Bing-Kan Xue and Pablo Sartori, as well as Archishman Raju.

As a main focus of his research, Leibler has also been developing a new line of investigation connected with complex terrestrial ecosystems. Together with Members Nicolas Lenner and Sirio Belga Fedeli, he has continued learning and thinking about soil ecosystems critical for sustainable plant growth, and in particular about agroecology.

C.V. Starr Professor **Michail “Misha” Tsodyks** continued his investigation of human memory together with Member Tankut Can, Visitor Mikhail Katkov, and past Visitor Antonios Georgiou. In the latest project, they studied the way subjects remember spoken narratives that were previously analyzed by William Labov. In particular, an interesting

question is how recognition and recall memory relate to each other when narratives become longer and hence contain more information. This project requires an extensive use of recently developed Large Language Models (LLMs) such as GPT4. Using LLMs, Tsodyks and his colleagues create multiple narratives of a predetermined length, segment them into meaningful short parts (clauses), and then determine which clauses are recalled. They also use LLM to generate ‘lures,’ i.e., clauses that could conceivably be part of the narrative but are not, and use them for recognition experiments to determine how many clauses are encoded in memory when subjects read the narrative. One of the goals of the project is to establish the scaling relation between the number of clauses retained in memory after acquisition of the narrative (M) and the number of clauses that subjects can recall (R). In a previous project by Tsodyks, a random list of items was used for studying memory. The square root scaling was predicted and confirmed experimentally, based on the idea that the recall process converges to a cycle due to random transitions between recalled items. In the case of meaningful

material such as narrative, it can be assumed that recall will preferentially progress in the correct order, hence changing the scaling. Indeed, the preliminary results show that recall is scaling linearly with memory.

In another project, Tsodyks and Member Gianluigi Mongillo developed a neural network model of working memory that is based on the idea previously proposed by them that working memory is kept by short-term plasticity of synaptic connections in the brain. This model accounts for numerous experimental observations and in particular allows for a natural explanation for otherwise unexplained very limited working memory capacity or approximately four items. The crucial aspect of working memory that was not accounted for by the previous model, as by all biologically motivated models, is the representation of temporal order. When several items are presented to people, they typically recall them in the correct order even if not explicitly instructed to do so. Tsodyks and Mongillo proposed that temporal order is represented by the so-called ‘primacy gradient,’ i.e., the gradual accumulation of representation



ANDREA KANE

Tankut Can, Eric and Wendy Schmidt Member in Biology, speaking to his Systems Biology colleagues at a blackboard. In his research, Can uses random matrix theory and statistical physics to study problems in machine learning and neuroscience.

strength of an item depending on how long it is encoded in working memory. The biological underpinning of the primacy gradient could be a specific form of short-term synaptic facilitation that is characterized by relatively long decay time of a few tens of seconds, such that the longer the item is in working memory, the more it accumulates the synaptic strength via facilitation. The model is currently being developed further to confront its predictions with experimental observations on working memory and to suggest further experimental tests.

In 2022–23, Professor Emeritus **Arnold J. Levine** and Research Associate Victor Mikhaylov addressed the problem of accurate and convenient-to-use pMHC modeling to predict which major histocompatibility complex (MHC) protein peptides will be presented on a cell's surface for T-cell surveillance and which T-cell receptors would recognize them. T-cells are crucial in affecting and regulating immune responses to infection, cancer, and autoimmunity. Their ability to recognize and respond to infected or abnormal cells is mediated by the interaction between T-cell receptors and peptides presented by MHC proteins on the cell surface. Reliable *in silico* prediction of which peptides will be presented and the T-cell receptors that will recognize them is an important problem in structural immunology, and is essential for designing effective vaccines and immunotherapies. Mikhaylov and Levine developed and tested an AlphaFold-based pipeline for predicting the three-dimensional structures of peptide–MHC complexes for class I and class II MHC molecules that demonstrates high accuracy, outperforming existing tools in class I modeling precision and class II peptide register prediction, and explored applications of this method to improving peptide–MHC binding prediction. Their method (TFold), posted to bioRxiv in March, 2023, uses paired pMHC template assignment, paired pMHC multiple-sequence alignments, and peptide register filtering with a sequence-based neural net.

Another continuing collaboration led by Levine has been studying DNA sequencing of 21 breast cancers from



Brian Swingle, Junior Visiting Professor (2018), presenting at the 2022 Qubit workshop on the subject of holographic measurements and quantum teleportation.

individuals with Li-Fraumeni Syndrome (in which one out of the two inherited copies of the *TP53* gene each of us has in every cell is not fully functional) showed that the loss of p53 function results (about 50% of the time) in the amplification of a cellular growth factor receptor gene called HER-2. This is commonly followed by increased activity of the estrogen receptor, which also promotes cell growth and division. This was the first description of the most probable order of events in the

development of breast tumors among individuals with LFS. Understanding the earliest events in the evolution of a developing tumor should help us to be better prepared to selectively treat and stop the tumor from progressing. These results demonstrate that breast cancer in LFS has a genetic signature that differentiates it from other breast cancers, with fewer genetic changes, likely because the cancers develop when the patients are younger. Determining what is unique or different



Members George Nathaniel Wong, Tomer Yavetz, Horng Sheng Chia, and Chris Hamilton browse archival materials at Founders Day 2023.

among all of the breast cancer types may allow clinicians to target these cancers with appropriate treatments.

Theoretical Physics

In 2023, a number of threads of investigation that Professor **Nima Arkani-Hamed** has been pursuing over the past five years—including finding new combinatorial structures underlying scattering amplitudes in the real world, as well as looking for similar structures in cosmology—began to reach fruition.

The first thread is the completion of a long project undertaken at the start of the pandemic: arriving at a new understanding of scattering amplitudes based on fundamentally combinatorial ideas in the kinematic space of the scattering data. This is seen for the simplest theory of colored scalar particles with cubic interactions. A novel formula for loop-integrated amplitudes was finally discovered, with no trace of the conventional sum over Feynman diagrams, but instead determined by a beautifully simple counting problem attached to curves on surfaces.

Arkani-Hamed's focus on these ideas for the past five years has been driven by the belief that understanding this simple toy model would lead to a description of scattering amplitudes in the real world. 2023 saw this happen in an entirely

unexpected way, associated with a wonderful surprise: far from the toy model it appears to be, the “stringy” theory of colored scalar amplitudes secretly contains the scattering amplitudes for pions, as well as non-supersymmetric gluons, in any number of dimensions. In leading approximation, the amplitudes for the different theories are given by one and same function, related by a simple shift of the kinematics. This discovery was spurred by another fundamental observation: the tree-level colored scalar field theory amplitudes have a hidden pattern of zeros when a special set of non-planar Mandelstam invariants are set to zero. These zeros are not manifest in Feynman diagrams, but are made obvious by the connection of these amplitudes to the new combinatorial understanding of the toy scalar theory.

Remarkably, essentially the same kinematic shifts of the toy scalar theory extend to include all quantum effects and directly leads to a formulation for the physics of pion scattering in the real world. The same ideas give a new understanding of the Yang-Mills theories at the heart of our description of nature. It is fascinating that a simple counting problem autonomously “knows” about everything needed to convert colored scalar to gluon amplitudes, exposing a striking

“discovery” of Yang-Mills amplitudes from elementary combinatorial ideas in kinematic space.

Arkani-Hamed believes that these results represent a major step forward in his venture, undertaken when he first arrived at IAS 15 years ago, to formulate the fundamental physics of the real world in a radically new language, where the rules of spacetime and quantum mechanics, as reflected in the principles of locality and unitarity, are seen to emerge from deeper mathematical structures.

Another thread of investigation for a number of years has been an extension of these ideas to cosmology. Again, 2023 saw a surprising new development: the discovery of an ab-initio description of differential equations satisfied by cosmological correlators in a simple class of theories, encoding bulk time evolution in a new way. Cosmological fluctuations retain a memory of the physics that generated them in their spatial correlations. The strength of correlations varies smoothly as a function of external kinematics, which is encoded in differential equations satisfied by cosmological correlation functions. Arkani-Hamed found a new perspective on the origin and structure of these differential equations in a class of cosmological models. These equations are associated with a surprising set of graphical rules describing a sort of “kinematic flow” directly in terms of the spatial variables the correlators depend on. The cosmological correlations as well as the time evolution of the associated spacetime emerge from these simple rules.

Yiming Chen, former Member Ibrahima Bah, and Carl P. Feinberg Professor **Juan Maldacena** explored the role of wormholes in violating global symmetries in gravity theories. While the conceptual understanding of these effects has been established, their analysis sheds light on the specific complex spacetime geometries contributing to such violations during exclusive, high-energy scattering processes. These geometries revealed surprising and novel features, the implications of which could extend to various other processes.

Subsequently, Maldacena turned his

attention to a quantum mechanical model with an Einstein gravity description. Together with Visitor Anna Biggs, he focused on the model's scaling similarity—a transformation that rescales time while leaving the equations of motion unchanged. This feature is beneficial for identifying low-energy excitations when the model is described by gravity. This approach facilitated the derivation of black hole quasinormal modes, which are the simplest excitations. The model's intriguing long-term potential for quantum simulations was also highlighted. This study further outlined the level of precision—termed “fine tuning”—required for simulating this model, especially in setting the number of relevant couplings to produce black hole behavior. To promote understanding among those working on quantum simulations, Maldacena wrote a review, arguing that a quantum computer advanced enough to breach typical classical encryption codes could potentially also be used to simulate these black holes.

Additionally, Maldacena collaborated with Biggs and Vladimir Narovlansky to explore quantum mechanical models of the Sachdev-Ye-Kitaev (SYK) type. These models involve bosonic and fermionic degrees of freedom related by supersymmetry. These models are solvable and display a scaling similarity at low energies. Initially suggested as analogs for the gravity dual model discussed earlier, their investigation revealed that despite their solvable nature, they might not have an Einstein gravity dual due to insufficient interactions among its basic constituents.

Former Member Scott Aaronson, Maldacena, and former Member Alexander Maloney organized a workshop on spacetime and quantum information, held in December 2022. This workshop explored ideas and concepts of quantum information theory to analyze problems in quantum gravity. These problems include the black hole information problem and the way that quantum information is stored and processed in spacetime. It also explored ideas of quantum complexity applied to spacetime. The workshop was also linked to a symposium on quantum information, complexity and the physical



Attendees of the 2022 Qubit workshop enjoying lunch in Simons Hall.

world, organized at Princeton University.

Charles Simonyi Professor **Nathan Seiberg** continued his explorations of quantum field theory and its various applications.

Meng Cheng and Seiberg explored some aspects of the relation between lattice systems of interest in condensed matter physics and their long-distance behavior, which is captured by continuum quantum field theory. They focused on the symmetries and their consequences.

In general, symmetries allow one to make robust predictions about the behavior of complicated systems. For example, if the system has a certain symmetry, its behavior should respect this symmetry. More interestingly, the behavior of the system can exhibit new symmetries, which are not exact symmetries of the original system. Such symmetries are often referred to as emergent symmetries or accidental symmetries. Since they are not present in the original formulation of the problem, they are only approximate, rather than exact. Cheng and Seiberg clarified that in some cases, one can find exact symmetries of the long-distance system that are not present at short distances. They called such symmetries emanant symmetries. Surprisingly, such emanant symmetries are rather common in several well-studied situations.

An important aspect of symmetries is

that they can be anomalous. This means that even though the symmetry is exact, in certain circumstances, the symmetry is slightly violated. This anomalous violation of the symmetry should be the same in the complete formulation of the problem and in its low-energy approximation. As such, it leads to powerful constraints about the low-energy behavior of complicated models. This has been a particularly useful tool in the study of quantum field theory over the past decades.

Motivated by earlier work, Cheng and Seiberg showed that certain results about lattice models, including the celebrated Lieb-Schultz-Mattis theorem and its generalizations, and Luttinger theorem can be formulated as constraints following from such anomalies. This understanding unified a number of distinct results in lattice models into a single framework—*anomalies*, as understood in the context of continuum quantum field theory.

Together with former Member Shu-Heng Shao, Seiberg extended this discussion to systems with fermions. In this case, the emanant symmetry is chiral, and again, it can have anomalies. Their analysis shed new light on some aspects on the Ising model—a classic model in classical statistical mechanics and in quantum systems. Their work identified a new peculiar symmetry of the lattice model. At long distances, this new symmetry



Qubit 2022 workshop participants engage in discussion at a blackboard in the Bloomberg Hall common room.

leads to an emanant peculiar symmetry of the continuum model.

Professor Emeritus **Stephen L. Adler** continued his work this year on gravitation and cosmology. In cosmology, Adler has proposed a novel model for the “dark energy” that drives the accelerated expansion of the universe, based on a frame-dependent action that is invariant under local rescaling of the gravitational metric (called Weyl scaling after the mathematician and former IAS Faculty Hermann Weyl, the originator of this invariance principle). Adler has written several papers analyzing this model, most recently a calculation of the effects of the novel action on solar system relativity tests—and, with Kumar Shwetketu Virbhadra, an analysis of the corrections to the photon sphere and black hole shadow radii, a topic of current experimental interest. Adler also wrote an invited mini-review of his papers on the Weyl scaling invariant alternative to the standard cosmological constant action,

commissioned by *Modern Physics Letters A*.

One of the implications of the novel action is that vacuum “black hole” solutions of the Einstein equations do not have an event horizon, a result further extended recently by Adler by showing that there are also no trapped surfaces, and hence no “apparent horizon.” In his latest work on black holes, Adler found a non-cosmological mechanism for creating horizonless, extremely-compact objects that mimic black holes, which may be what are observed astronomically as the “black holes” at the heart of galaxies. The mechanism consists of solving the Tolman-Oppenheimer-Volkoff equations that govern relativistic stars, with the assumption that the pressure is continuous, but that at sufficiently high pressures there is a jump from a relativistic gas equation of state with pressure equal to three times the density, to an equation of state in which the pressure plus density sum to approximately zero. These assumptions still obey the “null” and “strong” energy

conditions that are used to prove the Penrose and Hawking singularity theorems, but lead to a numerical solution with no trapped surfaces, that has an external region which very closely mimics that of a standard Schwarzschild black hole. Adler has posted online the Mathematica notebooks used in his analysis, as well as an annotated program designed for the Mathematica user community. Further analytical and numerical study of this fascinating model is underway.

Professor Emeritus **Edward Witten’s** most significant work of the last year has involved describing the experience of an observer in a semiclassical spacetime by a Type II von Neumann algebra—in which density matrices exist and entropy can be defined, but there is no notion of a quantum microstate. In successive papers, such a description was given for an observer outside the horizon of a black hole, or in the static patch in de Sitter space.

A drawback of these constructions was that they are not “background

independent”—a particular semiclassical spacetime is assumed in defining the algebra. However, in the simpler context of JT gravity in two dimensions coupled to matter, it is possible to define a Type II algebra in a completely background independent way. Witten showed this in a paper with Junior Visiting Professor Geoff Penington; in that paper, it was possible to achieve background independence because it was not necessary to take any large N or large c limit.

Contemplating the question of how to achieve background independence in more realistic situations in the real world, Witten came to suspect that one should think in terms of the algebra of observables along the worldline of an observer, rather than an algebra associated to a spacetime region. This line of thought

motivated work that Witten did with Alexander Strohmaier, proving a version of the “timelike tube theorem” in curved spacetime. The timelike tube theorem is a classic result about quantum field theory in Minkowski space, discovered by Borchers and Araki in the 1960s, but surprisingly little known. Twenty years ago, Strohmaier had proved the timelike tube theorem for free field theory in a curved spacetime; in this more recent work, Strohmaier and Witten generalized this result non-free theories.

In the last year, Witten has also written papers on several other topics: the canonical formalism for gravity; anomalies and nonsupersymmetric D-branes; and (with Member Gustavo Joaquin Turiaci) the relation between random matrix theory and $N=2$ JT supergravity.



ANDREA KANE

Harry's Bar, located in Simons Hall, also provided a discussion venue for participants at the Qubit workshop.



MARIA O'LEARY

In April 2023, the Institute's eyes were trained skyward as AMIAS Member Lia Medeiros hosted a family stargazing night on the Fuld Hall lawn, alongside colleagues from Princeton University.

2022–23 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

Kazuyuki Akitsu

Cosmology ♦ Institute for Advanced Study

Ignatios Antoniadis

Theoretical High Energy Physics ♦ Laboratoire de Physique Théorique et Haute Energies, Sorbonne Université and CNRS ♦ *s*
Funding provided by The Ambrose Monell Foundation

Lev Arzamasskiy

Astrophysics ♦ Institute for Advanced Study
Funding provided by Schmidt Futures

Pinaki Banerjee

Theoretical Physics ♦ Institute for Advanced Study

Sirio Belga Fedeli

Systems Biology ♦ Institute for Advanced Study
Funding provided by the Simons Foundation

Ruth Britto

Theoretical Physics ♦ Trinity College Dublin
J. Robert Oppenheimer Visiting Professor

Matthew Buican

Theoretical Physics ♦ Queen Mary, University of London ♦ *v/f*

Giovanni Cabass

Cosmology ♦ Institute for Advanced Study

Tankut Can

Physics, Neuroscience, Machine Learning ♦ Institute for Advanced Study
Eric and Wendy Schmidt Member in Biology; additional funding provided by the Simons Foundation

Simon Caron-Huot

Theoretical Physics ♦ McGill University ♦ *f*

Venkatesa Chandrasekaran

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the Simons Foundation

Stephen Chen

Cosmology ♦ Institute for Advanced Study
Bezos Member

Sihao Cheng

Astrophysics ♦ Institute for Advanced Study and Perimeter Institute for Theoretical Physics
Zurich Insurance Company Member

Hong Sheng Chia

Particle Physics, Astrophysics ♦ Institute for Advanced Study

Pratika Dayal

Theoretical Astrophysics ♦ University of Groningen ♦ *v/f*
Funding provided by the Bershadsky Fund

Lorenz Eberhardt

String Theory ♦ Institute for Advanced Study ♦ *m*
Marvin L. Goldberger Member; additional funding provided by the U.S. Department of Energy

Isabel Garcia Garcia

Physics ♦ Institute for Advanced Study and New York University
Funding provided by the National Science Foundation

Chris Hamilton

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

Holmfridur Hannesdottir

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the Simons Foundation

Nathan Haouzi

Mathematical Physics ♦ Institute for Advanced Study
Roger Dashen Member; additional funding provided by the National Science Foundation

Matthew Heydeman

Theoretical Physics ♦ Institute for Advanced Study and Princeton University
Funding provided by the U.S. Department of Energy and the Sivian Fund

Christopher Hirata

Astrophysics ♦ The Ohio State University
Funding provided by The Ambrose Monell Foundation

David Huse

Quantum Dynamics ♦ Princeton University ♦ *v*

Hsiang-Chih Hwang

Astronomy ♦ Institute for Advanced Study

Nissan Itzhaki

Theoretical Physics ♦ Tel Aviv University
Funding provided by the Adler Family Fund

Mikhail M. Ivanov

Cosmology, Black Holes ♦ Institute for Advanced Study
NASA Einstein Fellow

Mikhail Katkov

Neuroscience ♦ Weizmann Institute of Science ♦ *v/f*

Ahsan Z. Khan

Theoretical Physics ♦ Institute for Advanced Study
William D. Loughlin Member; additional funding provided by the National Science Foundation

Igor Klebanov

Quantum Field Theory and Strings ♦ Princeton University ♦ *dvp*

Jorrit Kruthoff

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the National Science Foundation

Jonah Kudler-Flam

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the National Science Foundation and the Paul Dirac Fund

Nicolas Lenner

Biophysics, Ecology, Evolution ♦ Institute for Advanced Study
Martin A. and Helen Chooljian Member in Biology; additional funding provided by the Simons Foundation

Itai Linial

Theoretical Astrophysics ♦ Institute for Advanced Study and Columbia University

Stephen Lubow

Astrophysics ♦ Space Telescope Science Institute, NASA, Baltimore ♦ *f*

Jan Manschot

Theoretical Physics ♦ Trinity College Dublin
Funding provided by The Ambrose Monell Foundation

Dalimil Mazac

Quantum Field Theory ♦ Institute for Advanced Study
Founders' Circle Member, in recognition of Edward and Kiyomi Baird; Funding provided by the U.S. Department of Energy

Anupam Mazumdar

Theoretical Physics ♦ University of Groningen ♦ *v/f*

Lia Medeiros

Astrophysics ♦ Institute for Advanced Study
AMIAS Member

Victor Mikhaylov

Biology ♦ Institute for Advanced Study ♦ *ra*

Sebastian Mizera

Theoretical Physics ♦ Institute for Advanced Study ♦ *m*
Funding provided by the U.S. Department of Energy and the Sivian Fund

Gianluigi Mongillo

Systems Biology ♦ Sorbonne Université
Charles L. Brown Member in Biology; additional funding provided by the Simons Foundation

Elias Most

Theoretical Astrophysics ♦ Institute for Advanced Study and Princeton University

Sunil Mukhi

Quantum Fields, Gravitation, String Theory ♦ Indian Institute of Science Education and Research, Pune ♦ *v/f*
Funding provided by The Ambrose Monell Foundation and the National Science Foundation

Patrick Dean Mullen

Astrophysics ♦ Institute for Advanced Study and Center for Computational Astrophysics
Funding provided by NASA

Kohta Murase

Astroparticle Physics ♦ The Pennsylvania State University
J. Robert Oppenheimer Visiting Professor

Tomohiro Ono

Astrophysics and Computational Science ♦ Institute for Advanced Study

Karl H. Palmquist

Systems Biology and Ecosystem Dynamics ♦ Institute for Advanced Study

Leopoldo Pando Zayas

AdS/CFT Correspondence, Quantum Black Holes ♦ University of Michigan
IBM Einstein Fellow

Matteo Parisi

High Energy Physics, Combinatorics ♦ Institute for Advanced Study and Harvard University
Funding provided by the U.S. Department of Energy

Geoff Penington

Theoretical Physics ♦ University of California, Berkeley ♦ *jvp*

Robert Penna

Theoretical Physics ♦ Institute for Advanced Study ♦ *v*

Martin Pessah

Theoretical Astrophysics ♦ Niels Bohr Institute, University of Copenhagen

Annika Peter

Astrophysics ♦ The Ohio State University
Funding provided by The Ambrose Monell Foundation

Massimo Porrati

Physics ♦ New York University ♦ *f*

Abhinav Prem

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the U.S. Department of Energy and the Sivan Fund

Roman Rafikov

Astrophysics ♦ University of Cambridge ♦ *v*

Carolyn Raithel

Astrophysics ♦ Institute for Advanced Study and Princeton University
John N. Bahcall Fellow

Riccardo Rao

Systems Biology ♦ Institute for Advanced Study
Starr Foundation Member in Biology; additional funding provided by the Simons Foundation

Bart Ripperda

Theoretical Astrophysics ♦ Institute for Advanced Study
NASA Hubble Fellow

Daniel Roggenkamp

Theoretical Physics ♦ Universität Mannheim

Phil Saad

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the National Science Foundation

Kailash Sahu

Astrophysics ♦ Space Telescope Science Institute, NASA, Baltimore
Funding provided by The Ambrose Monell Foundation

Sophie Lund Schröder

Astrophysics ♦ Institute for Advanced Study
Friends of the Institute for Advanced Study Member

Sahand Seifnashri

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the U.S. Department of Energy and the Sivan Fund

Alessandro Sfondrini

Theoretical Physics ♦ Università degli Studi di Padova ♦ *f*

Wilbur Shirley

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the Simons Foundation

S. Josephine Suh

Theoretical Physics ♦ Institute for Advanced Study and Princeton University ♦ *v*

Rashid Sunyaev

Astrophysics ♦ Max-Planck-Institut für Astrophysik ♦ *dvp*

Gustavo Joaquin Turiaci

Theoretical Physics ♦ Institute for Advanced Study
Funding provided by the National Science Foundation and the Sivan Fund

Digvijay Wadekar

Gravitational Waves, Dark Matter, Cosmology ♦ Institute for Advanced Study
Funding provided by the W. M. Keck Foundation Fund

Xiao-Gang Wen

Theoretical Condensed Matter Physics ♦ Massachusetts Institute of Technology
IBM Einstein Fellow

George Nathaniel Wong

Astrophysics ♦ Institute for Advanced Study and Princeton University
Frank and Peggy Taplin Member

Siyao Xu

Magnetohydrodynamic Turbulence, Turbulent Dynamo ♦ Institute for Advanced Study
NASA Hubble Fellow

Tomer Yavetz

Astrophysics ♦ Institute for Advanced Study
Corning Glass Works Foundation Fellowship

Muni Zhou

Plasma Physics ♦ Institute for Advanced Study and Princeton University

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.



FACULTY

Wendy Brown

UPS Foundation Professor

Didier Fassin

James D. Wolfensohn Professor

Alondra Nelson

Harold F. Linder Professor

PROFESSORS EMERITI

Joan Wallach Scott

Michael Walzer

In October 2022, K-Sue Park, Roger W. Ferguson, Jr., and Annette L. Nazareth Member in the School of Social Science, presented a seminar entitled “Homesteading and the American Dream.”

During the 2022–23 academic year, Faculty in the School of Social Science conducted research into important topics such as the journeys of migrants and refugees from Africa and the Middle East; vital questions around artificial intelligence, social media, and biotechnology; and the crisis of climate change. In total, 25 Members, 7 Visitors, and 1 Distinguished Visiting Professor joined the School during the year—who, in addition to working on the theme year topic “Climate Crisis Politics,” also examined such subjects as non-value in capitalism, the future of work, the American real estate market, the limits of machine learning, the experience of borders, and much, much more.

During the 2022–23 academic year, the School hosted their **special theme year** “Climate Crisis Politics,” led by Wendy Brown, UPS Foundation Professor, and Timothy Mitchell, William B. Ransford Professor of Middle Eastern, South Asian and African Studies at Columbia University and IAS Distinguished Visiting Professor. The climate disaster generates novel political questions and predicaments. The novelty arises from the crisis’s emergency quality, its global dimensions yet unequally distributed effects, and its severe indictment of existing ways of human life. The crisis also challenges conventional formulations of justice, sovereignty, progress, belonging, and even understandings of humanity and animality, ontology, historiography, temporality, power, and generational and collective responsibility. It raises questions about disciplinarity, methods, realism, and incrementalism; about nation-states, capitalism, colonialism, and technology. Scholars asked how these challenges and questions reorient twenty-first century political, social, and economic thought and practice. What kinds of theory meet these challenges?

The climate crisis also raises concrete questions for social scientists. There are issues of political economy: Is ecologically sustainable capitalism an oxymoron? Can capitalism’s dependence on fossil fuels and boundless consumption be replaced in time to save a widely habitable planet? Can renewable energy sources avoid new depredations of vulnerable peoples and places, such as those entailed in extracting rare earth minerals? Can “pricing nature” and other market instruments stem the crisis and yield climate justice? There are also issues of power and rule: What are the most effective governing levels (global, regional, national, or local) and forms (autocratic, technocratic, or democratic) for addressing the crisis? What are the roles of non-governmental entities, such as banks, corporations, and social movements? Can anti-democratic “global government” be avoided while achieving significant global agreements and cooperation to achieve more sustainable forms of production and ways of life? How can legacies of imperialism and colonialism be redressed rather than reinforced in responses to the climate emergency? Can de-centralized responses, such as local shutdowns of extractivist industries or building net zero cities, be effectively “scaled up” or multiplied?

These questions shaped the research and conversations among participants in the 2022–23 Climate Crisis Politics group, who were drawn from the disciplines of political economy, geography, philosophy, city planning, sociology, culture and media, political theory, law, anthropology, and communication. Members also addressed problems of species extinction and plastic pollution, “greenwashing” and reparations, and new iterations of

infrastructure and political economy. In addition to the regular theme seminar in which members shared their own research, the group spontaneously initiated year-long projects on climate fiction, climate film, and on experimental writing on climate issues. Many fruitful collaborations emerged that are materializing in forthcoming papers and articles. In spring 2024, the entire group will reconvene at the Institute to prepare a book manuscript on climate crisis politics.

Wendy Brown, UPS Foundation Professor, co-facilitated the Climate Crisis Politics seminar with Timothy Mitchell, Distinguished Visiting Professor at IAS and William B. Ransford Professor of Middle Eastern, South Asian and African Studies at Columbia University. In addition to her work with the theme group, Brown continued her own research and writing on political freedom in the Anthropocene and developed it in a new direction, one that considers the relationship between the crisis of liberal democracy and the climate crisis. Still centered on the problem of freedom, her speculative hypothesis is that foundational understandings and practices of politics in the West harbor consequential estrangements and exclusions in relation to both human and non-human activity. She also argues that freedom, far from merely a culprit in the climate emergency, is central to turning it—and us—back from the edge of the cliff. This claim runs against the contemporary discursive grain that identifies politics with freedom’s limit rather than its realization and is at odds with the commonplace that freedom is incompatible with addressing climate change. Recasting the understandings and practices of politics in which freedom is grounded, and replanting freedom in this ground, allows other possibilities to emerge. In addition to the theoretical work entailed in developing this argument, Brown drew from two contemporary protest movements for the analysis—the Iranian “Women, Life, Freedom” protest and the Atlanta, Georgia “Stop Cop City” protest. Both mobilizations entwine ecological with human justice and freedom concerns.

Brown presented this work in several venues, including as a keynote for a University of Pennsylvania conference, for the Selfridge Lecture at Lehigh University, at the Political Philosophy Colloquium at Princeton University, and for the Helene Moglen Memorial Lecture at UC Santa Cruz. She delivered lectures on other topics at The New School and (virtually) in Turkey, Ecuador, and Chile. Her book, *Nihilistic Times: Thinking with Max Weber*, published in March in English, German, and Spanish, was the subject of a number of interviews and podcasts; these ranged from philosophy and politics podcasts in Europe and the United

States to excerpts featured in the *Chronicle of Higher Education* and discussions in *Inside Higher Education*. In collaboration with Nikolas Rose and Partha Chatterjee, Brown also published a book chapter on the perplexities of the term, governmentality, and was interviewed by NPR's *Throughline* and *Dissent* as well as several Latin American media platforms on the future of neoliberalism.

James D. Wolfensohn Professor **Didier Fassin** has dedicated most of the year to ending the five-year research project he conducted on the anthropology of borders and migrations with Visitor Anne-Claire Defossez. They carried out the last part of their fieldwork in the Alps at the border between Italy and France, and finished writing their book *L'Exil, toujours recommencé. Chronique d'une frontière*, in press at Le Seuil. Based on more than two hundred interviews and several hundreds of hours of observant participation, their work explores the arduous and painful journeys of migrants and refugees from Africa and the Middle East to Europe in search of protection from persecution and poverty, while also studying the increasing political violence of borders enforced by the European Union on their territory and via its externalization in Maghreb, Niger, and Turkey. In parallel, Fassin prepared and delivered twelve lectures

on “Les Épreuves de la frontière” (The trials of the border) at the Collège de France, proposing a geopolitical approach and theoretical understanding of the current transformations of borders and the contemporary challenges of migrations on a global scale.

Continuing his long-term research on public social sciences, Fassin focused this year on the various risks these disciplines and their practitioners are facing in the book *La Recherche à l'épreuve du politique* published at Textuel, and on their epistemological, moral, and political implications for his inaugural lecture “Sciences sociales par temps de crise” (The Social Sciences in a Time of Crisis) at the Collège de France. He gave keynote lectures at the Sabanci University in Istanbul, discussing migrants’ and refugees’ vulnerability and resilience, and, at the University of Sarajevo in Bosnia-Herzegovina, presented an innovative legal-anthropology reading of police killing. He delivered the Bernd Lambert Memorial Lecture at Cornell University on “Portrait of the Anthropologist as an Investigator.” He also gave invited lectures to critique the notion of crisis for the opening ceremony of the academic year at the École Polytechnique, and to address punishment at the Paris Administrative Court of Appeal. In the context of a

coming reform of the prison system in France, he was invited to give a talk at the National Assembly and the opening lecture at the conference organized by the National Economic and Social Council.

Alondra Nelson, Harold F. Linder Professor, completed her public service leave at the White House, where she served as Deputy Assistant to President Joe Biden and Acting Director and Principal Deputy Director for Science and Society for the Office of Science and Technology Policy (OSTP). Including her in the list of “Ten People Who Shaped Science in 2022,” *Nature* said of Nelson’s OSTP tenure that “this social scientist made strides for equity, integrity and open access.”

She has returned to IAS and is at work on research about the role of the ‘platform’—including social media, artificial intelligence, and biotechnological—in society and social theory, and a book about science and technology policy in the Obama and Biden administrations. Her upcoming projects also include articles for the *Annual Review of Sociology* and *Foreign Affairs*.

Participants in the Science and the State theme year, which Nelson co-convened (with Visiting Professor Charis Thompson) in the 2020–21 academic year, have edited a special issue of *Public Culture* drawing on their collective work. The



MARIA O'LEARY

In June 2023, Harold F. Linder Professor Alondra Nelson chaired a public panel discussion between computer scientists, social scientists, technology developers, and policy advisors from the IAS AI Policy and Governance Working Group.

issue will be published in September 2023 and will be launched at a panel at the annual meeting of the Society for Social Studies of Science.

Nelson continues to contribute to national and international policy discussions. She participated in the Aspen Strategy Group's Transatlantic Technology Policy Dialogue in Brussels in February 2023 and was named a distinguished senior fellow at the Center for American Progress in March 2023. In 2023–24, she will give talks at Dreamforce, Oxford, Cambridge, and Columbia, among other prestigious venues.

In June 2023, Nelson launched and hosted the IAS AI Policy and Governance Working Group, an international group of researchers and policymakers, at the Institute to collaborate on sociotechnical strategies to help ensure that artificial tools and systems do not cause harm and instead benefit the global public.

She was also interviewed for the *New York Times's* The Ezra Klein Show, *Amanpour* on CNN, *Foreign Policy*, *Die Zeit*, *Washington Post Live* and the BBC *Newshour*.

Nelson was named a recipient of the Sage–CASBS Award from Sage Publishing and the Center for Advanced Study in the Behavioral Sciences at Stanford University for “outstanding achievement in the behavioral and social sciences that advances our understanding of pressing social issues.” She received an honorary Doctor of Public Service degree from Northeastern University in spring 2023.

Professor Emerita **Joan Wallach Scott** launched a project on the history of staff at IAS. The first “product” is a film called *Common Sense of the Institute for Advanced Study*, based on interviews she conducted with staff who are the second or third generation of their families to work here. The film, produced with Dario Mastroianni and Ezra Scott-Henning (and edited by Scott-Henning), will be shown to the Institute community on September 21, 2023. A second film will be based on interviews (to be conducted during 2023–24) with long-serving staff (twenty years or more).

In the light of current contests about the teaching of history, Scott began



MARIA O'LEARY

In November 2022, Natasha Iskander, Friends of the Institute for Advanced Study Member, gave a Happy Hour talk in Harry's Bar. She revealed how climate change and climate migration were exploited for profit at the 2022 World Cup.

research on the relationship between education for citizenship and the teaching of history. What counts as a democratic education? What have been the debates about it? A comparison between France and the U.S. is one way she will approach the topic.

Scott's published work on history was the topic of her keynote address to a conference of historians in Chile. Her work on gender was the basis for a lecture in New Delhi on the backlash against gender and sexuality studies by authoritarian rulers the world over. And a piece



MARIA O'LEARY

In March 2023, Anna Tsing of the University of California, Santa Cruz, delivered the IAS Public Policy Lecture (curated by the School of Social Science) entitled “Patchy Anthropocene: The Feral Impacts of Infrastructure.”



Professor Emerita Joan Wallach Scott poses a question during a seminar discussion.

she wrote on archives (“Archive Angst”) was the focus of a graduate class she gave for historians at Trinity Washington

University. All of these events were made possible by Zoom connections.

She joined a two-day workshop, in

person, held at Princeton University on “In/capacitation”—the study of the ways in which law and other regulatory norms enable or discourage political action. The papers were primarily on the history and politics of the Middle East.

In November, 2022, Scott received an honorary degree from the University of Paris 8 (Vincennes–Saint Denis). Given the history of this university (founded during the upheavals in France of May ’68) and its ongoing commitment to critical studies (among them of race and gender), this was a particularly moving experience for her.

Scott continues to edit the journal she founded, *History of the Present: A Journal of Critical History*, which has become a visible presence in her field. The School of Social Science seminars have proven to be a rich resource for articles for the journal.

2022–23 MEMBERS AND VISITORS

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

Lila Abu-Lughod

Anthropology, Gender Studies ♦
Columbia University ♦ *v*

Lorenzo Alunni

Anthropology ♦ Institute for
Advanced Study
Wolfensohn Family Member

Hillary Angelo

Sociology ♦ University of California,
Santa Cruz

Alyssa Battistoni

Political Theory ♦ Barnard College

David Bond

Anthropology and the Environment ♦
Bennington College ♦ *v*

Heather Davis

Cultural Studies ♦ Eugene Lang
College of Liberal Arts, The New
School

Anne-Claire Defossez

Sociology ♦ Institute for Advanced
Study ♦ *v*

Julia Dehm

Law ♦ La Trobe University ♦ *s*

Christina Dunbar-Hester

Science and Technology Studies,
Communication ♦ University of
Southern California

Stefan Eich

Political Theory ♦ Georgetown
University
Richard B. Fisher Member

Samera Esmeir

Law, Politics, Middle East Studies ♦
University of California, Berkeley

Assefa Fiseha

Law and Governance Studies ♦ Addis
Ababa University

Andreas Folkers

*Sociology, Critical Theory, Science and
Technology Studies*

Kian Goh

Urban and Environmental Planning ♦
University of California, Los
Angeles
AMIAS Member

Saygun Gökarıksel

Anthropology ♦ Bosphorus University

Heba Gowayed

Sociology ♦ Boston University

Maira Hayat

Anthropology ♦ University of Notre
Dame

Lynne Huffer

Philosophy, Environmental Studies ♦
Emory University

Natasha Iskander

*Climate Change and the Future of
Work* ♦ New York University
Friends of the Institute for Advanced
Study Member

Adil Hasan Khan

*Human Rights, Jurisprudence, Legal
Histories* ♦ Melbourne Law School ♦
v/s

Jan Kiely

Modern Chinese History ♦ Chinese
University of Hong Kong ♦ *v/s*

Philippe Le Billon

Political Ecology ♦ The University of
British Columbia

Jennifer Lee

Sociology
Robbert Dijkgraaf Member

Minhua Ling

Anthropology

Nayanika Mathur

Anthropology ♦ University of Oxford

Timothy Mitchell

*Political Theory, Middle Eastern
Studies* ♦ Columbia University ♦ *dvp*

Jonathan Morduch

Economics ♦ New York University ♦
v

Catalina Muñoz

History, Transitional Justice,
Colombia ♦ Universidad de los
Andes ♦ *f*

Nicholas Occhiuto

Sociology ♦ *v*

K-Sue Park

Race, Law, and History ♦
Georgetown University Law Center
Roger W. Ferguson, Jr., and Annette
L. Nazareth Member

Sara Pursley

History ♦ New York University

J.T. Roane

Black Studies, Black Ecologies ♦
Rutgers University–New
Brunswick

Matthew Salganik

Sociology ♦ Princeton University
Infosys Member

Special Programs

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.

SPECIAL PROGRAMS

Program in
Interdisciplinary Studies

Artist-in-Residence
Program

Director's Visitors

Digital Scholarship @IAS

Program for Women and
Mathematics

Prospects in Theoretical
Physics

IAS/Park City
Mathematics Institute

Summer Program in Social
Science

Participants from the
2022–23 Women and
Mathematics Program
work on problems in
Rubenstein Commons.



Program in Interdisciplinary Studies

Professor **Piet Hut**, head of the Institute's Program in Interdisciplinary Studies, continued to lead the main project that he started a year earlier, called "The Challenge." With a focus on the increase of global cascading failures at or before the middle of the century, he organized a "working workshop" in April 2023, together with Visitors in his program, including Will Cavendish, Eiko Ikegami, Tim Lenton, Barnaby Marsh, and D. Eric Smith. Two months earlier, Hut participated in a workshop at Princeton University titled "Mind and Representation in Buddhist and German Idealist Philosophy." To the best of his knowledge, this was the first public workshop involving a direct comparison between original source texts in European modern philosophy and ancient Indian philosophy. Combining short introductory summaries and in-depth discussion of specific passages made this workshop an example of interdisciplinary workshops at its best. Immediately after that workshop, Hut started to collaborate with

its main organizer, Alexander Englert, Visitor in the Program in Interdisciplinary Studies. They started to compare writings by Kant, Fichte, and Husserl in a project to investigate the use of working hypotheses in science as well as in both European and Asian philosophy. This project overlaps partly with an ongoing investigation by Hut and PIDS Visitor Mark van Atten, focused on Eugen Fink's role in extending aspects of Husserl's epoché methodology.

These activities mark the final year of the Program in Interdisciplinary Studies, with the retirement of Professor Hut, who will continue his interdisciplinary research at IAS. During its twenty-one year existence, the program explored different ways of viewing the world, spanning a range of disciplines from physics to astrophysics, geology, paleontology, and biology, to artificial intelligence, cognitive psychology, and philosophy. During its tenure, the program hosted a total of 67 Visitors.



Left: A discussion between Hut and Barnaby Marsh, Visitor in the Program in Interdisciplinary Studies, in the new Rubenstein Commons. Above: The participants at the *Mind and Representation* workshop, hosted at Princeton University, gathered for a group photo.

2022–23 VISITORS

Stephen Burlingham

Art and Science

Erica A. Cartmill

Anthropology, Psychology ♦ University of California, Los Angeles

Will Cavendish

Science Communication

Justin Clarke-Doane

Metaethics, Metaphysics, Epistemology, Philosophy of Logic & Mathematics

Jacob Gates Foster

Computational Social Science, Collective Intelligence ♦ University of California, Los Angeles

Rush Holt

Science and Society

Eiko Ikegami

Historical Sociology ♦ The New School

Alexander A. Kaurov

Astrophysics, Sociology, Science Communication ♦ Institute for Advanced Study

Tim Lenton

Earth Sciences, Climate ♦ University of Exeter

Jun Makino

Astrophysics, Computational Science ♦ Kobe University

Barnaby Marsh

Choice Behavior, Decision Making ♦ Harvard University

Michael Th. Rassias

Mathematical Analysis, Analytic Number Theory ♦ Universität Zürich

D. Eric Smith

Origin of Life ♦ Georgia Institute of Technology and Tokyo Institute of Technology

Edwin L. Turner

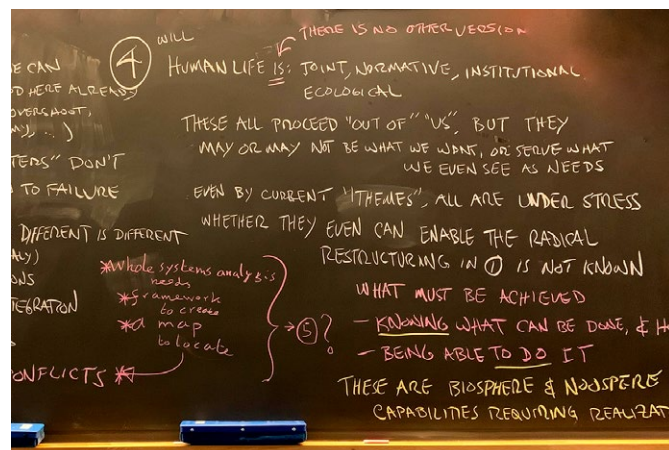
Astrophysics ♦ Princeton University

Mark van Atten

Philosophy of Logic and Mathematics, Phenomenology, Idealistic Philosophy ♦ Archives Husserl de Paris, CNRS

Harald Wiltsche

Philosophy of Science ♦ Linköping University



Hut met D. Eric Smith, Visitor in the Program in Interdisciplinary Studies, at the Earth-Life Science Institute at the Tokyo Institute of Technology to discuss the overlapping and interacting crises that humans will be facing before the middle of the century. This blackboard presents a visual record of their conversation.

Artist-in-Residence Program



The 2022–23 academic year marked the conclusion of David Lang’s remarkable tenure as the Institute’s Artist-in-Residence. Since he arrived here in 2016, Lang has bestowed upon the Institute community music from around the world through the Edward T. Cone Concert Series. In his final year, he invited the Vijay Iyer Trio, a trio dealing in dark, tuneful, restless, and inventive jazz; Trio Mediaeval, a group who perform monophonic and polyphonic medieval music from England, Italy, and France, as well as traditional Norwegian, Swedish, and Icelandic ballads and songs; and Sean Shibe, a classical guitar virtuoso. Finally, the concert series included, for the first time, music from Lang’s own compositions. The Lorelai Ensemble, led by Beth Willer, performed Lang’s *love fail*, a performance that moves back and forth between stories of ancient and modern love—from medieval texts about Tristan and Isolde to those by American writer Lydia Davis.



All photos this page: In April 2023, Artist-in-Residence David Lang hosted a concert showcasing his original composition *love fail*, performed by women’s singing group Lorelai Ensemble. This concert was the last in Lang’s tenure as IAS Artist-in-Residence.

ALL PHOTOS ANDREA KANE



Director's Visitors

Director's Visitors contribute much to the vitality of the Institute. Scholars from a variety of fields, including areas not represented in the Schools, are invited to the Institute for varying periods of time, depending on the nature of their work. This year, the Director invited four early-career historians of religion—Yonatan Binyam, David Gyllenhaal, Jillian Stinchcomb, and Edmond Shlomo Zuckier—who worked on topics ranging from rabbinic literature to the impact of trauma on Greek- and Syriac-speaking Christians and Arabic-speaking Muslims in Late Antiquity. Other Director's Visitors worked on topics including quantum field theory, translation in multilingual societies, medicine and theater, and the life of mathematician Andreas Floer.

Director and Leon Levy Professor David Nirenberg and Director's Visitors David Gyllenhaal, Edmond Shlomo Zuckier, Jillian Stinchcomb, and Yonatan Binyam gathered with various scholars of religion for a conference on the interconnected histories of Judaism, Christianity, and Islam.

2022–23 VISITORS

f First Term ♦ *s* Second Term ♦ *ra* Research Associate

Yonatan Binyam

History of Religion ♦ *ra*

Curtis Callan

Theoretical Physics, Biology ♦ Princeton University

David Gyllenhaal

History, Religion ♦ *ra*

Anna Laqua

Literary Studies, History of Theater

Lorenza Pescia De Lellis

Italian Studies, History of Romance Philology ♦ Institute for Advanced Study

Siobhan Roberts

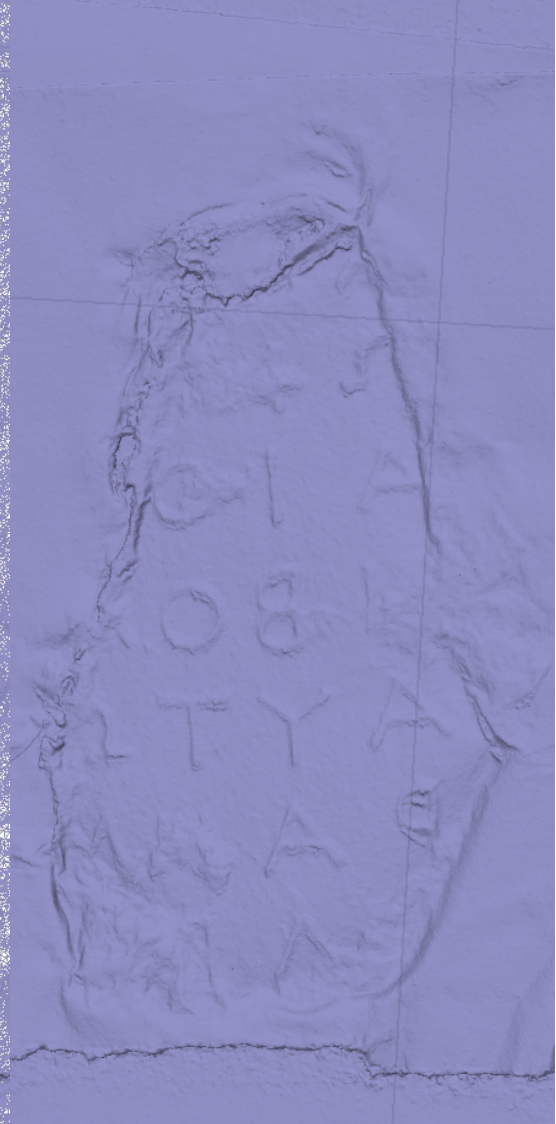
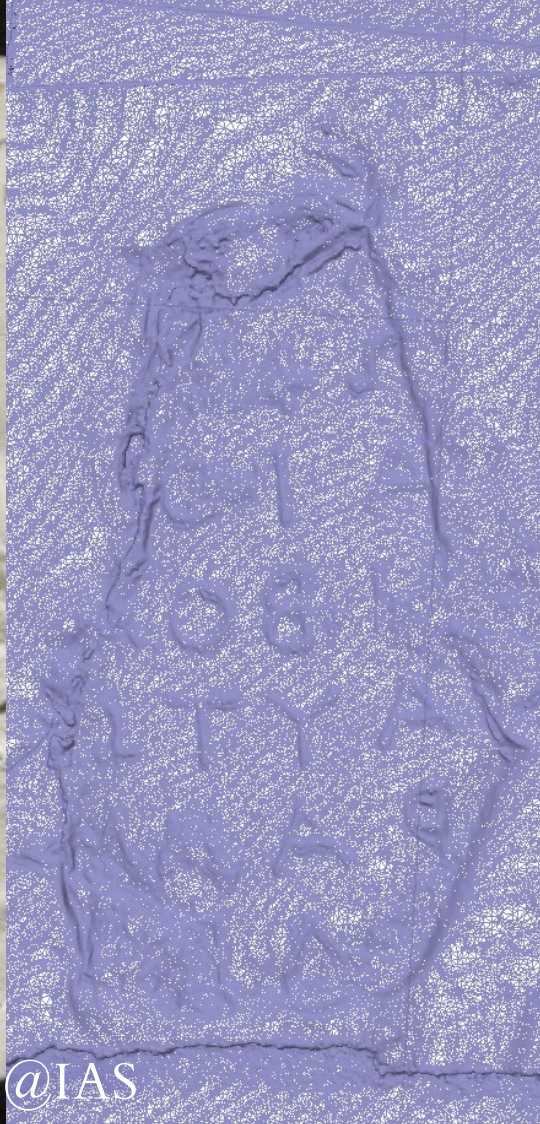
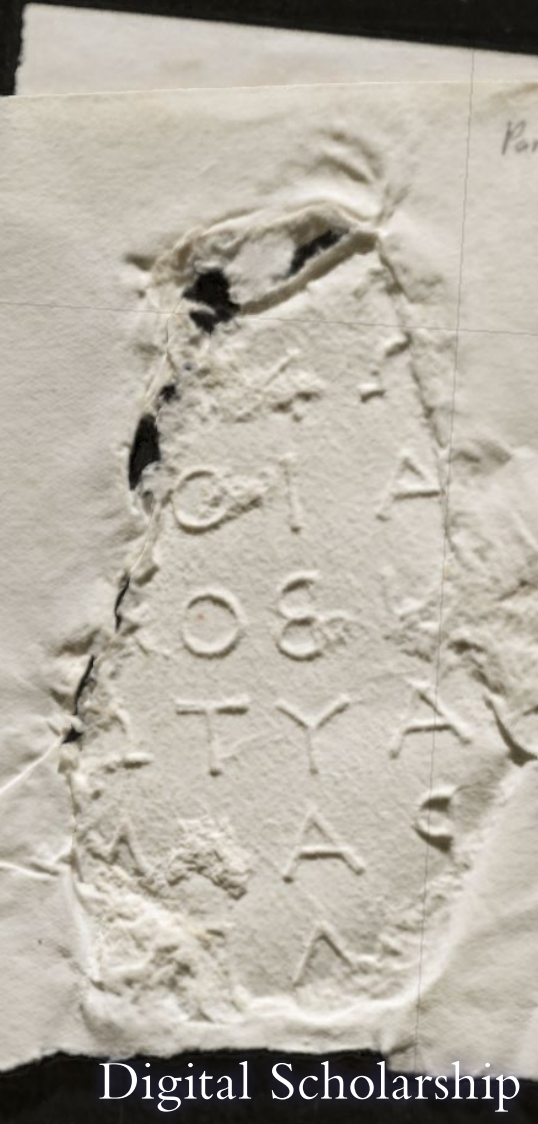
Independent Scholar ♦ *f*

Jillian Stinchcomb

Religious Studies, Biblical Studies, Jewish Studies ♦ *ra*

Edmond Shlomo Zuckier

Rabbinic Literature, Philosophy of Religion ♦ *ra*



Digital Scholarship @IAS

Digital projects continued to be at the forefront of the Institute's scholarship. This past academic year, the projects included the following:

■ The Zaydi Manuscript Tradition

In partnership with the Hill Museum and Manuscript Library, Professor Sabine Schmidtke's Zaydi Manuscript Tradition: A Digital Portal continued to grow. Moreover, the project was expanded by looking deeper into the history of the respective collections of Yemeni manuscripts in Europe. For this purpose, the extant papers and correspondence in the Archivio Eugenio Griffini in Milan, which sheds entirely new light on the history of the collection of some 2,000 manuscripts, brought together by the Italian merchant Caprotti, which are nowadays

kept in the Ambrosiana in Milan and the Bavarian State Library in Munich, have been digitized and are now being analyzed.*

■ Krateros: Squeezes of Greek Inscriptions at the IAS

The Krateros Project,* led by Angelos Chaniotis, Professor in the School of Historical Studies, and Aaron Hershkowitz as Project Manager, successfully completed the third and final year of its NEH grant, focused on metadata formulation and 3D scanning of the collection. The project team has continued its exploration of machine learning technology in partnership with Smith College, and has applied for a new NEH grant to further support that work.

■ Hidden Stories: New Approaches to the Local and Global History of the Book (2023–26)

This second phase of the Mellon-funded project "The Book and the Silk Roads,"* led by co-Principal Investigator Suzanne Conklin Akbari, Professor in the School of Historical Studies, widens the focus beyond Eurasia and Africa into the Americas to illuminate book history through a range of research methods drawn from the sciences and humanities. Hidden Stories* connects over 130 collaborators working across more than 60 institutions around the world. The four-year project brings together interdisciplinary and scientific research, cultural heritage preservation, community relationship-building, and the development of knowledge-sharing tools, protocols, and best practices.

Recent publications include “Automated Transcription of Gəʼəz Manuscripts Using Deep Learning,” *Digital Humanities Quarterly* 17.3 (2023) [with Samuel Grieggs et al.],* and a Library Trends Journal article, “Huluniixsu-waakan: The Role of the Library in Munsee Delaware Language Revitalization and the Development of Community Relationships on Lenape Land,” written in collaboration with Princeton University Library and Indigenous colleagues. This collaboration was launched in October 2022 with a workshop on birchbark as a writing substrate in South Asia and North America.

■ Practices of Commentary

With a five-year SSHRC Insight Grant and supported among others by Professor Suzanne Conklin Akbari, the Practices of Commentary* project seeks to develop a global perspective on practices of commentary, de-siloing regionally focused work in East Asia, South Asia, the Near and Middle East, and Europe, while simultaneously offering fine-grained and nuanced accounts of the function of commentary in cultures and communities of

the premodern world. Akbari is co-editing a special issue of the Open Access journal *The Medieval Globe* presenting the research group’s findings, to appear in early 2023.

■ Lyktos Archaeological Project

Since 2021, Professor Angelos Chaniotis has co-directed an archaeological excavation in the island of Crete, Greece. The excavation, a joint project with Professor Antonis Kotsonas (NYU), in the city of Lyktos (according to Hesiod, the birthplace of Zeus), explores the early phase of the city (ninth to fifth century B.C.E.), a public building dedicated to the cult of the emperor (second to fourth century C.E.), and a Byzantine basilica (eighth and ninth century C.E.). To assist documenting the ongoing project, a database was developed by Georgios Tsolakis (The University of Chicago) which currently includes the notebooks of the excavation, the list of finds, and photos of the excavation as well as the finds. Following a migration completed earlier this year, this database and all related digital materials now have a permanent home at IAS.

About DS @IAS

The strategic direction for the Institute’s support of digital scholarship continues to be provided by the Digital Scholarship Working Group, currently comprised of Jeff Berliner, Emma Moore, Caitlin Rizzo, Marcia Tucker, María Mercedes Tuya, and Sabine Schmidtke, Professor in the School of Historical Studies. This past year, the group again curated the Digital Scholarship Conversations series, many of which were carried out in collaboration with the Near Eastern and Medieval Studies at IAS.

The DS @IAS team has also been responsible for envisioning and supporting the Institute’s digital publishing infrastructure. This includes Albert,* the Institute’s digital repository, as well as the creation of digital object identifiers (DOIs), and integration with ORCID and Open Access policy.

To learn more about projects marked by asterisks, scan the QR Code:



Opposite page: Various visualizations of a squeeze 3D-scanned by the Krateros Project: the images show a rendering fully textured, in wireframe, and in solid form.
Bottom left: Squeezes undergoing 3D scanning.
Bottom right: Krateros Project Research Associate Jorge Maldonado cataloguing a digitized squeeze and some plaster casts of ancient coins.



MARIA O'LEARY



JORDAN BERMAN



Program for Women and Mathematics

The Institute for Advanced Study hosted the 29th Women and Mathematics program, “Patterns in Integers: Dynamical and Number Theoretic Approaches,” on campus from May 21–26, 2023. The 2023 program—sponsored by the National Science Foundation, Lisa Simonyi, Princeton University, and the Institute for Advanced Study (and organized by Wei Ho, Michelle Huguenin, Dust McDuff, and Lillian Pierce)—included 5 committee members and 32 participants (14 undergraduates, 14 graduates, and 4 postdocs). Participants engaged in the following curricular activities:

- Terng Lecture Series, “The Circle Method,” by Lillian B. Pierce;
- Uhlenbeck Lecture Series, “Ergodic Ramsey Theory,” by Tamar Ziegler;
- Colloquium, “Arithmetic Patterns in Dense Sets,” by Sarah Peluse;
- Young Researcher Seminar, “The Turán Number of Homeomorphs,” by Maya Sankar;
- Young Researcher Seminar, “Counting Solutions to Diophantine Inequalities in Function Fields,” by Kathryn Wilson;
- Young Researcher Seminar, “Exponential Sums with Applications in PDEs,” by Rena Chu;
- Young Researcher Seminar, “Dynamical Properties of the Indicator Sequence of Square-Free Numbers,” by Jessica Liu;
- Young Researcher Seminar, “Unbounded Fast Escaping Wandering Domains,” by Adi Glücksam;
- Young Researcher Seminar, “Small Scale Distribution of Primes in Four-Term Arithmetic Progressions,” by Katharine Woo.

The program’s Terng Lecture, named after Chu-Lian Terng, Member (1979, 1997–98) and one of the founders of WAM, was given by Lillian Pierce of Duke University. The lecture was titled “The Circle Method” and explored the method initially developed by G.H. Hardy and Srinivasa Ramanujan that asks how many ways a given integer may be expressed as a sum of s perfect k -th powers. Specifically, Pierce discussed its relationship to Ergodic Ramsey Theory.

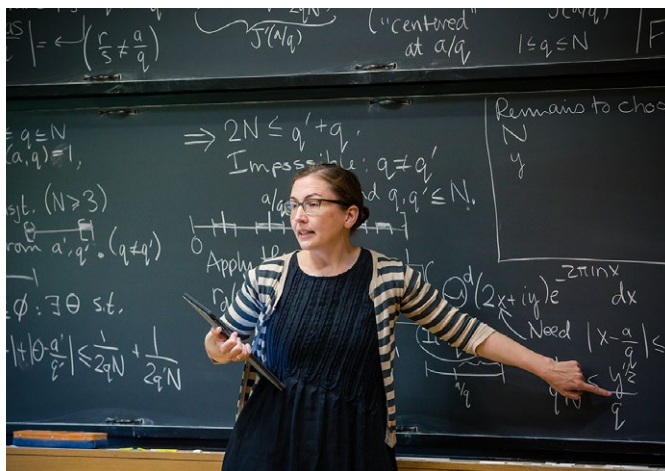
Distinguished Visiting Professor Tamar Ziegler, of The Hebrew University of Jerusalem, gave this year’s Uhlenbeck Lecture, named after current Distinguished Visiting Professor and founder of WAM Karen Uhlenbeck. It was titled “Ergodic

Ramsey Theory” and provided an introduction to the field.

Two Teaching Assistants, Rena Chu (Bei Ge Chu) (Duke University) and Adi Glücksam (Northwestern University) ran Daily Problem Sessions with the participants to review course notes and work on problems.

The Young Researcher Seminars enable postdocs and advanced graduate students to present current research related to the year’s theme to an audience of their peers and receive feedback from senior program participants. This year, in addition to the two Teaching Assistants Rena Chu and Adi Glücksam, the Young Researcher Seminars were given by Sarah Peluse (Institute for Advanced Study and Princeton University), Maya Sankar (Stanford University), Kathryn Wilson (Kansas State University), Jessica Liu (City University of New York), and Kathryn Woo (Princeton University).

Thanks to a generous grant from Lisa Simonyi, the WAM Ambassador Program concluded its sixth year of funding a series of mini-grants designed to build support and outreach networks across the country. Funded activities for 2022–23 included the inaugural Pittsburgh Women in Mathematics and Computing Symposium (WMCS) at Carnegie Mellon University; the 5th Annual Florida Women in Mathematics Day (FWIMD) at Florida Atlantic University; the first annual GT Science and Engineering Math and Computational Science Symposium at Georgia Institute of Technology; and a number of initiatives at Harvard University, including “Gender Inclusivity in Mathematics (GIIM)” and “Math Includes” mentoring programs, an “Inclusion and Belonging in Math” panel talk, and monthly “Real Representation” lunches.



ALL WAM PHOTOS ANDREA KANE



IAS/Park City Mathematics Institute

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, alongside Program Manager Dena Vigil.

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 80 graduate student participants, as well as many of the researchers (up to 60 participate in the program) and the more advanced undergraduate students.

PCMI's 45 undergraduate students participate in a program consisting of a parallel lecture course pertaining to the research

theme, as well as an “experimental math lab” that brings participants together to work on open-ended problems. There is also a 15-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 program is a 10-person workshop on issues related to equity and inclusion in the mathematics profession and classroom.

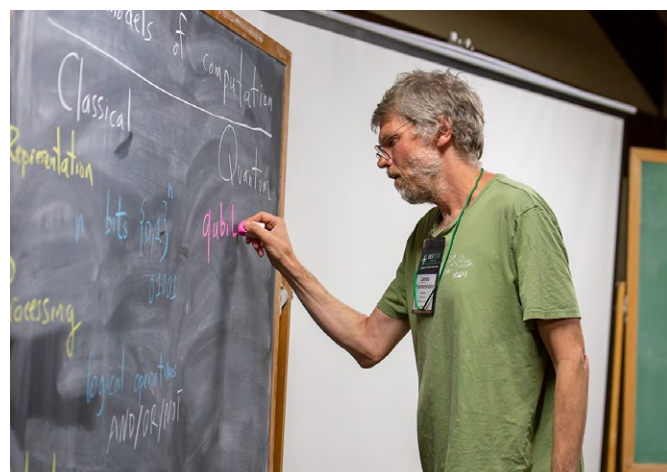
Lastly, PCMI features a large and widely known professional development opportunity for middle and high school teachers. Approximately half of the subprogram's 35 participants come from the New York-based Math for America program, while the rest come from school districts across the country. These teachers 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.

In 2023, the PCMI Graduate Summer School consisted of mini-courses on the topic of “Quantum Computation,” specifically overviews of quantum learning, information theory, and linear-algebraic algorithms; recent advances in quantum error-correcting codes; and the complexity theory of random circuits and Hamiltonians.

Its undergraduate counterpart took on the same topic with a

daily lecture series given by Jamie Pommersheim (Reed College), with morning sessions involving an experimental mathematics component with open-ended problems and computational work. Pommersheim's lectures included an introduction to the theory of quantum computation with a focus on quantum algorithms, as well as topics in quantum cryptography, quantum random walks, and the EPR paradox. A particular focus was the theory of quantum oracle algorithms (also known as "concept learning" or "black box" algorithms).

The PCMI 2023 Workshop on Rehumanizing Mathematics was organized by Rochelle Gutiérrez and continued PCMI's aim to better understand equity (identity and power issues) in mathematics. The workshop explored different perspectives/theories, reflections on practices, information from experts in the field who have been altering their practices, and the generation of action plans for the work participants intend to carry out in the future.



ALL PHOTOS DAVE TITENSOR

APARTHEID MUSEUM



Summer Program in Social Science

Having previously been held at the Institute for Advanced Study, the third cohort of the Summer Program in Social Science organized by James D. Wolfensohn Professor Didier Fassin took place this year at the University of the Witwatersrand in Johannesburg, for scholars from Africa and the Middle East, and at the Universidad Nacional in Bogotá for scholars from Latin America. This multidisciplinary group was composed of 20 scholars—10 women and 10 men—from Argentina, Uruguay, Brazil, Chile, Colombia, Ecuador, Côte d'Ivoire, Kenya, Nigeria, Egypt, Iraq, Kuwait, and the Palestinian Territories. The program draws together early-career scholars from the Global South. Its goals are to 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. Funding for the Summer Program in Social Science is provided by the Mellon Foundation.

Top: The African and Middle Eastern group at the Apartheid Museum in Johannesburg

Bottom: The Latin American session at Universidad Nacional de Colombia in Bogotá



A photograph of a modern building with large glass windows and a balcony. The balcony has a planter box with green plants. The windows reflect the surrounding autumn foliage in shades of orange and yellow. The building's structure is dark, and the overall scene is captured in a cinematic style.

Acknowledgements

For nearly a century, the Institute has served as one of the world's foremost centers for theoretical research and intellectual inquiry. The Institute's capacity for discovery has been catalyzed by its distinctive combination of a small and extremely distinguished permanent Faculty with approximately ten times their number in temporary Members, Visitors, and Research Associates who join IAS from around the globe, allowing the Institute to re-assemble dynamically around new questions each year. The gift of time at IAS is made possible with the support of an international network of philanthropic partners.

In 2022–23, the doors to Rubenstein Commons, the Institute's newest campus building, were officially opened. The Commons, which provide a nexus of gathering spaces for the IAS community, were enabled through a visionary gift from businessman and philanthropist David M. Rubenstein.

We are extremely grateful to the Trustees, Faculty, Friends of the Institute, Members and Visitors, Staff, organizations, and members of the community listed below for their visionary commitment and contributions. In fiscal year 2022–23 (ending June 30, 2023), gifts and pledges to the Institute totaled more than \$49 million.

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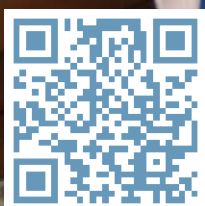


Record of Events and Financial Statements

A regular feature of past Annual Reports, the Record of Events and Financial Statements now have a new home. If you are looking for either item, use the provided QR codes to find their new digital locations on the IAS website.

DAN KOMODA

In March 2023, Director and Leon Levy Professor David Nirenberg hosted Daniel Weiss, president and chief executive officer of The Metropolitan Museum of Art, for a Director's Conversation event. Weiss also signed copies of his latest book for IAS scholars.



Record of Events



Financial Statements



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