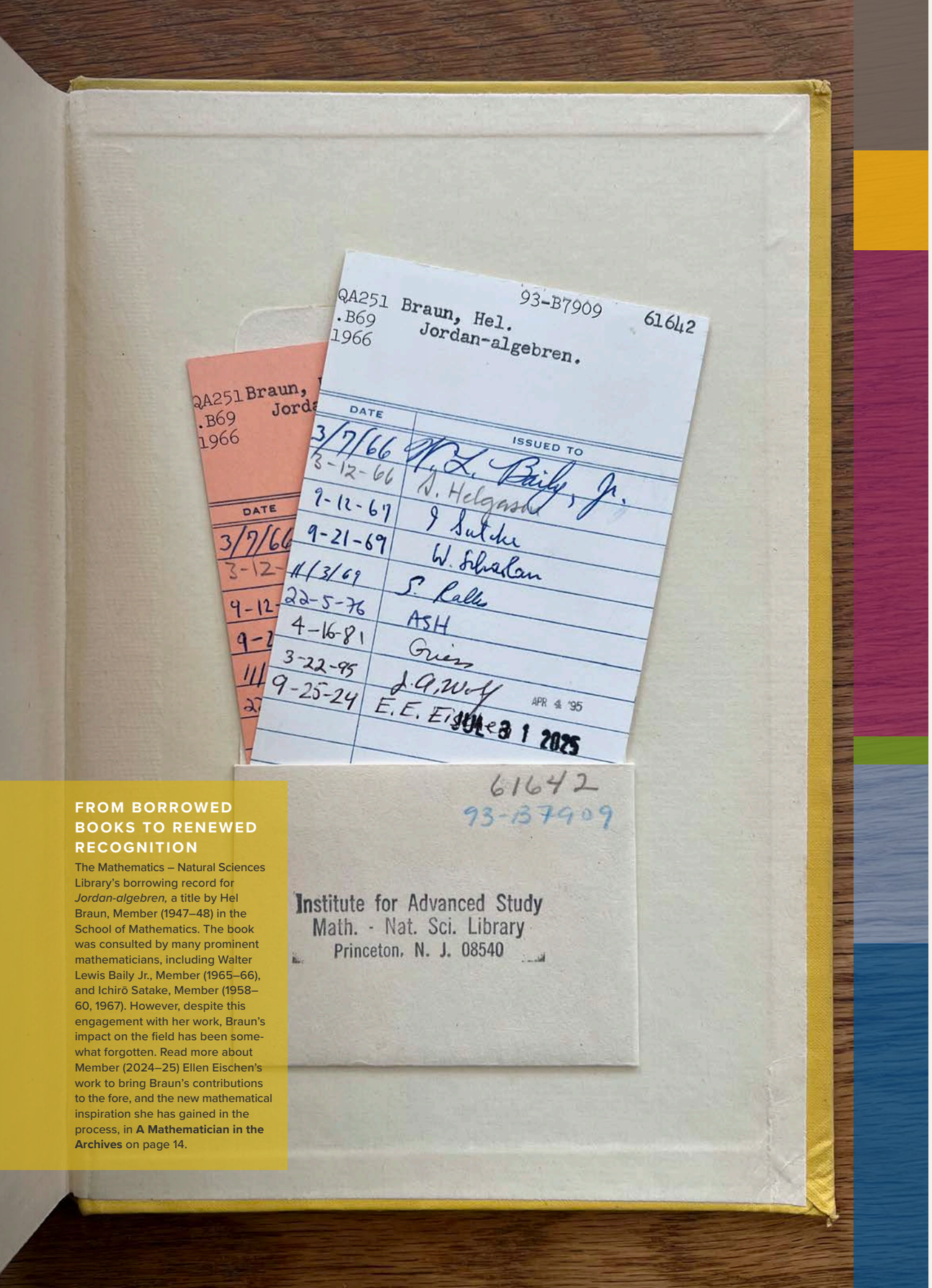
IAS | THE INSTITUTE LETTER

Fall / Winter 2026

Delving Into Digital (In)Equality

A Mathematician in the Archives

IAS Shaping the Field: From EPR to AdS/CFT and Beyond



FROM BORROWED BOOKS TO RENEWED RECOGNITION

The Mathematics – Natural Sciences Library's borrowing record for *Jordan-algebren,* a title by Hel Braun, Member (1947–48) in the School of Mathematics. The book was consulted by many prominent mathematicians, including Walter Lewis Baily Jr., Member (1965–66), and Ichirō Satake, Member (1958–60, 1967). However, despite this engagement with her work, Braun's impact on the field has been somewhat forgotten. Read more about Member (2024–25) Ellen Eischen's work to bring Braun's contributions to the fore, and the new mathematical inspiration she has gained in the process, in **A Mathematician in the Archives** on page 14.

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Fall/Winter 2026

Contents

Editor
Genevieve Looby

Staff Writer
Abbey Ellis

Design and Layout
ChingFoster

Communications and Public Relations Manager
Lee Sandberg

Editorial Associate
Emma Eaton

Illustrators
Donghyun Lim
David Salmerón

Cover Image
Paradox of Coexistence, digital illustration, is a reflection on the duality of digital technology—depicting the irony wherein technological advancement benefits some while simultaneously pushing others into a dark underside, revealing the paradox of coexistence. **Donghyun Lim** is a Seoul-based illustrator whose style works across a range of applications—from fashion, editorial, animation, and advertising—which has led to him expanding his client list to include internationally recognized names such as *Monocle* magazine.

Inside Front Cover
Abbey Ellis

Inside Back Cover
Maria O'Leary

Back Cover
Andrea Kane

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Paths of Inquiry

The Institute for Advanced Study campus is best experienced on foot.

As autumn sunlight filters through the canopy of the Institute Woods and the sturdy paths of slate underfoot give way to the green lawn behind Fuld Hall, each route seems to echo with the footsteps of those who have come before. The Woods, with their winding trails—blazed by early IAS scholars and protected today by a conservation easement—have long served as a source of inspiration.

This fall, the paths were animated by new energy: the Institute welcomed 259 new and returning scholars for the 2025–26 academic year, representing 39 countries and more than 130 institutions. They joined a tradition of inquiry and collegiality that stretches back nearly a century, and which lives in every corner of this singular campus.

A walk across the Institute is a journey through history. The hum of blackboard discussions in Simonyi Hall, galvanized by the School of Mathematics's special year on Arithmetic Geometry, Hodge Theory, and o-minimality, evokes the Institute's earliest days, when its founders envisioned a haven for unfettered inquiry. Nearby, in Bloomberg Hall, scholars from the School of Natural Sciences explore questions from quantum gravity to the origins of galaxies, while the *Slate Oasis* sculpture in the courtyard reminds visitors that creativity and curiosity are at the heart of scientific progress.

On the north side of campus, West Building stands as a vital hub for the Institute's humanistic endeavors. It houses both the Schools of Historical Studies and Social Science, fostering an environment where historians, anthropologists, sociologists, and philosophers work side by side. This year, that spirit of interdisciplinary exchange is embodied in the School of Social Science's theme seminar, which explores the paradoxes of digital (in)equality in different historical and social contexts.

Turning back across the lawn, Wolfensohn Hall comes into view—a concert hall and lecture venue at the heart of campus life. Whether it's a world-renowned scientist delivering a public talk, musicians filling the space with sound, or scholars from all four Schools gathering for shared celebration, the Hall embodies the Institute's commitment to bringing people together in pursuit of ideas. Stepping inside, one is reminded that intellectual life here thrives not only in quiet offices and seminar rooms, but also in the moments when the community assembles.

As Peter Goddard, IAS Director (2004–12) and Professor Emeritus in the School of Natural Sciences, once remarked at the dedication of a new sculpture by the Institute's pond, "Time and space for thought on fundamental questions in beautiful surroundings are among the important resources that the Institute offers to the leading scientists and scholars who come from all over the world to work here." Walking these grounds is a reminder that the world's most significant discoveries are accomplished when there's room to wander, to wonder, and to meet each other along the way.

Walking the Institute

Albert Einstein, founding Faculty (1933–55) in the School of Mathematics/Natural Sciences, is often quoted as saying that he came to the Institute campus for a single, cherished purpose: the pleasure of walking home with Kurt Gödel. Gödel, Einstein's colleague and fellow wanderer, was associated with the Institute from his first visit in 1933–34 until his death in 1978.

This tradition of thoughtful ambling—what Director and Leon Levy Professor David Nirenberg calls "peripatetic cogitation"—continues to shape life at IAS.

In his welcome address to the Institute community at the start of the 2025–26 academic year, Nirenberg also invoked the Institute's surroundings—its fields, forests, and meadows—as spaces deliberately designed not simply for work, but for reflection, encounter, and the cultivation of ideas. Here, among the "fractal leafiness and winding paths," scholars are invited to step away from the world's relentless utility and urgency, finding in the hush of the Woods the freedom to think, converse, and discover.

This installment of the Campus Conversations series features reflections from Members and Visitors across all four IAS Schools, highlighting how the simple act of walking—alone or in conversation—continues to animate the Institute community, echoing the footsteps of Einstein and Gödel along paths both familiar and new.

Scan the QR code to read more scholar responses.

Shelby White and Leon Levy Archives Center

"Visitors to the Institute often remark on how fortunate I am to enjoy such a generous office. Whilst this is true, I am always quick to suggest that we continue our conversations outside. The turtle-filled pond and wandering woodland paths offer a unique mindfulness. The pacing of feet paces conversation and guides it along unexplored directions—especially with a cuppa in hand!

In spring, as the pond thawed and turtles emerged from their wintry brumation, my collaborator and I filled our mugs and took a daily stroll around the water. During our own orbital circuits, we discussed planets embedded in gaseous disks, orbiting their star. The wake of ducks atop the pond is not too dissimilar to the waves launched by these planets. This resonance of ideas, forged by people and place, yielded novel results. I think I'll continue orbiting the pond and see what the next year brings."

– Callum W. Fairbairn, Friends of the Institute for Advanced Study Member (2023–26), School of Natural Sciences

"One of the great privileges of life at the Institute is the opportunity, in those moments when one is stuck, with incomplete sentences swirling around the head, to pause, shut one's laptop, and take a walk. This could mean a short stroll from the library to Fuld Hall, a loop around the pond, or, if feeling ambitious, a longer trek through the Institute Woods (in my case, typically accompanied by my intrepid cat). I can't say that I ever had an epiphany while underway in the woods, but these walks did exactly what I needed them to do—they offered a space to breathe, clear the head, and momentarily get lost in another rhythm before heading back, sitting down again, and getting back into the flow of writing. There's no better cure for writer's block!"

— Katerina Korola, Member (2024), School of Historical Studies

"One of my favorite parts of being at IAS is its close proximity to nature. In just a short walk through the woods and around the lake, I can see many different animals: deer, foxes, rabbits, frogs, herons, snakes, and, of course, fish. My work involves making connections between spectral algorithms and problems in coding theory, extremal combinatorics, and cryptography, which require ingenuity to explore, and I find that walking is a great way to clear my head when I'm stuck on a research problem!"

— Peter Manohar, Member (2024–26), School of Mathematics

"Walking on the Institute's paths to lunch and afternoon tea has led to many wonderful conversations, including one with sociologist R. L'Heureux Lewis-McCoy [Member (2024–25) in the School of Social Science] after he gave a seminar titled 'The Afterlives of Integration.' L'Heureux used the term 'muting' to characterize voices within minoritized communities sounding in majority spaces. To musicians and musicologists such as myself, 'muting' has many meanings beyond the familiar act of muting during an online meeting. A muted sound varies considerably depending on the type of instrument (e.g., violin, trumpet, saxophone) and type of mute (wood, fiber, metal, rubber). Our lively chat led to me sharing recorded sounds of muted instruments and my essay on the last movement of Ruth Crawford's String Quartet 1931, *in which three instruments play* sempre con sordino *(always with mute). That walking conversation impacted L'Heureux's articulation of the term in the published version of his paper."*

— Ellie M. Hisama, Edward T. Cone Member in Music Studies (2024), School of Historical Studies; Visitor (2025), School of Social Science

Albert Einstein walking with Peter G. Bergmann, Research Associate (1939–41) in the School of Mathematics/Natural Sciences, and Valentine Bargmann, Member (1937–43, 1954–55) in the School, on the Princeton University campus.

Campus Encounters

Meet this Year's New Scholars

For Nadine Soliman, NASA Hubble Fellow in the School of Natural Sciences, her walk from the Member housing complex to her office in Bloomberg Hall is the best part of her day. "It is not quite home, not quite work," she says. It offers "just some quiet time to think and ease into the rhythm of the day."

When exploring the campus on foot this academic year, you might run into Soliman, or any of the other new scholars featured in our annual start-of-term Q&As.

Alongside Soliman, who investigates the interplay between microphysical processes and large-scale astrophysical structures, you'll meet Corey Robin, Member in the School of Social Science, a political theorist and journalist whose scholarship addresses a range of topics across modern economic and political thought. Also featured is Rahul Ilango, a Member in the School of Mathematics who studies computational complexity theory, and Zeynep Çelik Alexander, Hans Kohn Member in the School of Historical Studies, who is interested in the history and theory of architecture since the Enlightenment.

In these Q&A snippets—available in full via the QR code—the scholars share insights into both their research and personal interests, from the intellectual influences shaping their work to unexpected passions.

Scan the QR code to learn more about these new members of the Institute's community of discovery.

Some answers have been edited for length and clarity.

Q Are there IAS scholars, past or present, who have impacted or influenced your research?

A **Robin:** Definitely Wendy Brown, UPS Foundation Professor in the School of Social Science, who was one of the first people to look at neoliberalism as a political rather than simply an economic form. She certainly is one of the people I think about, and am thinking with, all the time.

Before Brown there was Albert O. Hirschman, Professor (1974–2012) in the School, who was a great economist here. He wrote a brilliant book in the 1970s called *The Passions and the Interests*, about the ways in which early modern thinkers and economists thought that capitalism would tame political passions like ambition and heroism and glory. It's a book I'm always thinking with.

Ilango: One of my most recent papers builds off a really cool concept that Kurt Gödel, frequent Member and Professor (1953–78) in the School of Mathematics, worked on. He proved that there are true statements in math that we'll never be able to prove. Which was kind of a killing blow to some viewpoints of math, which held that we can prove everything that is true. And it turns out that's not the case! There exist, vexingly, statements that are true that you can't prove.

This seems like bad news, right? But actually, in my research, it's starting to become good news. You can use it to develop new, powerful cryptographic systems. In cryptography generally, you want to be able to do something easily that your enemy will not be able to do easily. The fact that something is true, but you can't prove it, can give you power that your enemy does not have.

Alexander: Is there any historian of art or architecture—or, for that matter, any humanist—not impacted by Erwin Panofsky, Professor (1935–68) in the School of Historical Studies? Jonathan Crary, Member (1993) in the School, has also had enormous influence on my personal intellectual development.

Soliman: Definitely! James Stone, Professor in the School of Natural Sciences, has had a big impact on my research. His expertise in numerical methods and star formation, along with his work across different areas of astrophysics, really resonates with what I'm doing. I am looking forward to working more closely with him at IAS and learning from his experience.

Q What is one challenge in your field that people often underestimate?

A **Alexander:** I'm a historian of architecture, but I don't always study buildings. Architectural history is a field that splintered off from art history in the mid-twentieth century and, in the last decade or two, has developed its unique set of questions and techniques. It's a surprisingly interdisciplinary field. You'll find that architectural historians engage in intellectual history, environmental history, media theory, data analysis, and even ethnographic fieldwork. They'll use the built environment to write the most unexpected histories: of obsolescence, for example, or of toxicity. This might be the least understood aspect of our field, but I'm very proud of my fellow architectural historians' intellectual adventurousness.

Q If you had to give a seminar on something unrelated to your field, what would it be?

A **Soliman:** I'd love to give a seminar on tea. I attended one a while ago, and it completely changed how I think about tea. There's so much to explore: the history, how tea is grown and processed in different regions, and how those factors shape its flavor. I love that tea connects culture, science, and history, and you really get to experience it with your senses instead of just hearing about it.

Robin: I really enjoy approaching political questions through literature. A course I would like to teach would be focused on only the *Oresteia*, *Hamlet*, and *Beloved*—each text is about the family, and about murder in the family, but in very different political moments, with quite different political valences.

Corey Robin

Corey Robin
Member (2025–26), School of Social Science

Andrea Kane

Nadine Soliman
NASA Hubble Fellow (2025–30), School of Natural Sciences

Rahul Ilango

Rahul Ilango
Member (2025–26), School of Mathematics

Andrea Kane

Zeynep Çelik Alexander
Hans Kohn Member (2025–26), School of Historical Studies

Seeing Faith in the Middle Ages

Éric Palazzo, Elinor Lunder Founders' Circle Member (2018–19) in the School of Historical Studies, explores the profound intertwining of art and theology in the Middle Ages in his recent book, *Medieval Art as Theology (L'art médiéval comme théologie)*. Rather than studying, as if from the outside, the forms and styles of medieval art, Palazzo invites readers to experience the medieval worldview from within, bridging the gap between modern perceptions and historical realities.

Through close examination of ten diverse works—including illuminated manuscripts, sculpture, stained glass, and architecture—Palazzo reveals how each piece embodies the spiritual and intellectual climate of its era. By situating each artwork in its historical context and interpreting its theological significance, the book immerses readers in the vibrant world where doctrine was vividly expressed through visual means.

Ultimately, Palazzo illuminates how medieval art functioned as a living theology, offering images of a God made incarnate.

Première Bible de Charles le Chauve (Charles le Chauve's first Bible), Paris, Bibliothèque nationale de France, folio 423r, © Bibliothèque nationale de France.

Memory in Motion in Post-war Peru

In her new book *Learning through Collective Memory Work: Troubling Testimonio in Post-war Peru*, written during her time at IAS, **Goya Wilson Vásquez**, Visitor (2023–24) in the School of Social Science, examines the creation of *testimonio*—a genre of testimonial narrative rooted in Latin American traditions—as collective memory work. At the heart of her book is the HIJXS de Perú, a collective of young adults whose parents were involved with the Tupac Amaru Revolutionary Movement, one of the insurgent groups at the center of Peru's internal war from 1980–2000.

Wilson Vásquez is not just a chronicler of these stories; she is herself a member of HIJXS. Her dual perspective—as both participant and researcher—shapes every page as she navigates the complexities of belonging and critical inquiry from within the group.

Goya Wilson Vásquez

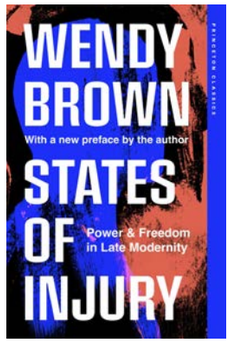
The book highlights the lived experiences of HIJXS de Perú members, whose childhoods were marked by the punishment, imprisonment, or disappearance of their relatives, and by the stigma of being labeled "children of terrorists." Their stories do not neatly fit into the dichotomy of "victim" and "perpetrator" that dominates public narratives about the conflict, and have often been left out of official accounts.

Wilson Vásquez explores the politics of breaking this silence through *testimonio*, which serve as both a pedagogical tool and a research methodology. The book unfolds in three "movements" of memory work: constructing testimonial narratives (a realist memory); critically examining the conditions and silences that shape these accounts (a politics of memory); and creatively engaging with the complexities of memory, voice, and representation (a poetics of memory).

Drawing on cycles of storytelling, reflection, and creative writing, the book shows how collective memory work can deepen understandings of memory, education, and transitional justice. It offers new ways to think about and learn from the experiences of those affected by violence in post-war Peru.

Drawing on cycles of storytelling, reflection, and creative writing, the book shows how collective memory work can deepen understandings of memory, education, and transitional justice.

The Making of a New Classic



In 1995, **Wendy Brown**, UPS Foundation Professor in the School of Social Science and American political theorist, published *States of Injury: Power and Freedom in Late Modernity*. In 1996, it won the Choice Outstanding Book Award, and has since been translated into French, Italian, Greek, Spanish and Chinese, with selected chapters translated into a dozen other languages. The book responded to specific predicaments of the Left at the close of the twentieth century; Brown focused especially on the politics of identity, its formation at the site of a wound, and the dangers of enshrining such wounds as a political position, or even in the law. How, Brown asked, might wounded attachments foreclose the emancipation and equality to which Left social movements aspired?

Thirty years later, Princeton University Press has recognized both the achievement of Brown's theoretical intervention in the nineties and its startling prescience for the contemporary political landscape, issuing the book as part of the Princeton Classics collection. *States of Injury* (2025) therefore joins the ranks of "works by leading scholars and writers that have made a lasting impact on intellectual life around the world." Other titles include those as definitive as *Walden* and *Mimesis*.

The 2025 edition features a new preface from Brown, which situates the book in the context of what has changed politically and intellectually—and what has not—since its original publication. She writes of the American political circumstances that originally animated *States of Injury*, describing how the Right mobilized notions of "freedom" in order to take down redistributive policies and programs, and the Left's reactive tempering of its own political aims. Of the ways in which the modern political landscape echoes, but also recasts, that earlier dynamic, Brown concludes: "Given the perennial appeal of freedom, and its importance to human thriving and democracy, leftist reclamations of the term along with articulations of its value and conditions have never been more important. If the challenge of the early 1990s was to recuperate Left struggles for freedom as emancipation, today we are challenged to integrate that struggle with one for freedom as democratic rule."

Nando Ochando

Pushing the Limits in Planet-Disk Interactions

What happens when a planet plows through the swirling disk of gas and dust that surrounds a young star? Whilst much of the previous research on this subject has focused on planets tracing neat, circular paths, the cosmos is rarely so orderly. In a recent paper, Friends of the Institute for Advanced Study Member **Callum W. Fairbairn** and NASA Einstein Fellow **Alexander Dittmann**, both from the School of Natural Sciences, have broadened our understanding of planets on elliptical, or "eccentric," orbits.

Using state-of-the-art hydrodynamic simulations, Dittmann and Fairbairn tested an analytical "linear theory" previously developed by Fairbairn and frequent IAS Visitor **Roman Rafikov**. This theory, which predicts mathematically how planets stir up spiral waves of gas in disks, was originally applied to those with small eccentricities. Dittmann and Fairbairn pushed the limits of this theory, exploring planets with highly eccentric orbits, including some that were moving supersonically relative to the disk.

Their findings are striking: even at extreme eccentricities, the linear theory remains robust, accurately capturing the complex push and pull between planet and disk. This is especially significant, as many observed planets—including those in our own solar system—do not follow perfect circles but rather exhibit significant eccentricities.

Beyond validating the linear theory, their work illuminates subtle, nonlinear phenomena. For instance, as planets whip through the disk, the spirals they generate can steepen and form shock-waves, changing the disk's structure. These effects, previously hard to model, are now better understood thanks to Dittmann and Fairbairn's detailed comparisons between simulation and theory.

The results not only provide a detailed benchmark for planet-disk interaction problems but also enrich scholars' knowledge of how planets shape, and are shaped by, their gaseous surroundings.

Alexander Dittmann

Illuminating the Invisible

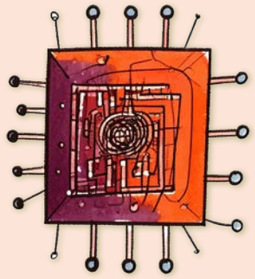
In a collaboration born from overlapping terms in the School of Natural Sciences, **Elena Murchikova**, Member (2018–22) and frequent Visitor, and **Kailash Sahu**, Member (2022–23), have challenged prevailing assumptions about the visibility of isolated black holes.

Their research centers on the question of whether stellar mass black holes—long thought to be very difficult to detect outside of binary pairs—can in fact be observed through the light they emit while they plow through interstellar gas.

In a recent paper published in *The Astrophysical Journal Letters*, Murchikova and Sahu demonstrated, by generating synthetic spectra and comparing them with current observational capabilities, that light emissions from solitary black holes are within reach of modern telescopes, particularly for those in dense environments or near our solar neighborhood.

Their findings reframe the search for black holes: the challenge is not whether these black holes can be seen, but whether we can identify them.

A "Mind-Blowing" Proof



Algorithms require time to run, and space (or memory) to store data while they do so.

For decades, computer scientists in the field of complexity theory—a branch of mathematics which deals with questions of resources like time and space in computing—have been working within the confines of a basic premise: that, because computational space can be reused, it should be a much more powerful resource than time (which is non-recyclable).

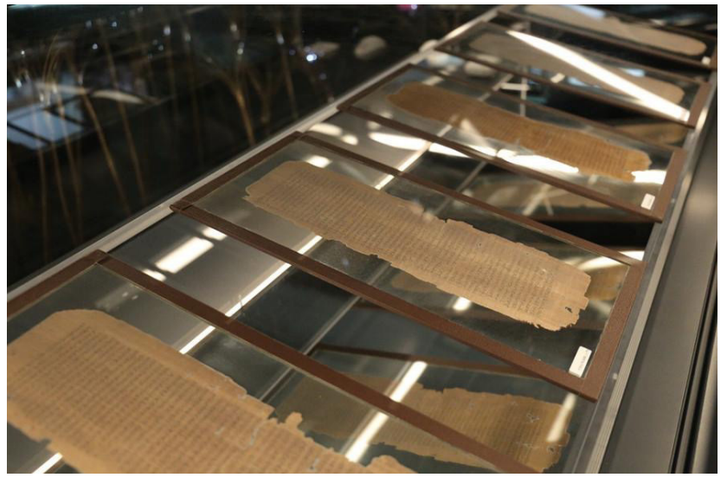
Providing a proof for this important question within the field of complexity theory offers new avenues to address one of the oldest open problems in computer science: P vs. PSPACE.

Though the concept seems intuitive, establishing a rigorous proof of it has stumped researchers. Some algorithms produce complex intermediate results over time that intuitively require a proportionate amount of space to store. It did not seem possible that there could be other algorithms solving the same task that used significantly less memory.

That was until spring 2025, when **Ryan Williams**, von Neumann Fellow in the School of Mathematics, announced a proof which transforms an algorithm—any algorithm, no matter what it does—into a version that uses much less memory than scholars once believed was possible. Providing a proof for this important question within the field of complexity theory offers new avenues to address one of the oldest open problems in computer science: P vs. PSPACE.

Upon hearing the news, Avi Wigderson, Herbert H. Maass Professor in the School of Mathematics, emailed Williams with a concise subject line: "You blew my mind."

D. Jonathan B. Foster



Sofía Torallas Tovar alongside exhibition designer Ángel Rocamora and co-curator Raquel Martín Hernández

Lives and Afterlives of a Codex

From an ancient Egyptian necropolis to a twenty-first-century Madrid gallery, the P967 codex—often called Ezekiel's Papyrus—has travelled a long arc of textual transmission and material transformation.

The papyrus, believed to date back to the third century C.E., was discovered in the Necropolis of Mir in Egypt in the late nineteenth or early twentieth century. It originally held 236 pages of the biblical texts of Ezekiel, Daniel, and Esther translated into Greek.

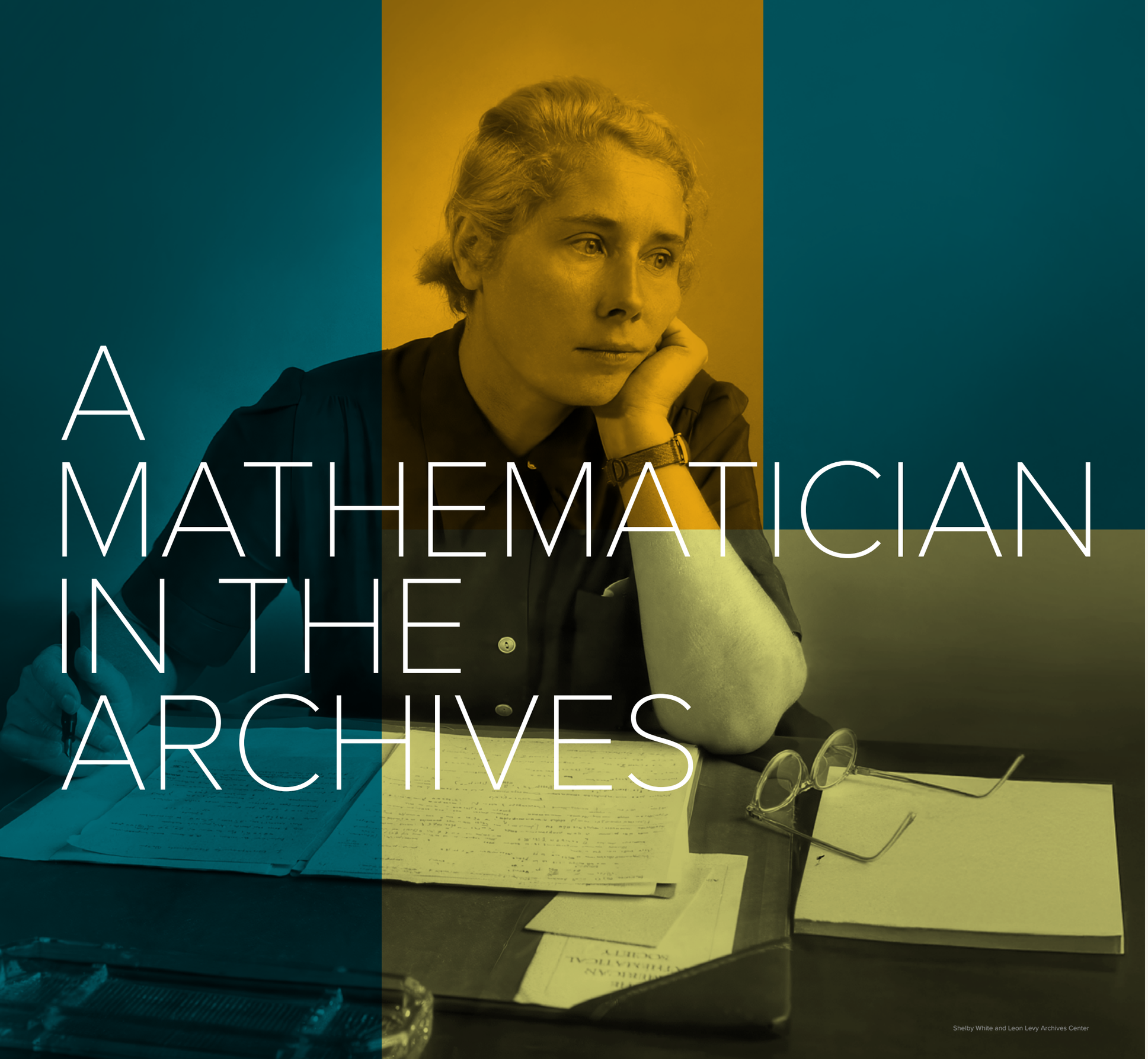
In a recent exhibition held at the National Library of Spain, **Sofía Torallas Tovar**, Distinguished Visiting Professor in the School of Historical Studies, and her co-curator Raquel Martín Hernández revisited the document as both artifact and argument.

The exhibition assembled ten original sheets from the papyrus, highlighting how dispersal has been a major feature of its history. Having been sold in pieces to the highest bidders during the antiquities boom of the nineteenth and twentieth centuries, its surviving leaves now reside in the Spanish National Library in Madrid, the Chester Beatty Library in Dublin, Princeton University, the University of Cologne, and the Abbey of Montserrat in Barcelona.

While physical reunification of the entire papyrus remains impossible, a virtual display within the exhibition reunited the distant pages. Five thematic cases—showcasing Roman-era writing tools, Greek and Hebrew biblical comparanda, and Renaissance prints of Ezekiel by Michelangelo and Raphael—situated the papyrus within the technologies, languages, and iconographies that produced and received it. This, in turn, reframed ancient codices as dynamic participants in global histories of media, scripture, and exchange—highlighting that they are by no means static relics severed from networks of trade, curation, and interpretation.

Beyond the exhibition, a digital facsimile of all 200 extant pages will be published online, extending access for future scholarship and public engagement.

A MATHEMATICIAN IN THE ARCHIVES



Shelby White and Leon Levy Archives Center

When Ellen Eischen, von Neumann Fellow (2024–25) in the School of Mathematics, discovered a lost mathematical perspective from the middle of the twentieth century, she dove into historical research for more. Her work reveals what a discipline forfeits when it overlooks the complex reality that shapes it.

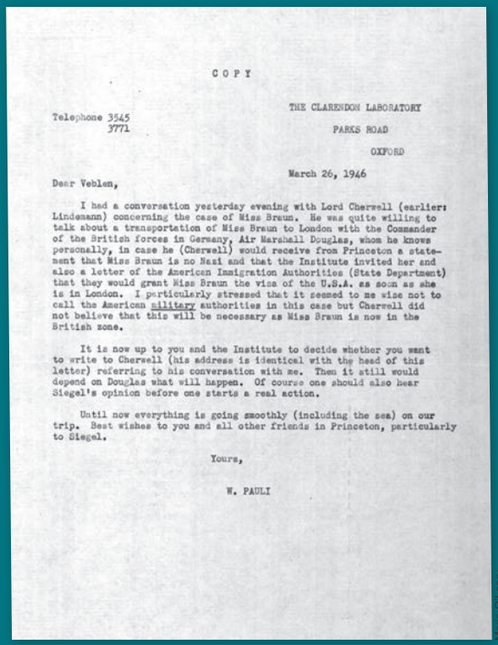
BY DEVORAH FISCHLER

Ellen Eischen wants us to think more about the human side of math—how it's molded by the people who practice it, the historical periods they lived through, and the areas where they worked and traveled.

"On some level, we know that life and math intersect," Eischen says. "We talk about places with significant concentrations of mathematicians and encounters that result in incredible work. At the same time, there's a prevalent idea that because our subject matter is timeless and universal, the development of mathematical knowledge stands apart from subjective human factors. That isn't realistic."

More importantly, Eischen notes, this perspective holds back progress. In a suite of new and forthcoming lectures and essays,[1] she shows what's at risk for a discipline that values truth but does not fully account for how that truth is produced. Her latest research looks back in time to shine light on the mathematician Hel Braun, whose contributions were obscured for reasons that were anything but mathematical.

[1] Eischen has shared her research in a lecture for the Friends of the Institute for Advanced Study and with her School of Mathematics colleagues as part of the Members Colloquium series. She has also published an article on Braun with the German Mathematical Society (DOI 10.1515/dmvm-2025-0077).



COPY

THE CLARENDON LABORATORY

Telephone 3545
3771

PARKS ROAD

OXFORD

March 26, 1946

Dear Veblen,

I had a conversation yesterday evening with Lord Cherwell (earlier: Lindemann) concerning the case of Miss Braun. He was quite willing to talk about a transportation of Miss Braun to London with the Commander of the British forces in Germany, Air Marshall Douglas, whom he knows personally, in case he (Cherwell) would receive from Princeton a statement that Miss Braun is no Nazi and that the Institute invited her and also a letter of the American Immigration Authorities (State Department) that they would grant Miss Braun the visa of the U.S.A. as soon as she is in London. I particularly stressed that it seemed to me wise not to call the American military authorities in this case but Cherwell did not believe that this will be necessary as Miss Braun is now in the British zone.

It is now up to you and the Institute to decide whether you want to write to Cherwell (his address is identical with the head of this letter) referring to his conversation with me. Then it still would depend on Douglas what will happen. Of course one should also hear Siegel's opinion before one starts a real action.

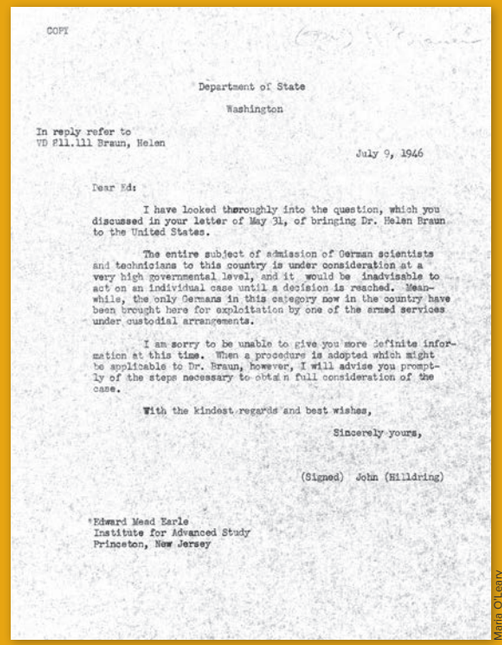
Until now everything is going smoothly (including the sea) on our trip. Best wishes to you and all other friends in Princeton, particularly to Siegel.

Yours,

W. PAULI

Maria O'Leary

Letter from Wolfgang Pauli to Oswald Veblen, March 26, 1946, 00028, Institute for Advanced Study (Princeton, N.J.). Director's Office. Member records, Box 14, Shelby White and Leon Levy Archives Center.



COPY

Department of State

Washington

In reply refer to
VD Fll.lll Braun, Helen

July 9, 1946

Dear Ed:

I have looked thoroughly into the question, which you discussed in your letter of May 31, of bringing Dr. Helen Braun to the United States.

The entire subject of admission of German scientists and technicians to this country is under consideration at a very high governmental level, and it would be inadvisable to act on an individual case until a decision is reached. Meanwhile, the only Germans in this category now in the country have been brought here for exploitation by one of the armed services under custodial arrangements.

I am sorry to be unable to give you more definite information at this time. When a procedure is adopted which might be applicable to Dr. Braun, however, I will advise you promptly of the steps necessary to obtain full consideration of the case.

With the kindest regards and best wishes,

Sincerely yours,

(Signed) John (Hilldring)

Edward Mead Earle
Institute for Advanced Study
Princeton, New Jersey

Maria O'Leary

Letter from John Hilldring to Edward Mead Earle, July 9, 1946, 00110, Institute for Advanced Study (Princeton, N.J.). School of Mathematics, Box 3, Shelby White and Leon Levy Archives Center.

INTO THE ARCHIVES

As of today, Eischen's research has brought her into contact with ten archives across the U.S. and the globe, including the Library of Congress. She's in active communication with several historians, including historians of mathematics, and she's preparing to write a book. It's a surprising pivot for the number theorist—even one as successful as she has been for her creative public engagement work. It all started with a conversation at IAS.

At a daily tea in Fuld Hall, Eischen was chatting with Akshay Venkatesh, Robert & Luisa Fernholz Professor in the School of Mathematics. "Akshay mentioned he was interested in the history of math. I asked him if he had ever heard of a mathematician called Hel Braun." This is something Eischen had been asking mathematicians for several years. Most have said no. "But Akshay said yes," Eischen says.

What's more, Venkatesh had a surprising fact to contribute. There were files on Braun onsite at the Institute's Shelby White and Leon Levy Archives Center. She'd been an IAS Member from 1947–48.

"My interest in Braun began with some extraordinary articles I came across," Eischen says. "They were published in the *Annals of Mathematics*—our most prestigious journal—in the late 1940s and early 1950s. A mathematician named Hel Braun wrote them, but at that point I'd never heard of her, even though she had produced significant, foundational work in my field."

Eischen wasn't aware that these articles were written at IAS. Newly arrived at the Institute, Eischen felt her curiosity piqued by the coincidence. The opportunity to learn more about the mystery of this lost math—sophisticated and consequential by any measure—was attractive, and Venkatesh soon introduced her to IAS archivist Caitlin Rizzo. Before long, decades-old documents were piling up in front of her.

"That first archival visit at the Institute was a transformational moment for me," Eischen says. "Even though I'd been more historically oriented than most, tracing results back to their origins and sharing those insights with others, I still had never thought of myself as a history person." In fact, Eischen shares, she'd been told since childhood that she just didn't have the "history gene."

"I really had this idea of myself as someone who just wasn't good at history," Eischen laughs. "I remember getting this brutal feedback on a paper on the Great Depression in ninth grade that really affected me. Math came naturally, but it felt like everyone was always telling me I had to work extra hard in history because I just wasn't cut out for it. And I believed them."

At the same time, Eischen reflects, she was always drawn to history. Born and raised in the Princeton area, she had a childhood fascination with the region's role in the Revolutionary War, imagining how troops had moved along familiar routes and homes that had been key in major battles. "I loved visiting the Old Barracks in Trenton and the Thompson-Neely House in New Hope. I would ask the living history actors questions," Eischen says. "And I remember insisting my dad drive us over the river to Pennsylvania so I could research a school project at the David Library of the American Revolution." In college too, she had enjoyed a course in the history of science taught by Angela Creager,[2] where she refined her skills in finding and interpreting primary sources.

"I actually crossed paths with that ninth-grade teacher later when I was in grad school," Eischen says, "and he was surprised to hear I was getting my doctorate in math and not in history!" She hadn't realized his criticism was meant to signal the strong potential of her work. "It shows how unnecessary and limiting it is to polarize different skills and interests," she says.

As Eischen launched into her archival research at IAS, the opposition between the historical and mathematical began to seem quite brittle. The

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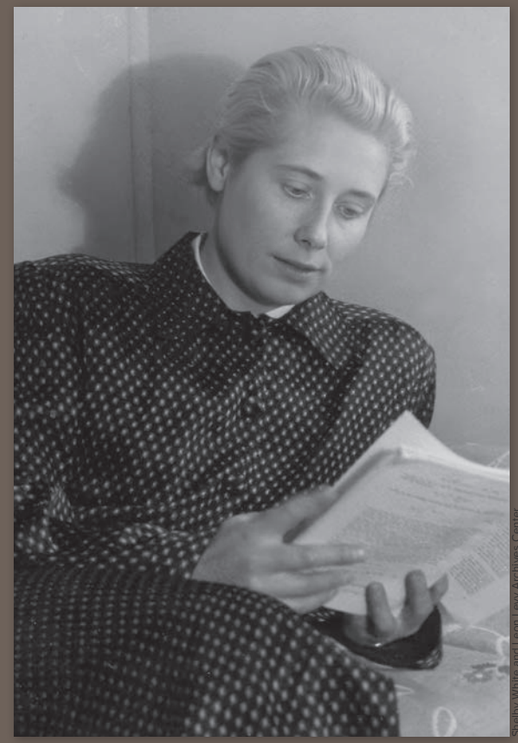
Eischen and IAS archivist Caitlin Rizzo exploring the IAS Registry, which has recorded the signatures of Institute scholars since 1933. Hel Braun is a signatory.



Shelby White and Leon Levy Archives Center

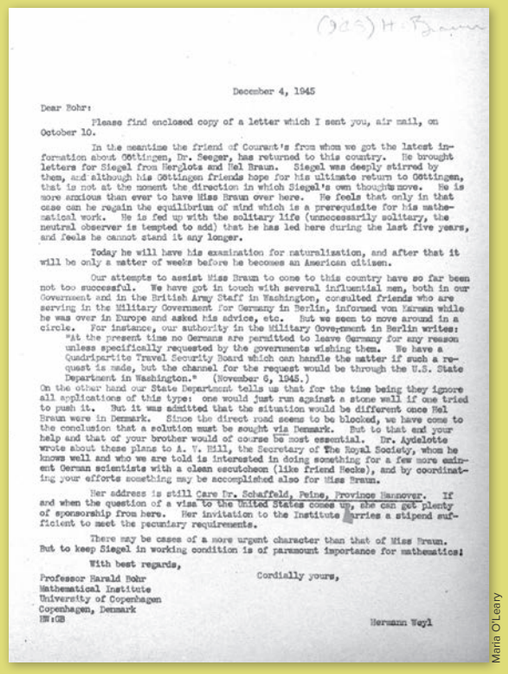
[2] Coincidentally, Creager spent time at IAS the year after teaching Eischen, as a Visitor in the School of Historical Studies (2002–03). Creager had also previously served as a Visitor in the School of Social Science (1996–97).

documents in front of her were telling a story that her mathematician's eye could discern with remarkable sensitivity.

Telegrams. Letters. Photographs. Paperwork. These humdrum exchanges and bureaucratic records were all anchored by names Eischen knew were driving one of the most monumental eras in math, a time when universities across continents were transforming under wartime pressures and scholars were crossing the Atlantic to saturate new centers of intellectual life.

"I was seeing a network of some of the greatest mathematicians of the twentieth century," Eischen explains. "These were Hel Braun's circles, and she was highly regarded in them. But I was also beginning to see this complex overlay of personal, institutional, social, and political issues that would eventually obscure Braun's story and contributions."

Decades earlier, Braun had laid the keystone Eischen hadn't even realized was missing from the foundation of her own research. Today, Eischen wants to account for that loss.



December 4, 1945

Dear Bohr:

Please find enclosed copy of a letter which I sent you, air mail, on October 10.

In the meantime the friend of Courant's from whom we got the latest information about Göttingen, Dr. Seeger, has returned to this country. He brought letters for Siegel from Herglotz and Hel Braun. Siegel was deeply stirred by them, and although his Göttingen friends hope for his ultimate return to Göttingen, that is not at the moment the direction in which Siegel's own thoughts move. He is more anxious than ever to have Miss Braun over here. He feels that only in that case can he regain the equilibrium of mind which is a prerequisite for his mathematical work. He is fed up with the solitary life (unnecessarily solitary, the neutral observer is tempted to add) that he has led here during the last five years, and feels he cannot stand it any longer.

Today he will have his examination for naturalization, and after that it will be only a matter of weeks before he becomes an American citizen.

Our attempts to assist Miss Braun to come to this country have so far been not too successful. We have got in touch with several influential men, both in our Government and in the British Army Staff in Washington, consulted friends who are serving in the Military Government for Germany in Berlin, informed von Karman while he was over in Europe and asked his advice, etc. But we seem to move around in a circle. For instance, our authority in the Military Government in Berlin writes:

"At the present time no Germans are permitted to leave Germany for any reason unless specifically requested by the governments wishing them. We have a Quadripartite Travel Security Board which can handle the matter if such a request is made, but the channel for the request would be through the U.S. State Department in Washington." (November 6, 1945.)

On the other hand our State Department tells us that for the time being they ignore all applications of this type: one would just run against a stone wall if one tried to push it. But it was admitted that the situation would be different once Hel Braun were in Denmark. Since the direct road seems to be blocked, we have come to the conclusion that a solution must be sought via Denmark. But to that end your help and that of your brother would of course be most essential. Dr. Aydelotte wrote about these plans to A. V. Hill, the Secretary of The Royal Society, whom he knows well and who we are told is interested in doing something for a few more eminent German scientists with a clean escutcheon (like friend Hecke), and by coordinating your efforts something may be accomplished also for Miss Braun.

Her address is still care Dr. Schaffeld, Peine, Province Hannover. If and when the question of a visa to the United States comes up, she can get plenty of sponsorship from here. Her invitation to the Institute carries a stipend sufficient to meet the pecuniary requirements.

There may be cases of a more urgent character than that of Miss Braun. But to keep Siegel in working condition is of paramount importance for mathematics!

With best regards,

Cordially yours,

Professor Harald Bohr
Mathematical Institute
University of Copenhagen
Copenhagen, Denmark
HW:GB

Hermann Weyl

Maria O'Leary

Letter from Hermann Weyl to Harold Bohr, December 4, 1945, 00110, Institute for Advanced Study (Princeton, N.J.). School of Mathematics, Box 3, Shelby White and Leon Levy Archives Center.

OUT OF THE SHADOWS

Hel Braun was born Helene in a generation full of Helenes. She took the name Hel as a child to distinguish herself in school, and kept it for the rest of her life.

Her success in math was remarkable by any standard, and exceptionally so for a woman of the time—though she never publicly acknowledged a challenge or discrepancy of experience. She was the second woman ever to habilitate—an advanced stage of qualification that comes after a doctoral degree but before a professorship—at what was, at the time, the world's leading center for mathematical innovation, the Mathematical Institute in Göttingen. The revered mathematician Emmy Noether, who fled Germany in the 1930s, was the first.[3]

Braun too came to the United States through the persistent advocacy of a leading mathematician, her former Ph.D. advisor and close colleague Carl Ludwig Siegel. However, she couldn't be welcomed in the States until after the war had ended.

Siegel, a permanent Faculty member (1945–51) in the School of Mathematics[4] and arguably the leading mathematician of his time, had been eager to have her join the vibrant community of scholars in Princeton. But the state of the world and her own hesitations about their relationship put a damper on the plans. "Siegel had strong feelings for Braun, which weren't reciprocated," Eischen explains. "He referred to her as his fiancée and there are some accounts that they lived together in Princeton, but there's no evidence either of those things was true."

What was true was that Siegel championed Braun's research as vital, not only to number theory but to all of mathematics. In 1947–48, having fulfilled the U.S. government's criteria for intellectual visas (anti-Nazi, with knowledge of value for the country, and financially secure), she flourished at the Institute and produced the extraordinary publications that began Eischen's archival journey.

Yet, by the time Braun left IAS, at the end of a single year of residence, she and Siegel had fallen out. "For most of his life, Siegel refused to reconcile with her," Eischen says. Braun returned to Germany, where she led a long and successful career in math, publishing work that branched out fruitfully in many directions. But memory of her impact faded as time went on.

This series of papers she produced in the late 1940s and early 1950s—the first two of which she wrote at IAS—introduced sophisticated mathematical objects called Hermitian modular forms, which opened doors to new avenues of research. Under the unofficial conventions of the field, they would normally have been named after Braun and been called Braun modular forms. However, there is no formal process for naming objects after mathematicians. "The reason they never became Braun modular forms is that no one started calling them that," Eischen says.

Still, Eischen points out, Braun wasn't forgotten for this reason alone. Braun's contributions were enormously influential, but a broader collection of non-mathematical factors limited the discipline's ability to retain a reliable record of her impact. "She actually applied to come back to IAS in the 1960s to research connections between automorphic functions and Jordan algebras, a topic she had been investigating with a colleague named Max Koecher," Eischen notes. "The rejection letter she received stated that IAS was looking to sponsor junior scholars that year. So, she and Koecher stayed in Germany, where they ended up writing the first-ever book published on Jordan algebras. It was very successful, ending up in the Institute's Mathematics - Natural Sciences Library and in the hands of many major mathematicians. I was blown away by the borrowing record on that book, it's tremendous."

Despite the influence her work had, Braun's citation record remains thin. A German-language book had limited longevity in a discipline adopting English as its lingua franca.

Institutional politics also played a role. Braun capped off her career, happily, with a prestigious

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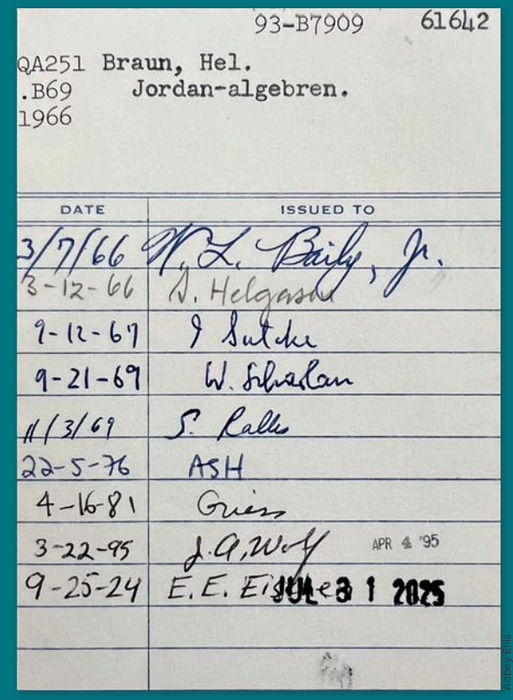

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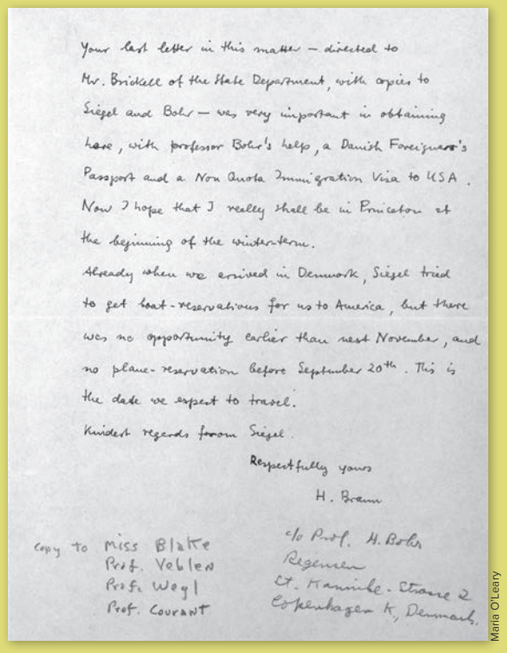
Abbey Ellis

[3] Noether was a frequent Visitor (1933–35) to the Institute while based at Bryn Mawr College.

[4] Although he joined the Faculty in 1945, Siegel had been at IAS as a Member in the School of Mathematics since 1940.



Your last letter in this matter – directed to Mr. Brickell of the State Department, with copies to Siegel and Bohr – was very important in obtaining here, with professor Bohr's help, a Danish Foreigners's Passport and a Non Quota Immigration Visa to USA. Now I hope that I really shall be in Princeton at the beginning of the winterterm.

Already when we arrived in Denmark, Siegel tried to get boat-reservations for us to America, but there was no opportunity earlier than next November, and no plane-reservation before September 20th. This is the date we expect to travel.

Kindest regards from Siegel

Respectfully yours

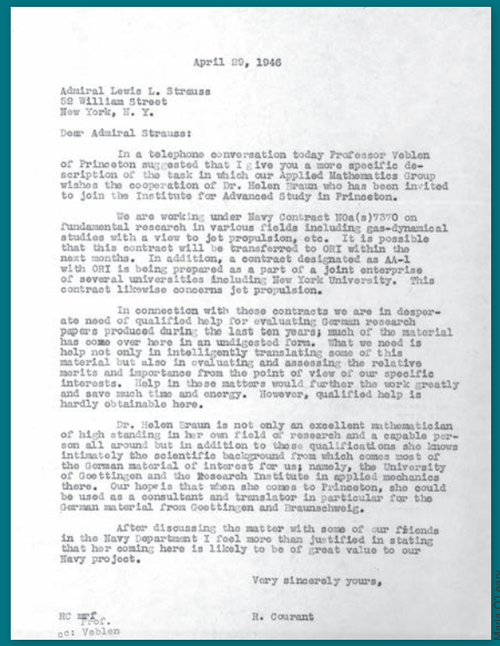
H. Braun

copy to Miss Blatte
Prof. Veblen
Prof. Weyl
Prof. Courant

c/o Prof. H. Bohr
Regensen
Ct. Hannibe-Stoure 2
Copenhagen K, Denmark.

Maria O'Leary

Letter from Helene Braun to Frank Aydelotte, June 18, 1947, 00028, Institute for Advanced Study (Princeton, N.J.). Director's Office. Member records, Box 14, Shelby White and Leon Levy Archives Center.



April 29, 1946

Admiral Lewis L. Strauss
52 William Street
New York, N. Y.

Dear Admiral Strauss:

In a telephone conversation today Professor Veblen of Princeton suggested that I give you a more specific description of the task in which our Applied Mathematics Group wishes the cooperation of Dr. Helen Braun who has been invited to join the Institute for Advanced Study in Princeton.

We are working under Navy Contract NOa(s)7370 on fundamental research in various fields including gas-dynamical studies with a view to jet propulsion, etc. It is possible that this contract will be transferred to ORI within the next months. In addition, a contract designated as AA-1 with ORI is being prepared as a part of a joint enterprise of several universities including New York University. This contract likewise concerns jet propulsion.

In connection with these contracts we are in desperate need of qualified help for evaluating German research papers produced during the last ten years; much of the material has come over here in an undigested form. What we need is help not only in intelligently translating some of this material but also in evaluating and assessing the relative merits and importance from the point of view of our specific interests. Help in these matters would further the work greatly and save much time and energy. However, qualified help is hardly obtainable here.

Dr. Helen Braun is not only an excellent mathematician of high standing in her own field of research and a capable person all around but in addition to these qualifications she knows intimately the scientific background from which comes most of the German material of interest for us; namely, the University of Goettingen and the Research Institute in applied mechanics there. Our hope is that when she comes to Princeton, she could be used as a consultant and translator in particular for the German material from Goettingen and Braunschweig.

After discussing the matter with some of our friends in the Navy Department I feel more than justified in stating that her coming here is likely to be of great value to our Navy project.

Very sincerely yours,

RC mef.
cc: Veblen

R. Courant

Maria O'Leary

Letter from Richard Courant to Admiral Lewis Strauss, April 29, 1946, 00110, Institute for Advanced Study (Princeton, N.J.). School of Mathematics, Box 3, Shelby White and Leon Levy Archives Center.

professorship at the University of Hamburg. In 1968, she succeeded Helmut Hasse to take over one of the highest-level academic positions in the German university system. When she retired, however, in 1981, the position was discontinued due to institutional politics and memory of its significance diminished.

TOWARDS NEW PERSPECTIVES

"The collective forgetting of Hel Braun has been silently undermining years of work," Eischen explains. "Math is cumulative. We layer our inquiries on top of our predecessors' and build off each other's results. When something goes missing, it weakens the entire structure."

And, as math accumulates new strata of knowledge over time, it also strengthens the mathematician's ability to make significant internal connections. Mathematicians often make progress by finding connections between ideas or problems that, at first, seem completely unrelated. When they notice that two different ways of thinking about something in math are linked, it can reveal deeper patterns or truths that apply broadly across mathematics. Key among Eischen's objects of inquiry and active in her current research program are Braun's Hermitian modular forms—which allow mathematicians to investigate geometric phenomena and arithmetic properties in a single lens—and the broader class of automorphic functions to which they belong.

"During the same period that I was doing this archival research, I was working on a joint project with mathematicians Giovanni Rosso and Shrenik Shah," Eischen shares. "And we were stuck. We couldn't find a systematic strategy to addressing a challenge that had arisen in our research. We were working with an approach called the Rankin-Selberg method, which makes it possible to reformulate certain important mathematical objects in terms of automorphic forms, such as those studied by Braun. In our case, though, we weren't arriving at a reformulation with the properties we needed to fully achieve our goals." The team was trying a patchwork of methods, and none was quite getting them where they needed to be. The more Eischen tried to address this problem, the more fascinated she became with the apparent need to invoke ad hoc methods where it felt like there ought to be a more systematic approach.

"With my mathematical focus on the Rankin-Selberg method, I immediately paid attention when Selberg's name popped up in my archival work," Eischen says. "It was mentioned in Braun's application to the Institute in 1963. She wrote that she was studying a connection between automorphic functions and Jordan algebras, and that Atle Selberg, Member (1947–48, 1949–51) and Professor (1951–2007) in the School of Mathematics, would be likely to have important input. Selberg rejected the application and doesn't seem to have ever branched out into Jordan algebras."

At the same time, Eischen continued to follow the thread of Braun's work and learned that her collaboration with Koecher managed to use Jordan algebras to develop a uniform treatment of a wide variety of spaces on which automorphic functions are defined.

"Later, I read her correspondence with Hans Maass, a prominent mathematician, where I could trace her moving organically from her work with Siegel to that on Hermitian modular forms to using Jordan algebras in this striking way," Eischen says. "Encountering Braun's perspective gave me new inspiration for how to move ahead. It's too early to say for certain what the full impact will be on the problem my collaborators and I were stuck on, but one thing is for certain: Learning how Braun thought about various topics and linked them together has given me clarity and inspired new directions for my work."

While the new perspectives—from decades past—have energized Eischen's mathematical research, their significance extends well beyond individual insights, holding broader implications for the discipline as a whole.

"The human side of math is as important as the absolute truth we are pursuing," Eischen says. "They're profoundly connected. How we treat each other matters. How we remember and forget things matters. How we deal with contingency and grey areas and impasses matters. Ignoring the complicated reality that surrounds our work only hinders progress."

Maria O'Leary

Illustrations by Donghyun Lim

Delving Into Digital (In)Equality

BY EMMA EATON

In the nineties and aughts, the term "digital divide" came into widespread use, marking an early and decisive frontier in digital scholarship. It articulated two essential relationships to technology, defined along an axis of *access*. (Some research, including a landmark report by the National Telecommunications and Information Administration, used the language of "haves" and "have-nots" to refer to these newly delineated social groups, imagining the world as a strict binary: people with computers and the internet, and people without them.)[1] The metaphor popularized—and concretized—the notion that digital technologies could shape a person's opportunities. Like any other resource, the web was a vector of social power.

This theory branched, as theories do, into more specific fields. Scholars studied the "gender gap" and the "age gap," and defined inequalities in usage, as well: digitally marginalized populations had more access to entertainment and less to education and creative endeavor, for example. Over the course of the next thirty years of digital expansion, however, this framework began coming up short. Digital inequality could no longer be solely imagined as a function of exclusion. Digital *inclusion*, too, creates systematic inequalities.

With these challenges in mind, the Institute's School of Social Science is turning its focus for the 2025–26 academic year to the theme of Digital (In)Equality. The parentheses in the title gesture to what Alondra Nelson, Harold F. Linder Professor in the School and the theme year's organizer, refers to as the "double-edged-ness" of the contemporary digital ecosystem. Nelson's convening insight challenges the dominant narratives around technology: both techno-optimism and techno-pessimism miss the point, she contends. Digital technologies are simultaneously creating new forms of equality *and* new forms of inequality. Understanding this co-constitution, rather than choosing one narrative over the other, is essential to the development of the analytical frameworks needed to better understand contemporary society.

Put differently: As more and more of our encounters, labor, and lives are digitalized, the potential goods and potential harms of these technologies on individuals and groups also become more pronounced. Both societal possibilities are occurring rapidly and concurrently: electronic health record (EHR) technology,

1 National Telecommunications and Information Administration. 2001. "Falling through the Net: A Survey of the 'Have-Nots' in Rural and Urban America." In Compaine, B. M. (ed.) *The Digital Divide: Facing a Crisis or Creating a Myth?* DOI 10.7551/mitpress/2419.001.0001

for example, can help doctors better understand the social determinants of a patient's health, yet that same data collection also increases the risk of racialized surveillance.[2] The acceleration itself represents a threat: scholars of technology and society repeatedly warn that digital technologies are outpacing our ability to research them. Without the time and resources to thoughtfully implement our new tools, it is difficult to manage their consequences.

This is a precarious balance. One can envision new technology, like artificial intelligence, accelerating social progress, bringing previously underserved communities into liberatory networks of communication and exchange; or envision it depleting resources, dispossessing workers, and consolidating wealth and power. It does these things already. Alondra Nelson and her collaborators want to face this precarity head-on, moving beyond the "digital divide" to pose questions adequate to today's landscape. Moreover, they hope to explore further the ways that digital inequality and digital equality are co-constituted, actively shaped by and shaping one another. The Digital (In)Equality theme year is Nelson's attempt to do what technology policy has consistently failed to do: bring together the scholarly resources needed to think seriously about how digital systems concentrate and distribute power, and to envision genuinely democratic applications and oversight.

Nelson spoke with *The Institute Letter* this fall about the perils of technological domination—how dominant groups in society might protect and extend their power via digital channels. She spoke too about the work being done to imagine otherwise, and the singular promise of a year dedicated to focused collaboration.

Above all, Nelson wants to cut through the assumption that digital technology is inherently "neutral." This isn't always intuitive. Digital tools are so integrated into our interactions—with goods, with services, with opportunities, and with one another—that they seem utilitarian, or else a condition of modernity. Though they are not necessarily designed to cause harm, Nelson argued, they emerge from systems that already do. "Even if it feels like it's 'just coding,'" she said, "scholars would say that anything that comes into the world as *technology* is the culmination of all of these flows of power, and materials, and social networks."

One salient example is algorithmic bias, which can occur when discriminatory patterns result from embedded design choices or the way an algorithm's training data is collected, labeled, or sampled. "Existing data sets the fundamental conditions for what we can predict about the future. That means that we are often dragging this bag of historic inequalities into the present," Nelson explained. To illustrate this idea, Nelson pointed to redlining, a historical practice of racial discrimination in the housing market. Community members in redlined areas saw essential services, like insurance and loans, withheld from entire neighborhoods on the basis of their racial and ethnic makeup. "If that community or zip code has always been understood not to have access to mortgage loans for whatever reason, and then you build an algorithm that says, *we want the good predictors in the past to be predictors for the future*, then you have a whole swath of people

[2] Cruz, T. M. 2023. "Racing the Machine: Data Analytic Technologies and Institutional Inscription of Racialized Health Injustice." *Journal of Health and Science Behavior*. DOI 10.1177/00221465231190061

who are being discriminated against."

"And then we also have something that's more material," she continued, "because those are forms of structural inequality where the algorithm becomes *part of* that infrastructure. The fundamental issue is that we are very much constrained by the world that data allows us to create."

In addition to (ostensibly) determining an individual's likelihood to default on a loan, algorithms are now used to sort résumés for potential employers; decide eligibility for social services; predict crime and recidivism; and diagnose health conditions from X-rays, among other uses.[3]

If the world is increasingly defined and mediated by information, and that information is increasingly a kind of algorithm echo chamber, society loses its problem-solving abilities—its agency.

Algorithmic bias is just one touchpoint. All of the theme year participants seek to articulate the compound, complicated ways in which existing data and its applications have limited—and might limit, in novel ways, in the future—choices and lives, even as they appear to enhance them. At the same time, part of the work of the theme year is to imagine other, more just digital infrastructure. The latter ambition often relies on the former project. What would it mean for

[3] Le, V. and Moya, G. 2021. "Algorithmic Bias Explained: How Automated Decision-Making Becomes Automated Discrimination." *Greenlining Institute*

technology to genuinely support social mobility or amplify political voice? Do data and the digital have a use in efforts to achieve equality?

Nelson believes they do. "Digital equality looks more like taking users as partners in the work of innovation," she offered.

This is just one (as yet, somewhat hypothetical) approach. But the idea has legs, and history. In a recent article for *Science*,[4] Nelson recalls a model of this kind of equality effort: the Ethical, Legal, and Social Implications (ELSI) program developed for the Human Genome Project. In 1990, leadership of the Project designated a portion of their research budget to examining the social, ethical, and legal questions inherent to genomic work. Crucially, predicting and preventing potential harms of biotechnology were embedded in the creation of the biotechnology itself, and the work of this oversight was distributed across multiple agencies and research centers. The paper argues that ELSI's "co-design ethos"—wherein social scientists, historians, philosophers, legal experts, and community members were treated as partners to genomic scientists—should be centered "upstream" in our approach to research in artificial intelligence, in order to avoid AI harms.

The work of Shobita Parthasarathy, Member in the School of Social Science, follows a similar argument, critiquing the notion that AI equity and justice concerns can be solved from the top down (e.g., by policymakers, academics, and the technical community themselves). These approaches, such as educating software developers about the impact of algorithmic bias, "may address some harms [...] but will always be behind the curve of inequities that emerge as AI makers exercise, and strive to protect, profit-seeking prerogatives."[5]

Instead, AI agenda-setting for social good requires incorporating thinking from members of marginalized communities, not for optics, but because those voices are the ones with the most at stake. The advantages are plural: these efforts allow for the governance agenda to reflect those whose welfare it seeks to protect, while at the same time fostering democratic engagement in emerging technologies and the decisions made about them.

This idea is not the only path forward for digital equality, nor is it a solution per se. It is, however, an example of the kinds of inquiry that the Digital (In)Equality theme year will move towards: thinking that is cautious but hopeful, resourceful while grounded in research. The work of the year is, then, to reclaim agency over our digital futures, which requires facing thorny theoretical questions, as well as big existential ones, head-on.

One of the theme year's participants will research whether and how women's marginalization from the venture capital sector—and therefore the rooms in which technological ideas are literally invested in—further embeds gender inequality into innovation. Another will focus on the use of media and journalism by communities denied access to media power, examining the relationship between online virality and African American history. Yet another studies the indigenous borderlands of the Pakistani state; how lives and livelihoods there are shaped by China's Belt and Road Initiative. All will tread the theme's two "edges": goods and harms, optimisms and pessimisms.

Generative, urgent questions

can yield generative, urgent answers—when afforded the right conditions. Nelson's approach to making the theme year into such a space is less prescriptive and more about collective imagination. "I am pretty committed to the synergy of scholars working together and figuring out what the collaboration looks like," Nelson said. Her refusal to prescribe outcomes is itself a methodological stance: one that prioritizes scholars from different social science disciplines working across fields and perspectives to develop genuine collective insight.

The fact that Members come only for a fixed period of time—and are outside of their usual academic contexts, and possess rich thinking lives elsewhere—heightens what Nelson calls the "magic" of their encounters with one another's scholarship, in the Institute's formal and informal settings. "These eight or ten people have never been in a room together before. Ever. And now they're going to be in a room together, every fortnight, for a year. Moreover, they'll be neighbors and they'll have lunch together," described Nelson. "What are the conversations, projects, theorizing, writing that could only happen through these people being here together at this time? That was the question: What can we distinctively do here, together?"

The theme year therefore offers both prescient material to be worked through on campus and a handhold for continued collaboration once scholars have departed. The group that was gathered by Nelson for PLATFORM, the 2023–24 theme year, continues to correspond and co-imagine. Nelson considers this a testament to the rare thinking enabled and enriched by the theme. This past June, PLATFORM participants gathered for a weeklong reunion at the Institute, and special issues of the journals *Poetics: Journal of Empirical Research on Culture, the Media and the Arts* and *Limn* are forthcoming from the group, as is a book, "Auditing AI" (MIT Press). "It's still going because people want to do it and it's work that they've created. It's not anything that I've done," said Nelson. "It's organic to the experience of being here together."

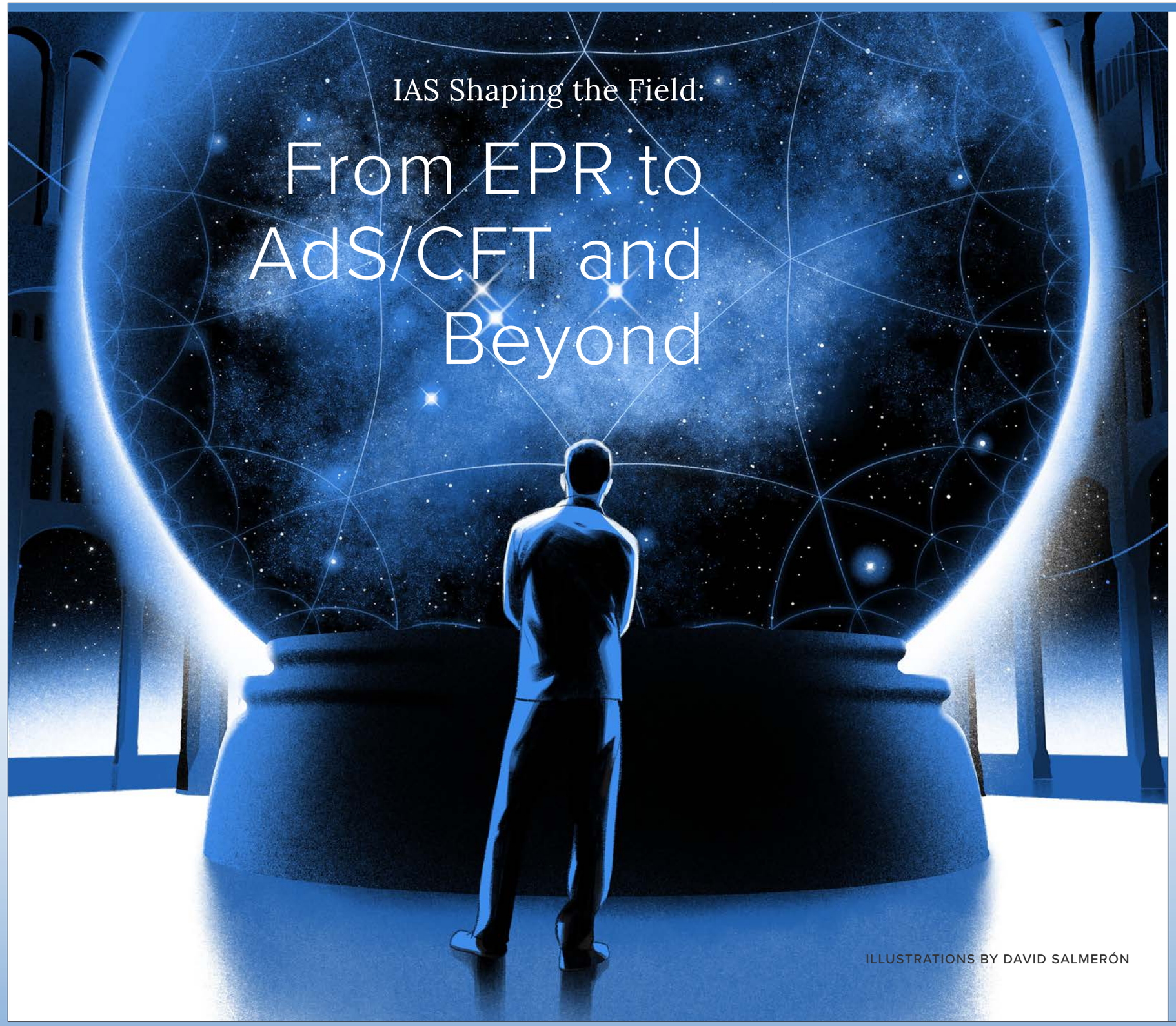
She concluded: "It's just such a rare opportunity to both deepen our thinking for individual projects and to have more impact at scale, in the work either while they're here or in the years to come."

[4] Nelson. A. 2025. "An ELSI for AI: Learning from Genetics to Govern Algorithms." *Science*. DOI 10.1126/science.aeb0393

[5] Parthasarathy, S. and Katzman, J. 2024. "Bringing Communities In, Achieving AI for All." *Issues in Science and Technology*. DOI 10.58875/SLRG2529

IAS Shaping the Field:

From EPR to AdS/CFT and Beyond



ILLUSTRATIONS BY DAVID SALMERÓN

BY ABBEY ELLIS

What actually happens when something falls into a black hole? While this question might seem simple, it has opened up one of the most profound mysteries in modern science.

Objects that fall into black holes possess specific properties—such as position, velocity, charge, and spin—which together constitute their "information." According to Albert Einstein's theory of gravity, known as general relativity—which governs everything from an apple falling from a tree to the movement of stars and galaxies—when this information crosses a black hole's event horizon, much of it is lost forever. But quantum mechanics, which governs the world of the small—the strange realm in which a particle can move through solid objects and be in two places simultaneously—insists that information is never created or destroyed.

These two principles cannot both be true, and the contradiction they create is known as "the black hole information paradox."

The work of renowned physicist Stephen Hawking complicated the puzzle further. He showed that black holes slowly evaporate over extremely long timescales, emitting thermal (or "Hawking") radiation as they do so. Models of this evaporation suggest that the information content of a black hole is irretrievable when it dissipates. The same paradox arises in this context: if black holes do erase information in this way, the foundations of quantum theory would again be shaken.

Resolving this deep conflict between the principles of gravity and quantum mechanics—and more generally, developing a theory of "quantum gravity"—is a major open question in theoretical physics. By building on and extending one another's research, IAS scholars have made substantial progress in this area, generating insights that continue to influence research.

Integral foundations were laid by founding Professor (1933–55) Albert Einstein, who published, alongside his IAS collaborators, two influential papers: one on quantum entanglement

and another on so-called "wormholes." At first glance, these papers seem to have little to do with one another, but breakthroughs by Juan Maldacena, Carl P. Feinberg Professor in the School of Natural Sciences, and Leonard Susskind, Member (1997, 2026) and Visitor (1995) in the School, conjectured a significant connection between them. Further connections that shed light on quantum gravity have been proposed by today's generation of IAS postdoctoral scholars, including Beatrix Muehlmann, Leinweber Physics Member in the School. Her work provides a tantalizing next step towards understanding quantum gravity in our universe.

A GLOVE IN PRINCETON, A GLOVE IN PARIS

The journey begins in 1935, when Albert Einstein, along with Boris Podolsky, Member (1934–35) in the School of Mathematics/Natural Sciences, and Nathan Rosen, Member (1934–36) in the School, published the results of a thought experiment that began with a conversation at IAS teatime.

Their paper, now known as simply "EPR," after the three scholars' last initials, questioned whether quantum mechanics truly describes reality. It made front-page news.

At the heart of the issue was what Einstein described as "spooky action at a distance,"[1] namely that measuring the properties of one quantum particle in an entangled pair seemed to have an instantaneous effect on the state of the other, regardless of the distance by which the particles in the pair were separated.

This troubled Einstein, as it appeared to violate a fundamental principle of relativity: that information cannot be transmitted faster than the speed of light. For Einstein and his colleagues, the fact that information could seemingly be shared more quickly than this between pairs of entangled particles suggested that quantum mechanics did not provide a complete description of reality.

However, the EPR argument was based on a false assumption. Entangled particles do not communicate instantaneously, telling each other how to behave from a great distance—rather, their connection is the result of a fundamental "quantum correlation." The correlation between the particles means that when you measure one, you learn about the other, without information having to pass between the two.

As an analogy, imagine a pair of gloves: you place one glove in a box and send it to Paris and keep the other in a box in Princeton. If your friend in Paris opens their box and finds a left glove, they immediately know that you have the right one, regardless of the distance between you. There is no mysterious, faster-than-light communication. The key difference in the case of quantum particles is that they do not start out with definite identities like the left and right glove each did. Like Schrödinger's cat, which is neither alive nor dead until the box is opened, the particles do not possess any fixed qualities until they are observed.

Thus, despite being imperfect, the EPR paper was nevertheless a significant milestone in understanding quantum entanglement.

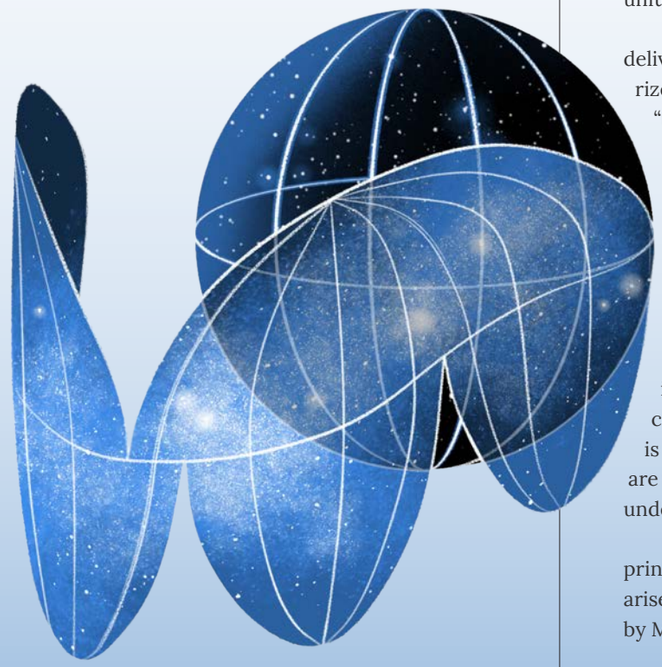
TUNNELS THROUGH SPACE

Einstein's contributions did not stop there. In that same year, he joined forces once again with Rosen (just "ER" this time!) to describe another kind of connection that can be understood by opening a closet. Instead of reaching for a pair of gloves, imagine that the universe takes the form of a giant bedsheet, laid out flat on the floor.

Typically, if you want to travel from one point to another in the universe, you would have to move across its flat surface. But what if you could fold a sheet-like universe and connect those two points directly with a tunnel?

That's what Einstein and Rosen proposed in their paper, a bridge connecting two distant places in a universe, making it possible (in theory) to travel between them much more quickly. This connection is called an Einstein-Rosen bridge, but is also now known as a "wormhole."

Such wormholes are a mathematical consequence of Einstein's theories of general relativity: when scientists use Einstein's equations to describe how gravity shapes space and time, these equations naturally allow for the possibility of wormholes. But only in certain conditions.



One of the specific contexts in which wormholes can arise is Anti-de Sitter (AdS) space. Crucially, AdS space functions like the folded bedsheet, i.e., it can have a constant negative curvature, taking the form of a saddle shape. It is these features that, theoretically, would allow the wormholes to be formed.

It was within this AdS framework that a remarkable new connection was uncovered—one that would ultimately tie Einstein's work on wormholes with his insights into quantum entanglement, setting the stage for a revolutionary unification of these concepts.

BUILDING BRIDGES WITH QUANTUM THREADS

Enter Juan Maldacena and Leonard Susskind. In 2013, they joined forces to ask: What if the two kinds of connections identified by Einstein—entanglement and wormholes—are not just similar, but actually the same? Their bold conjecture, known as ER=EPR, is what unites Einstein's seemingly unrelated papers.

In an article based on a lecture that he delivered at IAS in 2016, Susskind summarized the ER=EPR conjecture as follows: "the immensely complicated network of entangled subsystems that comprises the universe is also an immensely complicated (and technically complex) network of Einstein-Rosen bridges."[2]

In summary, he and Maldacena proposed that any two particles connected by entanglement are effectively joined by a tiny, quantum wormhole. The reverse is also true: they suggested that the connection that physicists call a wormhole is equivalent to entanglement. ER and EPR are two different ways of describing the same underlying reality.

At the heart of this proposal lies the principle of duality. Duality most famously arises in string theory, where it was recognized by Maldacena in 1997, as part of the Anti-de

[1] The phrase "spooky action at a distance" was not contained within the EPR paper itself, but is an expression that Einstein used later to describe the phenomenon of quantum entanglement.

[2] Susskind, L. 2016. "Copenhagen vs Everett, Teleportation, and ER=EPR." DOI: 10.1002/prop.201600036.

Sitter/Conformal Field Theory correspondence (AdS/CFT for short).

To understand AdS/CFT, imagine a snow globe, where everything happening inside—the swirling snow, the miniature trees and houses—can be perfectly described by information etched on the glass surface. Maldacena's insight was that a universe with gravity (the snow globe) could be fully described by a quantum theory on its boundary (the glass). This so-called "holographic principle" suggests that the universe, in some sense, is a grand illusion: our three-dimensional reality may be encoded in two dimensions, like a hologram.

In this way, everything that happens inside Anti-de Sitter space is defined by the boundary. If you understand the boundary, you understand the interior. There is duality between the two.

AdS/CFT forms the mathematical basis for the ER=EPR conjecture. In ER=EPR, the entanglement between quantum systems on the boundary of space is reflected as a wormhole in the interior.

If ER=EPR is correct, it would provide a deeper understanding of the very fabric of spacetime, suggesting that the geometry of our universe emerges from the quantum phenomenon of entanglement. This is a radical shift in perspective. For centuries, space and time were seen as the stage on which the drama of the universe unfolds. Now, they may be the product of the drama itself—a web spun from the interactions and entanglements of quantum particles.

Whether the conjecture applies to our universe, however, remains an open question.

BEYOND AdS: QUANTUM GRAVITY IN OUR UNIVERSE?

The breakthroughs of Maldacena and Susskind have vastly improved our understanding of quantum theory in Anti-de Sitter universes, but our own universe does not exist in such a space—it does not have a negative curvature.

Instead, "a good approximation" for our universe, says Beatrix Muehlmann, is provided by de Sitter space. de Sitter space describes a spacetime expanding at an accelerated rate, like our own universe.

In a recent paper with colleagues Scott Collier from Syracuse University and Lorenz Eberhardt, Marvin L. Goldberger Member (2019–23) in the School of Natural Sciences, Muehlmann has provided a concrete, calculable blueprint for quantum gravity in de Sitter space through considering a simplified, "toy" universe.[3]

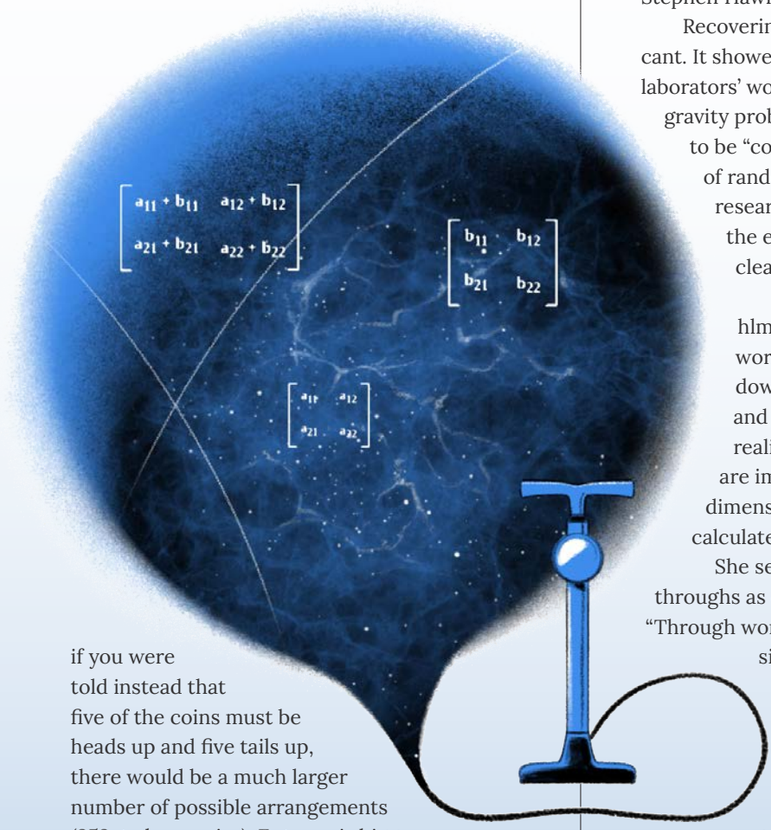
Crucially, the toy universe in which they have developed this framework has only two dimensions of space and one of time. It is known as dS_3 space. This low-dimensional approach has enabled them to generate key insights. "We took this approach so that the math needed to make the calculations stays manageable," explains Muehlmann.

Within this setting, they have proposed a new kind of duality. They have shown that a special "double-scaled matrix integral," which comprises huge grids of random numbers, provides a means to calculate properties of the so-called "cosmological horizon" of their dS_3 universe. This is the boundary in spacetime that marks the limit of the observable universe.

"Our own universe has a cosmological horizon," states Muehlmann. "It's around ten billion light years away from us. We don't know what's behind it!"

As well as establishing this key duality, she and her colleagues have shown how to calculate the entropy of the horizon of this universe using the same matrix model. Entropy is a measure of how disordered a system is—or, more precisely, how many ways it can be rearranged microscopically without changing its macroscopic state.

As a simplified example,[4] imagine you were given a stack of ten coins, and told that just one coin in the stack must be placed heads up and all the others tails up. Without swapping the order of any coins, there would be precisely ten arrangements of heads and tails you could make which would achieve this outcome. But



if you were told instead that five of the coins must be heads up and five tails up, there would be a much larger number of possible arrangements (252, to be precise). Entropy is bigger when many different detailed arrangements of a system give rise to the same broad description. Therefore, the "five heads up" state has higher entropy than the "one head up" state.

The horizon of a de Sitter universe is known to have a high entropy, and Muehlmann and her colleagues found a new way to precisely calculate it. To do this, they again reformulated the problem into the language of random matrices,[5] and identified the density of eigenvalues of these matrices. When they integrated this density over a specific regime, they reproduced the entropy of the dS_3 horizon as originally calculated by Gary Gibbons and Stephen Hawking in the 1970s.

Recovering this classic result was significant. It showed that Muehlmann and her collaborators' work enables the difficult quantum gravity problem of an expanding universe to be "compressed" into the mathematics of random matrices. Through their research, the complicated system at the edge of a universe becomes a cleaner, computable object.

The universe in which Muehlmann and her colleagues are working is, of course, a stripped down model in low dimensions, and it does not incorporate realistic matter, but their findings are important nevertheless. "Low dimensional models really allow you to calculate things!" she says.

She sees the next important breakthroughs as coming from such regimes. "Through working in, for example, two dimensions, we can gain something meaningful," she concludes. "Ultimately, we will be able to learn something that can tell us about the real world."

From Einstein's early insights to ER=EPR and the holographic revolution, IAS scholars have repeatedly shown how bold ideas can recast old paradoxes as solvable questions. And today, by pushing beyond AdS and crafting computable, low-dimensional models, scholars are closer than ever before to understanding how quantum gravity fits within our expanding universe.

[3] Collier, S., Eberhardt, L., and Muehlmann, B. 2025. "A microscopic realization of dS3." DOI: 10.48550/arXiv.2501.01486

[4] While the coin example illustrates how entropy counts the number of microscopic arrangements compatible with a macroscopic state, in the context of dS space, the precise meaning of entropy remains an open question. Scholars do not yet know exactly what, if anything, the entropy of a de Sitter horizon is counting. It could correspond to the number of underlying microstates, as in the coin example, but it might also be related to entanglement entropy, or something else entirely.

[5] More precisely, they reformulated the problem in terms of a double scaled 2 matrix integral.

Dwarf Planet is a Giant Discovery

In May 2025, Sihao Cheng, Martin A. and Helen Chooljian Member (2022–25) in the School of Natural Sciences, led a team to the discovery of an extraordinary trans-Neptunian object (TNO), named 2017 OF_{201}, at the edge of our solar system. The TNO is potentially large enough to qualify as a dwarf planet, the same category as the much more well-known Pluto. News of this discovery attracted media attention from outlets across the globe, including The New York Times. *Below, Cheng shares—in his own words—a close-up look at how the new object was discovered and a reflection on how his time at IAS was pivotal to making the detection.*

When I first started searching for new objects beyond Neptune, I was motivated by the mystery of the rumored ninth planet in our solar system, known as Planet Nine. Mike Brown from Caltech had given a talk at Princeton University about all the failed searches, and I thought maybe I had something new to contribute. I've always been interested in image processing and discovering new things, and my background as an amateur astronomer meant I was used to tinkering with data.

What made our discovery possible was looking where no one else had. I used the Dark Energy Camera Legacy Survey, which was built for studying distant galaxies, not for spotting moving objects in our own solar system. That meant its images were spaced months or even years apart—far from ideal for tracking solar system bodies. To use the data for our purpose, I had to write entirely new algorithms and run them for days on computing clusters. It was a real computational challenge, but I was excited by the possibility of finding something new, even if Planet Nine itself wasn't there.

Being a Member at the Institute was crucial for this. IAS is a rare place that encourages you to take risks—where you can spend a year pursuing an uncertain project, and that's considered valuable, whether or not you find what you set out to. That freedom made it possible to invest the time and effort needed for a search like this, not knowing what the outcome would be.

When I finally found this new TNO, its orbit stood out right away: extremely elongated, coming as close as Neptune, but stretching over a thousand astronomical units from the Sun. Based on its brightness and distance, we estimate that it measures about 700 km across, likely large enough to be round and even qualify as a dwarf planet. The orbit also hints at a hidden population of more objects like it: finding even one object like this suggests there are a hundred times more out there, not seen with current data. Our object is also an outlier; its orbit doesn't fit the expected clustering you'd expect to see if Planet Nine really is out there. It puts new constraints on where Planet Nine could be, but the real lesson is how much we still have to learn from the available data—especially when you have the freedom to look with fresh eyes."

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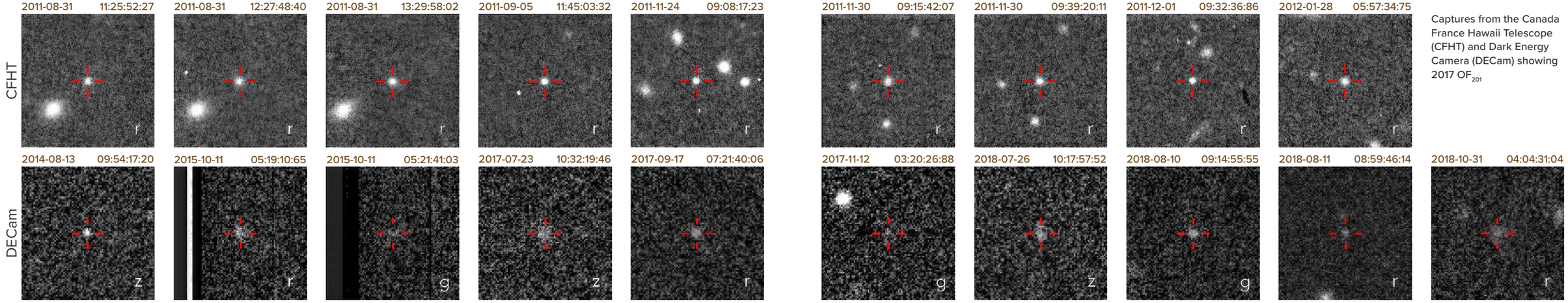


Captures from the Canada France Hawaii Telescope (CFHT) and Dark Energy Camera (DECam) showing 2017 OF_{201}

1930 November
2017 OF_{201} last passes closest to Earth on its orbit; Institute for Advanced Study founded

2004 September
2017 OF_{201} first appears in data collected by the Sloan Digital Sky Survey (SDSS)

2011 August
2017 OF_{201} first appears in data collected by the Canada France Hawaii Telescope (CFHT)

2014 August
2017 OF_{201} first appears in data collected by the Dark Energy Camera (DECam)

2022 September
Sihao Cheng joins the Institute for Advanced Study as a Member

2024 March
Mike Brown's talk at Princeton University on Planet Nine inspires Cheng's research

2025 February
Cheng first identifies 2017 OF_{201} in the earlier images from DECam

2025 March
Cheng identifies 2017 OF_{201} in the earlier images from CFHT, after acting on a suggestion from Mike Alexandersen of the International Astronomical Union's Minor Planet Center

2025 May
Cheng and his collaborators announce the discovery of 2017 OF_{201}

Alyssa Battistoni on
Free Gifts and Freedom

Political and environmental theorist Alyssa Battistoni is interested in what it means to be *free*, in more than one sense of the word. As a Member (2022–23) in the School of Social Science, Battistoni spent her year at the Institute thinking through value, ecology, and economics as she dismantled a draft manuscript—originally, her Ph.D. dissertation—and reconstructed it into a full-length book.

Published in August 2025, *Free Gifts: Capitalism and the Politics of Nature* recycles a term from classical political economy, the titular "free gifts of nature," in order to interrogate the ways in which the nonhuman world appears within capitalism. Despite nature's obvious use and usefulness in economic production, some kinds of nature are nevertheless not *valued* in economic exchange. Think, for instance, of the nonhuman capacities essential to industry, like the wind that powers sails or the land that grows crops. Why haven't certain ecological processes come to have a price under capitalism, when everything else does?

This question animates *Free Gifts*; to answer it, Battistoni extends Marxist political economic logics onto the environment and our relationship to it. One central reading, for example, argues that "free gifts" are treated as such because of the wage labor model: nonhumans cannot sell their efforts and therefore cannot earn wages. Across four examples of the free gift—natural agents in industry, pollution in the environment, reproductive labor in the household, and natural capital in the biosphere—the book describes both the enigma of the free gift and how it might help us interpret climate politics today.

In Chapter 4, "No Such Thing as a Free Gift," Battistoni considers her second kind of "free gift"—the generation of harmful byproducts in commodity production. Here, the economic theory of externality is brought to bear on pollution. *Externalities* are side effects of economic choices: the term describes the consequences of an action which go beyond an individual actor, and which are not represented in market prices. The externality was one of the most significant economic concepts of the twentieth century, first used in 1920 to describe minor flaws in the market like the unpriced "external effects" of smoky chimneys on laundry. In turn, it has animated the core policy frameworks of late-twentieth-century environmental politics, most obviously via carbon taxes and cap-and-trade

Frans Snyders, *Draped Table Laden with Game, Fruit, Vegetables and a Boar's Head* (1609–57), oil on canvas. This artwork, a characteristic still-life from the Dutch Golden Age, was chosen by Battistoni for her book cover to convey the sense of nature's bounty—and the wealth it could engender—as represented in the early days of capitalism. Incorporating both the beautiful and the grotesque, *Draped Table* captures the violence that nevertheless attends this abundance.

programs, and has been taken up in many theories of just climate action.

Yet the externality itself has gone largely unexamined. As Battistoni's logic goes, it is altogether too simple for capital to abdicate responsibility for the effects of byproduction: expelling surplus matter, by default, is costless. If surplus matter has no buyers, however, it nevertheless has consumers. The ability to impose pollution on others is another aspect of class rule—and the inability to refuse it is a form of unfreedom in its own right.

The relationship between capitalism and nature as articulated in this chapter and across *Free Gifts* is doubly useful: Battistoni both unfolds a persuasive case for the theoretical underpinnings of our contemporary ecological plight and reads the mechanics of capitalism anew. In so doing, she offers a new, more constructive approach to the twinned problems of market rule and climate change—one in which their entanglement is not taken for granted, but continually questioned, negotiated, contended with. This, in turn, forms the basis of the double-register of "free" in *Free Gifts*, and its ultimate claim: freedom as a work of the imagination, an ongoing compromise, and a choice about how and what we value.

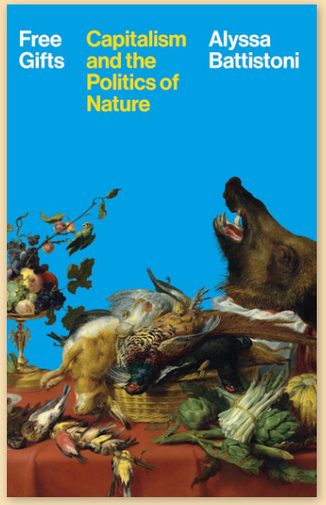
This interview has been edited for length and clarity.

In your words, what is a free gift?

I think the free gift describes something distinctive to how nature appears in capitalist society. It only makes sense to describe nature as a "free gift" in a world where most things are acquired through the process of commodity exchange; in which most things have a price. It's in the market that we interact with one another and acquire what we need to survive. The commodity is the elementary social form of capitalism, as Marx famously argues; it has both use value—qualitative features that are useful to human beings—and exchange value, a quantitative form of value—in other words, price. The "free gift," by contrast, describes things that tend *not* to have prices: the quality of *having use but not exchange value*. The free gift appears in a physical form, and has effects in the material world, but it doesn't appear in the abstract form of value that's central to capitalism, and doesn't show up in forms of economic value assessment and accounting. This, I think, can help us understand a lot of features of contemporary environmental politics, from the idea of climate change as an "externality" to the status of "ecosystem services" which work for free.

Can you describe how you arrived at this argument? Where did this book start?

It began as a paper that I wrote in a class in grad school taught by a great professor named Karen Hébert. The paper extended Marxist-feminist critiques of unvalued household work onto nonhuman nature and the unvalued activity of ecosystems. That became the core argument of my dissertation: that we could take Marxist-feminist theories of unwaged work and social reproduction and use them to think about the world of ecological regeneration. I did a historical-genealogical reading of the ways that women's work and ecosystem activity have been treated in parallel. Those elements are still present in the book, but the



Chapter 4

No Such Thing As a Free Gift

"Politically, pollution is perhaps most widely understood as a problem of justice in the distribution of harms. For decades, environmental justice activists and scholars have drawn attention to the disproportionate siting of landfills, incinerators, chemical plants, livestock excrement, and other deleterious facilities in working-class communities and communities of color. Within political theory and philosophy, too, environmental 'bads' have overwhelmingly been considered through the lens of distributive justice, considered in terms of racial and global disparities, as well as in terms of the temporal distribution of risks and harms across present and future generations. [...]

These diagnoses do essential work to disclose the politics lurking within seemingly amorphous miasmas, and to expose their troubling effects. There are indisputably stark and disturbing disparities in the distribution of environmental harms, which are quite plausibly understood in terms of violence: pollution does attack people's bodily integrity, undermine their physical function, cause injury and even early death. Yet while critiques of the unequal and unjust distribution of pollution rightly identify its harmful effects, they often stop short of adequately tracing its causes. [...] The problem frequently named as social murder or slow violence is, in other words, a particularly visceral form of the unintended consequences generated by market rule. Critics of complicity are right that we are all implicated in these harms to some degree. Yet this is largely because so many of our decisions are mediated by markets in ways that constitutively exclude social costs, and divorce our actions from their effects. Although consumption is the most common culprit for pollution, moreover, its more significant origin is elsewhere: in production.

Pollution, then, is an odder phenomenon than is often recognized. It is surplus matter—not simply surplus in an absolute sense, but matter in excess of what can be bought and sold.

Indeed, pollution largely emerges from exactly the same production process as the commodity: the same process that generates a car, for instance, also generates smoke, ash, carbon dioxide, and other material byproducts. Unlike the commodity, however, this byproduct has no exchange value—and unlike the free gift of nature, it has no use value either. Pollution, then, is an odder phenomenon than is often recognized. It is surplus matter—not simply surplus in an absolute sense, but matter in excess of what can be bought and

argument has changed quite significantly since.

More generally, I started grad school not even thinking I was going to be an academic—just wanting to understand climate change and climate politics. Climate change is an unbelievably massive and overwhelming problem, and I felt like I needed time and space to make sense of it. This book is less about climate politics per se, and more about the broader conditions of how nature is treated under capitalism. That's sometimes felt like a detour on the way to getting back into climate politics—but I think it's essential to address some of the larger questions before zeroing back in on climate specifically.

There's a tension inherent in the book, between theory and praxis. How did this research grow out of your time in community organizing?

I do think that pretty much all of my intellectual work is in some way informed by the experience of organizing for my grad student union. It was where I really learned about politics, in doing and trying to do politics.

In the union, I was always trying to think through the problem of how you get people to act collectively in the face of very difficult challenges. *Free Gifts* does address labor as one of the central sites of struggle for critics of capitalism: it proposes new ways to analyze labor in relation to nature, and thinks about what it would mean to organize labor in different ways. But it also extends the analysis of capitalist collective action problems beyond labor to other forms of social and political life, like pollution and biospheric preservation. People sometimes say climate change is unprecedented and totally different than any previous political problem. There are ways in which that's true—but in other ways I think it's very continuous with some familiar kinds of political problems and practices, and that we can draw on the resources of.

What did your time at IAS mean to you?

I loved my time at IAS. I can't imagine having finished the book without it. I was part of the Climate Crisis Politics theme year, which was really fantastic: it was a group of brilliant people who read my work closely and gave feedback as I worked to finish the manuscript, but who also just talked through ideas more generally, and helped me take a step back from the weeds of the project. We had a climate film series and a climate fiction reading group. It was invigorating to be able to move between the intensity of holing up and working on a manuscript all day, every day, for weeks, and then emerging and having great conversations with people who were either thinking about the same questions in different ways, or thinking about really different aspects of the problem. My conversations really pushed my thinking and made *Free Gifts* a richer book. It was totally instrumental to finishing the manuscript. I stayed on campus literally until the last day.

sold. Capital's control over production, then, is also control over what I call *byproduction*—control over what is produced unintentionally, which is not to say unknowingly. It is all too easy for capital to abdicate responsibility for the effects of byproduction: expelling surplus matter, by default, is costless. If surplus matter has no buyers, however, it nevertheless has consumers: as Commoner's 'second ecological law' asserts, 'Everything must go somewhere.' Waste does not simply disappear because it is not valued economically. The ability to impose pollution on others is another aspect of class rule—and the inability to refuse it is a form of unfreedom in its own right. The harms named as pollution or 'slow violence,' then, should be read as the unintentional but no less systematic consequence of a particular organization of social relations expressed in and through the material world, one that consistently compels us to treat ecological effects as costless.

This chapter, then, looks at how pollution has been represented in economic terms, via the concept of externality. Externalities occur when economic activity causes costs that are not reflected in the costs to the producer, such that they are not taken into account in economic decisions. In retrospect, the externality is plausibly the most significant economic concept of the twentieth century: first conceptualized in 1920 to describe minor flaws in the market like the unpriced 'external effects' of smoky chimneys on laundry, by the early twenty-first century it would be described as the cause of a phenomenon that threatens to end human civilization as we know it. In turn, it has animated the core policy frameworks of late-twentieth-century environmental politics, most obviously via carbon taxes and cap-and-trade programs, and has been taken up in many theories of just climate action. Yet the externality itself has gone largely unexamined. [...]

Externalities also reveal something about markets as such. In systems of logic or infrastructure, it is often the points of failure that are most revealing, and this is no less true of so-called 'market failure.' Most theorists of the externality assume that individuals are the basic unit of economic analysis, and markets the central institution. They treat markets, in turn, as an ideal type of allocation mechanism—a means by which goods (or bads) might be distributed via exchanges negotiated amongst individual actors—and assume markets should generally operate without intervention. But the condition of generalized market dependence, in which most people work for wages and obtain most of what they need to survive through exchange rather than through subsistence activity, is a unique and defining feature of capitalism in particular as a system of political and economic organization. It is this condition that makes the prospect of market failure so threatening—and so rich for political interrogation. Although externalities are frequently treated as an exception to the rule, they illuminate the rule of the market itself: how markets are supposed to work, and what happens when they become the organizing institution of collective life."

FACULTY

Angelos Chaniotis, Professor in the School of Historical Studies, presented the inaugural Kyoto University Ancient History Lecture.

Camillo De Lellis, IBM von Neumann Professor in the School of Mathematics, was elected as a fellow of the Accademia Nazionale dei Lincei.

Didier Fassin, James D. Wolfensohn Professor in the School of Social Science, was the subject of a five-episode series about his lifetime career on the French national public radio station France Culture.

Helmut Hofer, Hermann Weyl Professor in the School of Mathematics, gave the Gauss Lecture of the German Mathematical Society in October 2025.

Jacob Lurie, Frank C. and Florence S. Ogg Professor in the School of Mathematics, was announced as a plenary lecturer at the 2026 International Congress of Mathematicians.

Alondra Nelson, Harold F. Linder Professor in the School of Social Science, received the IP3 Award from Public Knowledge for "ingenuity and dedication in the field of information policy."

Francesca Trivellato, Andrew W. Mellon Professor in the School of Historical Studies, was elected as a member of the American Academy of Arts & Sciences and received an honorary doctorate from the European University Institute.

Avi Wigderson, Herbert H. Maass Professor in the School of Mathematics, was named to the Carnegie Corporation of New York's 2025 Class of Great Immigrants.

EMERITI

Peter Sarnak, Professor Emeritus in the School of Mathematics, was announced as a special plenary lecturer at the 2026 International Congress of Mathematicians.

Edward Witten, Professor Emeritus in the School of Natural Sciences, was named an honorary fellow of the Learned Society of Wales.

MEMBERS

Richard Anderson, Member (2025) in the School of Historical Studies, was awarded a grant from the Graham Foundation for his upcoming publication, *El Lissitzky: Writings on Architecture and the City*. He was also awarded the Visegrad Scholarship from the Open Society Archive in Budapest, where he will be in residence in spring 2026.

Robert A. Beckman, Member (2008) and Visitor (2008–09) in the School of Natural Sciences, was elected as a 2025 Fellow of the American Statistical Association.

Brigitte Bedos-Rezak, Member (1996–97) in the School of Historical Studies, was elected as a member of the American Philosophical Society.

Dina Boero, Member (2024–25) in the School of Historical Studies, won the 2025 Hagiography Society Article Prize for her article, "The Space of the Stylite: Columns and Their Topographical Contexts."

John Richard Bond, Member (2018) and Visitor (2012) in the School of Natural Sciences, and **George Efstathiou**, Visitor (1986) in the School, jointly received the Shaw Prize in Astronomy.

Eshan Chattopadhyay, Member (2026, 2017–18) in the School of Mathematics, and **David Zuckerman**, Member (2011–12) in the School, were awarded the 2025 Gödel Prize by the Association for Computing Machinery.

Legalizing the Revolution: India and the Constitution of the Postcolony, by **Sandipto Dasgupta**, Member (2024–25) in the Schools of Historical Studies and Social Science, was awarded the American Political Science Association's Frankel Prize for Best Book on South Asian Politics.

Cathy N. Davidson, Visitor (2025) in the School of Social Science, was awarded the 2025 McGraw Prize in Higher Education.

Lorenz Eberhardt, Marvin L. Goldberger Member (2019–23) in the School of Natural Sciences, was awarded the 2025 Gribov Medal by the European Physical Society.

The Currency of Politics: The Political Theory of Money from Aristotle to Keynes, by **Stefan Eich**, Richard B. Fisher Member (2022–23) in the School of Social Science, was awarded the David and Elaine Spitz Prize for the best book in liberal and/or democratic theory.

Marco Fantuzzi, Member (2012) and Visitor (2013) in the School of Historical Studies, was awarded the 2025 Carl Friedrich von Siemens Research Award from the Alexander von Humboldt Foundation.

Kenji Fukaya, Member (2002) in the School of Mathematics, was awarded the Shaw Prize in Mathematical Sciences.

Gary Gibbons, Member (1984) in the School of Natural Sciences, was awarded a 2025 Dirac Medal by the International Centre for Theoretical Physics.

Heba Gowayed, Member (2022–23) in the School of Social Science, was named as a 2025 Andrew Carnegie Fellow.

Hanneke Grootenboer, Member (2025) in the School of Historical Studies, was elected as a member of the Royal Netherlands Academy of Arts and Sciences.

Michael Harris, Member (1983–84) and AMIAS Member (2011) in the School of Mathematics, was elected as a member of the American Philosophical Society.

Gary Horowitz, Member (1981–83) in the School of Mathematics, was awarded a 2025 Dirac Medal by the International Centre for Theoretical Physics.

Peniel Emmaus Joseph, Friends of the Institute Member in the School of Social Science, was named as a 2025 Andrew Carnegie Fellow. He was also awarded the 2025 Texas Writer's Award for his book *Freedom Season: How 1963 Transformed America's Civil Rights Revolution*.

Prophetic Maharaja: Loss, Sovereignty, and the Sikh Tradition in Colonial South Asia by **Rajbir Singh Judge**, Member (2024–25) in the School of Social Science, was awarded the Best First Book in the History of Religions from the American Academy of Religion, and was also a finalist for the Award for Excellence in the Study of Religion: Analytical-Descriptive Studies.

Zander Kelley, Member in the School of Mathematics, received an honorable mention in the ACM Doctoral Dissertation Awards.

Jessica S. Purcell, von Neumann Fellow (2015) in the School of Mathematics, was elected as a 2025 Fellow of the Australian Academy of Science.

The Age of Choice: A History of Freedom in Modern Life by **Sophia Rosenfeld**, Ed Kaufmann Founders' Circle Member in the School of Social Science (2014–15), was shortlisted for the Cundill History Prize.

Charles Theodore Sanft, Starr Foundation East Asian Studies Endowment Fund Member (2011) in the School of Historical Studies, was presented with a Carl von Siemens Research Award by the Alexander von Humboldt Foundation.

Samson Shatashvili, Member (1992–94) in the School of Natural Sciences, was awarded the 2025 Dannie Heineman Prize for Mathematical Physics.

Valerie Ann Smith, Visitor (2005–06) in the School of Historical Studies, was elected as a member of the American Philosophical Society.

Shivaji Sondhi, Member (1998) in the School of Natural Sciences, was elected as a fellow of the Royal Society.

Giovanni Maria Tomaselli, Rubicon Fellow (2024–28) in the School of Natural Sciences, was awarded the CAN Thesis Prize 2025

Nine Scholars Honored with 2025 Guggenheim Fellowships

From the School of Historical Studies, the newly elected Guggenheim Fellows include Members **Thomas Burman** (2025–26), **Ana Lucia Araujo** (2022), and **Karen B. Graubart** (2021); Willis F. Doney Members **M. Cecilia Gaposchkin** (2025–26) and **Rhodri Lewis** (2015–16); George William Cottrell Jr. Member **Katherine L. Jansen** (2013); and Hetty Goldman Member **Yannis Hamilakis** (2012–13). Collectively, their scholarship spans subjects from the social meanings of classical monuments to the early writings of Sir Francis Bacon.

From the School of Mathematics, Veblen Research Instructor (2003–05) **Maria Chudnovsky** was recognized for her contributions to graph theory and combinatorics.

From the School of Social Science, Visitor (2006–07) **Kristin Hoganson** was honored for her work on the history of U.S. foreign relations.

by the University of Amsterdam for his doctoral research.

Jacob Tsimerman, Distinguished Visiting Professor (2025–26) in the School of Mathematics, was elected as a fellow of the Royal Society.

Lauren K. Williams, von Neumann Fellow (2017) in the Schools of Mathematics and Natural Sciences, was named as a 2025 MacArthur Fellow.

Deva R. Woodly, Friends of the Institute for Advanced Study Member (2012–13) in the School of Social Science, was named as a distinguished research fellow for the advancement of inclusive democracy by the Charles F. Kettering Foundation.

Ronit Yoeli-Tlalim, Willis F. Doney Member (2023–24) in the School of Historical Studies, was awarded the Leverhume Emeritus Fellowship.

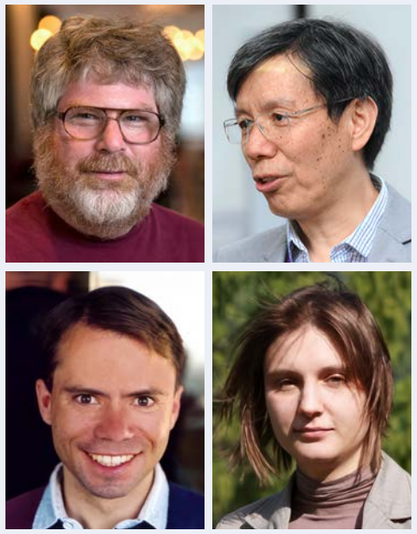
INSTITUTE

Victoria B. Bjorklund, Trustee, was presented with the insignia of Knight of the Légion d'Honneur, France's most prestigious decoration.

Robbert Dijkgraaf, IAS Director and Leon Levy Professor (2012–22), was elected as a fellow of the Royal Society. Dijkgraaf also rejoined the Simons Foundation Board of Trustees.

Mario Draghi, Trustee, received the 2025 Princess of Asturias Award for International Cooperation.

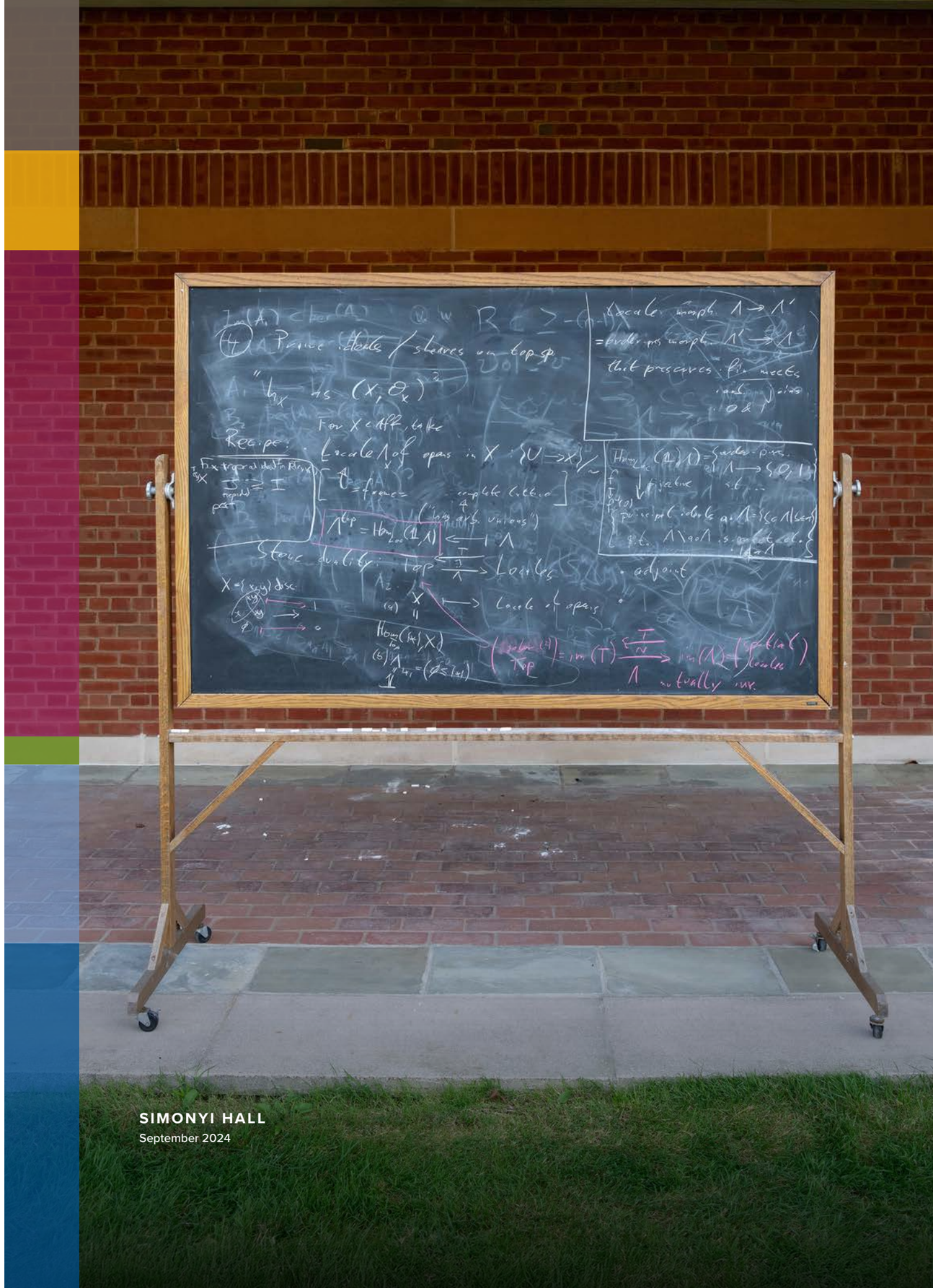
Kevin L. MacMillan, Partner at Allegaert Berger & Vogel LLP, was appointed to the Institute's Board of Trustees.



IAS Mathematicians Named to the National Academy of Sciences

Four scholars from the Institute's School of Mathematics were elected to the National Academy of Sciences (NAS) in 2025 "in recognition of their distinguished and continuing achievements in original research."

This included **Russell Impagliazzo**, Member (2003) and frequent Visiting Professor, who specializes in computational complexity; **Fang-Hua Lin**, Member (1988, 1994–95), whose research spans nonlinear partial differential equations, geometric measure theory, and geometric and applied analysis; **Scott Sheffield**, Member (2006–07) and Visiting Professor (2022–23), who is interested in probability, game theory and mathematical physics; and **Maryna Viazovska**, Member (2023), winner of the 2022 Fields Medal, who works on the geometry of spheres.



SIMONYI HALL
September 2024

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