Dean for Research Innovation Funds 2014–23

REPORT

Office of the Dean for Research

PRINCETON UNIVERSITY

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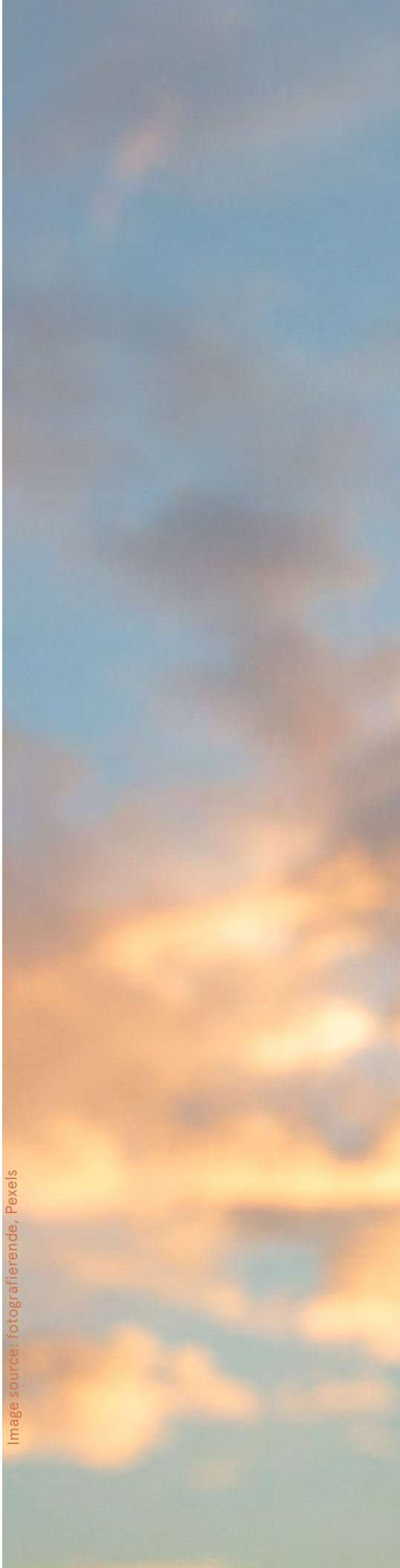
In the Nation's Service and the Service of Humanity



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Introduction

Innovation describes the quest to create, to explore, and to improve our world. The Dean for Research Innovation Funds seed ideas, spur new collaborations, and initiate projects not yet ready for external funding. The funds enable Princeton researchers and scholars to follow their inspiration and intellect rather than following trends or safe bets.

Since its inception in 2014, the program has enabled investigations in the humanities, social sciences, natural sciences and engineering, as well as fostered collaborations between artists and scientists or engineers, and enabled new industrial collaborations to tackle real-world challenges. In 2022, we announced two new funds, one devoted to solutions for sustainability and the other to support exploratory energy research.

By sparking discoveries, redefining the frontiers of knowledge, and forging opportunities, the Dean for Research Innovation Funds propel journeys of the mind that exemplify the quality and vitality that is Princeton research.

Pablo G. Debenedetti

Dean for Research

Class of 1950 Professor in Engineering and Applied Science

Professor of Chemical and Biological Engineering

Far-Reaching Impacts

Dean for Research Innovation Funds nurture a deep and broad range of outcomes, scholarship and discovery. These metrics continue to grow as the ideas planted by the innovation funds bear fruit.

81
funded research projects

153
scholarly publications

17
conferences, performances and exhibitions

9
patents pending or issued

The projects have created more than 150 educational and early-career opportunities.

71
undergraduate students

54
graduate students

30
postdoctoral researchers

Photo by Denise Applewhite

Return on Investment

The investment has laid the groundwork for significant subsequent external funding for research and innovation.

Investing in the Future

Unconventional or untested ideas can be difficult to fund through conventional sources. The University created the Dean for Research Innovation Funds to make such explorations possible.

The program supports a broad range of intellectual inquiry across campus. In the sciences and engineering, the Innovation Funds enable laboratory experiments and theoretical or computational modeling, the results of which often inform successful subsequent proposals to external funding agencies. In the social sciences and humanities, the funds support faculty conferences, lecture series and other endeavors that catalyze new scholarship.

Now in its tenth year, the program has demonstrated that these seed funds indeed return rewards that far exceed initial investments. Through 2023, the program has fostered significant outcomes, including discoveries published in journal articles, books and monographs; new collaborations across disciplinary lines; exhibitions and performances; competitive proposals to federal agencies; and invention disclosures and patents. These projects have impacts well beyond the University.

This report illustrates the numerous outcomes of the funded projects, from transformative findings that attract subsequent external investments in research to expansions of scholarship in entirely new directions.

Photo by Denise Applewhite

"Opportunities like these impact the quality of both the faculty members that we are able to attract to Princeton, and the research that they are able to do once here."

—Pablo G. Debenedetti
Dean for Research

The Dean for Research Innovation Fund program, supporting early-stage exploratory projects, is one of several funding initiatives within the Office of the Dean for Research. Other programs support technology transfer, new equipment, transformative science and technology, and research collaborations with historically Black colleges and universities. Learn more at research.princeton.edu/funding.

Fund Categories

New Ideas in the Natural Sciences
supports the exploration of high-potential ideas that are at an early stage and therefore not ready to form the basis of a competitive proposal to an external funding agency. Faculty members in the Natural Sciences are eligible to request up to $100,000 per year for projects lasting up to two years, for a total of $200,000. A faculty committee evaluates the proposals with an eye towards enabling exploratory research.

New Industrial Collaborations
fosters research collaborations between industry and academia. Industry often plays an essential role in identifying interesting problems of societal relevance, bringing innovations to fruition, and making them available as devices or services. The awards support faculty members in the Natural Sciences or Engineering with up to $100,000 in the first year and $75,000 in the second year, with a requirement of a matching $75,000 contribution from an industry collaborator, for a total of up to $250,000 over two years.

Collaborations Between Artists and Scientists or Engineers
brings faculty members in the Arts and in the Natural Sciences or Engineering together to develop synergistic innovations. Through this fund, experts in seemingly unrelated fields exchange and expand their respective areas of knowledge in ways that benefit both disciplines. Investigators may request up to $75,000 per year for projects lasting up to two years, or $150,000 in total.

New Ideas in the Humanities
encourages innovative scholarship on original theories as well as enduring questions. Projects aim to advance the discipline through support for activities such as conferences, new collaborations and creative work. The awards provide a total of up to $50,000 for projects lasting up to two years.

New Ideas in the Social Sciences
promotes scholarship and explorations of society and human advancement. Support for the social sciences may include development of new research resources, data collection and analysis, and novel scholarly work. Awards provide a total of up to $50,000 for projects lasting up to two years.

Sustainability of Our Planet
enables research focused on discovering, developing and adopting sustainable solutions aimed at mitigating the effects of natural resource exploitation, climate change and other unsustainable human activities. The fund, made possible thanks to the extraordinary vision and generosity of John McDonnell ’60, prioritizes high-impact approaches that can make a difference in the near- and medium-term. Awards can be made to one project receiving up to $300,000 or two projects for up to $150,000 for a period of up to three years.

Exploratory Energy Fund
supports research aimed at fundamental solutions to humanity's energy challenges. The fund exemplifies the University’s commitment to support innovative curiosity-driven energy research that is critical to securing a sustainable shared future. Each project will be funded for up to $100,000 per year for up to two years.

Photo by Sigrid Adriaenssens

Program Goals

- Explore early-stage, high-potential concepts and gather evidence for future funding proposals to research sponsors.
- Advance disciplines and enable scholarship through conferences, seminar series, digital resources, technologies and the exchange of ideas.
- Spur innovation and discoveries that have the potential to transform everyday life and benefit society.
- Promote collaboration to provide a rich cross-fertilization of ideas with synergistic outcomes.

The movement of dancers enables explorations of nets as resilient building façades in a project led by Sigrid Adriaenssens, Professor of Civil and Environmental Engineering, and Rebecca Lazier, Professor of the Practice, Dance in the Lewis Center for the Arts.
—Collaborations Between Artists and Scientists or Engineers

Note: Faculty titles are current as of date of this report, not the date of award.

The U.S. Department of Defense awarded

$6.25M

to create a multi-university research center.

Explore High-Potential Concepts

New Ideas in the Natural Sciences

Advances in the understanding of photonic crystals, materials that manipulate the flow of light for use in telecommunications, contributed to a successful grant proposal that was awarded $6.25M by the U.S. Department of Defense. Page 12.

Advance Disciplines

New Ideas in the Humanities

Researchers are translating a globally important medieval work of Ethiopian literature into English. The resulting annotated translation will be of interest to scholars and the public alike. Page 29.

Spur Innovation

New Industrial Collaborations

A collaboration with Adobe Research used artificial intelligence to improve the quality of voice recordings. The research led to the granting of one patent with three additional patent applications in progress. Page 20.

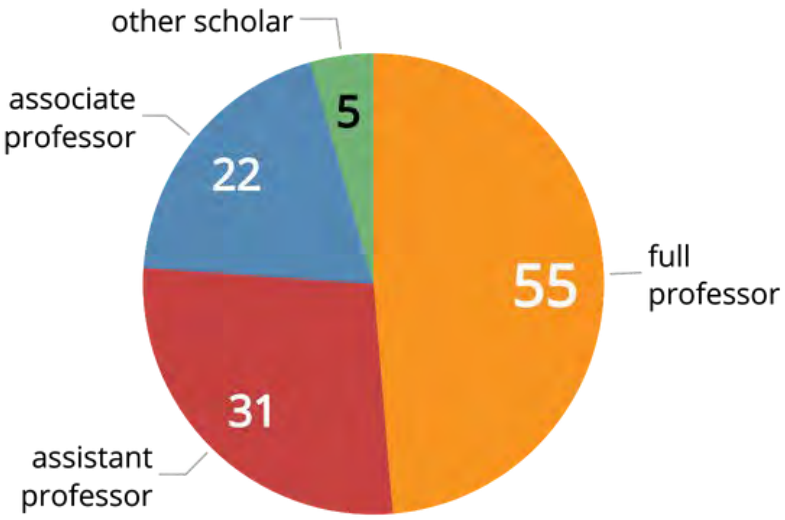
Promote Collaboration

Collaborations Between Artists and Scientists or Engineers

An archaeologist and a civil engineer co-designed a method for exploring buried clues to the histories of old buildings. The team used ground penetrating radar combined with computer models to create interactive 3D models containing material and structural information. Page 25.

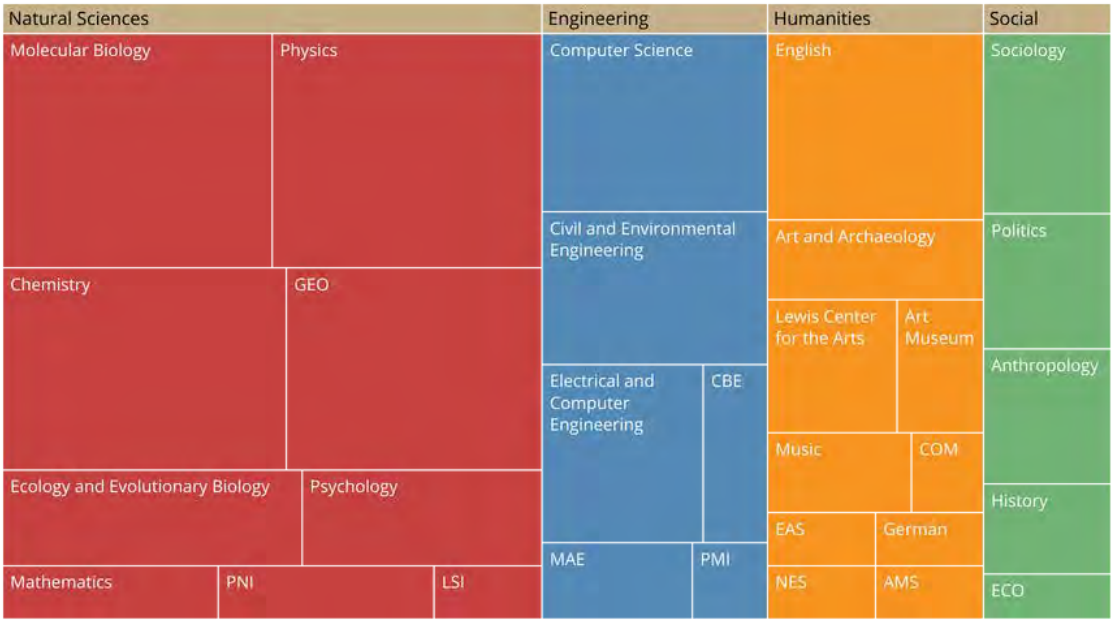
Faculty Participation

Participation by members of the faculty occurs at all career stages. The 113 award-receiving scholars include 31 assistant professors, 22 associate professors, 55 full professors and four other scholars. (Career stage at time of award)



Participation by Department

Participation occurs across Princeton's four academic divisions: Natural Sciences, Engineering, Humanities and Social Sciences. Each space below is sized in proportion to the number of principal investigators from a given department at time of award.



Abbreviations: GEO - Geosciences; COM - Comparative Literature; LSI - Lewis-Sigler Institute for Integrative Genomics; PNI - Princeton Neuroscience Institute; EAS - East Asian Studies; CBE - Chemical and Biological Engineering; MAE - Mechanical and Aerospace Engineering; PMI - Princeton Materials Institute; NES - Near Eastern Studies; AMS - American Studies; ECO - Economics.

Selection Process

Projects are awarded following a competitive application process that involves anonymous peer review by teams of Princeton faculty. Nearly 170 faculty members have participated as proposal reviewers.

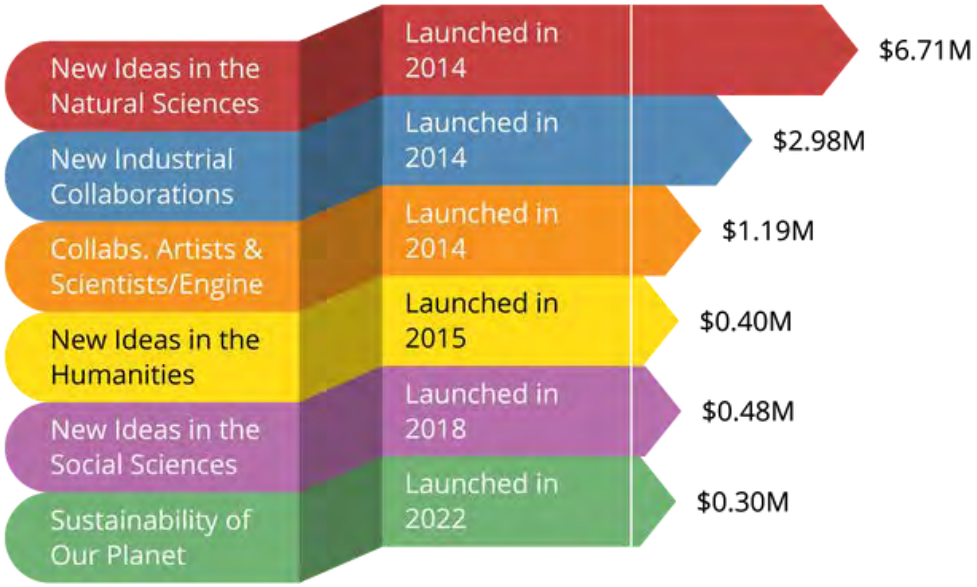
Awards have been made to 81 of the 416 submissions across all categories, a success rate of 19%.

19%

of submissions funded following a competitive application process

Funding per Category

Since inception, the Dean for Research Innovation Fund program has awarded $12.06M across seven fund categories. Two categories, New Ideas in the Natural Sciences and New Industrial Collaborations, typically support laboratory teams and equipment as well as theoretical and computational work. Calls for proposals are issued annually, and thus reflect larger overall fund distributions. The next three categories, Collaborations Between Artists and Scientists or Engineers, New Ideas in the Humanities, and New Ideas in the Social Sciences, have operated four or more of the last ten years, and have dispensed smaller award amounts consistent with the funding needs of research in these areas. Two new funds were announced in 2022: Sustainability of Our Planet, which had one awarded project, and Exploratory Energy Research, for which the first awards will be granted in 2023.



Awards and Outcomes

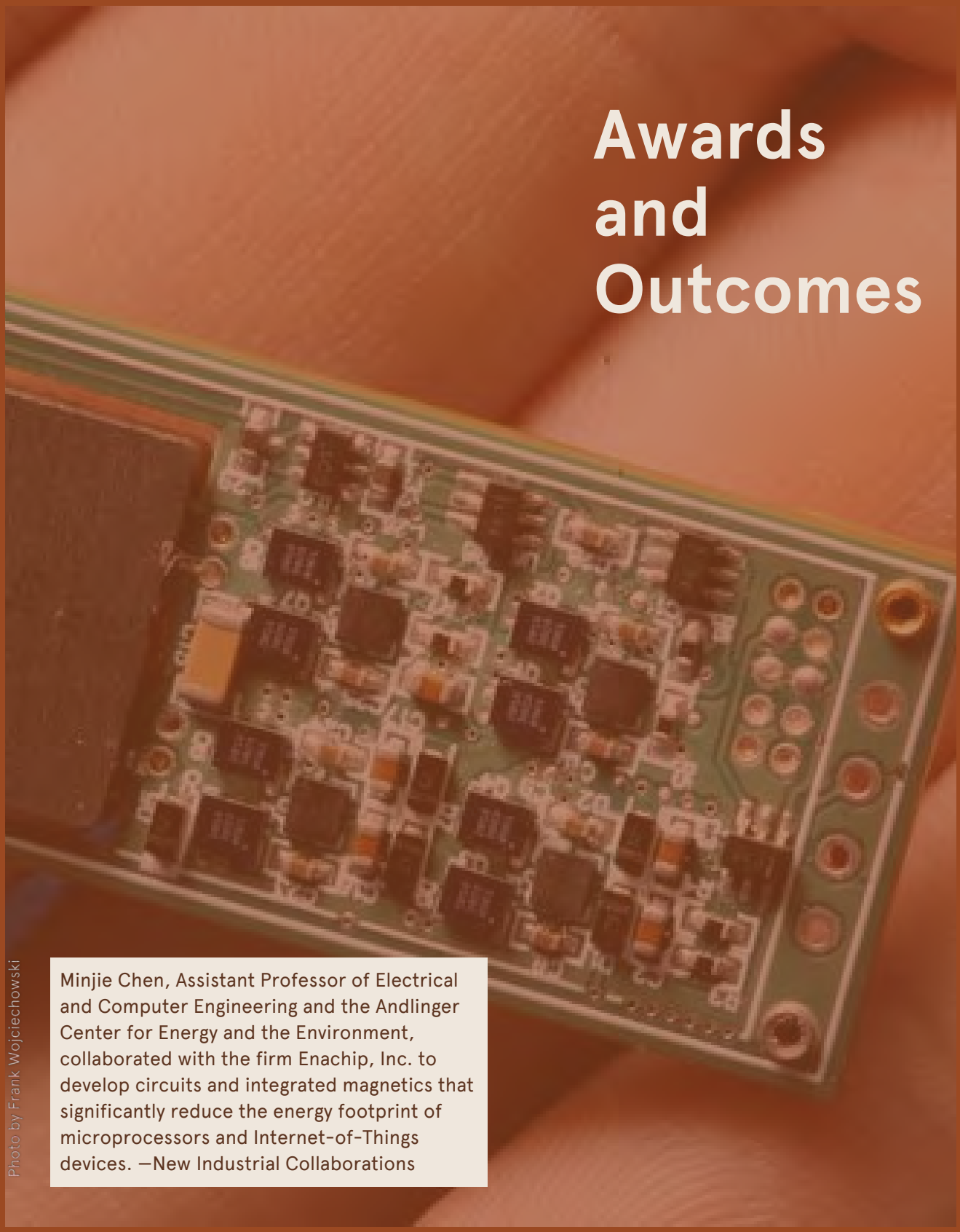


Photo by Frank Wojciechowski

Minjie Chen, Assistant Professor of Electrical and Computer Engineering and the Andlinger Center for Energy and the Environment, collaborated with the firm Enachip, Inc. to develop circuits and integrated magnetics that significantly reduce the energy footprint of microprocessors and Internet-of-Things devices. —New Industrial Collaborations

New Ideas in the Natural Sciences

The fund supports the exploration of ideas that have the potential for substantial impact on a field in the natural sciences, but that may be too preliminary to compete successfully for grants from funding agencies.

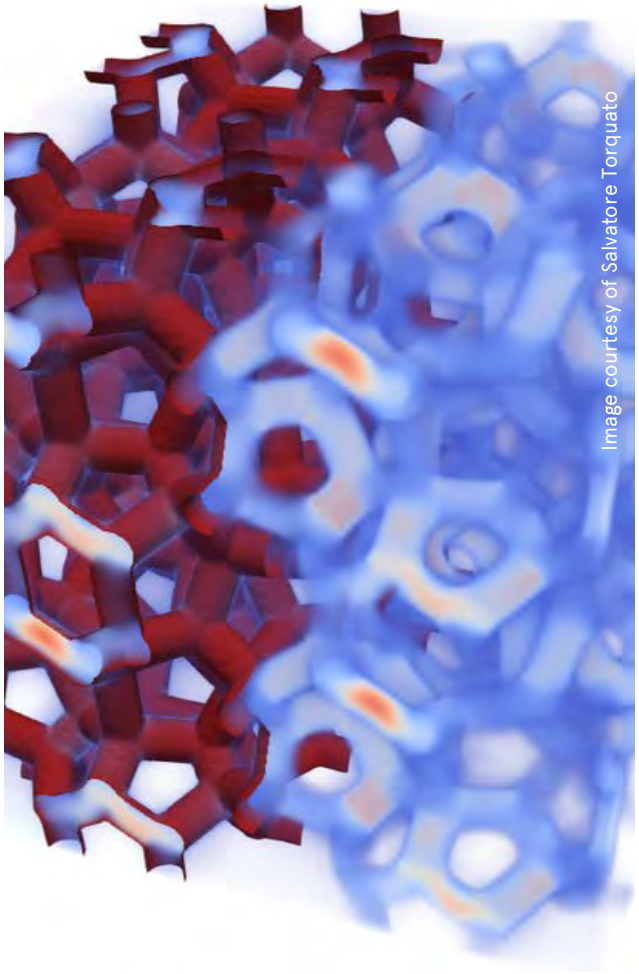


Image courtesy of Salvatore Torquato

Bringing new technologies to light

Advances in the Design of 3D Disordered Photonic Solids

Photonic crystals are materials that manipulate the flow of light for use in telecommunications, providing faster transmission of information than today's silicon semiconductor-based devices. For years, researchers thought that only materials containing highly ordered arrangements of atoms could form structures known as band gaps that allow selective propagation of light.

Several years ago, a team led by Torquato and Steinhardt challenged the assumption that a high degree of order is required. They constructed two-dimensional solids that were both disordered and also hyperuniform, demonstrating order over large scales. The team showed that these

Salvatore Torquato
Lewis Bernard Professor of Natural Sciences, Professor of Chemistry and the Princeton Materials Institute

Paul Steinhardt
Albert Einstein Professor in Science, Professor of Physics

Bringing new technologies to light
continued

materials have complete photonic band gaps. The discovery overturned the conventional view that long-range order is essential for obtaining a photonic band gap.

The team is now pioneering approaches to extending the two-dimensional concept to three dimensions, a characteristic that is essential to the most promising applications.

The challenge has been to find a method for generating a 3D structure that is at once hyperuniform, disordered, and contains the required arrangement of atoms with correct angles and distances from each other.

In a journal article published in Proceedings of the National Academy of Sciences (2019), the team presented the first known examples of complete photonic band gaps in a 3D foam-based structure. These foams are promising candidates for the self-assembly of large photonic networks with combinations of physical characteristics that may be advantageous in designing waveguides and circuits that propagate light for applications such as telecommunications.

Through an extensive series of high-precision numerical computations, the researchers explored the conditions under which photonic band gaps form. They also focused on transport and structural characteristics of 3D disordered hyperuniform materials. Another area of research focused on the case of quasicrystals, hyperuniform systems that are ordered but lack translational symmetry, meaning that a shifted copy will never match exactly with its original.

New investigations of the formation of quasicrystals under extreme conditions of pressure and temperature may lead to novel methods of synthesizing quasicrystals and hyperuniform solids in the laboratory. The mathematical tools developed for generating novel quasicrystal patterns in two-, three- and higher-dimensions emerging from these studies are now being used to generate novel hyperuniform photonic networks.

The research laid the groundwork for a five-year grant of $6.25 million from the U.S. Department of Defense to form a Multidisciplinary University Research Initiative (MURI). Torquato leads the project to advance the field of disordered hyperuniformity with co-investigator Steinhardt and colleagues at Arizona State University and Pennsylvania State University.

Image courtesy of Joshua Peterson

Exploring the power of first impressions

SocialGAN: Generating infinitely many hyper-realistic faces with a simple web application

When we meet someone new, we subconsciously form first impressions about not just their age or attractiveness but also about what we think they are like. Are they trustworthy, extroverted, smart, electable? To study what it is about faces that leads us to these conclusions, Griffiths and colleagues turned to artificial intelligence (AI) to process realistic and diverse faces.

Tom Griffiths
Henry R. Luce Professor of Information Technology, Consciousness, and Culture

The team used a type of AI called a generative adversarial network (GAN) to generate one thousand synthetic faces, and then asked human participants to rate them on 34 attributes, including age and trustworthiness, for a total of more than one million human judgements.

From these data, the researchers created a computer program that can create an infinite number of faces that vary along the 34 different attributes. The program can transform any face image along these dimensions, and predict how people react to a given face image. The software became part of an exhibit at the University of Chicago Booth School of Business's museum of behavioral science, Mindworks, in the form of an educational photo booth that is free to the public. The team is also exploring the potential to expand access to the technology via a startup company.


Photo source: iStock

Stopping mosquito-borne diseases

Dissecting mosquito courtship behaviors: Towards a novel control intervention

The mosquito Aedes aegypti represents a major health challenge due to its role in spreading dengue, Zika, chikungunya and yellow fever. Murthy and McBride explored a promising approach to reducing mosquito populations by disrupting mosquito mating.

The team characterized interactions between males and females during courtship, drawing on the Murthy team's expertise in acoustic communication, quantitative behavioral assays and computational modeling, as well the McBride team's expertise in mosquito biology, genetics and olfactory signaling. They built a testing environment to track the movement of tiny insects while recording the noises they make as they fly during courtship. Using gene editing, they embedded sensors in the mosquito brain to record activity. With these advances, studies of mosquito courtship are underway.

Mala Murthy
Karol and Marnie Marcin '96 Professor, Professor of Neuroscience, Director of the Princeton Neuroscience Institute

Lindy McBride
Assistant Professor of Ecology and Evolutionary Biology and Neuroscience

All Awardees: New Ideas in the Natural Sciences

Year Awarded	Principal Investigators	Project
2014	**Joshua Shaevitz** *Professor of Physics and the Lewis-Sigler Institute for Integrative Genomics* **Andrew Leifer** *Assistant Professor of Physics and Neuroscience*	All-Neuron I/O in Freely Behaving Animals
2014	**Daniel Sigman** *Dusenbury Professor of Geological and Geophysical Sciences, Professor of Geosciences*	Reconstructing Past Atmospheric Carbon Dioxide Concentrations
2014	**Jean Schwarzbauer** *Eugene Higgins Professor of Molecular Biology* **Jeffrey Schwartz** *Professor of Chemistry, Emeritus Senior Scholar*	The Neuron Bridge: A Novel Platform Architecture
2015	**Zemer Gitai** *Edwin Grant Conklin Professor of Biology, Professor of Molecular Biology*	Developing "Resistance-Resistant" Antibiotic Strategies
2015	**Jared Toettcher** *Associate Professor of Molecular Biology* **Alexander Ploss** *Professor of Molecular Biology*	Dissecting Signalizing Complexity Using Cellular Optogenetics in vivo
2015	**Gregory Scholes** *William S. Tod Professor of Chemistry* **Garnet Chan** *formerly the A. Barton Hepburn Professor of Chemistry*	New Chemical Reactions Through Many-Particle Quantum Mechanics
2016	**Susanne Staggs** *Henry DeWolf Smyth Professor of Physics* **Lyman Page** *James S. McDonnell Distinguished University Professor in Physics*	Development of a Cryogenic Backplane for Observations of the Cosmic Microwave Background
2016	**Mala Murthy** *Karol and Marnie Marcin '96 Professor. Professor of Neuroscience, Director of the Princeton Neuroscience Institute* **Lindy McBride** *Assistant Professor of Ecology and Evolutionary Biology and Neuroscience*	Dissecting Mosquito Courtship Behaviors: Toward a Novel Intervention to Control Mosquito-Borne Diseases
2016	**Robert Pringle** *Professor of Ecology and Evolutionary Biology*	DNA-Based Characterization of Diet and Microbiome in African Wildlife and Livestock
2017	**Daniel Marlow** *Evans Crawford 1911 Professor of Physics* **Thomas Gregor** *Professor of Physics and the Lewis-Sigler Institute for Integrative Genomics*	Exploring Beta-Decay-Based Detection for Tracking Colonies of Self-Organized Insects in 3D

All Awardees: New Ideas in the Natural Sciences

Year Awarded	Principal Investigators	Project
2017	**Abigail Doyle** *Visiting Research Scholar in Chemistry, formerly the A. Barton Hepburn Professor of Chemistry*	Photoinduced Cross-Coupling for Sustainable Chemical Synthesis: Harvesting Visible Light With Earth-Abundant Catalysts
2017	**Julien Ayroles** *Assistant Professor of Ecology and Evolutionary Biology and the Lewis-Sigler Institute for Integrative Genomics*	The Turkana Project: The Genetic Footprints of Selection in Our Past May No Longer Fit Our Urban Lifestyle
2018	**Ralph Kleiner** *Assistant Professor of Chemistry*	A "Turn-On" Fluorescent Probe to Visualize Interactions of the Anti-Cancer Drug Cisplatin With Cellular RNA
2018	**Salvatore Torquato** *Lewis Bernard Professor of Natural Sciences. Professor of Chemistry and the Princeton Institute for the Science and Technology of Materials* **Paul Steinhardt** *Albert Einstein Professor in Science Professor of Physics*	Advances in the Design of 3D Disordered Photonic Solids
2018	**Mohamed Abou Donia** *Associate Professor of Molecular Biology*	An Unexpected Origin of Antibiotic Resistance
2019	**Bridgett vonHoldt** *Associate Professor of Ecology and Evolutionary Biology* **Andrea Graham** *Professor of Ecology and Evolutionary Biology*	Defending the Elephant Seal: Organismal Immunity to Species Conservation
2019	**Nan Yao** *Senior Research Scholar, Princeton Materials Institute; Professor of the Practice in the Princeton Materials Institute; Director of the Imaging and Analysis Center* **Nieng Yan** *Visiting Research Scholar in Molecular Biology, formerly the Shirley M. Tilghman Professor of Molecular Biology*	Novel Techniques for Applying Electric Field to Voltage-Responding Membrane Proteins for Cryo-EM Analysis
2019	**Alexander Todorov** *formerly Professor of Psychology* **Tom Griffiths** *Henry R. Luce Professor of Information Technology, Consciousness, and Culture*	SocialGAN: Generating Infinitely Many Hyper Realistic Faces With a Simple Web Application
2020	**Ricardo Mallarino** *Assistant Professor of Molecular Biology*	Functional Evolution of Antimicrobial Peptides in Marsupials

All Awardees: New Ideas in the Natural Sciences

Year Awarded	Principal Investigators	Project
2020	**Amit Singer** *Professor of Mathematics and the Program in Applied and Computational Mathematics* **Charles Fefferman** *Herbert E. Jones, Jr. '43 University Professor of Mathematics*	Optimal Transportation Manifold Learning With Application to Structural Biology
2020	**Lisa Boulanger** *Associate Professor of Neuroscience*	Lowering Barriers to Gene Therapy
2021	**Timothy Buschman** *Associate Professor of Psychology and Neuroscience*	Developing Tools and Techniques for Using Ultra-High-Density Silicon Electrodes (Neuropixels) in Non-Human Primates
2021	**Elizabeth Gavis** *Damon B. Pfeiffer Professor in the Life Sciences, Professor of Molecular Biology*	CRISPR-Cas 13-Based Tools for Dissecting RNA Localization in Drosophila
2021	**Ching-Yao Lai** *Assistant Professor of Geosciences*	Deep Learning Ice Dynamics
2021	**Lyman Page** *James S. McDonnell Distinguished University Professor in Physics*	A New Search for Dark Matter
2021	**Mohammad Seyedsayamdost** *Professor of Chemistry*	Does Redox Stress Underlie 'Cryptic' Natural Product Biosynthesis in Bacteria?
2022	**Catherine Peña** *Assistant Professor of Neuroscience*	Using Natural Variation in Wild Mice to Dissect the Neurobiological Basis of Paternal Behavior
2022	**Elizabeth Niespolo** *Assistant Professor of Geosciences*	Geochemical Methods to Interrogate the Age and Ecology of Dinosaurs
2022	**Marissa Weichman** *Assistant Professor of Chemistry*	Quantum-State-Resolved Spectroscopy of Endohedral Fullerenes
2023	**Jie Deng** *Assistant Professor of Geosciences*	Habitability of Super-Earths: Water and Magnetic Field
2023	**Thomas Gregor** *Professor of Physics and the Lewis-Sigler Institute for Integrative Genomics*	Two-Photon Oblique Plane Microscopy: Probing Biological Organization With Molecular Resolution
2023	**Ralph Kleiner** *Assistant Professor of Chemistry*	Can Post-Transcriptional RNA Pyrimidine Modifications Protect Cells From UV Photodamage?
2023	**Sabine Petry** *Associate Professor of Molecular Biology* **Joshua Shaevitz** *Professor of Physics and the Lewis-Sigler Institute for Integrative Genomics*	Mission Impossible: Solving the Structure of the Mitotic Spindle
2023	**Jordan Taylor** *Associate Professor of Psychology*	Representational Change in Motor Skills: New Insights From Music Performance

New Industrial Collaborations

Industry can play an essential role in research by helping identify challenges of relevance to society and by aiding the transformation of discoveries into technologies and devices for the benefit of humanity.


Photo source: Canva

AI transforms low-quality recordings into studio-quality tracks

Machine learning improves clarity of recorded and synthetic speech

Adam Finkelstein
Phillip Y. Goldman '86 Professor in Computer Science

Industry Partner: Adobe Research

Through an artificial intelligence (AI) approach known as deep learning, Finkelstein's team and collaborators at Adobe Research modeled how humans perceive audio quality with the goal of improving speech processing applications. The project involved two parts: collecting human judgements about audio quality to develop machine-learning models that characterize human perception; and using these perceptually driven models to improve applications such as speech enhancement of audio for podcasts and videos.

Collecting human judgements about audio quality can be time-consuming and expensive, but the alternative — using automatic methods — can correlate poorly with human perception. To address this issue, the team constructed a novel approach by fitting a deep neural network to a new large dataset of crowdsourced human judgments. These judgements were obtained by asking people a straightforward, objective question: are two recordings identical or not?

The team presented the participants with pairs of recordings that were

AI transforms low-quality recordings into studio-quality tracts

continued

algorithmically generated under a variety of perturbations, including noise, reverb and compression artifacts, with the goal of efficiently identifying the level at which the differences between the two recordings is just barely noticeable. The resulting learned metric is well-calibrated with human perception, outperforming existing methods.

Next the team developed a learning framework for estimating the quality of a recording without resorting to human judgements. The main component of this approach was a quality-preference strategy that synthetically injects into an audio clip various degrees of noise and other artifacts whereby quality preferences can be established a priori, making learning more robust. The result was a model that predicts quality on an absolute scale. The researchers showed that the resulting learned metric calibrates well with human judgments, despite the lack of human reference data.

Having developed perceptually based models that can automatically evaluate audio quality, the team then moved to the second phase of the project, exploring applications of these models for speech processing. The team developed techniques to transform low-quality recordings of human speech into high-quality clips that approach the crispness and clarity of a studio-recorded voice.

Today's podcasts, video narrations and audiobooks typically require high-quality audio to create a pleasant listening experience. However, real-world recordings captured with consumer-grade equipment often suffer from quality degradations including noise, reverberation, equalization distortion and loss of bandwidth. To address these issues, the team developed two successive deep-learning methods called HiFi-GAN and HiFi-GAN-2. They used a deep-learning architecture called a generative adversarial network (GAN) that pits two learned networks against each other as they are trained. The job of the "generator" is to improve the quality of a low-quality recording, whereas the job of the "discriminator" is to determine whether a particular clip was actually recorded in a studio or was one of the improved low-quality recordings. The resulting process transforms recorded speech into sound of the quality achieved by studio recordings.

The research has been presented at several conferences and in academic papers, and led to a patent and several patent applications. The technology promises to improve the listening experience for podcasts and other audio applications.

All Awardees: New Industrial Collaborations

Year Awarded	Principal Investigators	Project
2014	**Paul Prucnal** *Professor of Electrical and Computer Engineering* **L-3 Communications Telemetry-East**	Miniaturization of the Optical Interference Cancellation System
2014	**Richard Register** *Eugene Higgins Professor of Chemical and Biological Engineering, Director of the Princeton Materials Institute* **Promerus, LLC**	Novel Block Copolymers for Butanol Pervaporation Membranes
2015	**Kai Li** *Paul M. Wythes '55 P86 and Marcia R. Wythes P86 Professor in Computer Science* **Sebastian Seung** *Evnin Professor in Neuroscience, Professor of Computer Science and Neuroscience* **Intel Corporation**	Accelerating High-Dimensional Deep Learning on Emerging Platforms: Multicore, Manycore and CPU-FPGA
2015	**Robert Prud'homme** *Professor of Chemical and Biological Engineering* **OptoFluidics Inc and Optimeos Life Sciences, LLP**	Surface Characterization and Binding Affinity of Single Nanoparticles Using NanoTweezers
2016	**Nick Feamster** *formerly Professor of Computer Science* **Comcast Corporation**	Securing the Internet of Things in Broadband Access Networks
2017	**Eric Larson** *Senior Research Engineer, Andlinger Center for Energy and the Environment; Lecturer in Chemical and Biological Engineering and the Andlinger Center for Energy and the Environment* **NRG Energy**	Deep Decarbonization of the Grid - Addressing the Challenge of Intermittent Renewable Electricity
2017	**Robert Tarjan** *James S. McDonnell Distinguished University Professor of Computer Science* **Microsoft**	New Algorithms for Content-Serving Systems
2017	**Aarti Gupta** *Professor of Computer Science* **Sharad Malik** *George Van Ness Lothrop Professor in Engineering, Professor of Electrical and Computer Engineering* **Amazon Web Services**	Security Verification
2018	**Mohammad Seyedsayamdost** *Professor of Chemistry* **Johnson & Johnson**	Discovering New Targets in P. acnes, the Causative Agent of the Skin Disorder Acne
2019	**Adam Finkelstein** *Phillip Y. Goldman '86 Professor in Computer Science* **Adobe Research**	Machine Learning to Assess the Quality of Recorded or Synthetic Speech

All Awardees: New Industrial Collaborations

Year Awarded	Principal Investigators	Project
2019	**Kaushik Sengupta** *Associate Professor of Electrical and Computer Engineering* **Qualcomm**	Universally Reconfigurable Millimeter-Wave Front Ends for Future Wireless, Communication, Sensing and Imaging Systems
2020	**Gerard Wysocki** *Associate Professor of Electrical and Computer Engineering* **Photonics Management: a Hamamatsu Company**	Time-resolved Breath Oxygen Monitor for Critical Care-Clinical Prototype Development
2020	**Howard Stone** *Donald R. Dixon '69 and Elizabeth W. Dixon Professor of Mechanical and Aerospace Engineering; Chair, Department of Mechanical and Aerospace Engineering* **NovaFlux Inc.**	Novel Nanostructured Complex Fluids for Biofilm Removal
2021	**Minjie Chen** *Assistant Professor of Electrical and Computer Engineering and the Andlinger Center for Energy and the Environment* **Enachip, Inc.**	Circuits and Integrated Magnetics for Vertical Power Delivery of Microprocessors and IoT Devices
2021	**Peter Jaffe** *William L. Knapp '47 Professor of Civil Engineering, Professor of Civil and Environmental Engineering* **The Chemours Company**	Defluorination of PFAS in Biosolids From Industrial Waste Treament Plants
2022	**Jeroen Tromp** *Blair Professor of Geology; Professor of Geosciences and Applied and Computational Mathematics; Director, Princeton Institute for Computational Science and Engineering* **De Beers Group**	Unlocking the Path to Rapid, Field-Deployable MRI-Quality Ultrasonic Imaging
2023	**AJ te Velthuis** *Assistant Professor of Molecular Biology* **Ascend Performance Materials**	Design of Devices for Detection and Deactivation of Viruses

Collaborations Between Artists and Scientists or Engineers

Collaborations Between Artists and Scientists or Engineers brings faculty in seemingly unrelated fields together to expand their respective domains of knowledge in ways that benefit both disciplines.

Photo source: Jebulon, Creative Commons License

Forensic engineering to save historic buildings

Integrative technology for holistic analysis of heritage structures

Historic buildings have stories to tell, and often these stories are buried below ground in archeological sites. Glišić and Koortbojian combined their respective expertise in civil engineering and archaeology to develop a methodology and associated software to document and analyze both the seen and the unseen features of historic buildings and sites, above and below ground.

The methodology combines documentation above ground using automated digital reconstruction, and below ground, using ground penetrating radar (GPR) surveys to generate interactive 3D models with complete material and structural information. The results are presented in virtual reality environments to interpret and disseminate the results.

By integrating various disciplines —

Branko Glišić
Professor of Civil and Environmental Engineering

Michael Koortbojian
M. Taylor Pyne Professor of Art and Archaeology

Forensic engineering to save historic buildings

continued

including archaeology, architecture, history, geophysics, and civil engineering — the researchers enabled an accessible and holistic approach to data and analysis of historic structures and cultural heritage sites. The work allows scholars to answer new research questions about historic sites and transform the way heritage structures are researched, preserved and understood by engineers, archaeologists, historians, conservators and the general public.

The research led to more than 30 academic publications and conference presentations, as well as works of art, performance and exhibitions. The project also resulted in an online interactive database of construction materials used during the Roman empire, and modules on this work are being used in Princeton courses.

All Awardees: Collaborations Between Artists and Scientists or Engineers

Year Awarded	Principal Investigators	Project
2014	**Robert Bagley** *Professor of Art and Archaeology, Emeritus* **Christopher Tully** *Professor of Physics*	Ancient Art and the Higgs Boson
2014	**George Scherer** *William L. Knapp '47 Professor of Civil Engineering, Emeritus; Professor of Civil and Environmental Engineering and the Princeton Institute for the Science and Technology of Materials, Emeritus* **James Steward** *Nancy A. Nasher-David J. Haemisegger, Class of 1976, Director, Princeton University Art Museum; Lecturer With the Rank of Professor in Art and Archaeology*	Creative Matter, Materials Science Environmental History, and the Sustainability of Art
2014	**Naomi Leonard** *Edwin S. Wilsey Professor of Mechanical and Aerospace Engineering; Director, Council on Science and Technology* **Susan Marshall** *Professor of Dance in the Lewis Center for the Arts; Director, Program in Dance* **Daniel Trueman** *Professor of Music*	Flock Logic With Sound and into Three Dimensions

All Awardees: Collaborations Between Artists and Scientists or Engineers

Year Awarded	Principal Investigators	Project
2017	**Satish Myneni** *Professor of Geosciences* **James Steward** *Nancy A. Nasher-David J. Haemisegger, Class of 1976, Director, Princeton University Art Museum; Lecturer With the Rank of Professor in Art and Archaeology*	Did Widespread Toxic Metal Exposure Play an Important Role in the Collapse of Mayan Civilization?
2017	**Branko Glisic** *Professor of Civil and Environmental Engineering* **Michael Koortbojian** *M. Taylor Pyne Professor of Art and Archaeology*	Integrative Technology for Holistic Analysis of Heritage Structures
2017	**Adam Finkelstein** *Phillip Y. Goldman '86 Professor in Computer Science* **Thomas Levin** *Associate Professor of German*	Media Archaeology and the Science of Optical Audio Capture: Recovering the Forgotten Sonorine Archive of Vocal Performance (1905-1907)
2020	**Sigrid Adriaenssens** *Professor of Civil and Environmental Engineering* **Rebecca Lazier** *Professor of the Practice, Dance in the Lewis Center for the Arts*	NODES - Net tOpology and Dance Exploration Systems
2020	**Eduardo Cadava** *Philip Mayhew Professor of English* **John Higgins** *Associate Professor of Geosciences* **Mark Zondlo** *Professor of Civil and Environmental Engineering*	Exposure
2023	**Elizabeth Margulis** *Professor of Music* **Uri Hasson** *Professor of Psychology and Neuroscience*	Music and the Narrative Imagination
2023	**Allison Carruth** *Professor of American Studies and the High Meadows Environmental Institute* **John Higgins** *Associate Professor of Geosciences*	Climate Stories Incubator

New Ideas in the Humanities

New Ideas in the Humanities encourages innovation and scholarship on enduring questions through the development of new collaborations and conversations or a major piece of scholarly work.

Enhancing access to early African literature

Translating a medieval text from classical Ethiopic into English

A globally important medieval work of Ethiopian literature will reach students and scholars through a new English translation. The text, the Kəbrä Nägäśt (The Glory of the Kings), is an African retelling of the Biblical story about the Queen of Sheba and King Solomon. Imaginatively expanding on the sparse Biblical account, the Kəbrä Nägäśt tells how Solomon seduced the Queen of Sheba and how their son eventually took the Ark of the Covenant from Israel to Ethiopia, thus transferring God's blessings to a new chosen people. This 117-chapter text, composed roughly eight centuries ago, is celebrated in Ethiopia but is little known to European and English-speaking scholars.

Belcher teamed with renowned translator and scholar Michael Kleiner to translate the text from Gəʿəz (classical Ethiopic) into English. Penguin Classics intends to publish a teaching version of the Kəbrä Nägäśt translation, and Princeton University Press will publish the full scholarly edition. The resulting annotated translation will be of interest to scholars and the public alike.

Wendy Laura Belcher
Professor of Comparative Literature and African American Studies

All Awardees: New Ideas in the Humanities

Year Awarded	Principal Investigators	Project
2015	**Martin Kern** *Joanna and Greg Zeluck '84 P13 P18 Professor in Asian Studies, Professor of East Asian Studies*	Migrating the Thesaurus Linguae Siricae to Princeton
2015	**Sarah Chihaya** *Assistant Professor of English* **Joshua Kotin** *Associate Professor of English* **Kinohi Nishikawa** *Associate Professor of English and African American Studies*	The Contemporary: Literature in the Twenty-First Century
2016	**Sophie Gee** *Associate Professor of English* **Sarah Rivett** *Professor of English and American Studies*	The Global Enlightenment
2019	**Wendy Laura Belcher** *Professor of Comparative Literature and African American Studies*	Early African Literature Project: Kəbrä Nägäśt Translation
2019	**Joshua Kotin** *Associate Professor of English*	The Shakespeare and Company Project
2021	**Jane Cox** *Professor of the Practice, Theater in the Lewis Center for the Arts; Director, Program in Theater*	Gathering Black Theater Histories
2021	**Marina Rustow** *Khedouri A. Zilkha Professor of Jewish Civilization in the Near East, Professor of Near Eastern Studies and History*	Handwritten Text Recognition for Medieval Hebrew-Script Documents
2022	**Anna Arabindan-Kesson** *Associate Professor of Art and Archaeology and African American Studies*	Art Hx: Visual and Medical Legacies of British Colonialism

New Ideas in the Social Sciences

New Ideas in the Social Sciences encourages scholarship and innovation through conferences, technologies or expanded access to research resources.

Photo by Maria Micaela Sviatschi

Expanding safety and access for women

Sexual harassment in public spaces and police patrolling: Experimental evidence

Maria Micaela Sviatschi
Assistant Professor of Economics and Public Affairs, School of Public and International Affairs

For women around the world, sexual harassment can deter access to public places, education, and participation in the labor force. To improve women's safety, a pilot project in Hyderabad, India, placed uniformed and undercover police officers on foot patrol in bus stops, railway stations and other harassment hotspots to monitor gender-based violence and arrest perpetrators. Sviatschi teamed with colleagues at the World Bank, the University of Connecticut, Northeastern University, and partners in Hyderabad to evaluate the benefits of the program.

Due to the stigma associated with reporting harassment, the team could not rely on regular survey methods. Instead,

Expanding safety and access for women

continued

the authors employed non-uniformed observers alongside the officers to collect data on harassment incidents at given hotspots. The project collected data on over 24,000 incidents. Because observers were blind to the experiment and randomly allocated to hotspots, they provided unbiased and rigorous reporting of harassment rates.

The team found that uniformed police patrols reduced severe forms of sexual harassment by 27% relative to hotspots without any policing. In contrast, hotspots assigned to undercover police patrols did not experience a reduction in street sexual harassment compared to the control group.

Although the uniformed police presence significantly reduced severe harassment such as stalking, touching and groping, the police presence did not reduce incidence of milder forms of harassment such as unwelcome comments, catcalling and whistling. The study found that officers were less willing to sanction mild offenses, signaling their tolerance of milder forms of harassment. Women in hotspots patrolled by officers with stricter attitudes toward harassment experienced a decrease in all levels of sexual harassment.

The study provides robust documentation of the detrimental impact of sexual harassment on women's behaviors and mobility in public spaces. The findings point to the need for a strong and visible police presence to combat street sexual harassment, as well as the need to educate police officers about the benefits of addressing mild infractions.

The researchers hope that the results, which are being presented at seminars and conferences, will result in a model that can be applied around the world to improve women's access to public spaces.

All Awardees: New Ideas in the Social Sciences

Year Awarded	Principal Investigators	Project
2018	**Jennifer Rampling** *Associate Professor of History*	Through a Glass Darkly: Depicting Alchemical Change 1400-1700
2018	**Miguel Centeno** *Musgrave Professor of Sociology, Professor of Sociology and School of Public and International Affairs*	Workshop on Historical System Collapse
2019	**Andrew Guess** *Assistant Professor of Politics and Public Affairs, School of Public and International Affairs; Class of 1934 University Preceptor in the School of Public and International Affairs* **Dean Knox** *formerly Assistant Professor of Politics* **Brandon Stewart** *Associate Professor of Sociology*	Do Online Video Personalization Algorithms Polarize Users?
2019	**Maria Micaela Sviatschi** *Assistant Professor of Economics and Public Affairs, School of Public and International Affairs*	Street Police Patrols and Crime Against Women in Public Space
2020	**Leonard Wantchekon** *James Madison Professor of Political Economy, Professor of Politics and International Affairs*	New Advances in Historical Applied Microeconomics
2020	**Katja Guenther** *Professor of History*	Resilience: A Psycho-Ecological History
2022	**Ryo Morimoto** *Assistant Professor of Anthropology; Richard Stockton Bicentennial Preceptor*	Atoms for Memory: Inter-Institutional Storytelling of Nuclear Science at Princeton
2022	**João Biehl** *Susan Dod Brown Professor of Anthropology* **Agustín Fuentes** *Professor of Anthropology*	Conservation Frontiers: Engaging Indigenous Ecologies of Knowledge
2023	**Brandon Stewart** *Associate Professor of Sociology*	Evaluating a Document's Impact: Counterfactual Text Generation for Experimental Design
2023	**Matthew Desmond** *Maurice P. During Professor of Sociology*	Who Finances Evictions?

Sustainability of Our Planet

The fund focuses on discovering, developing and adopting sustainable solutions to environmental challenges.

Exploratory Energy Fund

The fund exemplifies the University's commitment to support innovative curiosity-driven energy research that is critical to securing a sustainable shared future.

Sustainability of Our Planet

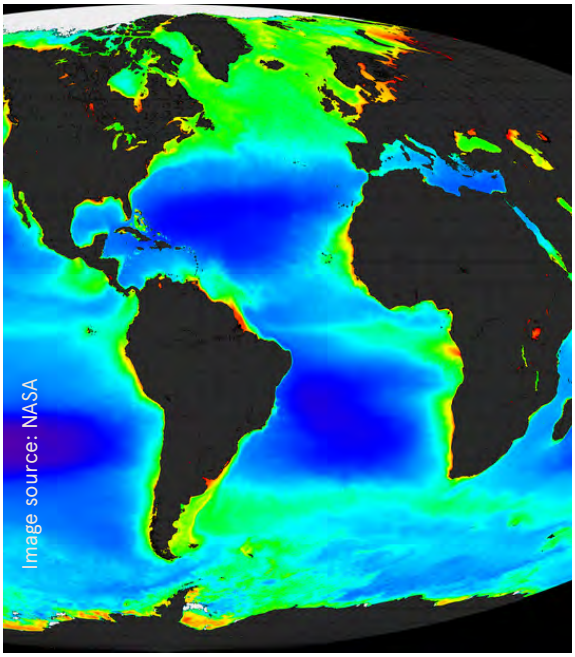
Established in 2022, the fund is made possible by the extraordinary vision and generosity of John McDonnell ’60. The first funded project explores the environmental benefits of seaweed farming in the open ocean to mitigate climate change.

The inaugural awardee is Daniel Sigman, Dusenbury Professor of Geological and Geophysical Sciences and an oceanographer and geochemist, in collaboration with Curtis Deutsch, professor of geosciences and the High Meadows Environmental Institute, and Laure Resplandy, assistant professor of geosciences and the High Meadows Environmental Institute.

Open-ocean seaweed farming has the potential to sequester large amounts of carbon dioxide. When seaweed debris from the farms sinks, it carries its carbon down into the deep ocean.

Most of this carbon will be converted back to carbon dioxide as bacteria and other organisms break it down. However, deep waters are isolated from the atmosphere for hundreds of years or longer, sequestering the seaweed-derived carbon dioxide from the atmosphere.

In the planned research project, the team will use computer models to simulate the performance and environmental effects of open ocean seaweed platforms.



Daniel Sigman
Dusenbury Professor of Geological and Geophysical Sciences, Professor of Geosciences

Year Awarded	Principal Investigators	Project
2022	**Daniel Sigman** *Dusenbury Professor of Geological and Geophysical Sciences, Professor of Geosciences*	Open ocean mariculture platforms as breadbasket and carbon sink: A seaweed revolution?

Image source: Canva

Exploratory Energy Fund

This fund, announced in 2022, supports research aimed at fundamental solutions to humanity's energy challenges. The Innovation Fund for Exploratory Energy Research is part of Princeton's larger Energy Research Fund. The Office of the Dean for Research oversees funding for fundamental energy research projects, while the Andlinger Center for Energy and the Environment distributes funding for research projects in collaboration with corporate partners. The first awards will be given in 2023.

Princeton › Research

Office of the Dean for Research
New South, 5th Floor
Princeton, NJ 08544

research.princeton.edu
dfr@princeton.edu
609-258-5500

Learn more about the projects supported by the Dean for Research Innovation Funds at research.princeton.edu/funding.

Image source: Library of Congress

Anna Arabindan-Kesson, Associate Professor of Art and Archaeology and African American Studies, led a team of artists and scholars to explore the lasting effects of colonialism on art and medicine through the project "Art Hx: Visual and Medical Legacies of British Colonialism." —New Ideas in the Humanities

Cover photo by Denise Applewhite
Report produced by Karla Ewalt, Senior Associate Dean for Research
Text and layout by Catherine Zandonella, Senior Associate Director for Communications, Office of the Dean for Research