

THE HARVARD COLLEGE UNDERGRADUATE RESEARCH ASSOCIATION

MISSION:

To increase the presence of undergraduate research by fostering an interdisciplinary research community and developing projects that enrich the undergraduate research experience.



HCURA

HARVARD COLLEGE UNDERGRADUATE RESEARCH ASSOCIATION

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The National Collegiate Research Conference (NCRC) is a forum to promote collaboration.

We connect future researchers with their peers and specialists in their fields of interest.

NCRC provides undergraduate researchers across all disciplines with a platform for sharing their work. As a result of our past experience with hosting local undergraduate research symposia, the Harvard College Undergraduate Research Association (HCURA) strongly believes in the ability of undergraduates to make meaningful and significant contributions through research. NCRC serves as a medium not only to share these contributions, but also to generate a sense of pride and identity in the undergraduate research community.

We maintain that collaboration with researchers from all backgrounds—university faculty, graduate school students, policymakers, experts from industry, and entrepreneurs—can have a profound impact on young and talented aspiring researchers. NCRC seeks to provide undergraduate participants with a forum to collaborate and learn about research from myriad backgrounds.

WELCOME FROM THE CO-PRESIDENTS

On behalf of the staff, members, and executive board of the Harvard College Undergraduate Research Association (HCURA), welcome to the tenth annual National Collegiate Research Conference (NCRC) and to Harvard University!

The challenges facing our world today are great, but the desire for the production of knowledge and for the advancement of social reality has never been more compelling. Our generation stands at the precipice of a century uniquely marked by its pursuit of technological, socio-humanistic, and scientific networks, and as the arc of learning in higher education grows increasingly conscious of institutional and cultural-political circumstance, the presence of undergraduate students in research, scholarship, and innovation expands at an ever-quickening pace. At the same time, the traditional lines of demarcation between disciplines have begun to blur as researchers become more attuned to the advantages and limitations within and across fields of study.

Born out of a distinct awareness of these underlying needs and norms, the mission of the Harvard College Undergraduate Research Association has been to advance undergraduate access to and involvement in research, so that we, as some of the youngest minds in the scholastic community, can also partake in the processes of scholarly discovery, innovation, interpretation, and discourse. Since its establishment in 2012, the National Collegiate Research Conference has represented the apical culmination of our objective and vision. In annually convening NCRC, we strive to promote a national—and now international—platform for conversations converging from multiple perspectives and grounded in myriad intellectual trajectories and genealogies. Our goal is to enrich the undergraduate research experience around the world by providing an opportunity to connect motivated students from various institutions, in the hope that sharing, discussion, and engagement will further advance and compel each and every individual in his or her own scholastic pursuits. NCRC provides the opportunity to hear from some of the

world's most distinguished scholars, policymakers, writers, educators, and theorists, to attend panels and workshops, and to receive valuable feedback and advising through our poster competition and mentoring roundtables. It is our hope that with this diverse and creative programming, NCRC catalyzes important interactions that inspire undergraduates to continue their research and engagement in the production of knowledge.

In the past nine years, NCRC has successfully brought together hundreds of undergraduates from over 90 universities. This number continues to grow each year as our conference gains momentum and recognition, and we are pleased that in the past years, undergraduate students at several other prominent institutions have also begun similar conference initiatives. NCRC 2015 marked the first year that we were joined by undergraduate researchers from outside the United States, and this year, we welcome our most intellectually diverse group of conference participants to date. As the first undergraduate-run, national, interdisciplinary research conference, we continue to pride ourselves on being completely student-run, and the three days ahead of you are the product of the tireless efforts, enormous dedication, and sustained enthusiasm of our executive board, members, and staff, who have worked unremittingly over the past year to prepare for this conference, as well as of the continued support from our numerous faculty advisors, collaborators, and financial sponsors. Without them, NCRC 2023 could not have been possible.

We thank you for joining us at Harvard this January for NCRC 2023, and look forward to meeting you. Please don't hesitate to stop by and introduce yourself to us during the conference. We hope you find the three days ahead to be fulfilling and illuminating, as we celebrate such an expansive undergraduate research community.

With our best wishes,

Lara van Rooyen & Brandon Kwon

Co-Presidents, 2022-2023

Harvard College Undergraduate Research Association

ABOUT *HCURA*

The Harvard College Undergraduate Research Association (HCURA) was founded in 2007 upon the mission of building an interdisciplinary research community among undergraduates. Now at the sixteenth year anniversary of our founding, we are thrilled with how the undergraduate research community has expanded in the past decade and optimistic for the future.

Our goal to increase the scope and visibility of Harvard undergraduate research in all disciplines is the focus of our many on-campus initiatives, including the Graduate Student Mentoring Program, where graduate students mentor undergraduates interested in research; the *Visitas* Research Symposium, which showcases research by experienced Harvard students to admitted high school seniors; and new projects such as Research Week in the fall, which introduces research opportunities to freshmen through panels, socials, and workshops; the Harvard Science Research Conference (HSRC), a two-day conference started in 2015 for exceptional high school students interested in STEM research; and *Brevia*, our general readership publication for short articles that present nontechnical treatments of cutting-edge research.

Every January, we host our flagship event, the National Collegiate Research Conference (NCRC), at Harvard as an extension of our vision to provide the best platform for undergraduates from across the nation to share their research. NCRC features distinguished speakers, panelists, and students, along with workshops and mentoring sessions that highlight important issues in undergraduate research and several opportunities for participants to present their own research through our plenary sessions and poster competition. Through NCRC, we hope, ultimately, to further sustain interest in and access to undergraduate research as well as to foster a community of undergraduate scholars.

NCRC 2023 Conference Directors



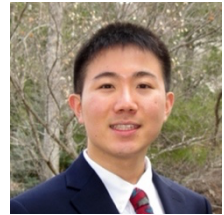
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Rooyen, '23**
Co-President



**Brandon Kwon,
'24**
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Justin Han, '24
Vice President



**Christopher
Meng, '24**
Chief of Internal
Operations



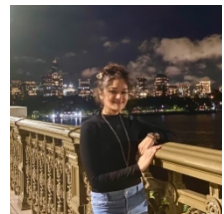
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Jay Pratap, '25
Co-Director of
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**Christopher Li,
'25**
Co-Director of
Programming



Khushi Kohli, '25
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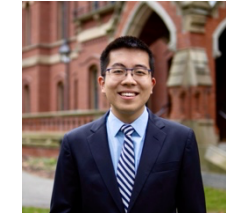
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**Michael Young,
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Milen Negasi, '25
Co-Director of
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DAY 1: January 20th (Friday)

All events in Emerson Hall (Harvard Yard, 25 Quincy St) - **Emerson 105**

9:00 - 10:00 AM	Registration & Breakfast
10:00 - 10:30 AM	Welcome & Opening Remarks
10:30 - 11:30 AM	Harvard Undergraduate Research and Fellowships Workshop
11:30 AM - 12:30 PM	Lunch
12:30 - 1:30 PM	Keynote: Professor Cora Dvorkin
1:30 - 2:00 PM	Plenary Session I
2:00 - 2:30 PM	Plenary Session II
2:30 - 3:00 PM	Plenary Session III
3:00 - 4:00 PM	Workshop/ Panel I
4:00 - 5:00 PM	Keynote: Professor William Shih

DAY 2: January 21st (Saturday)

All events in Northwest Building Basement (52 Oxford St)

8:30 - 9:00 AM	Breakfast
9:00 - 10:30 AM	Poster Session I
10:30 - 11:30 AM	Keynote: Professor Gabriela Soto Laveaga
11:30 - 12:30 PM	Lunch
12:30 - 1:30 PM	Harvard Undergraduate Research and Fellowships Workshop
1:30 - 2:30 PM	Keynote: Professor Emery Brown
2:30 - 4:00 PM	Poster Session II
4:00 - 5:00 PM	Panel/Workshop II
5:00 - 6:00 PM	Social
6:00 - 8:00 PM	Gala Dinner

DAY 3: January 22nd (Sunday)

9:00 - 10:00 AM	Breakfast
10:00 - 11:00 AM	Medical/Graduate School Panel
11:00 AM - 12:00 PM	Keynote: Professor Matthew Meyerson
12:00 - 1:00 PM	Lunch
1:00 - 2:30 PM	Poster Session III
2:30 - 3:00 PM	Break
3:00 - 4:00 PM	Panel/Workshop III
4:00 - 4:30 PM	Closing Remarks

PAM GADDI (URAF WORKSHOP)

Dr. Pam Gaddi is an assistant director of the Harvard College Office of Undergraduate Research and Fellowships, the campus coordinator for Harvard's Mellon Mays Undergraduate Fellowship Program, and the program manager of the Harvard College Amgen Scholars Program.



Outside of these roles, she leads the operations of many of Harvard's summer undergraduate research programs. Dr. Gaddi earned her Ph.D. in Medical Science from Brown and a B.S. in Biology from St. John's University.

TOM HAMEL (URAF WORKSHOP)

Tom Hamel is the associate director of the Office of Undergraduate Research and Fellowships, overseeing day-to-day supervision of student programming, leading administrative management of the fellowships program, and advising undergraduates.



CONFERENCE KEYNOTE
SPEAKER

CORA DVORKIN

Dr. Cora Dvorkin is an Associate Professor at the Department of Physics at Harvard University. As a theoretical cosmologist, her research centers on the nature of dark matter and neutrinos as well as early-universe physics. Prior to her

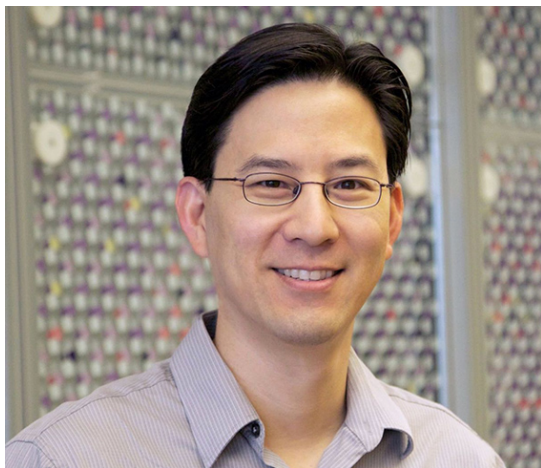


faculty position at Harvard, Dr. Dvorkin was a NASA Hubble Fellow and an Institute for Theory and Computation (ITC) Fellow at the Center for Astrophysics at Harvard.

She received her PhD at the University of Chicago, where she received the Sydney Bloomenthal Fellowship for outstanding performance in research. Additionally, she received her undergraduate degree and Diploma of Physics at the University of Buenos Aires School of Science.

WILLIAM SHIH

Dr. William Shih is a Professor in the Department of Biological Chemistry and Molecular Pharmacology at Harvard Medical School and the Department of Cancer Biology at the Dana-Farber Cancer Institute. His current research aims to leverage Synthetic Biology approaches to aid in the development of DNA nanostructures capable of self-assembling to be used in biomedical contexts. His work has received recognition from numerous institutions, including the NIH, Blavatnik Institute, Foresight Institute, and ISNSCE.



Dr. Shih received his PhD from Stanford University and conducted his postdoctoral training at The Scripps Research Institute.

CONFERENCE KEYNOTE
SPEAKER

GABRIELA SOTO LAVEAGA

Dr. Gabriela Soto Laveaga is a professor of the history of science and for the Study of Mexico at Harvard University. Currently, her academic interests center on medical professionals and social change, the production and circulation of knowledge between Mexico and India, and 20th century science and development projects. She has written two award-winning books and has received numerous fellowships, including the Fulbright, Mellon, and Ford Fellowships. Before arriving at Harvard, she earned her BA from California State University and her MA and PhD from the University of California, San Diego.



EMERY BROWN

Dr. Emery N. Brown is the Warren M. Zapol Professor of Anaesthesia at Harvard Medical School and an anesthesiologist at Massachusetts General Hospital (MGH). Dr. Brown received his B.A. in Applied Mathematics from Harvard College, his M.A. and Ph.D. in statistics from Harvard University, and his M.D. from Harvard Medical School. Dr. Brown is the only person to hold endowed professorships at both Harvard and MIT.



Dr. Brown is an anesthesiologist-statistician whose experimental research has made important contributions towards understanding the neuroscience of how anesthetics act in the brain to create the states of general anaesthesia. In particular, his work has shown that highly structured oscillation maintained by the anesthetic drugs are a primary mechanism through which anesthetics create the altered arousal states of general anesthesia. His statistics research has developed signal processing algorithms to help understand how the brain represents and transmits information.

Dr. Brown served on President Obama's BRAIN Initiative Working Group, and is the first African American, first statistician, and the first anesthesiologist to be elected to all three branches of the National Academies of Sciences, Engineering, and Medicine.

MATTHEW MEYERSON

Dr. Matthew Meyerson is the director of cancer genomics at the Broad Institute of MIT and Harvard, professor of pathology at Dana-Farber Cancer Institute (DFCI) and Harvard Medical School, director of the Center for Cancer Genome Discovery at Dana-Farber Cancer Institute, and a principal investigator in The Cancer Genome Atlas project (TCGA) of the National Institutes of Health.



Currently, his laboratory aims to utilize genomic approaches to elucidate the genetic changes that give rise to cancer and the role of infectious agents in causing diseases with unknown causes.

Dr. Meyerson has received numerous honors for his work, including the Paul Marks Prize in Cancer Research, the Caine Holter Hope Now award from Uniting Against Lung Cancer, the and the AACR Team Science Award. He received his BA, MD, and PhD from Harvard University.

CONFERENCE

PANELS AND WORKSHOPS

WORKSHOPS/PANELS SESSION I

TITLE: Clinical Applications of Artificial Intelligence: Future Trends in Digital and Robotic Surgery.

SPEAKER: Professor Marco Zenati

COORDINATOR: Nouraldeen Ibrahim

DESCRIPTION: The field of surgery can gain a great deal from the convergence of artificial intelligence (AI) and robotic technologies. To increase procedural efficiency, accuracy and safety while decreasing surgeon's focus on rote tasks and fatigue, combining robotics with AI aims to recognize surgical tasks with computer vision/machine learning and automate them using surgical robots. Future possibilities range from virtual robotic assistants (e.g., AI Coach), automatic visual interpretation of surgical scenes, virtual mentors and autonomous robotic executions of surgical tasks or whole procedures.

SPEAKER BIO: Dr. Marco Zenati is a Professor of Surgery at Harvard Medical School, Associate Surgeon in the Department of Surgery, Brigham & Women's Hospital and the Chief of Cardiac Surgery at the U.S. Department of Veterans Affairs, Boston Healthcare System. He is the founder and the director of the Medical Robotics & Computer-Assisted Surgery (MRCAS) Laboratory. In the 1990s he was deeply involved in the development of minimally invasive cardiac surgery and robotics, and he was among the first to pioneer their clinical applications. Dr Zenati serves as the co-Chair of the Bioengineering, Technology and Surgical Sciences (BTSS) Study Section of the NIH Center for Scientific Review. Dr Zenati is the National Study Chair for the REGROUP and CART randomized clinical trials.

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PANELS AND WORKSHOPS

TITLE: Mindfulness: The Science behind Meditation, Yoga, and Awareness

WORKSHOP SPEAKER: Dr. Sara Lazar

WORKSHOP COORDINATOR: Devin Kancherla

DESCRIPTION: Mindfulness is defined as “awareness that arises through paying attention, on purpose, in the present moment.” While many are weary of tangible benefits of meditation, Dr. Sara Lazar will systematically explain the benefits of mindfulness and yoga. Hopefully after this workshop you will find motivation to meditate yourself.

SPEAKER BIO: **Dr. Sara Lazar** is an associate researcher in the Psychiatry Department at Massachusetts General Hospital and an assistant professor in psychology at Harvard Medical School. Dr. Lazar primarily studies the impact of yoga and meditation on various cognitive and behavioral functions and even found evidence that meditation may slow down the age-related atrophy of certain areas of the brain. Having practiced yoga since 1994, Dr. Lazar frequently gives lectures about the benefits of mindfulness, and her research has been covered by numerous news organizations including The New York Times, USA Today, and Time Magazine.

WORKSHOP/PANEL SESSION II

TITLE: Shall We Play a Game?

SPEAKER: Dr. John Wesley Cain

COORDINATOR(S): Chris Li, Khushi Kohli

DESCRIPTION: During this talk, I'll ask you a mix of funny and serious questions about the game of tic-tac-toe and its generalizations. We'll make wild conjectures together. We'll resolve some of those conjectures, and we'll realize that others are surprisingly hard to tackle. We'll also see that this children's game has some surprising connections to problems of major scientific interest, and I'll point out some related research opportunities that are accessible to undergraduates. At some point, I'll also explain the title of this talk, which is drawn from a 1980s movie in which a computer is asked to play tic-tac-toe against itself to avert World War III (long story, best not to ask) in exactly the same way that I programmed a computer to play tic-tac-toe against itself in the context of trying to resolve an open conjecture (for personal amusement, not related to averting World War III).

SPEAKER BIO: Dr. John Wesley Cain serves as a Senior Lecturer in Mathematics at Harvard University. Outside of his role as a professor, Dr. Cain conducts research at the crossroads of mathematics, biology, and medicine. Prior to working at Harvard University, he completed his PhD at Duke University and spent 10 years as a mathematics professor in Virginia.

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TITLE: Policy, Safety, and Design for Impartial Artificial Intelligence Algorithms

SPEAKERS: Kosuke Imai, Hong Qu

COORDINATOR: Victor Cai

DESCRIPTION: Every day, artificial intelligence (AI) and statistical algorithms find new uses, such as detecting and quantifying gerrymandering, analyzing social media misinformation trends, and assessing arrested individuals for bail release. The growing influence of algorithms on human decision-making requires programmers and policymakers to carefully direct rapid developments to the benefit of society. Our panelists discuss how to discover and mitigate discrimination, ethical conflicts, privacy concerns, and other blindspots in algorithm design.

SPEAKER BIO(S): **Dr. Kosuke Imai** is a professor in the Department of Government and the Department of Statistics at Harvard University. He is also an affiliate of the Institute for Quantitative Social Science. Before moving to Harvard in 2018, Imai taught at Princeton University for 15 years where he was the founding director of the Program in Statistics and Machine Learning. He has been Professor of Visiting Status in the Faculty of Law and Graduate Schools of Law and Politics at the University of Tokyo. He specializes in the development of statistical methods and machine learning algorithms and their applications to social science research. His areas of expertise include causal inference, computational social science, program evaluation, and survey methodology. His substantive applications range from the randomized evaluation of Mexican and Indian national health insurance programs to the assessment of pretrial public safety assessment in the United States criminal justice system.

Hong Qu is an adjunct lecturer at Harvard Kennedy School teaching data and information visualization courses. He also serves as a research fellow at the Malcolm Wiener Center for Social Policy. Qu was one of the first engineers on YouTube's startup team, building key features such as video sharing, channels and skippable ads as well as

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PANELS AND WORKSHOPS

pioneering the “social engineering” aspect such as fostering a constructive community and training the algorithm to prioritize meaningful comments over obnoxious ones. He participated in the Berkman Klein Center and MIT Media Lab's 2019 Assembly program working together with a team of data scientists and civil society leaders to produce AI Blindspot, a discovery process for spotting unconscious biases and structural inequalities in AI systems. He is a fellow at the Stanford Institute for Human-Centered Artificial Intelligence (HAI) and the Stanford Digital Civil Society Lab. He graduated from Wesleyan University and UC Berkeley's School of Information, and is currently a PhD candidate at the Network Science Institute at Northeastern University, where he contributes to the 50-State COVID-19 Project and a vaccine misinformation on Twitter dashboard.

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WORKSHOPS/PANEL SESSION III

TITLE: Building a Future of Reproductive Justice Beyond Roe.

SPEAKERS: Professor Jocelyn Viterna, Professor Elizabeth Janiak, Professor Alicia Ely Yamin

COORDINATOR: Coby Garcia

DESCRIPTION: In *Building a Future of Reproductive Justice Beyond Roe*, Professor Jocelyn Viterna, Dr. Elizabeth Janiak, and Professor Alicia Ely Yamin will discuss their research on issues around reproductive rights, healthcare access, and equity, and its intersection with societal issues like poverty, race, and policy making. Conversations will explore the current state of reproductive rights in the United States and the challenges faced in conducting research in the field of abortion and reproductive justice.

SPEAKER BIO(S): **Jocelyn Viterna** is Professor of Sociology and Director of Undergraduate Studies at Harvard University. Viterna's research centers on social mobilization and gender, with her current work examining anti-abortion legislation in El Salvador and its powerfully negative consequences on pregnant people there.

Elizabeth Janiak is an Assistant Professor at Harvard Medical School and the Harvard T.H. Chan School of Public Health, Lecturer at Massachusetts Institute of Technology, and Director of Social Science Research at Planned Parenthood League of Massachusetts. Her research spans fields of sociology, epidemiology, and health systems. Her current work examines public health policy, social inequity, and reproductive healthcare accessibility and quality.

Alicia Ely Yamin is a Lecturer on Law and the Senior Fellow on Global Health and Rights at the Petrie-Flom Center for Health Law Policy, Biotechnology and Bioethics at Harvard Law School; Adjunct Senior Lecturer on Health Policy and Management at the Harvard TH Chan School of Public Health; and Senior Advisor on Human Rights and

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PANELS AND WORKSHOPS

Health Policy at the global health justice organization, Partners In Health. Bridging academia and activism, Yamin's work focuses on human rights and advocacy. She has been a key proponent internationally in advocacy health as a human right.

TITLE: Global Health Sustainability: Frontiers of Synthetic Biology

SPEAKER: Pamela A. Silver

COORDINATOR: Nouraldeen Ibrahim

DESCRIPTION: Advances in synthetic biology are opening the door to new technologies that can tackle the pressing challenges of today and tomorrow. With extensive expertise in the field, Professor Silver has made significant strides in developing innovative technologies that greatly enhance efficiency. In this workshop, Professor Silver will delve into the bioeconomy of this burgeoning landscape and explore how these cutting-edge models are driving scientific progress.

SPEAKER BIO: Pamela Silver is the Elliot T. and Onie H. Adams Professor of Biochemistry and Systems Biology at Harvard Medical School and a founder of the Wyss Institute for Biologically Inspired Engineering at Harvard University. In 2004, she became one of the first members of the Dept of Systems Biology at Harvard Medical School where her laboratory now resides. She founded and served as the first Director of Graduate Program in Systems Biology at Harvard University. She is the recently appointed Director of the new Synthetic Biology HIVE at Harvard Medical School, an elected member of the American Academy of Arts and Sciences and the past Daniel's Fellow of the Radcliffe Institute for Advanced Study. She has received the Distinguished Alumni Award from UCSC, the Innovative Technology Prize (BIO), the FastCompany Innovation Award and the Joseph Henry Lecture of the Philosophical Society. She has been recognized as one of the top Global Synthetic Biology Influencers and her work named as one of the top 10 Breakthroughs by the World Economic Forum.

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PLENARY SESSIONS:

Session I: 1:30 PM - 2:00 PM

Dhruv Goel: Mathematics, Harvard University

Pencils of Conics via Intersection Theory: An Island in the Rising Sea

Sophia Marie Joseph: Political Science, American University

The Conquest of the Latinidad: Historical and Contemporary Colorism in Hispaniola

Talia Blatt: Integrative Biology, Harvard University

Evaluating the impact of fire, drought, and management on California forest ecosystems

Session II: 2:00 PM – 2:30 PM

Ashrit Challa: Molecular and Cell Biology, University of Pennsylvania

AI-Based Quantification of Cellular Protein Expression Levels

Paula Kirya: Bioengineering, University of California San Diego

Nanophotonic Metasurfaces for Living Material Characterization

Angela Busheka: Electrical and Computer Engineering, Lafayette College

*Ingesting and Analyzing Open Source Automatic Speech Recognition Data for Low-Resource Languages***SCHEDULE**

CONFERENCE

PLENARY SESSIONS:

Session III: 2:30 PM - 3:00 PM

Calvin Bell III: Political Science, Morehouse College

Reimagining the Carceral Landscape: From Discipline and Punishment to Social Reckoning and Radical Love in Academic Spaces

Nour Khachemoune: Chemistry, Harvard University

Diet and Animal Management at Copán, Honduras

Ashini Modi: Astrophysics, Harvard University

Impact of M-dwarf Stellar Wind and Photoevaporation on the Atmospheric Evolution of Small Planet



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HARVARD UNIVERSITY

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and Applied Sciences

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Trinity Ghering	Indu Parameswaran	John Yang
Abigail Gilbert	Ellen Patronas	Xiaomian Yang
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Dhruv Goel	Joanna Peng	Katya Zaraska
Bailey Goldschmidt	Kanna Pichappan	Alexander Zavalny
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