18TH NANO-BIO SYMPOSIUM

MAY 5, 2025

Transforming Bioengineering Research with AI and Machine Learning

JOHNS HOPKINS
INSTITUTE *for*
NANOBIOTECHNOLOGY

WELCOME

Welcome to the 18th Nano-Bio Symposium, hosted by the Johns Hopkins Institute for NanoBioTechnology. This year's theme—Transforming Bioengineering Research with AI and Machine Learning—invites us to explore the powerful convergence of artificial intelligence, scientific expertise, and human creativity in advancing bioengineering breakthroughs.

Our goal for this event is to foster collaboration and dialogue across disciplines as we collectively shape the future of healthcare and biomedicine through AI and machine learning.

Each year, this symposium serves as a platform for bold ideas and interdisciplinary engagement. This year, we are especially excited about the rapid growth of possibilities at the intersection of science and technology, powered by emerging AI and ML capabilities.

As bioengineering evolves, researchers are increasingly turning to AI and ML to optimize experimental design, analyze large-scale data, model complex biological systems, and uncover new insights. These tools are already driving advancements in key areas of research—from drug discovery and nanoparticle optimization to biomaterials, diagnostics, medical imaging, and tissue engineering.

We are deeply grateful to our speakers, attendees, poster presenters, and judges—your participation and contributions make this symposium possible. We also extend our sincere thanks to INBT's exceptional staff for their thoughtful planning and execution of today's event.

We hope you enjoy the symposium and leave inspired by the ideas and connections formed here. Please share your feedback with us. We are always looking to enhance the value of this annual gathering.

HAI-QUAN MAO
DIRECTOR

SASHANK REDDY
ASSOCIATE DIRECTOR

18TH NANO-BIO SYMPOSIUM:
TRANSFORMING BIOENGINEERING RESEARCH WITH AI AND MACHINE LEARNING

MONDAY, MAY 5, 2025

Lectures: **Arellano Theater**
Registration and Poster Competition: **Glass Pavilion**
Breakfast, Lunch, and Breaks: **Great Hall**

Use the QR code
for an interactive map of the
Johns Hopkins Homewood campus.

8:15 TO 9 A.M.

REGISTRATION CHECK IN AND BREAKFAST

9 TO 9:10 A.M.

WELCOME AND OPENING REMARKS

Ed Schlesinger

Hai-Quan Mao

9:10 TO 9:55 A.M.

KEYNOTE I

AI-Driven Development of Next-Generation mRNA Vaccines
Dong Shen

9:55 TO 10:45 A.M.

INVITED TALKS: FACULTY RESEARCH SPOTLIGHTS SESSION I

AI-Based 3D Cellular Imaging
Denis Wirtz

AI-Driven Design of Lipid Nanoparticles for mRNA and Gene Editors Delivery
Bowen Li

10:45 AM TO 11 A.M.

BREAK AND NETWORKING

11 A.M. TO 12:15 P.M.

INVITED TALKS: FACULTY RESEARCH SPOTLIGHTS SESSION II

Progress Towards a Self-Driving Biomaterials Laboratory
Adam Gormley

AI Meets Stem Cell Biology: Tales of Caution and Discovery
Patrick Cahan

AI Tools for Antibody Engineering
Jeff Gray

12:15 TO 1 P.M.

LUNCH AND NETWORKING

1 TO 1:20 P.M.

RAPID-FIRE PRESENTATIONS

1:20 TO 2:05 P.M.

KEYNOTE II

Pioneering Scientific Superintelligence: Turning the Wheel of Science with AI
Alexandra Sneider

2:05 TO 2:50 P.M.

PANEL DISCUSSION: EMPOWERING BIOENGINEERING RESEARCH WITH AI AND MACHINE LEARNING

Alexis Battle

Adam Gormley

Bowen Li

Dong Shen

Alexandra Sneider

Denis Wirtz

3 TO 4:30 P.M.

POSTER COMPETITION AND RECEPTION

Poster Session A: **3 to 3:45 p.m.**

Poster Session B: **3:45 to 4:30 p.m.**

4:30 TO 4:45 P.M.

AWARD PRESENTATIONS AND CLOSING REMARKS

Hai-Quan Mao

ED SCHLESINGER

9 TO 9:10 A.M.
WELCOME AND OPENING REMARKS

Ed Schlesinger is the Benjamin T. Rome Dean at Johns Hopkins University's Whiting School of Engineering, where he is also a professor in the Department of Electrical and Computer Engineering.

At Johns Hopkins, Schlesinger has launched numerous initiatives aimed at enhancing the student experience and the impact of the Whiting School of Engineering's educational and research efforts on society. This has included co-chairing the Second Commission on Undergraduate Education and the creation of the Institute for Assured Autonomy in partnership with the Applied Physics Laboratory, the Ralph O'Connor Sustainable Energy Institute, and the Malone Center for Engineering in Healthcare.

HAI-QUAN MAO

9 TO 9:10 A.M.
WELCOME, OPENING REMARKS, AND MODERATOR

Hai-Quan Mao has been the director of the Institute for NanoBioTechnology since January 2022 and was previously its associate director from 2017 to 2022. He is a professor in the Department of Materials Science and Engineering with joint appointments in the Department of Biomedical Engineering and Translation Tissue Engineering Center at Johns Hopkins School of Medicine. His research interests are in polymeric nanomaterials for regenerative engineering, therapeutic delivery, and immunoengineering. Mao received his PhD in polymer chemistry from Wuhan University and completed his postdoctoral training in biomedical engineering at Johns Hopkins University.

SASHANK REDDY

9:55 TO 10:45 A.M
MODERATOR

Sashank Reddy is an associate professor of plastic and reconstructive surgery and biomedical engineering at the Johns Hopkins University School of Medicine, associate director of INBT, and senior medical director of Johns Hopkins Technology Ventures. Reddy's research centers on mechanisms of regeneration and homeostasis in skin and development of methods to query and alter cell fate. Reddy is also an accomplished biomedical innovator and a founder of venture-backed companies. In his role at the Institute for NanoBioTechnology, he works to grow the scientific and translational excellence of the Institute. Reddy completed his undergraduate studies at Johns Hopkins as a Beneficial Hodson Scholar, followed by MD and PhD studies at Harvard Medical School and the Massachusetts Institute of Technology.

DONG SHEN

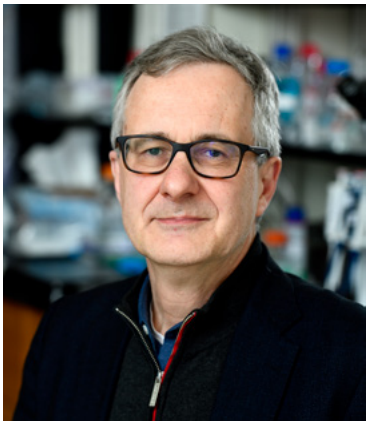
9:10 TO 9:55 A.M. AND 2:05 TO 2:50 P.M.
AI-DRIVEN DEVELOPMENT OF NEXT-GENERATION MRNA VACCINES

Dong Shen is the founder and CEO of RNAimmune Inc., a clinical-stage biotechnology company specializing in mRNA vaccines and therapeutics. He earned his MD from Shanghai Jiao Tong University School of Medicine and his PhD from Johns Hopkins University School of Medicine under Bert Vogelstein. A leader in AI-driven mRNA technology, Shen has guided RNAimmune to global recognition with 35 patents, advanced lipid nanoparticle innovations, and a diverse pipeline targeting RSV, COVID-19, cancer, and more. In 2023, RNAimmune's RSV vaccine became the first FDA IND-approved in Asia. With over 23,000 citations, Shen continues to drive health care innovation worldwide.

ALEXANDRA SNEIDER

1:20 TO 2:05 P.M. AND 2:05 TO 2:50 P.M.
PIONEERING SCIENTIFIC SUPERINTELLIGENCE: TURNING THE WHEEL OF SCIENCE WITH AI

Alexandra Sneider is a co-founder and the head of corporate development at Lila Sciences, a company pioneering scientific superintelligence to solve humankind's greatest challenges. She is also a principal at Flagship Pioneering, which invents and builds platform companies with the potential to change the world. Sneider has demonstrated expertise in venture creation, including establishing and advancing platform science, research and development strategy, corporate strategy, foundational intellectual property, and high-performance teams. Sneider completed her PhD in chemical and biomolecular engineering from Johns Hopkins University. She received several awards, including the National Science Foundation Graduate Research Fellowship and the Siebel Scholarship.

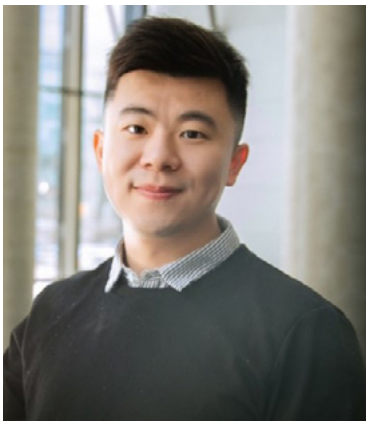


DENIS WIRTZ

9:55 TO 10:45 A.M. AND 2:05 TO 2:50 P.M.
AI-BASED 3D CELLULAR IMAGING

Denis Wirtz's research lies at the interface of physics, biology, and oncology to better understand cancer cell migration, cytoskeleton biophysics, and mechanobiology. He has pioneered research in cell migration in 3D settings and high-throughput cell phenotyping. Recently, he developed CODA, an AI-based method to image large volumes of tissues and tumors in 3D and velocity receptors which mediate highly effective infiltration of cellular therapies into solid tumors. Wirtz is the vice provost for research at Johns Hopkins University, a core member of the Institute for NanoBioTechnology, and the Theophilus Halley Smoot Professor in the Department of Chemical and Biomolecular Engineering. Wirtz received his physics engineering degree from the Free University of Brussels and his MSc and PhD in chemical engineering from Stanford University.

BOWEN LI



9:55 TO 10:45 A.M. AND 2:05 TO 2:50 P.M.
AI-DRIVEN DESIGN OF LIPID NANOPARTICLES FOR MRNA AND GENE EDITORS DELIVERY

Bowen Li is an assistant professor at the Leslie Dan Faculty of Pharmacy, University of Toronto, and an affiliate scientist at the Princess Margaret Cancer Centre. He holds the tier 2 Canada research chair in RNA vaccines and therapeutics and the GSK chair in pharmaceutics and drug delivery. Li earned his PhD in bioengineering from the University of Washington in Seattle and completed a postdoctoral fellowship under Bob Langer and Daniel Anderson at MIT. His lab employs interdisciplinary approaches, including biomolecular engineering, combinatorial chemistry, autonomous high-throughput platforms, and machine learning to develop next-generation delivery systems for nucleic acid medicines. Li's work has resulted in over 60 publications in top journals such as *Nature Biotechnology*, *Nature Materials*, *Nature Biomedical Engineering*, *Nature Medicine*, *Nature Communications*, *Science Advances*, and *PNAS*, as well as ten patents.

ADAM GORMLEY

11 A.M. TO 12:15 P.M. AND 2:05 TO 2:50 P.M.
PROGRESS TOWARDS A SELF-DRIVING BIOMATERIALS LABORATORY

Adam Gormley is an associate professor of biomedical engineering at Rutgers University, executive editor of *Advanced Drug Delivery Reviews*, and co-founder of Plexymer Inc. He obtained his PhD in bioengineering from the University of Utah in the laboratory of Hamid Ghandehari, and a BS in mechanical engineering from Lehigh University. In January 2017, Gormley started his lab, which seeks to develop bioactive nanobiomaterials using robotics and artificial intelligence. Gormley is the recipient of a NIH R35 MIRA Award, an NSF CBET award, and an NSF Designing Materials to Revolutionize and Engineer our Future award. He is also the recipient of the A. Walter Tyson Assistant Professorship, the Young Innovator Award by Cellular and Molecular Bioengineering, and the Presidential Fellowship for Teaching Excellence.

PATRICK CAHAN

11 A.M. TO 12:15 P.M.
AI MEETS STEM CELL BIOLOGY: TALES OF CAUTION AND DISCOVERY

Patrick Cahan began his academic journey at UMBC, majoring in computer science and working on information retrieval systems. Drawn to computational biology, he earned a PhD from Washington University in St. Louis and completed postdoctoral training in George Daley's lab at Boston Children's Hospital. As an associate professor in the Department of Biomedical Engineering and Institute for Cell Engineering, Cahan leads an experimental-computational lab developing methods to extract actionable insights from single-cell omics data. His team focuses on understanding the development and diseases of synovial joints and improving experimental methods for generating synovial joint lineages from pluripotent stem cells.

JEFFREY GRAY

11 A.M. TO 12:15 P.M.
AI TOOLS FOR ANTIBODY ENGINEERING

Jeffrey Gray is the creator of a pioneering computer code architecture used by thousands of biomedical researchers worldwide to predict and design protein structure. The computational tools he and his lab develop are resolving disease and immunity challenges, including cell signaling, DNA regulation, Alzheimer's disease, HIV, and cancer. Gray is a professor of chemical and biomolecular engineering, associate researcher at the Institute for NanoBioTechnology, and a member of the Data Science and Artificial Intelligence Institute. He received his BSE in chemical engineering from the University of Michigan, his PhD in chemical engineering from the University of Texas at Austin, and completed his postdoctoral training on protein-protein docking at the University of Washington.

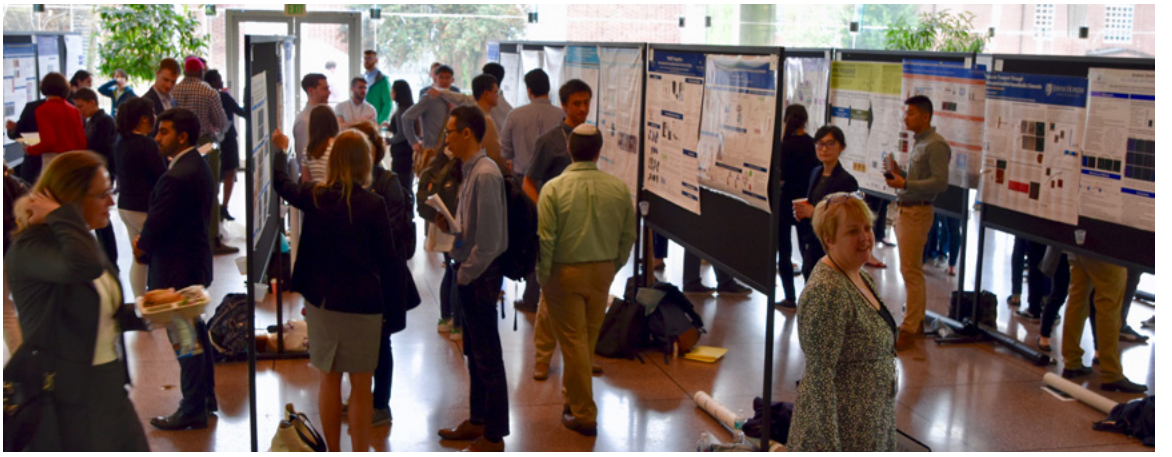
ALEXIS BATTLE

2:05 TO 2:50 P.M.
PANEL DISCUSSION: EMPOWERING BIOENGINEERING RESEARCH WITH AI AND MACHINE LEARNING

Alexis Battle is a professor of biomedical engineering and computer science. She also serves as the director for the Malone Center for Engineering in Healthcare and the interim co-director of the Data Science and AI Institute. Her research group uses machine learning to analyze large-scale genomic and health data to understand how genetic variation affects the human body. They have made major contributions to understanding how individual genetic differences interact with environmental risk factors, temporal processes, and cell type to influence gene regulation and disease risk. Battle earned her PhD in computer science and her bachelor's degree in symbolic systems from Stanford University. Before joining Johns Hopkins, she was a software engineer and engineering manager at Google. Battle has received several awards including the JHU President's Frontier Award, was a Searle Scholar, and a Microsoft Investigator Fellow.

THANK YOU

The yearly Nano-Bio Symposium showcases and celebrates the latest discoveries from our multidisciplinary research teams. It brings together scholars from the Johns Hopkins community, academia, industry, government, and more to network, share knowledge and ideas, and foster new collaborations with the goal of improving health and well-being for all. We thank everyone who made this event a success, including attendees, guest speakers, poster competitors, volunteers, and INBT staff. We also thank Tom Fekete, INBT's former director of corporate partnerships, and his wife, Lois Fekete, for their generosity in sponsoring the undergraduate poster awards since 2019. Please join us at the INBT's 19th Nano-Bio Symposium in 2026.



REFLECTING ON THE INBT'S 17TH NANO-BIO SYMPOSIUM: RNA INNOVATIONS

Innovations in RNA biology and therapeutics show immense potential in transforming the landscape of medical research and biotechnology development. RNA—particularly messenger RNA (mRNA)—has emerged as a groundbreaking tool and is revolutionizing the way researchers and clinicians approach medicine. On Monday, May 13, 2024, the Institute for NanoBioTechnology hosted its 17th Nano-Bio Symposium, which explored the unprecedented possibilities of RNA innovations and its novel therapeutic avenues. We welcomed experts, researchers, and enthusiasts to share knowledge, exchange ideas, and delve into the latest advancements so that our collective efforts advance the full potential of RNA-based technologies and shape the future of healthcare and biomedicine.

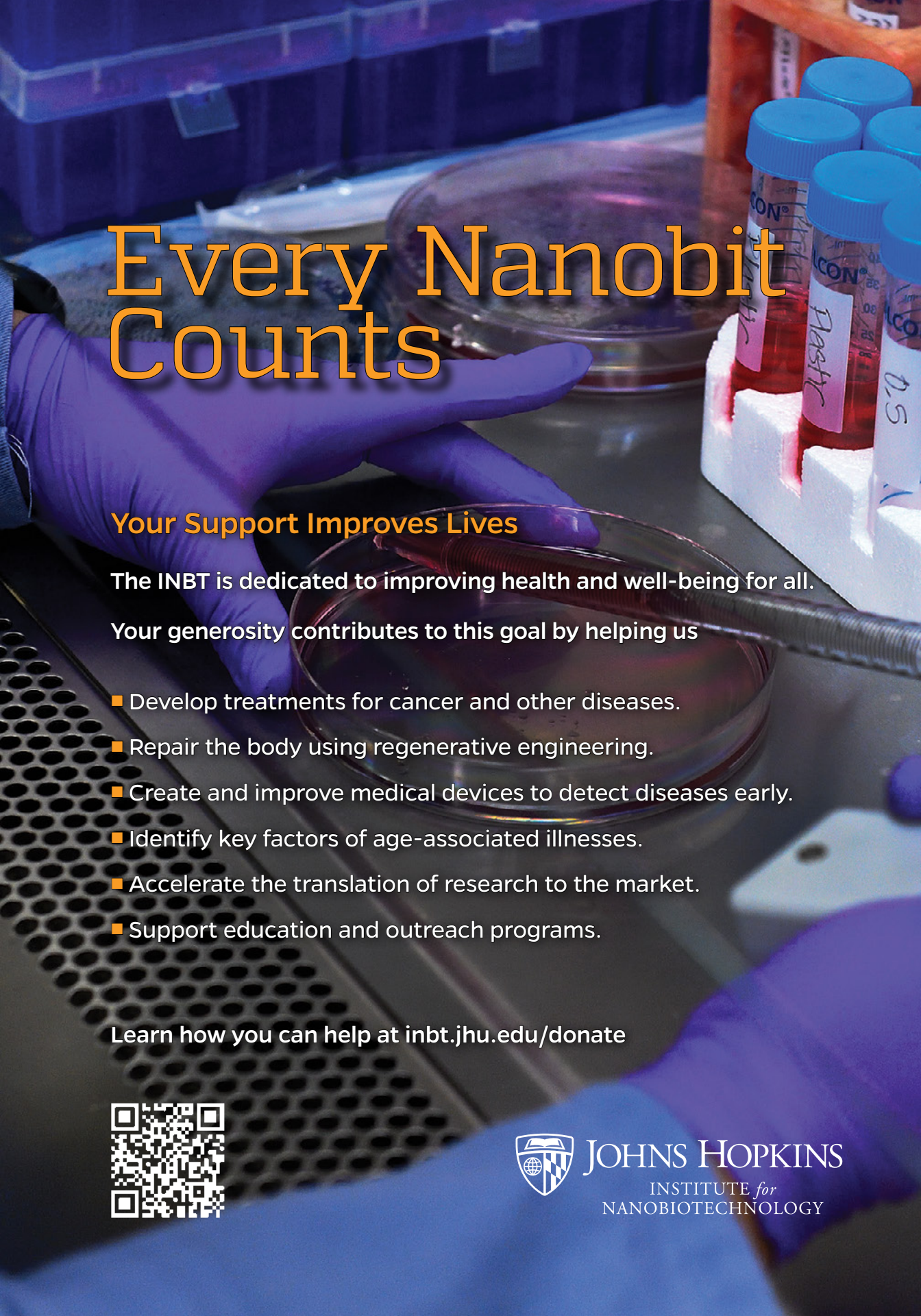
The event featured academic and industry thought leaders pushing the boundaries of RNA biology and engineering, and was an opportunity to learn about methods to tune RNA metabolism, approaches to create synthetic gene regulatory networks, chemical modifications that optimize RNAs as medicines, and how these advances are brought to patients by leaders in RNA manufacturing.

"I am hopeful that this day is going to translate to a lot of research activity on campus and student training opportunities to understand the sophistication, promise, and potential of unlocking mRNA medicines," said Hai-Quan Mao, director of the INBT and a professor of materials science and engineering.

During the morning lectures, eight guest speakers from across Johns Hopkins University and Medicine, the National Institutes of Health, Maravai Life Sciences, Houston Methodist Hospital, Arcturus Therapeutics, and Tevard Biosciences spoke to attendees about the importance of RNA in biology and medicine. Keynote speaker Jeff Coller, Bloomberg Distinguished Professor of RNA biology and therapeutics at Johns Hopkins University, as well as the other speakers in academia and industry, spoke about the critical role nanotechnology plays in bringing RNA advancements to patients.

The launch of the RNA Innovation Center, which will be housed in INBT, was also announced during the day. With the support of Maravai Life Sciences, the best industrial practices for the development of preclinical RNAs for researchers will be brought to the Johns Hopkins community.

"The [RNA Innovation Center] will lower the activation energy for scientists to test RNA-based approaches in basic biology and in therapeutics, catalyzing a wave of discovery across our schools," said Ed Schlesinger, Benjamin T. Rome Dean at Johns Hopkins University's Whiting School of Engineering.



Every Nanobit Counts

Your Support Improves Lives

The INBT is dedicated to improving health and well-being for all.

Your generosity contributes to this goal by helping us

- Develop treatments for cancer and other diseases.
- Repair the body using regenerative engineering.
- Create and improve medical devices to detect diseases early.
- Identify key factors of age-associated illnesses.
- Accelerate the translation of research to the market.
- Support education and outreach programs.

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Knowledge. For the world.

Launched on May 15, 2006, the Johns Hopkins Institute for NanoBioTechnology aims to solve complex challenges in health care and the environment through tiny science and diverse partnerships at the interface of nanoscience, engineering, biology, and medicine. By removing research silos and fostering cooperative spaces, the INBT enables scientists, clinicians, industry professionals, and others to collaborate and advance areas like aging, cell sensing and programming, diagnostic tools, cancer and other disease therapies, stem cell and regenerative engineering, and process engineering. These multidisciplinary teams from academia and the public, private, and government sectors integrate research, education, and technology transfer to create new knowledge and innovative technologies.

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