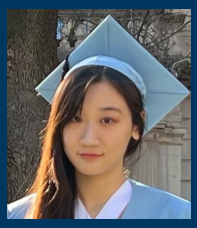
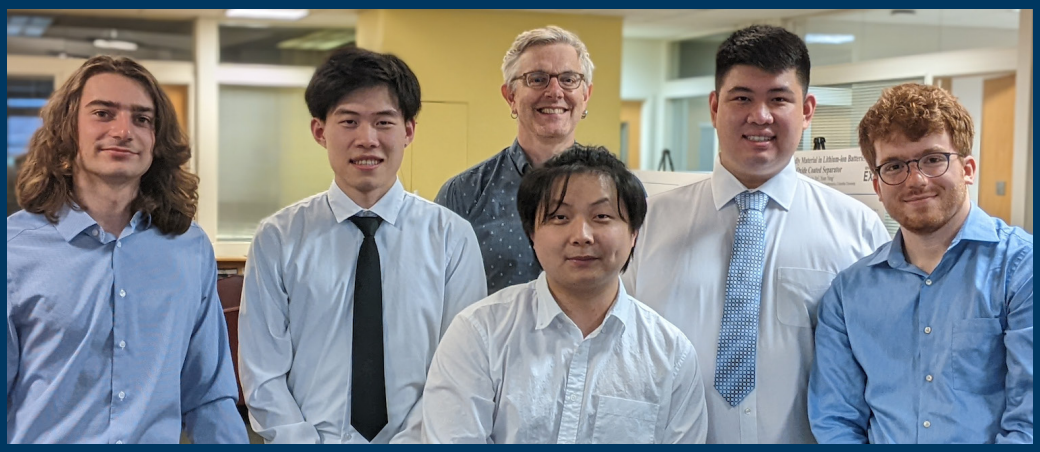
COLUMBIA | ENGINEERING
The Fu Foundation School of Engineering and Applied Science

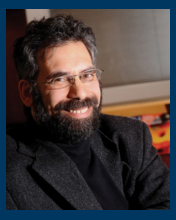
Spring 2022, Vol. 16 Issue 2

APAM NEWS

Applied Physics & Applied Mathematics Department
with Materials Science & Engineering
Columbia University in the City of New York







Dear APAM Community,

Another exciting school year has come to a close and we are happy to share with you all the fantastic achievements of our students, alumni, faculty, and scientists. We start with congratulations to the amazing class of 2022 who have thrived, and excelled despite all the challenges of the past few years. In particular, kudos to our 2022 Simon's Prize winner for outstanding research in DNA nanotechnology and our three undergraduate Faculty award winners for excellence in Applied Mathematics, Applied Physics, and Materials Science. We congratulate them and the entire class of 2022. We wish them well on their next endeavors and welcome them into the illustrious ranks of APAM Alums.

This newsletter also highlights multiple accomplishments of our Alumni and thank all the Alumni who have returned to speak and meet with our APAM students through our Alumni Chat series. You are always welcome in APAM. In particular, we extend a huge thanks to Dr. Dick Post (PhD '73) for establishing a new scholarship for APAM undergraduates in honor of Prof. Thomas Marshall.

This year has also seen scientific advances from our Faculty and Research scientists across a dizzying array of problems including advanced sensors and materials to applications of quantum mechanics to the deep Earth. We highlight multiple awards and honors in both research and teaching.

Finally, we mourn the loss of Prof. Aron Pinczuk and Dr. John Arbo, two long standing and beloved members of the APAM family who have left us this year. Together with Prof. Thomas Marshall, we celebrate their legacy as scientists, educators, and leaders.

Best regards,

Marc Spiegelman
APAM Department Chair

Cover images: Students and award winners from the class of 2022

2022 Simon Prize Winner: Aaron Michelson

Aaron Michelson

The APAM Department is proud to announce that **Dr. Aaron Michelson** is the winner of the 2022 Simon Prize for the most outstanding dissertation in the APAM Department.

Aaron Michelson received his PhD from Columbia University in January 2022, advised by Professor Oleg Gang. His thesis, "The Design of Complex Material aided by DNA Nanotechnology" is about the development of DNA nanotechnology towards practical applications. Key milestones of his work included leveraging in-situ microscope to hone kinetic pathways of assembly, speeding-up superlattice fabrication by a factor of 50x, and increasing crystal volume by a factor of 1000x. Aaron's work builds from the molecularly charged backbone of DNA, which was used to create an extensive library of solid state architectures enabling exploration of superconductivity and mechanical properties of 3d nanolattices. One chief accomplishment was development of a novel technique for the visualization of superlattices resolving DNA components from 7nm to over 2um, enabling the characterization of defects and grain boundaries of hierarchy designed material. Aaron's work has been published in *Science* (2022), *Nanoletters* (2021), *Science Advances* (2021), *ACS Nano* (2020) and *Nature Communications* (2020).

While at Columbia, Aaron married and raised two children, Yonah and Ezra, along with his charming wife, Batya (MD). After graduating from Columbia University, Aaron took on post-doctoral work at the Center for Functional Nanomaterial at Brookhaven National Laboratory investigating the adaptation of DNA nanotechnology for optically active nanostructures.

History of the Robert Simon Memorial Prize

The Robert Simon Memorial Prize is awarded annually by the APAM Department to the graduate student who has completed the most outstanding dissertation. Robert Simon (1919–2001) received a B.A. degree cum laude in classics from the City College of New York in 1941, where he was elected to Phi Beta Kappa, and an M.A. in mathematics from Columbia University in 1949. Between 1941 and 1944, he was a lieutenant in the US Armed Forces serving in England, France, and Italy. He participated in the D-Day operation as a navigator for a plane that dropped paratroopers in the vicinity of Omaha Beach. General Dwight Eisenhower personally shook his hand and wished him well the night before the D-Day assault. Mr. Simon, who was born and lived in New York City, spent a lifetime making valuable contributions to the field of computer science. Starting in 1953, he worked for 15 years at Sperry's Univac Division in various capacities including marketing, planning, systems engineering, systems programming, and information services. He also spent a year working at the Fairchild Engine Division as director of the Engineering Computer Group. He personally directed the establishment of several company computer centers at sites throughout the United States. Between 1969 and 1973, he was a partner with American Science Associates, a venture capital firm. Mr. Simon was a founder and vice president of Intech Capital Corporation and served on its board from 1972 to 1981 and a founder and member of the board of Leasing Technologies International, Inc. from 1983 until his retirement in 1995. The prize was established in 2001 by the late Dr. Jane Faggen with additional support from friends and relatives of Mr. Simon.

Undergraduate Award Winners

Professor Marc Spiegelman, Chair of the APAM Department, presented awards to three outstanding seniors at the 2022 APAM Senior Dinner and Award Ceremony on May 2, 2022. Each winner was selected by the APAM faculty in recognition of their excellent academic achievements.

Matthew Molinelli

Applied Physics Faculty Award Winner

Matthew majored in Applied Physics and minored in Applied Math and Computer Science. He took a variety of specialized and interdisciplinary classes at Columbia Engineering and also worked with Professor Sebastian Will on his AMO experiments. Matthew said, "The experiences and knowledge gained at Columbia will set the foundation for my future work in graduate school." Matthew will begin a PhD program at Princeton University in Electrical and Computer Engineering, with the goal of doing research in Quantum Computing.

Ruoxi Li

Applied Mathematics Faculty Award Winner

As a student in the Applied Mathematics program, Ruoxi engaged in all areas of mathematics, from the foundations of probability theory to the frontiers of algebraic geometry. Recently, Ruoxi was involved in an effort to quantify the thick points in a model for Liouville quantum gravity.

Moving forward, her academic pursuits will be taking her to UC Berkeley, where she will begin a doctorate program in mathematics.

Ruiwen Zhang

Frances B.F. Rhodes Prize in Materials Science and Engineering Winner & Paul Duby Research Award in Electrochemistry

Ruiwen is a combined plan student who attended Colgate University before coming to Columbia. At Colgate, he majored in physics and was elected to Sigma Pi Sigma and Phi Beta Kappa. At Columbia, he was involved in battery research with Professor Yuan Yang. He is listed as a coauthor on three publications, including two articles in peer-reviewed scientific journals and one book chapter. After graduation, he will stay at Columbia for the masters program in materials science and engineering.

In addition to winning the Rhodes Prize, Ruiwen is also the first winner of the Paul Duby Research Award in Electrochemistry for his research productivity in Prof. Yang's lab. This new award is given to students who demonstrate great potential through research carried out in a Columbia Electrochemical Energy Center lab and who plan to pursue a career in clean energy technology.

NSF Graduate Fellowship Winners

Two APAM students have received 2022 National Science Foundation (NSF) Graduate Research Fellowships! The fellowship includes a 3-year annual stipend of $34,000 and a $12,000 education allowance.

Joseph T. Lee '21 received his BS degree in applied physics from Columbia in 2021, where he is currently pursuing his PhD in physics.

Anushka Murthy '22 majored in applied mathematics and studied probability theory and its connections with analysis and discrete math. At Columbia, she performed an integrable probability research project in the Mathematics Department with Evgeni Dimitrov, where they studied the one point marginals for the height function of ASEP started from half-flat initial conditions. She will begin her PhD studies in mathematics at Stanford this fall.

Congratulations Graduates!

October 2021 MS: Myeongsam Chu (AM/CVN), Unique Divine (AM), Yifei Fan (AM), Ian Jenkins (AP/CVN), Simei Li (AM/CVN), Emily Popp (MSE/CVN), Michael Ramsdell (MSE)

October 2021 MPhil: Tianwei Jin (MSE), Francesco Ruta (AP)

October 2021 PhD: Mel Abler (AP), Lyuwen Fu (MSE), Jared Ginsberg (AP), Wenkai Pan (AP), Mehmet Hazar Seren (MSE), Ian Stewart (AP)

February 2022 BS: Xueyi Bu (AM), Edita Bytyqi (AP), Victor Lue (AM), Samuel Morgan (AP)

February 2022 MS: David Arnold (AP), Mark Ashby (AM), Connor Bracy (AP), Yan Cheng (AM), In Wai Cheong (AM), Hoi Chun Chiu (AP), Rishav Choudhury (MSE), Paulina Czarnecki (AM), Luke Holtzman (MSE), Wanli Hong (AM), Shanhua Hu (AM), Zekun Ji (AM), Remy Kassem (AM), Jingyi Liu (AM), Peter Liu (AP), Sean McOwen (AM/CVN), Jackson Miller (MSE), Swarnava Sanyal (AP), Eric Shen (MSE), Michael Suchman (AM), Mei Sun (AM), Zachary Thatcher (MSE), Zihan Wan (AM), Fengkai Wei (MSE), Yuan Xu (AP), Billy Yang (MSE), Su Yang (AM), Xingchen Zhai (MP), Hongjun Zhang (AM), Yucheng Zhang (AM), Mushan Zhong (AM), Yin Zhou (AM)

February 2022 MPhil: Philip Dinenis (AM), Zirui Xu (AM)

February 2022 PhD: Alexander Battey (AP), Bok Young Kim (AP), Cheng-Chia Tsai (AP)

May 2022 BS: Christine Anagnos (AM-CC), Farooq Ansari (AM), Andy Aviles (AM), James Bollas (AM), Zachary Briscoe (AP), Siyi Chen (AP), Arjun Choudhry (AM), Bethan Cordone (AP), Hope Delaney (AM-CC), Mikhaela Diaz (AM), Yutong Dong (AM), Anna Flieder (AM-CC), James Franco (AM), Kallee Gallant (AP), Katharina Gallmeier (AP), Cy Gilman (AM-CC), Francesca Gnuva (AM-CC), Sophie Hecht (AM-CC), Nicholas Holfester (AP), Dongfang Hou (AM), Junhui Huang (AM), Shikai Huang (AM), Wangdong Jia (AM), Jonathan Katz (MatSci), Alexander Killips (MatSci), Ji Kim (AM), Ji Kim (AP), Naomi Kim (AM), Andrew King (AM), Daniel Knop (AM), John Koerner (AM), Ang Li (AM), Casey Li (AP), Jiajing Li (AM), Jialu Li (AM), Ruoxi Li (AM), Shuhang Li (AP), Ioana Lia (AM-CC), YuXuan Liu (AP), Zeqi Liu (AM), Henry Manelski (AM), Rami Matar (AM), Matthew Molinelli (AP), Michael Moubarak (AM), Anushka Murthy (AM), Priyanka Nehra (AM), Matthew Park (AM), Rea Rustagi (AM), Xzavier Seto (AP), Madisen Siegel (AM-CC), Charanpreet Singh (AM), Sahr Singh (AM-CC), Anshul Singhvi (AP), Haolan Sun (MatSci), Yi Tao (AP), Matthew Teshome (AM), Shashank Vineet (AM), Beini Wang (AM), Jennifer Wang (AM-CC), Wentong Wang (AM), Yifan Wang (AM), Yipeng Wu (AM), Zhizhen Xie (AM), Egem Yorulmaz (AM), Shiyi Yuan (MatSci), Ruiwen Zhang (MatSci)

May 2022 MS: Chenxu Bao (MSE), Savannah Bennett (MSE), Michelle Borovskoy (AP), Igor Bundalevski (MP), Weijie Chen (AM), Xiaohan Chen (MSE), Luke Connell (MP), Abby Corrigan (AP/CVN), Jiahao Fang (MSE), Jordon Fletcher (AP/CVN), Kevin Flynn (AM/CVN), Xingyu Guo (MSE), Yu Fei Kung (MSE), Yiyang Li (AM), Daozhe Lin (AM), Yuchen Lin (AP), Jiaming Liu (AM), Yongxin Ma (AM), Mark Morrissey (AM), Srija Mukhopadhyay (MSE), Anushka Murthy (AM), Adithya Nair (MSE), Joshua Petshaft (AM/CVN), John Vahedi (AM), John Willey (AP/CVN), Jun Yao (AM/CVN), Beichen Zhang (MSE), Dongliang Zhao (MSE), Ruoyu Zhi (AM/CVN)

May 2022 MPhil: Wen Ding (AM), Zeyu Hui (MSE), Richard Oliver (AP), Alex Saperstein (AP), Zhen Zhang (AP)

May 2022 PhD: Xiang Hua (AP), Kathy Li (AM), Aaron Michelson (MSE), Chanyang Ryoo (AM)

AM: Applied Math |AP: Applied Physics | MatSci: Materials Science | MP: Medical Physics|MSE: Materials Science & Enginering | CVN: Columbia Video Network | CC: Columbia College

Dressed for Success

Two Columbia engineers behind fashion app Upcomers on creating a marketplace to showcase Black-owned brands

By Kyle Barr, Originally published by Columbia Engineering

Yelissa Lopez & Stephen Mgbemeje

Yelissa Lopez BS '24 Applied Physics and **Stephen Mgbemeje** BS '24 Computer Science know what they think looks good on their fellow New Yorkers. Hoodies, track pants, chains, Timberland boots—the kind of streetwear that simultaneously conveys personal style and community identity.

And that's an ethos they find not just sartorially inspiring. For the two undergraduates at Columbia Engineering, designing technology means more than producing a product. It can also be an opportunity to use those skills to express a point of view and benefit a community—in their case, marginalized groups who have had a hard time breaking into tough markets like the fashion industry.

So in August of last year, the pair turned their engineering skills and shared love of fashion into Upcomers, an online marketplace showcasing apparel from small, mostly local companies. To curate their site, they look for looks with the potential to go viral or brands they just feel particularly deserve recognition. Most of those featured are Black-owned and also work to counter bad trends they've seen in the garment industry, such as unethical labor practices in overseas factories and the use of unsustainable materials.

Both founders spent formative years in NYC. Lopez, an applied physics major, grew up in the Bronx. Mgbemeje, a computer science major, came to the city from Nigeria at just 7 years old. That background, they say, gave them insight into what it means for minority-owned businesses to succeed. Lopez said that personal stake in their work is what drives Upcomers.

"Before we started, we both knew a lot of people who started their own fashion company, but they don't have the resources to get the kind of exposure they need," Lopez said. "Why we do this comes from our own personal interest in these subjects and our desire to find solutions to problems that we're facing in the world."

In just 7 months, their project has ballooned into an expansive array of small fashion brands. They now represent 40 companies, mostly from NYC but from a few other cities as well. They have just under 20 ambassadors, mostly college students, who scout and promote existing brands to their campuses and beyond.

But even with swift expansion of the site, their designers remain more than just partners to Upcomers' founders. They're friends and compatriots, and not by accident. Mgbemeje said they worked hard to create a close network among ambassadors and creators who often have to do all the up-front work themselves. "We are not just a company, we are trying to build a tight knit community," he said.

Already, the experience has deeply informed their career outlook. Lopez, who sees how technology can be used to "address problems like the wealth gap between the Black community and wider society," ultimately wants to go into quantum technology. There she hopes to develop small-scaled affordable computers that can bridge the digital divide between high and low income schools.

Mgbemeje wants to go into software engineering and blockchain technology. His entrepreneurial experience, he said, has not only improved his interpersonal and decision making skills, but cemented his belief in the purpose of technology.

"If you're just doing it for the money, there's going to be a time where you lose motivation, or you lose interest in whatever you're trying to build," Mgbemeje said. "So if you had that intrinsic motivation to solve an actual problem, especially if it's something like a social issue that impacts your own community, it'll keep you pushing on to put your best foot forward." **https://bit.ly/3MpKI3o**

Prof. Bahram Jalali

Jalali '89 Elected to the National Academy of Engineering

Originally published in Columbia Engineering

Bahram Jalali (MS '86, MPhil '87, PhD '89) has been elected to the National Academy of Engineering "for contributions to silicon photonics, high time-resolution scientific instruments, and biomedical imaging."

Dr. Jalali is the Fang Lu Endowed Chair of Engineering and Professor of Electrical and Computer Engineering at UCLA with joint appointments in the Biomedical Engineering Department and the California NanoSystems Institute (CNSI). An expert in silicon photonics and techniques for ultra-fast data generation and capture, he also co-founded Cognet Microsystems, an LA-based fiber optic component company. He has received numerous honors, including the R.W. Wood Prize from the Optical Society of America and is a Fellow of the IEEE and the Optical Society of America. He was chosen by the *Scientific American Magazine* as one of the 50 Leaders Shaping the Future of Technology and his demonstration of the first silicon laser was named one of the top 10 technology trends by *MIT Technology Review* magazine in 2005. He is also a current member of the Columbia Engineering Board of Visitors.

Feltus '90 Received ANS Oestmann Professional Women's Achievement Award

Dr. Feltus & Dr. Hashemian, chair of the ANS honors & awards committee

Madeline Feltus (BS '77, PhD '90) received the Mary Jane Oestmann Professional Women's Achievement Award from the American Nuclear Society (ANS) on December 1, 2021. The award was presented during the organization's annual winter meeting today in Washington D.C. and recognizes outstanding achievements by women in the fields of nuclear science, engineering, research, or education. She was recognized for "her outstanding personal dedication, leadership, and technical achievements in the fields of nuclear science, engineering, research, and education." She received a $1,000 monetary award and an engraved plaque for her achievements.

Dr. Feltus is an accomplished nuclear engineer with the U.S. Department of Energy's Office of Nuclear Energy. She joined the Department in 1999 and has led several research and development programs to support projects focused on sustaining the current fleet of U.S. reactors and developing new advanced reactors and fuels. She most recently led the TRISO fuels development and qualification program which resulted in the first TRISO fuels licensing topical report submission to the U.S. Nuclear Regulatory Commission in 2020.

Prior to DOE, she was a professor at Penn State University for 8 years and earlier worked 14 years in the nuclear industry. She has 4 nuclear engineering degrees from Columbia University and published 18 referred journal articles, written and presented many conference papers and technical reports, over her illustrious 44-year career. Dr. Feltus served on the ANS Nuclear Technology journal editorial board for 16 years and continues to review manuscripts for several technical journals.

"I feel very honored to receive the ANS Oestmann Award," said Dr. Feltus, "My nuclear engineering career has allowed me to grow technically, teach, and now to enjoy leading research and development work for DOE."

Ozel '96 Reveals First Images of the Milky Way Galaxy's Black Hole

Feryal Özel (BS '96 Applied Physics), a Professor in the Departments of Astronomy and Physics at the University of Arizona, is part of the Event Horizon Telescope project and revealed the first image of the Black Hole at the center of the Milky Way Galaxy. She was recently featured in several news outlets including the *Global News, The New York Times, The Wall Street Journal, NPR,* and *USA Today*.

Career Events Featuring APAM Alumni

by Kristen Henlin, Career Placement Officer

The Applied Physics and Applied Mathematics Department continued our alumni chat series during the Spring 2022 semester. The School of Engineering hosted weekly information sessions beginning in January and ending in March 2022. In addition, the APAM Department hosted a range of employers with many of our alumni.

In January, the department collaborated with **Rebecca (Xuefei) Yuan** (PhD '11, Applied Mathematics), Director of Quantitative Analytics Consultant at Wells Fargo, to provide insight about opportunities in quantitative finance.

In February, our students had the opportunity to attend virtual employer showcases and alumni chats with our alumni. First, we connected with **Sai Sunku Swaroop** (PhD '21, Applied Physics), a Software Engineer at Amazon Web Services. Students also met with **Preston Bradham** (MS '19, Applied Mathematics), Transformation Solution Delivery Manager at Ernst & Young. Next, students networked with **Harish Ramesh** (MS '19, Materials Science), an Associate Consultant at Azzur Group, to learn how they could leverage their skills in the Life Science consulting field.

We also hosted **Kavya Prasad** (MS '18, Medical Physics) to learn about life as a Physicist at Memorial Sloan Kettering Cancer Center. Then, the department hosted the Global Research and Global Markets team members at Bank of America. Next, we connected with **Mike Purewal** (PhD '08, Applied Physics), Lead Markets Data Scientist at Bank of America. Our students learned about how they could leverage their backgrounds in Data Science. Lastly, the department held a special information session with Vianai Systems. Students had the opportunity to network with their engineering team members to solve a real-life data science problem.

In March, we welcomed **Pratap Ranade** (PhD '08, Applied Physics), CEO and Co-founder of Arena – AI, for our first in-person information session. Students learned about internship and full-time opportunities and connected with seven members of Pratap's team.

We ended the month with **Kevin Liu** (MS '20, Medical Physics), a doctoral student at The University of Texas MD Anderson Cancer Center. Kevin will be hosting two of our Medical Physics students this Summer as Research Assistants.

If you are interested in collaborating with the department for a virtual event, or if you have full-time/part-time or summer internships available, please reach out to **Kristen Henlin** at kah2247@columbia.edu.

Alumni Reports

Thomas Altshuler MS '56: "I worked for General Electric in atmospheric physics for four years. Then, I went to Oxford University to obtain my Doctor of Philosophy in physical metallurgy. After that, I did a one-year post-doctorate at the University of Pennsylvania and served as an associate professor at Dartmouth College. Later, I worked at GCA Corporation and then at NASA Cambridge until they closed down. Left to my own devices, I started my own company called Advanced Materials Laboratory, Inc. There, I invented a blood clotting time instrument with my brother, a hematologist. The instrument won an IR-100 award in 1973. I also was a consulting engineer at Digital Equipment Corporation, a visiting professor at Northeastern University, and a leader at the Creative Problem Solving Institute."*

Michelle Bettelheim BS '07: "My new last name is Boyle. I got married back in 2010 and have identical twin girls starting kindergarten. I live in a suburb of Albany, NY."*

Andrea Garofalo (PhD '97) is one of two winners of the 2021 Award for International Scientific Cooperation of the Chinese Academy of Sciences. He shares the prize with Gretchen Daily, from Stanford University.

Spencer Greenberg BS '05: "After graduating from Columbia, I completed my math PhD at NYU specializing in machine learning. Now, I work at the intersection of social science/psychology and software with the company I founded, Spark Wave. We are a startup studio that creates new tech companies from scratch based on our own ideas."*

Charles Henager BS '67 retired from Pacific Northwest National Laboratory (PNNL) in December 2019 after 40 years as a materials scientist. Chuck started working at PNNL in 1976 and had gone on to obtain his PhD in metallurgical engineering from the University of Washington in 1983. He had a career working in a variety of materials science areas concentrating on radiation effects, mechanical properties and strengths of materials, and computational materials science. He was also an adjunct professor in the Department of Materials Sciences at the University of Washington in Seattle, WA until his retirement. He and his spouse, Pam Lommers Henager, traveled to South Africa in early March 2020 and went on a three-day safari near Kruger National Park. They returned from that just in time to quarantine for COVID-19. They will retire for now at their home in Kennewick, WA.*

Marvin Kohn '54: "I retired from FMC Corporation in 1999 and have been doing volunteer work since then. I am currently an instructor in AARP's driver safety program and a counselor in their tax aide programs."*

Michael Jiang BS '14: "I completed medical school at the University of California, San Diego, as well as an internal medicine residency at Northwestern University McGaw Medical Center in downtown Chicago. I currently serve as a chief medical resident for my internal medicine program and am now applying for cardiology fellowships. My experiences at Columbia prepared me well, and I reflect fondly on my time there."*

David Maurer PhD '00, professor in the Physics Department at Auburn University, has been named the Stewart W. Schneller Endowed Chair. "Being selected as the Schneller Endowed Chair is truly a great honor and makes me reflect upon my contributions to Auburn and my broader research community, and motivates me to continue to make a difference through my future research, teaching, and service," Maurer said.

Hamid Mohtadi MS '75 "I went back to school and received my PhD in economics from the University of Michigan. Since then, I have been a professor of economics at the University of Wisconsin with a few visiting stints at MIT and elsewhere. Although I have published widely in many areas of economics, I have spent much of my time the past several years on two areas: statistics of extremes and climate change. In a recent article that used about 1 billion observations around the earth over the past 40 years, we showed the dramatic adverse effects of extreme heat waves on agricultural productivity by the end of the century. In other research, still ongoing, we've examined how heat waves and dry spells interact. Over the year, I have also worked as a Columbia

Special Thanks to Dick Post '73

The APAM Department warmly thanks **Dr. Dick Post**, PhD '73, a former student of **Prof. Thomas Marshall** (1935-2021). Dr. Post was instrumental in the creation of the Thomas C. Marshall Scholarship fund. The new scholarship will be awarded annually to an undergraduate student in the APAM Department and will impact generations to come. **See page 10 for more details!**

MP Prakash PhD '85 writes: "I was already familiar with the concept of magnetic reconnection in plasmas, but only recently was I inspired to apply that concept to the magnetic field topology around a blackhole. I hope to present my findings at the American Physical Society meeting next April. This past year, I participated in an online workshop called 'A Rainbow of Dark Sectors' hosted by the Aspen Center for Physics in Aspen, CO; I participated in the online US Particle Accelerator Summer School organized by Fermi National Laboratory; and I earned an online teaching certificate from Stony Brook University."*

Bill Quirk BS '67, PhD '70 writes: "My second grandchild arrived on April 17, 2021. I am still working full-time as an assembly member in my ninth year in the California State Legislature."*

Robyn Ridley BS '15 writes: "I started graduate school at the University of California, San Diego. I completed my masters in 2017 and my PhD in July 2020. I am now back on the East Coast and in my second year as Assistant Professor of the Practice at Wesleyan University."*

Anthony Ruda BS '13 presented at the International Symposium on Jainism and Mathematics in December 2020 and was subsequently awarded the Bhagwan Mahavira Fellowship to study Prakrit in India through 2022.*

Changmin Shi MS '19 writes: "I am a PhD student at the University of Maryland, where we are revolutionizing Li-S batteries to achieve high energy density and stable performances. I am grateful to the professors at Columbia who educated me on the fundamental knowledge that I needed to make fruitful progress. I'll never forget the time spent discussing lecture notes with my classmates until two in the morning in the Engineering Library. And am I glad that work paid off!"*

Robert Siegfried MS '78 writes: "Like so many other people, I spent half of the Spring 2020 term teaching online and continued that through the 2020-2021 academic year. My wife, Kathy, was also working online; I was upstairs in my attic office and she was downstairs in the den. The pandemic also stalled the job search for our son, Jason. I'm going back to teaching live and in person, and I am looking forward to it, even if it means a face mask (or preferably a face shield)."*

Shelly Weinig MS '53 writes: "I tried academia and served as an assistant professor for two years before founding Materials Research Corporation. Thirty years later, the corporation was acquired by SONY, and I remained with them for five years as vice chairman of US manufacturing and engineering. I then spent 25 years teaching pro bono at Columbia Engineering. I also wrote a book entitled Rule Breaker about my entrepreneurial experiences. I was inducted into the National Academy of Engineering for my development of electronic materials. I now mentor students, read, and day trade."*

Allen Wu MS '19 is now working as a manufacturing engineer on F-35 fighter jets at Northrop Grumman.*

***Originally published in Columbia Engineering Magazine**

We'd love to hear from you! Please send your news and address updates to apam@columbia.edu.

Michal Lipson

Sensing a New Market

Startup founders out of Lipson photonics lab receive $15.4 million investment to make machine sensing tech smaller and cheaper

By Kyle Barr, Originally published by Columbia Engineering

Voyant Photonics is the latest entrepreneurial brainchild hatched from Columbia's renowned Lipson Nanophotonics Group lab, headed by **Professor Michal Lipson**. What began five years ago when the group won an on-campus startup competition has now turned into a $15.4 million investment from key partners.

Voyant is developing a new, smaller and cheaper LiDAR scanner, a kind of sensing technology using lasers and receptors to measure the distance between objects; in the real world, that's how many modern vehicles monitor their surroundings in order to stay in their lane or stop the car before a collision. This tech is also already used in robotics, from industrial machines to cutting-edge designs, as well as cars and other consumer electronics. But while current devices are large, unwieldy and can cost tens of thousands of dollars, Voyant's device is meant to be the size of a fingernail and cost much less to produce.

Startup founders Steven Miller and Chris Phare joined the Lipson lab at Columbia Engineering as researchers after both graduated from Cornell University in 2017. The pair were part of the team working on silicon photonics, which are optical arrays built to manipulate light and are used in a host of modern electronic systems. Their team was working on a U.S. Defense Advanced Research Project Agency-funded project to build one of the world's largest optical phased arrays devices to control how light interacts on a two-dimensional surface, and the two quickly realized the commercial potential for such technology. Their startup placed first in the 2017 Startup Columbia Challenge, and in 2018 the two went on to establish their own entrepreneurial venture.

The Lipson lab has been the springboard for a number of photonics-based projects taking the entrepreneurial plunge. Other current Lipson-based startups include Pharos Imaging, which is making strides in medical imaging, and X-Scape Photonics, which is using light-based technology to make high-end computing more efficient.

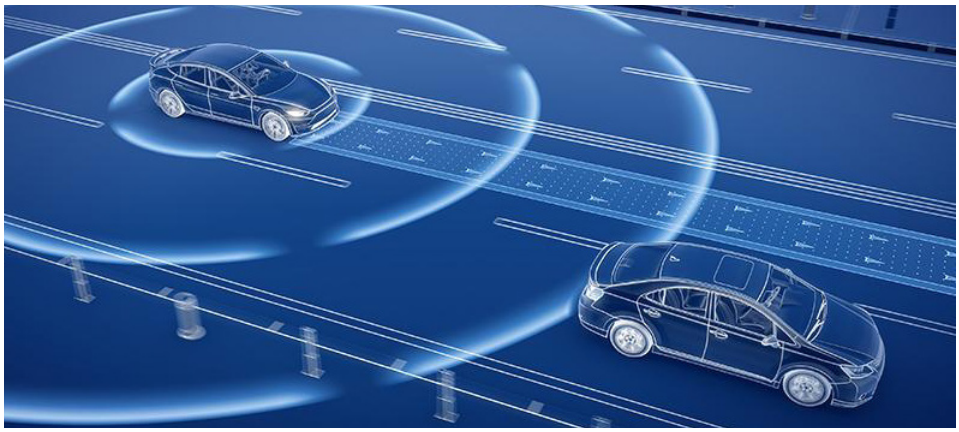
Those who have worked in that lab say there's a good reason why so many projects are spun out from Lipson's group. Though they both came from Cornell, Miller said he and his fellow founder had only worked on separate projects up until converging at Columbia Engineering. It was there among the host of talented engineers that they started to cross-pollinate.

"[The Lipson lab's] culture is very collaborative, and even when grad students are working on separate projects, they're always interacting with each other very, very closely, learning from each other, bouncing ideas off of each other," he said.

Their latest investment comes from transportation industry financiers UP.Partners with the help of earlier investors LDV Capital and Contour Ventures. It's a significant boost to an already upward trajectory. The latter two, alongside DARPA, previously raised $4.3 million for Voyant back in 2019.

As much as the transportation industry seems invested in the device, the possibilities inherent to a smaller, more compact LiDAR may well actually be endless. Voyant's chip boasts thousands of optical components fabricated on a single semiconductor chip, and that makes it enticing for devices that have previously not used LiDAR.

"I think you're going to see LiDAR going into its markets where people haven't really thought about using LiDAR before," Phare said. "I think there's a lot of long term opportunity in autonomous guided vehicles, but what about really small robots? What about consumer electronics or consumer adjacent electronics?" **(Continued on page 10)**



A New Vision for Virtual and Augmented Reality

Originally published by Columbia Engineering, *The Aging Issue: Engineering the Body*

For years, virtual reality (VR) and augmented reality (AR) have been on the cusp of revolutionizing how we engage with our environments. When it comes to everyday quality of life for those struggling with decreased function, the possibilities are particularly profound—from virtually delivering physical therapy or improving cognition to overlaying step-by-step navigation or even correcting vision. Little of that promise can be fully realized, however, until the hardware gets a dramatic upgrade. Today's headsets are often too heavy, big, and power hungry to practically offer these transformative experiences on a wide scale. That's why **Michal Lipson** and her team are developing the fundamental technology needed to sharply reduce their size, weight, and power consumption.

The devil is in the display. Most VR and AR units rely on a suite of multiple components to project their images, rendering the whole device unwieldy and energy-intensive. In contrast, Lipson, along with her PhD student Min Chul Shin and colleagues, integrated their chip-based, low-power, image-beam-steering platforms into one sleek package.

Lipson's group achieved this by "recycling" their light; by repeatedly feeding it back through the same phase shifter, they reduced the total power consumption dramatically. At the same time, they leapt over another technical hurdle: all the colors of the rainbow are not created equal. Blue light has the smallest wavelength in the visible spectrum and scatters more readily because it travels as shorter, smaller waves. To correct for that, the team precisely placed their emitters in a random configuration to converge in a single high-resolution beam.

These advances have brought them tantalizingly close to their ultimate goal, an ultra-high-resolution VR/AR headset no bigger than an ordinary pair of glasses. But even cooler, their tiny but mighty laser engine could give birth to a host of game-changing technologies. Researchers see their beam-steering system one day driving the lidar used by autonomous vehicles to scan the landscape, a quantum computing system capable of manipulating individual ions, and microscopic lasers able to pinpoint specific neurons inside the brain.

Michal Lipson is the Eugene Higgins Professor of Electrical Engineering and Professor of Applied Physics at Columbia Engineering.

Seeing More Deeply into Nanomaterials

New 3D imaging tool reveals engineered and self-assembled nanoparticle lattices with highest resolution yet—7nm—about 1/100,000 of the width of a human hair

By Holly Evarts, Originally published by Columbia Engineering

From designing new biomaterials to novel photonic devices, new materials built through a process called bottom-up nanofabrication, or self-assembly, are opening up pathways to new technologies with properties tuned at the nanoscale. However, to fully unlock the potential of these new materials, researchers need to "see" into their tiny creations so that they can control the design and fabrication in order to enable the material's desired properties.

This has been a complex challenge that researchers from Columbia Engineering and the U.S. Department of Energy's (DOE) Brookhaven National Laboratory have overcome for the first time, imaging the inside of a novel material self-assembled from nanoparticles with seven nanometer resolution, about 1/100,000 of the width of a human hair. In a new paper published April 6, 2022, in *Science*, the researchers showcase the power of their new high-resolution x-ray imaging technique to reveal the inner structure of the nanomaterial.

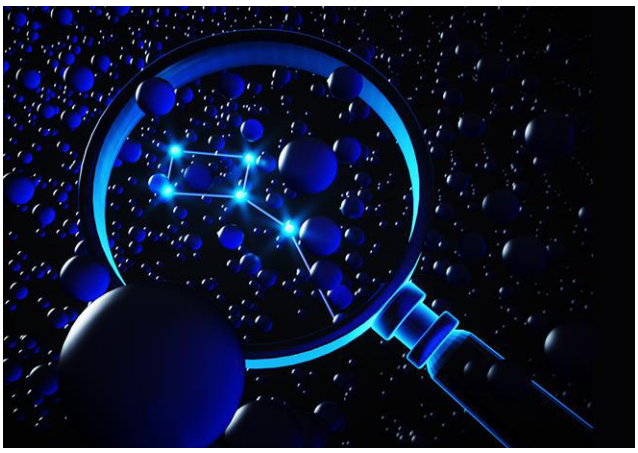


Image: Researchers used x-ray tomography as a magnifying lens to see into the inner structure of nanomaterials. Credit: Oleg Gang/Columbia Engineering

The team designed the new nanomaterial using DNA as a programmable construction material, which enables them to create novel engineered materials for catalysis, optics, and extreme environments. During the creation process of these materials, the different building blocks made of DNA and nanoparticles shift into place on their own based on a defined "blueprint"—called a template—designed by the researchers. However, to image and exploit these tiny structures with x-rays, they needed to convert them into inorganic materials that could withstand x-rays while providing useful functionality. For the first time, the researchers could see the details, including the imperfections within their newly arranged nanomaterials.

"While our DNA-based assembly of nanomaterials offers a tremendous level of control to fine-tune the properties we desire, they don't form perfect structures that correspond fully to the blueprint. Thus, without detailed 3D imaging with single-particle resolution, it is impossible to understand how to design effective self-assembled systems, how to tune the assembly process, and to what degree a material's performance is affected by imperfections," said corresponding author **Oleg Gang**, professor of chemical engineering and of applied physics and materials science at Columbia Engineering, and a scientist at Brookhaven's Center for Functional Nanomaterials (CFN).

Creating new nanostructures: As a DOE Office of Science user facility, the CFN offers a wide range of tools for creating and investigating novel nanomaterials. It was at the labs of the CFN and at Columbia Engineering where Gang and his team first built and studied new nanostructures. Using both DNA-based assembly as a new fabrication tool at the nanoscale and precise templating with inorganic materials that can coat DNA and nanoparticles, the researchers were able to demonstrate a novel type of complex 3D architecture.

"When I joined the research team five years ago, we had studied the surface of our assemblies really well, but the surface is only skin deep. If you can't go further, you'll never see that there's a blood system or bones underneath. Since the assembly inside our materials drives their performance, we wanted to go deeper to figure out how it worked," said **Aaron Noam Michelson**, first author of the study who was a PhD student with Gang and is now a postdoc at the CFN.

And deeper the team went, collaborating with the researchers at the Hard X-ray Nanoprobe (HXN) beamline at the National Synchrotron Light Source II (NSLS-II), another DOE Office of Science user facility located at Brookhaven Lab. NSLS-II enables researchers to study materials with nanoscale resolution and exquisite sensitivity by providing ultrabright light ranging from infrared to hard x-rays.

"At NSLS-II, we have many tools that can be used to learn more about a material depending on what you are interested in. What made HXN interesting for Oleg and his work was that you can see the actual spatial relationships between objects within the structure at the nanoscale. But, at that time when we first talked about this research, 'seeing into' these tiny structures was already at the limit of what the beamline could do," said Hanfei Yan, also a corresponding author of the study and a beamline scientist at HXN.

Overcoming hurdles: To push through this challenge, the researchers discussed the various hurdles they needed to overcome. At the CFN and Columbia, the team had to figure out how they could build the structures with desired organization and how to convert them into an inorganic replica that can withstand powerful x-ray beams, while at NSLS-II the researchers had to tune the beamline by improving the resolution, data acquisition, and many other technical details.

"I think the best way to describe our progress is in terms of performance. When we first tried to take data at HXN, it took us three days and we got part of a data set. The second time we did this, it took us two days, and we got most of a whole data set, but our sample got destroyed in the process. By the third time it took a little over 24 hours, and we got a full data set. Each of these steps was about six months apart," said Michelson.

Yan added: "Now we can finish it in a single day. The technique is mature enough that we also offer it to other users who would want to use our beamline to investigate their sample. Seeing into samples on this scale is interesting for fields such as microelectronics and battery research." **(Continued on page 10)**

The study is titled "Three-Dimensional Visualization of Nanoparticles Lattices and Multimaterial Frameworks." Authors: Aaron Michelson, Brian Minevich, Hamed Emamy, Xiaojing Huang, Yong S. Chu, Yan Hanfei, and Oleg Gang, *Science*, 7 Apr 2022, Vol 376, Issue 6589, pp. 203-207, DOI: 10.1126/science.abk0463

Barmak and Colleagues Win AFOSR MURI Award for Precision Testing and Evaluation of Computer Chips

Barmak and Colleagues Win the Highly-Competitive Multidisciplinary University Research Initiative (MURI) Award from the Air Force Office Scientific Research (AFOSR) for Precision Testing and Evaluation of Computer Chips

Katayun Barmak

Katayun Barmak, Philips Electronics Professor in the Department of Applied Physics and Applied Mathematics is a member of the multi-investigator team that has been awarded by the Department of Defense (DoD) a $7.5 million project to develop new concepts for non-invasive precision testing and evaluation of semiconductor chips.

The lead institution is the University of Buffalo (UB), and the lead investigator is Professor Paras Prasad, SUNY Distinguished Professor in UB's departments of chemistry, physics, medicine and electrical engineering, and executive director of UB's Institute for Lasers, Photonics and Biophotonics (ILPB). In addition to UB and Columbia University, Boston University, the University of Maryland, the University of Arizona, the University of Central Florida, the National University of Singapore and the University of Cambridge will be participants.

The research is funded by the Air Force Office of Scientific Research through the DoD's highly competitive Multidisciplinary University Research Initiative (MURI).

"Our ambitious MURI project focuses on testing the structure, function, operation and security of the integrated circuits that comprise semiconductor chips," says UB researcher Paras Prasad, the project's principal investigator. We have a great team, and this is exciting work."

"Microelectronic circuits are omnipresent in our lives, from our phones, computers, cars and appliances to all kinds of industrial and military equipment. We will develop new and dramatically improved ways to ensure that computer chips are authentic and will work as expected. This helps to avoid potentially devastating consequences of either intentional or unintentional malfunction of everything from smartphones to fighter jets."

Research goals include increasing fundamental understanding of physical processes that could be used to evaluate chip performance and security, and creating new, ultra-sensitive testing strategies that build on this knowledge. The award supports a variety of studies, including several that aim to exploit the power of quantum science and engineering. Monitoring heat generation, using advanced microscopy to study circuits, and detecting ultra-weak electric and magnetic signals around chips are among many areas of interest.

The key team members at the University of Buffalo include: Paras Prasad, PhD, Jonathan Bird, PhD, Alexander Baev, PhD, Andrey Kuzmin, PhD, Vasili Perebeinos, Mark Swihart, PhD, Luis Velarde, PhD, and Hao Zeng, PhD.

Co-principal investigators include Katayun Barmak, PhD, at Columbia University; Alexander Sergienko, PhD, at Boston University; Ronald L. Walsworth, PhD, at the University of Maryland; and John Schaibley, PhD, at the University of Arizona. Other senior investigators include Abdoulaye Ndao, PhD, at Boston University and Kevin Coffey, PhD, at the University of Central Florida. Independently funded international partners include Jeroen A. van Kan, PhD, at the National University of Singapore and Mete Atatüre, PhD, at the University of Cambridge.

The team will also partner with researchers in the Air Force Research Laboratory, including Joshua Hendrickson, PhD, and Michael Slocum, PhD, both in Ohio. The lead program manager for the grant is Brett Pokines, PhD, who heads the Agile Science of Test and Evaluation program at the Air Force Office of Scientific Research.

Gang & Colleagues Win MURI Grant

Oleg Gang

A team of researchers, led by **Oleg Gang**, was awarded a Department of Defense MURI grant on structurally and functionally switchable nanomaterials. The effort will establish platform approaches for creating dynamic 3D nanomaterials and integrating them with molecular-level control circuitry to enable reconfiguration processes governed by chemical, biomolecular, and physical signals.

The team includes groups from Columbia University (Oleg Gang and Nanfang Yu), Johns Hopkins University, University of Michigan at Ann Arbor, University of Wisconsin-Madison, Sydney University, Melbourne University, and Swinburne University of Technology. The anticipated amount is $6.25M with additional $5M for their Australian partners. Professor Gang is leading the effort.

Yang Named Materials Today Rising Star

Yuan Yang

Yuan Yang, associate professor of materials science and engineering, has been named one of the 2021 Materials Today Rising Star Award Winners. The 'Rising Star Awards' "recognize researchers in materials science and engineering who have demonstrated themselves to be exceptionally capable researchers with the potential to become future leaders in the field.

He received his B.S. in physics at Peking University in 2007, followed by the completion of his Ph.D. in materials science and engineering at Stanford University in 2012. After three years as a postdoc in the mechanical engineering department at MIT, he joined Columbia in 2015. Dr. Yang's research interests include advanced energy storage and thermal energy management. He has published more than 90 peer-reviewed papers with a total citation over 29,000 times and an H-index of 55. He is a Scialog fellow on Advanced Energy Storage, and a Clarivate Highly Cited Researcher in 2020 and 2021. He has won 3M Nontenured Faculty Award in 2021, Young Innovator Award by Nano Research, Emerging Investigators Award by *Journal of Materials Chemistry A*." **(https://www.materialstoday.com)**

Ren Wins Distinguished Faculty Teaching Award

Kui Ren

Kui Ren, Professor of Applied Physics and Applied Mathematics, won a 2022 Distinguished Faculty Teaching Award (DFTA) from the Columbia Engineering Alumni Association (CEAA).

The award is conferred annually to SEAS faculty members who excel in teaching. Professor Ren was nominated by several of his students and selected by the Columbia Engineering alumni who serve on the DFTA committee.

University Faculty Team Up Again to Design Tech Innovations for NYC

For second year in a row, faculty win Urban Tech Awards to develop technology innovations to improve urban living in the face of the COVID-19 pandemic, superstorms, and other extreme events

By Allison Chen, Originally published by Columbia Engineering

Nine Columbia University faculty teams have each won an $85,000 Urban Tech Award for projects to develop technology applications to improve urban living in the face of superstorms like Sandy and Ida and the current COVID-19 pandemic. Each proposal focuses on designing technological solutions to protect from and prevent future pandemics, attacks, and disasters in New York City and other major cities in the world. To encourage impactful collaborations across the University, each team includes at least one Engineering and Applied Sciences faculty member and at least one faculty member from either a different school or a different department.

The award's inaugural round last year, funded by a gift from a generous Columbia Engineering alumni donor, was highly successful, and the same donor is supporting the program's second year.

"The COVID-19 pandemic has certainly exposed weaknesses in the design and infrastructure of modern cities like New York, as have the onslaught of natural disasters over the past few years," said Shih-Fu Chang, Columbia Engineering interim dean. "It's clear we need a broad range of innovations as we emerge from an extraordinarily difficult time, and bringing together the best minds in New York City and at Columbia can only lead to exciting, innovative solutions. We're very grateful to our donor for being so generous in continuing this visionary program."

The themes for this year's round are smart cities and logistics, sustainable building design and sensors, safe work and public spaces, enhanced learning technologies, and improved diagnostics. The proposals came from faculty across the University, including from Columbia University Irving Medical Center (CUIMC), Columbia Climate School, the Dental School, Mailman School of Public Health, and Teachers College. Six of the nine winning teams are renewals for a second year of funding.

APAM faculty award winners include **Daniel Bienstock** (IEOR/APAM), **Kyle Mandl**i, and **Yuan Yang**. Two of the award winning projects include:

An Integrated Radiative Cooling/ Solar Cell System for Sustainable Buildings

Yuan Yang, Associate Professor, APAM
Vijay Modi, Professor, Mechanical Engineering (Engineering)

The project will develop an integrated and sustainable system on building roofs to harvest energy from both sunlight as electricity generation and cold outer space as cooling water. It will reduce energy consumption in buildings.

Urban Living in the Face of COVID-19: Preparing for the Next Pandemic and Super-Storm (Renewal)

Kyle Mandli, Associate Professor, APAM
George Deodatis, Professor, Civil Engineering
Daniel Bienstock, Professor, IEOR/APAM
Jonathan Surry, Project Director, Disaster Preparedness

The combined threat of a pandemic occurring alongside a hurricane or other major storm is not theoretical, it has happened and will occur again. This project focuses on how to slow the spread of the disease while keeping people safe from the storm.

How Can Quantum Physics Help Researchers Understand the Deep Earth?

For Earth Day, learn about how science at its smallest scale is applied to the depths of our planet

By Ellen Neff, Originally published by Columbia Quantum Initiative

Renata Wentzcovitch

Our planet is full of mysteries. How exactly did Earth form and evolve to its current state? Why do some places in its interior seem hotter or colder, rising or sinking? For answers, geoscientists experiment on materials expected to be found in Earth's interior, but these exist at immense pressures and temperatures that are impractical to reproduce in the lab. **Renata Wentzcovitch**, a condensed matter physicist, says quantum simulations can help.

"Nature is quantum," said Wentzcovitch, a professor at Columbia Engineering and the Lamont Doherty Earth Observatory.

Quantum mechanics is a theory concerned with the wave-like motion of minuscule particles, like electrons circling an atom. Atoms and their electrons combine into molecules that form materials that make up the Earth—all of which have quantum properties. Although quantum mechanical equations can be applied to any material, they are most often invoked to describe phenomena that cannot be understood with classical physics, she said.

During her PhD, Wentzcovitch studied the quantum nature of hard materials, like diamond and graphite, and how extreme temperatures and pressures can change a material's electronic and structural properties. She then developed quantum simulation methods in her postdoc years to address complex materials. Where else can complex materials subject to extreme conditions be found? The deep Earth.

To understand the deep Earth's evolution and current state, researchers must combine information about its material composition with the effects of external forces like temperature and pressure. There, Wentzcovitch applies techniques she helped develop in condensed matter physics to study the nearly 4,000 miles of material below our feet.

For example, last fall, she and colleagues combined more than 15 years of work on a quantum property called the spin state, which occurs in materials containing iron. Combining those results with seismological evidence, the team identified the signature of a spin transition deep within the Earth's mantel. This strictly quantum phenomenon changes the speed at which sound travels in solids and helps explain the mysterious pattern of seismic velocities observed 1,200 kilometers below ground.

In January, she and her team revealed that Earth's molten iron core solidified upon cooling in a two-step process, rather than one. This result is another step towards solving a long-standing paradox that says it should have taken longer than the Earth's age, 4.5 billion years, for its inner core to solidify.

She and her group are currently working with seismologists and geodynamicists on a reference model of the distribution of mineral phases and their compositions in the Earth's mantle. All to shed light on the deep Earth's evolution with the help of quantum simulations.

Gerald Navratil, the Edison Professor of Applied Physics, discussed exciting breakthroughs in the field of nuclear fusion at large in the article, "A private company just made a huge breakthrough in nuclear fusion." Read more at **https://bit.ly/3EFmcsk**

Seeing More Deeply into Nanomaterials (continued from page 7)

The team leveraged the beamline's abilities in two ways. They not only measured the phase contrast of the x-rays passing through the samples, but they also collected the x-ray fluorescence—the emitted light—from the sample. By measuring the phase contrast, the researchers could better distinguish the foreground from the background of their sample.

"Measuring the data was only half the battle; now we needed to translate the data into meaningful information about order and imperfection of self-assembled systems. We wanted to understand what type of defects can occur in these systems and what is their origin. Until this point, this information was only available through computation. Now we can really see this experimentally, which is super exciting and, literally, eye-opening for the future development of complex designed nanomaterials," said Gang.

New software to better manage data: Together, the researchers developed new software tools to help untangle the large amount of data into chunks that could be processed and understood. One major challenge was being able to validate the resolution they achieved. The iterative process that finally led to the groundbreaking new resolution stretched over several months before the team had verified the resolution through both standard analysis and machine-learning approaches.

"It took my whole PhD to get here but I personally feel very gratified for being part of this collaboration. I was able to get involved in every step of the way from making the samples to running the beamline. All the new skills I have learned on this journey will be useful for everything that lies ahead," said Michelson.

Pushing the boundaries: Even though the team has reached this impressive milestone, they are far from done. They already set their sights on the next steps to further push the boundaries of the possible.

"Now that we have gone through the data analysis process, we plan to make this part easier and faster for future projects, especially when further beamline improvements enable us to collect data even faster. The analysis is currently the bottleneck when doing high-resolution tomography work at HXN," said Yan.

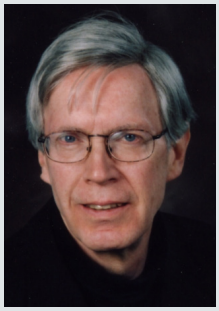
Gang added, "Aside from continuing to push the performance of the beamline, we also plan to use this new technique to dive deeper into the relationships between defects and properties of our materials. We plan to design more complex nanomaterials using DNA self-assembly that can be studied using HXN. In this way we can see how well the structure is built internally and connect this to the process of the assembly. We are developing a new bottom-up fabrication platform that we would not be able to image without this new capability."

By understanding this connection between material's properties and the assembly process, the researchers hope to unlock the path to fine-tuning these materials for future applications in designed nanomaterials for batteries and catalysis, for light manipulation, and for desired mechanical responses.

Thomas C. Marshall Scholarship

The Fu Foundation School of Engineering and Applied Science (SEAS), has established an endowed scholarship fund in memory of **Thomas C. Marshall** (1935-2021), Professor *Emeritus* of Applied Physics in the Department of Applied Physics and Applied Mathematics (APAM).

Professor Marshall's former student, APAM alum, **Dick Post (PhD '73)**, was instrumental in the creation of this fund.



Thomas Marshall

Professor Marshall joined Columbia University in 1962 as a professor in the Department of Electrical Engineering. He became a Professor of Engineering Science in 1970 and was a member of the Plasma Physics Committee where he launched groundbreaking experimental research into the physics of plasmas, relativistic electron beams, and free electron lasers.

Professor Marshall was one of the nine founding faculty members of the Department in 1978, becoming one of Columbia's first Professors of Applied Physics. He was awarded Columbia's Great Teacher Award in 1995. During his forty-four years at Columbia University, he has supervised or co-supervised 44 doctoral students. During the decade before he retired in 2006, Professor Marshall was the dedicated faculty advisor to our students in the Medical Physics Program.

The Thomas C. Marshall Scholarship will be awarded to a student in the Applied Physics and Applied Mathematics Department starting in Fall 2022.

To learn more or make a contribution to the fund, please see: **https://bit.ly/3L0OAaI**

Sensing a New Market (continued from page 6)

"Things like this are really much closer to our everyday life," he continued, "where LiDAR is basically enabling machines to see objects in 3D can really open up possibilities and let computer vision work that much better."

The foundational IP for the Voyant's LiDAR chip was licensed from Columbia, and Phare said having that support from the university is integral when approaching investors. He said their team is still in communication with Columbia Technology Ventures executives Gregory Maskel and Orin Herskowitz.

Miller added that this latest multi-million dollar investment will allow the company to box up the first test kits and send them out to customers on a waiting list later this year. It's an important step for getting real-world feedback. They expect their first full product to launch in the first or second quarter of 2023.

In the meantime, their company is already expanding. Voyant's new CEO Peter Stern was brought on in the middle of 2020. As their startup takes off, Phare and Miller recognized early the value of bringing aboard somebody who knows the business side of things.

And, afterall, sharing a common vision and a collaborative environment is the biggest key to success.

"I think it's like it's good to have a well balanced team," Miller said. "That goes for the founding team and it also goes for more people as your team grows."

In Memoriam: Aron Pinczuk

Aron Pinczuk

Columbia Engineering mourns the loss of **Aron Pinczuk**, Professor of Applied Physics and Professor of Physics at Columbia University. He passed away on February 13, 2022.

Professor Pinczuk was born on February 15, 1939 in Buenos Aires, Argentina. He received a licenciado degree in Physics from the University of Buenos Aires in 1962 and a Ph.D. in Physics from the University of Pennsylvania in 1969. Following the completion of his doctoral studies, he worked as an Assistant Professor of Physics at the University of Pennsylvania until 1970.

From 1971-1976, he worked at the National Atomic Energy Commission, was a member of the National Research Council, and was a faculty member in the Department of Physics at the University of Buenos Aires, Argentina, from 1973-1974. From December 1975-August 1976, he worked at the Max Planck Institut für Festkörperforschung in Stuttgart, Germany, and then made his way to New York where he worked as a Visiting Scientist at IBM Research in Yorktown Heights from 1976-1977. He was a member of the Technical Staff at Bell Telephone Laboratories (later renamed AT&T Bell Laboratories and then Lucent Technologies) from 1978-1998, in Murray Hill, New Jersey, where he received the Distinguished Member of Staff Award in 1985.

Professor Pinczuk joined the faculty at Columbia University in 1998 and held a joint appointment in the Department of Applied Physics and Applied Mathematics and the Department of Physics and, until 2008, was also a Technical Staff Member at Lucent. In addition to his teaching and research efforts, Professor Pinczuk was a member of the Columbia Nanoinitiative (CNI) - an interdisciplinary community within Columbia University dedicated to the support and development of research efforts in Nanoscale Science and Engineering.

Professor Pinczuk was a leader in the field of resonant light-scattering from solids, with a focus on correlated electronic states in two dimensional materials. Professor Pinczuk explored the frontiers of basic physics, of fabrication protocols, and of materials science in nanoscale (one-billionth of a meter) artificial patterns. The fabrication of artificial patterns in semiconductor structures allows for the exploration of impact of fine-tuning (engineering) of electron states on device characteristics.The devices created in his research served as simulators of novel quantum phenomena and of advanced device concepts and addressed issues important to scientists seeking to create fundamental and applied science for the development of the next-generation of electronic and opto-electronic devices.

Professor Pinczuk's research introduced novel optical methods that enabled a new understanding of the properties of novel materials and the physics of exotic phases of matter that emerge in semiconductors and semimetals at extremely low temperatures. His experiments, of a remarkable precision and delicacy, revealed quantum phenomena not previously believed to be observable including the excitation spectrum in the quantized hall effect, and his work was important to the initial understanding of the 'Dirac liquid' in graphene.

The author of numerous papers, Professor Pinczuk has also been the Editor in Chief of *Solid State Communications* since 2005. He also served on review panels for the U.S. NSF Division of Materials Research, the U.S. DOE Division of Materials Sciences and Engineering, and the Ministerio de Ciencia, Tecnología e Innovación Productiva, Argentina.

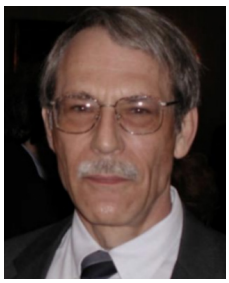
Professor Pinczuk was named a Fellow of the American Physical Society (APS) in 1987, a Fellow of the American Association for the Advancement of Science (AAAS) in 2002, and a Fellow of the American Academy of Arts and Sciences in 2009. He was also a member of the Materials Research Society (MRS) and the Optical Society of America (OSA).

In 1994, Professor Pinczuk received the Oliver E. Buckley Prize for Condensed Matter Physics from the American Physical Society - one of the top prizes of the society; received an "Honoris-Causa" Doctorate Degree from the Universidad Autónoma in Madrid, Spain, in 1997; was the recipient of the Columbia University Avanessians Diversity Award in 2008; and received the Columbia University Fu Foundation School of Engineering and Applied Science Faculty Excellence Award in 2015.

Professor Pinczuk was an active faculty member, advisor, and researcher at Columbia University up until the time of his death. He will be remembered by his colleagues and students for his excellence, kindness, and dedication to his teaching and research.

Symposium Honoring the Life and Work of Professor Aron Pinczuk

The Physics Department and APAM Department, along with alumni, family, and friends, will be hosting a one-day symposium on Saturday, October 8, 2022 to celebrate the life and work of Professor Aron Pinczuk. We will post details on the APAM Department website in the coming months. You are also invited to submit a tribute which will be posted on the APAM Department website: **https://bit.ly/3LhB3M9**



John Arbo

In Memoriam: John Arbo

The Department of Applied Physics and Applied Mathematics mourns the loss of **John Arbo**, Associate in the Discipline of Applied Physics and Applied Mathematics. He was a cornerstone of the graduate program in Medical Physics from its inception. For 22 years he served as the Medical Physics graduate student academic advisor, taught the Radiation Instrumental and Measurement Laboratory courses, and was the coordinator and host of the Medical Physics Seminar. In 2008, the APAM Department recognized John for his "Leadership in the Development and Nurturing of the Medical Physics Program" and for his "Service as Instructor of Outstanding Quality and Dedication." In 2010, he was appointed Associate in the Discipline of Applied Physics and Applied Mathematics. He is survived by his wife Marlene Arbo, the former Department Administrator of the APAM Department, his daughter, Rani, and son, John. Our thoughts are with his family at this difficult time.

Faculty & Student News, continued

Columbia Quantum Initiative: Several faculty members in the APAM Department are part of the Columbia Quantum Initiative. Alexander Gaeta is co-chair of the Quantum Initiative Task Force. Key members in the Columbia Quantum Initiative also include Simon Billinge, Irving Herman, Michal Lipson, Chris Marianetti, Latha Venkataraman, Michael Weinstein, Renata Wentzcovitch, and Nanfang Yu. "Building on the collaborative culture long fostered at Columbia, the Quantum Initiative is combining interdisciplinary expertise in materials science, photonics, quantum theory, and more, all while taking advantage of our unique position in the global hub that is New York to develop novel quantum technologies that will open new frontiers into how we compute through complex problems, communicate with one another, and sense the world around us." (https://quantum.columbia.edu)

Statistical Methods for Climate Scientists: Congratulations to Timothy Delsole, from George Mason University, and Michael Tippett, from the APAM Department, on the publication of their new book - *Statistical Methods for Climate Scientists*, Cambridge University Press 2022, ISBN: 9781108659055.

How Electric Vehicles Could Fix the Electrical Grid: Daniel Bienstock (IEOR/APAM) was recently featured in the Columbia News article, "How Electric Vehicles Could Fix the Electrical Grid" by Anuradha Varanasi. (https://bit.ly/3ty8EKN)

Sobel on Broadway: Adam Sobel was a speaker at TEDxBroadway 2022. The event, which took place on May 17, 2022, featured a global community of changemakers who answered the TEDx central mission question, "What's the BEST Broadway can be?" (https://www.tedxbroadway.com). Sobel was also featured on TEDx Short - *Climate change and the challenge of long-term thinking* (http://go.ted.com/tedxshorts) as well on Sea Change Radio - *A Climate Science Midlife Crisis* (https://bit.ly/3k07a6N).

Senior Design Project: Materials Science seniors, overseen by Professor Simon Billinge, presented research projects at the annual Senior Design Expo on May 5, 2022. Participants included: Jonathan Katz (Laser-Induced Crystallization of Multilayer Amorphous Si Thin Films), Alexander Killips (Laser Synthesis and Processing of SiC), Haolan Sun (Characterizing Nano-ceria Particles by XRD follow-up with Pair Distribution Function Analysis), Shiyi Yuan (Thermoreflectance based thermal microscope), and Ruiwen Zhang (Indigo Dye as an Ecofriendly Material in Lithium-ion Batteries With Graphene Oxide Coated Separator).

Cover image - MSE Senior Design particiapants: (front row) Jonathan Katz, Shiyi Yuan, Haolan Sun, Ruiwen Zhang, Alex Killips, (back row) Professor Simon Billinge

Contact Us

We'd love to hear from you and stay connected! Follow us on social media and please send your news and updates to **apam@columbia.edu**

Department of Applied Physics & Applied Mathematics
Fu Foundation School of Engineering & Applied Science
Columbia University in the City of New York
500 W. 120th Street, Room 200 Mudd, MC 4701, New York, NY 10027
Phone: 212-854-4457 | Fax: 212-854-8257

Contributing Authors

Marlene Arbo, Katayun Barmak, Kyle Barr, Allison Chen, Columbia Engineering, Columbia Engineering Magazine, Columbia News, Madeline Feltus, Holly Evarts, Kristen Henlin, Ellen Neff

Photos/Images

Marlene Arbo, Eileen Barosso, Simon Billinge, Columbia Engineering, Columbia Engineering Magazine