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The Fu Foundation School of Engineering and Applied Science

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APAM NEWS

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

Dear APAM Family,

This past term has seen the beginning of the return to normal conditions during the COVD-19 situation. Research on campus is in full swing and the APAM office now has limited operation; however, spring classes were still mostly remote. We expect we will have near-normal conditions in the coming Fall 2021 term. I expect this will mean that the number of emails requesting a chat on Zoom will decrease greatly (though not approach zero). Once again, I thank the wonderful efforts of our faculty, staff, and students for making this spring term one of distinction.

APAM continues to have much to be proud of! This term has seen our faculty being awarded new honors (Qiang Du and Yuan Yang), founding new journals (Qiang Du), publishing new books (Oleg Gang), and engaging in service to their research communities (Katayun Barmak, Qiang Du, and research scientist Yoshitomo Okawachi). This Newsletter also highlights our research in protecting coastlines from storms (Kyle Mandli and Daniel Bienstock), building tough 3D nanomaterials with DNA (Oleg Gang), and the use of light in quantum information systems (Alex Gaeta, Michal Lipson, and Nanfang Yu).

We follow the accomplishments of our students and alumni, and, of course, we honor our many winners of student awards and distinctions this term: Shaowen Chen, Alex Paskov, Joseph Lee, Junhui Zhang, Ruby Aidun, Anjali Verma, and Samantha (Sam) Mayers.

In closing, this will be my final APAM Newsletter, as I end my third (non-consecutive) three-year term as chair of our fabulous department. It has been an honor to serve you. I am positive that APAM will continue to prosper under the leadership of incoming chair, Marc Spiegelman.

Stay well,

Irving P. Herman
Chair, APAM

Images: Congratulations to the Class of 2021! See pages 2-4 to learn more about our undergraduate and graduate degree recipients.

2021 Simon Prize Winner: Shaowen Chen

The APAM Department is proud to announce that this year's Simon Prize has been awarded to **Dr. Shaowen Chen**. A virtual award ceremony was held in his honor on Wednesday, April 28.

Dr. Chen received his PhD from Columbia University in Oct 2020, advised by Prof. Cory Dean. His thesis, "Transport measurements of correlated states in Graphene flat bands", explores the phenomena when electrons "cooperate" through Coulomb interactions to form various states of matter, where the electronic response ranges from insulating to superconducting. One guiding experimental focus of his work has been to maintain extremely low disorder in the material of study. Shaowen's works with Prof. Dean, in collaboration with Prof. James Hone's group of Mechanical Engineering, and others around the world, were published in Science (2016, 2019), Nature Physics (2020), Physical Review Letters (2019), Nano Letters (2019) and so on. Shaowen received his B.S. in Physics from Peking University in 2014. After graduating from Columbia, Shaowen was selected as Harvard Quantum Initiative (HQI) fellow in 2020, where he is now working as a postdoc fellow to investigate electron correlation with emerging quantum sensors such as nitrogen vacancy centers in diamond.

His advisor, Prof. Dean, stated, "It is a great pleasure to see Shaowen's efforts recognized by this prize. Shaowen is an excellent researcher who demonstrates an unflinching enthusiasm for tackling almost any problem. His PhD work focused on understanding how to engineer exotic quantum states in graphene by forcing electrons to interact strongly with one another. His groundbreaking work in twisted bilayer graphene provides an exciting new path to realize the dream of building a working quantum computer. In addition to my lab, Shaowen actively collaborated across many efforts in both the MRSEC and EFRC research centers at Columbia. His efforts established several new paradigms in the field of two-dimensional materials that not only pushed the research efforts at Columbia into new and unexpected directions, but will undoubtedly shape the whole community for years to come."

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.

Paskov Named SEAS 2021 Salutatorian

Alex Paskov (BS '21, Applied Mathematics) was named the 2021 Columbia Engineering Salutatorian. The following interview was originally published by Columbia Engineering.

Why Columbia Engineering? Initially, what drew me to Columbia was the fact that it's a world-class educational and research institution embedded within the most vibrant city in the world. But after attending the Days on Campus orientation, I realized that what truly made Columbia unique was the incredible density of hyper-talented people on campus. Almost every situation, whether it's grabbing a cup of coffee, going to class or doing something as mundane as laundry, has been an opportunity to have an amazing conversation, many of which I still think about years later. And it's from among this set of people that I've had the privilege of making incredible lifelong friends.

Favorite Course? While it's very difficult to choose just one, if I had to pick, I would say *Analysis of Algorithms* with Prof. Daniel Bienstock, because it strikes a rare balance between interesting and challenging mathematics, while simultaneously remaining incredibly relevant for the real world.

Most meaningful project? One of the most meaningful projects was the "Prime Number Project" in my *Discrete Mathematics* class with Prof. Ansaf Salleb-Aouissi. There, we were tasked with learning about various computer-algorithms for factoring and classifying prime numbers. I specifically remember being unsatisfied with how slowly my program ran, but after deriving some clever mathematical and algorithmic ideas, my program's runtime reduced from over 100 seconds to mere microseconds — a 100 million-fold speed-up. Ultimately, this impressed my professor and made me realize, viscerally, just how much potential there is in applying clever mathematics to computer science.

How Columbia Engineering prepared you for your career? The Engineering Core, which pushes us to take classes in similar areas to our major, has definitely had the biggest positive impact on my research internships and classes. Specifically, when starting my internships, I always surprised my mentors with my strong knowledge of programming, optimization theory, and machine learning, as they had only expected me to be strong at math. Last summer, for instance, I surprised my mentor with my knowledge of reinforcement learning and distributed computing systems, both of which ended up being critical for the success of our Poker AI project.

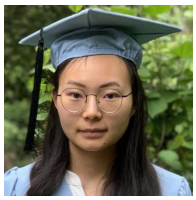
What engineering for humanity means to you? A few weeks ago OpenAI, an AI company founded by Elon Musk, predicted that within the next decade "artificial intelligence will generate enough wealth to pay each adult $13,500 a year." If this holds true, humans will have immensely more freedom to pursue their interests, whether in STEM or the humanities, and have significantly greater access to better healthcare. To me, that's exactly what Engineering for Humanity means — using science and technology to improve the human condition and expand the set of opportunities each person has.

The most inspirational people in your life? My entire family, because they have always encouraged my scientific curiosity. Whether it was introducing me to programming in the third grade, helping me build custom computers, or launching model rockets equipped with LEDs to turn the nighttime sky into our own canvas, my family has shown me how exciting science is. And by building a life in America from scratch after immigrating as PhD students from poverty-stricken communist Bulgaria, my parents in particular have shown me the importance of hard work in succeeding in both science and in life.

Plans for after graduation? I'll be heading to MIT to pursue a PhD in optimization, machine learning, and statistics with MIT Prof. Dimitris Bertsimas. My Columbia education has provided me with an incredible background, which I am now excited to leverage to tackle important and meaningful real-world problems.

Undergraduate Award Winners

Joseph Lee - Applied Physics Faculty Award Winner
Joseph Lee (BS '21, Applied Physics) is the recipient of the 2021 Applied Physics Faculty Award. He took numerous graduate level courses, maintained a 4.03 GPA, and received second place at the 2019 Columbia Fast Pitch Competition. He was heavily involved in research with Prof. Sebastian Will, focusing on experimental AMO work and also on a theoretical/computational project in Condensed Matter and AMO. In the summers, he also worked with Dr. Jim Fredericks at Georgetown University on quantum computing and its applications to condensed matter. Their work has led to a publication, and they are currently finishing their second. After graduation, Joseph will pursue a PhD at Columbia and work with Prof. Ana Asenjo-Garcia on quantum optics theory.



Junhui Zhang - Applied Math Faculty Award Winner
Junhui Zhang (BS '21 Applied Mathematics) is the recipient of the 2021 Applied Math Faculty Award. She is an outstanding student who took many challenging courses while maintaining a 4.07 GPA. She also performed research with Professor Henry Lam in the IEOR Department on distributionally robust optimization, and with Professor John Wright in the EE Department on robust Principal Component Analysis. In addition, she was a TA in the Math Department for Modern Analysis I and PDE. After graduation, she will begin a PhD at MIT, studying Operations Research.

Ruby Aidun - Materials Science Rhodes Prize
Ruby Aidun (BS '21, Materials Science) is the winner of the Frances B.F. Rhodes Prize for materials science. She took a series of challenging courses, maintained a 3.95 GPA, was on the Dean's List each semester, and was elected to Tau Beta Pi. She participated in materials research in several groups at Columbia, as well as at Sandia National Labs, where she became a coauthor on four scientific publications in the area of energy-related materials. She served on Columbia's Undergraduate Integrity Advisory Board, led trips with the Urban New York program, and was a teaching assistant and camp counselor for high-school summer STEM programs. After graduation, Ruby will serve as an Americorps VISTA volunteer.

Anjali Verma - King's Crown Award & Marshal
Anjali Verma (BS '21, Applied Physics) is the winner of the 2021 King's Crown Leadership and Excellence Award for Inclusion and Advocacy and was named a Class of 2021 Senior Marshal. She is a powerful advocate in Applied Physics, Columbia Engineering, and across Columbia University. As president of Columbia Spectra and through the Society for Women in Physics, she pushed for the discipline to be more socially and culturally responsible. She also successfully campaigned to rename a classroom after C.S. Wu, one of the only women in the Manhattan Project. Additionally, Anjali created critical spaces for Black students as co-chair of the Columbia Mentoring Initiative's Black Family Tree and through her work with Mobilized African Diaspora in challenging public safety practices/structures. After graduation, she plans to continue her research in the lab of Dr. Ruben Gonzalez and will apply to graduate school.

Samantha Mayers - Wendell Prize Nominee
APAM nominated Samantha "Sam" Mayers (BS '21, Applied Mathematics) for the 2021 George Wendell Memorial Medal in recognition of her exceptional aptitude in leadership, service, and scholarly activities. Her senior presentation for Columbia's Applied Mathematics Seminar was on "Understanding Pregnancy Prediction from a Self-Reporting Women's Health Mobile Application" and she also worked on an international research project at Imperial College, London, on "When Will We Know Global CO2 Storage Capacity?". Next year, Sam will start a Master's degree at Columbia University in Computer Science.

Congratulations Graduates!

October 2020 - MS
Yinan Dong (MSE), Ayan Nandi (AM/CVN), Matthew Sekerke (AM/CVN)

October 2020 - PhD
John Brooks (AP), Shaowen Chen (AP), E-Dean Fung (AP), Peijie Ong (AP), Oded Stein (AM)

February 2021 - BS
Joon-hee Jo (AM), Nikolay Mamut (AM), Sunand Raghupathi (AP), Nicholas Vallin (MatSci), Miguel Yepes (MatSci), Kyung Duk Yoon (AM)

February 2021 - MS
Peter Aydin (MP), Sasaank Bandi (MSE), Isabelle Bunge (AM), Chunrun Chen (MSE), Jeffrey Chen (AM), Endric Daues (AM), Yu Hui Du (AP), Megan Eisele (MSE), Xiaoyu Fan (MSE), Lauren Farrell (MP), Vahe Gharakhanyan (MSE), Julia Hestenes (MSE), Hao Yun Hsu (MP), Hsiang-Yun Hsu (MSE), Yunxiao Hu (AM), Crystal Ji (MSE), Hengyi Lei (MSE), Xuan Li (AM), Jiayi Liang (MP), Weichang Lin (AP), Chang Liu (MSE), Rui Ma (MSE), Yirui Ma (MSE), Rohan Mahnot (AP), Benjamin Markham (AP), Matthew Maroun (MP), Aimee Moses (AM), Andreani Mouzourou (MP), Patrick Orenstein (AM), Ye Ouyang (MSE), Berrak Ozer (MSE), Matthew Patrick (MSE), Sidarth Raghunathan (AP), Admir Sehovic (MP), Junru Shen (MSE), Jonas Sheng (AM), Charles Shin (AM), Alpar Solyom (AM/CVN), Jiawen Sun (MSE), Eric Chung Chih Tsai (MSE), Oliver Wang (AP), Wenxuan Wang (MSE), Yitian Wang (MSE), Zhiyuan Wang (MSE), Jinlin Xiong (MSE), Jie Xu (AM), Tianze Xu (MSE), Sweeney Yang (AM), Zhi Yao (AM), Guanhua Yu (AM), Zhenghao Yu (AM), Yang Yue (MSE), Edith Zhang (AM), Zhichu Zhang (MSE)

February 2021 - PhD
Zhengqian Cheng (AP), Jiayang Hu (MSE), Rachael Keller (AM), Long Yang (MSE)

April 2021 - BS
Gabriel Agostini (AM), Ruby Aidun (MatSci), Lana Awadallah (AM), Mikhalya Brown (AM/CC), Teresa Brown (AM/CC), Julius Buonanno (AM/CC), Edita Bytyqi (AP), Gary Casey (AM), Arthur Chen (AM/CC), Zhengyang Cui (AP), Matthew Donahue (AM), Rebecca Dubovsky (AM/GS), Dahlia Ghoshal (AP), Allison Ghuman (AM/CC), David Giliver (AM), Max Gupta (AM/CC), Garrett Harrison (AM), Dingyuan He (AM), Hanrui Huang (AP), Isaac Ick (AM/CC), Aaron Jaffe (AM/CC), Lauren Kranis (MatSci), Joseph Lee (AP), Janette Levin (AM), Jaime Madridejos Varela (MatSci), Samantha Mayers (AM), Andrew Meador (AM/GS), Jane Pan (AM), Alexander Paskov (AM), Emma Plimpton Liebowitz (AM), Anthia Prapa (AP), Shanzhao Qiao (AM), Reuben Rahmeyer (AP), Neeraj Sakhrani (AM/CC), Sebastian Salazar (AP), William Shamma (AM), Jonathan Sheppard (AP), Shin, Junsup (AM), Peihan Song (AM), Qian Sun (AM), Daye Um (MatSci), Jason Vassiliou (AM/CC), Anjali Verma (AP), Michael Wahrman (AP), Meng Wu (AM), Kelvin Xu (AM), Yudi Xu (AM), Man Yang (AM), Alan Zhang (AM), Jiawei Zhang (AM), Junhui Zhang (AM), Liyi Zhang (AM/CC), Shunxing Zhang (AP), Wanchen Zhao (AP), William Zheng (AM)

April 2021 - MS
Jalaluddin Butt (AP), Rian Chandra (AP), In Wai Cheong (AM), Justin Cohen (AP), Piaoying Deng (AM), Sarah Dimonte (AM/CVN), Graydon Flatt (AP), Qi Gao (AM), Chaoxuan Gu (MSE) Sameh Nadeem Hameedi (AM), Levi Holmes (AM), Madison Ihrig (AM), Samuel Jubb (MSE/CVN), Hugh Krogh-Freeman (AM/CVN), Ananth Kumar (AM), Conor McGuire (MSE/CVN), Maurice Pierre (AM), Thomas Rebbecchi (MSE/CVN), Feng Yu (AM), Qing Zhu (AM)

April 2021 - PhD
Hwi Lee (AM), Jessica Oehrlein (AM), Mehmet Hazar Seren (MSE), Sai Sunku (AP)

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

Undergraduate Spotlights

Edita Bytyqi (BS '21, Applied Physics)

From: Skopje, Macedoni

Highlights: "Physics 1401 (I decided to major in Applied Physics because of this class); Ski team (I learned how to ski); and I was a CP Davis Scholar."

Lessons: "I have learned that we have a great amount of control on how we perceive things and that if we are able to manage and organize our thoughts external factors dissipate and don't affect us as much."

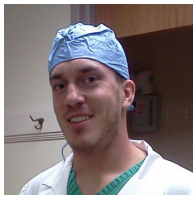
Plans: "I am planning to pursue graduate studies in Atomic and Molecular Physics and take part in pioneering research in the quest for building a quantum computer."

Dahlia Ghoshal (BS '21, Applied Physics)

From: Glastonbury, Connecticut

Highlights: "I really enjoyed doing experiments in Prof. Gaeta's lab! I was also honored to teach in and be president of *Columbia Girls Who Code*!"

Plans: "I'll be interning with NASA this summer; afterwards I'll be doing quantum engineering research for a PhD at UChicago!



Andrew Meador (BS '21, Applied Mathematics)

From: Winnetka, IL

Highlights: "Lots of differential equations, proofs, and programming!"

Lessons: Columbia taught me "how to abstract a problem into simpler pieces."

Plans: "Med school!"

Michael Wahrman (BS '21, Applied Physics)

From: Detroit, MI

Highlights: "Weekly meetings of the Society of Physics Students"

Plans: "I will be pursuing a PhD in Applied Physics at Stanford"

Alan Zhang (BS '21, Applied Mathematics)

From: Bethesda, MD

Highlights: "President of Alpha Kappa Psi, Co-Chair of SEAS 2021 Student Fund, and Independent Research in Political Science and Neuroscience/Electrical Engineering"

Lessons: "Columbia Engineering has taught me how to be resourceful and analytical in solving any problem."

Plans: "I hope to be a leader of change in the world and have a positive impact on people's lives. Someday, I hope to give back to the Columbia Engineering community so others can benefit from the opportunities offered to me by the school."

Graduate Student Spotlights

Jessie Oehrlein (PhD '21, Applied Mathematics - Atmospheric Science)

From: Oklahoma City, OK

Highlights: "Center for Teaching and Learning Journal Club, my Teaching Assessment Fellowship from 2019-2021, and working with two Provost-Funded Project teams, including one within SEAS, on assessing new course designs/redesigns.

Plans: "I'm excited to take what I've learned about research and teaching at Columbia forward and continue doing atmospheric science research and teaching mathematics and statistics, now (as an Assistant Professor) at Fitchburg State University!"

Maurice Pierre (MS '21, Applied Mathematics)

From: Stormville, NY

Highlights: My Master's Thesis - *Identities of the Fractional Fourier Transform and the Versor Transform*; Women in Science at Columbia (WISC)'s Undergraduate Mentoring Program

Lessons: "The most important thing I've learned at Columbia Engineering is how important it is to give back to others. One of my most fulfilling experiences this semester was participating in the Women in Science at Columbia (WISC) program as a mentor to an undergraduate student. I was paired with someone who had an interest in architecture, but wanted to apply ideas from math and physics into her work. It is satisfying to see more women getting involved in STEM, and I am happy I was able to help her in some way."

Plans: "After I graduate, I plan to expand on the research I did for my Master's Thesis. I also plan to expand on a paper I coauthored with Robert Connelly at Cornell University, Maximally Dense Disc Packings on the Plane. In addition, I am working on creating interactive illustrations and animations for a textbook on dynamical systems."

Hestenes Wins NSF PhD Award

Julia Hestenes has won an NSF Phd award! She is a second year PhD student in the Materials Science & Engineering program in the APAM Department, advised by Prof. Lauren Marbella in the Department of Chemical Engineering.

Julia stated, "I'm using nuclear magnetic resonance as an advanced materials characterization technique to elucidate chemical and structural degradation mechanisms in emerging Lithium-ion battery cathode materials. I'm passionate about studying Lithium-ion batteries because of their potential to help solve global energy challenges imposed by climate change, such as by helping to enable the widespread use of electric vehicles and grid-scale energy storage."

Watch 2021 Ceremonies Online

The virtual 2021 Columbia Engineering Undergraduate Class Day and Graduate Class Day ceremonies, as well as the Columbia University Commencement ceremony, are all online. Celebrate our outstanding graduates, get inspired by faculty and key note speakers, view the student slide show, and relive the wonderful memories!

https://www.engineering.columbia.edu/celebrating-class-day-2021

Alumni Updates

Sean Blanton (BS '91, Applied Physics) is applying his Columbia degree and University of Chicago PhD in physics at a new job this year at Citadel, LLC, in Chicago. He continues to visit his wife's native Turkey each summer for Aegean seaside family visits and vacation. He also travels for youth soccer and is active in raising money for girls' education in rural Turkey. **(Originally published by *Columbia Engineering Magazine*)**

Ethan Coon (PhD '06, Applied Mathematics) is a computational hydrologist in the Climate Change Science Institute at ORNL and was part of the Amanzi–ATS team that was named one of the R&D 100 Award winners in the Mechanical/Materials category.

Jinko Gotoh (BS '80, Applied Mathematics): "2019 was a very busy year. I produced *The Lego Movie 2*: *The Second Part* and *Klaus*, the first original animated feature for Netflix. I'm also living in NYC and working on my next animated feature." **(Originally published by *Columbia Engineering Magazine*)**

Samantha John (BS '09, Applied Mathematics) was featured on ABC's *Shark Tank* and made $550,000 deal with Mark Cuban to fund Hopscotch - a subscription-based coding platform for children. John, a Brooklyn native and Cofounder/CEO of Hopscotch, shared her experience on Buzzfeed. **https://bzfd.it/2SG4UHz**

Endri Mani (MS '15, Materials Science & Engineering) stopped by the virtual APAM Commencement Ceremony to offer words of inspiration and encouragements to the Class of 2021. Endri is an Associate Director and Head of the Data Science Platform at RBC Capital Markets.

Clara Orbe (PhD '13 , Applied Mathematics) a Research Physical Scientist at NASA's Goddard Institute for Space Studies has also been appointed an Adjunct Associate Professor in the APAM Department.

Jia Wan (B.S. '18, Applied Mathematics, Columbia College; M.S. '20, Computer Science, SEAS) has been named a Rhodes China Scholar.

Two APAM alumni presented talks at the Department's virtual Applied Mathematics Colloquium this year. **Braxton Osting** (PhD '11, Applied Mathematics) is an Associate Professor in the Department of Mathematics at the University of Utah. **Alexander Watson** (PhD '17, Applied Mathematics) is a Postdoc in the School of Mathematics at the University of Minnesota.

Career Events Featuring APAM Alumni

by Kristen Henlin, Career Placement Officer

The APAM Department hosted several alumni chats, information sessions and panel discussions this semester. We kicked off the new semester with an APAM PhD Alumni panel. Undergraduate and graduate students had the opportunity to connect with **John Dwyer** (PhD '14, Applied Mathematics), a Lead Machine Learning Engineer at Dia & Co, **Kenneth Hammond** (PhD '17, Plasma Physics), a Staff Research Physicist at Princeton Plasma Physics Laboratory, **Nikolaus Rath** (PhD '12, Plasma Physics) a Site Reliability Engineer at Google, and **Melinda Han** (PhD '10, Applied Physics) a Chief Data Scientist at Dstillery. Our alumni answered a series of questions regarding their positions, how they got there, and how their positions evolved during the pandemic.

The APAM Department worked in collaboration with the Mechanical Engineering and Earth and Environmental Engineering departments to host a series of industry showcases this Spring. The topics included Health & Medical Technology, Energy & Sustainability, and Computer Technology & Digital Innovation. We had the privilege to connect with several alumni from SEAS, including APAM graduate **Endri Mani** (MS '15, Materials Science) who is Head of the Data Science Platform at RBC. Our department hosted a range of employers in addition to our wonderful alumni. These company partners included BD, Enertis, IBM, Memorial Sloan Kettering, Johns Hopkins Applied Physics Laboratory and many more. 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.

Du & Tian Publication Selected a Springer *Nature* 2020 Research Highlight

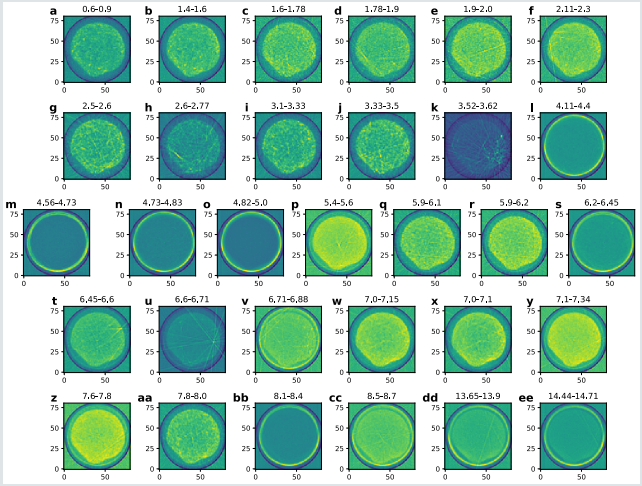
A publication by **Prof. Qiang Du** and **Dr. Xiaochuan Tian** (PhD '17, Applied Mathematics), "Mathematics of Smoothed Particle Hydrodynamics: A Study via Nonlocal Stokes Equations", was one of six papers selected as a Springer *Nature* 2020 Research Highlight in Mathematics – "a selection of the most popular articles and book chapters published last year and reflecting top research that made an impact." Qiang Du is the Fu Foundation Professor of Applied Mathematics and is affiliated with Columbia's Data Science Institute. Xiaochuan Tian is an Assistant Professor in the Department of Mathematics at the University of California, San Diego.

Is there Life on Mars?

NASA's Mars Perseverance Rover recently landed on the surface of Mars with a mission to search for signs of ancient microbial life. One of Perseverance's tools can pick up and store rocks that will be later brought back to earth for study. To avoid contamination (of the rocks by the earth environment but also of the earth environment by the rocks[1]!) the rocks will be entombed in sarcophagi. These are titanium-aluminum-vanadium alloy tubes that are sealed shut. It will then be necessary to carry out structural and morphological analyses of the rocks in place inside the tubes. They won't be here for 10 years or so, so we have time to prepare.

As part of his PhD thesis, **Chris "CJ" Wright** (PhD '19, Materials Science & Engineering), developed a software analysis framework and tested it on a phantom sample containing Earth rocks that are similar to Mars rocks. The strategy was to combine computed tomography with x-ray diffraction and PDF analysis that is a specialty of **Prof. Simon Billinge's group**, to get cross-sectional spatially resolved images that contain complete information about the local structure at each position in the rock. Working with scientists from Stony Brook University and Brookhaven National Laboratory (BNL), CJ used high energy x-rays from the National Synchrotron Light Source II (NSLS-II) at BNL to get thousands of diffraction images at different positions and orientations of the sample, and developed a streaming data analysis pipeline that converted the data to scientifically useful functions and did the tomographic reconstructions. The resulting images have a somewhat 'other worldly' look, but contain vital scientific information that can give geologists insights into the geological and climactic history of the red planet. This is a preliminary piece of work that shows how feasible it is to do a complete, spatially resolved, structural characterization of the rocks in place inside their sarcophagus and formed part of CJ's PhD thesis.

[1] https://en.wikipedia.org/wiki/The_War_of_the_Worlds



Images from CJ Wright's thesis, "Towards Real Time Characterization of Grain Growth from the Melt" (Billinge Group)

Speigelman Named APAM Chair

Marc Spiegelman

Marc Spiegelman, the Arthur D. Storke Memorial Professor of Earth and Environmental Sciences and Professor of Applied Physics and Applied Mathematics, has been named Chair of the APAM Department, effective July 1, 2021.

Spiegelman develops theoretical and computational tools to understand the dynamics and observable consequences of fluid flow in strongly deformable porous media. These general problems have critical applications in Earth Science including the flow of magma and fluids in the deep earth, the role of fluids in earthquake physics, reactive cracking for geological carbon sequestration and the effects of subglacial hydrology on the stability of ice-sheets.

All of these problems require a consistent coupling of fluid and solid dynamics together with thermodynamics. Driven by these applications, his computational research focuses on methods and software for more flexible exploration and solution of these and other multi-physics problems. In particular, his group, has been developing several open-source software packages that leverage advanced computational libraries into flexible model building systems for both mechanics and thermodynamics with the goal of providing more flexible, transparent and reproducible computational research.

Spiegelman received a B.A. in Geology from Harvard University in 1985 and a PhD in Geology and Geophysics from the University of Cambridge in 1989. He holds a joint appointment between the APAM and the Department and the Earth and Environmental Sciences (DEES). He is also a member of the senior staff at the Lamont-Doherty Earth Observatory (LDEO) and has multiple collaborations to integrate theoretical models with Lamont's strong observational and experimental programs in petrology, geochemistry, and mantle and cryosphere dynamics. He received the DEES Outstanding Teaching Award 1998 and 2002, the SEAS Alumni Teaching Award in 2004, and the SEAS Kim Award, also in 2004. The Kim Award was created to honor a faculty member who is not only an excellent teacher, but one who also shows a special and personal commitment to students.

Irving Herman

The APAM Department bids a fond farewell to **Irving P. Herman**, the Edwin Howard Armstrong Professor of Applied Physics, who served as Chair for nine years in total - from 2006-2012 and then from 2018-2021.

Herman graduated with SB and PhD degrees in physics from MIT in 1972 and 1977. From 1977-1986 he was a member and section leader in O-group within the Physics Department at the Lawrence Livermore National Laboratory, where he was engaged in research in laser isotope separation of deuterium and tritium, and the use of direct laser writing in thin film processing. In 1986, he joined the faculty of Columbia University in the APAM Department. He is a member of the Columbia Nano Initiative (CNI) and the Columbia Materials Research Science and Engineering Center (MRSEC), which he directed from 1998-2010. He is Director of the Columbia Optics and Quantum Electronics IGERT (Integrative Graduate Education and Research Traineeship program).

Herman has written three comprehensive books: the monograph *Optical Diagnostics for Thin Film Processing* (Academic Press, San Diego); the textbook *Physics of the Human Body* (Springer, Berlin-Heidelberg-New York), now in its second edition; and *Coming Home to Math: Become Comfortable with the Numbers that Rule Your Life* with World Scientific. He has also developed three interactive seminars on ethics and presents them to students in his department.

The Department is indebted to Prof. Herman and his outstanding leadership. Prof. Marc Spiegelman said, "Through three separate rounds as Chair (a feat I am hoping not to repeat), Prof. Herman has demonstrated unflagging dedication to the Department and its many different programs. The challenges and uncertainties of the last year have been particularly daunting, yet he always rose to meet every one. Through an immense amount of work, he has left us well positioned to meet a hopefully brighter future. We cannot thank him enough".

Faculty Updates

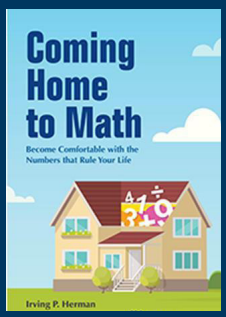
Mark Cane, the G. Unger Vetlesen Professor *Emeritus* of Earth and Climate Sciences and Professor *Emeritus* of Applied Physics and Applied Mathematics, was featured in the article, "The sun may offer key to predicting El Niño, groundbreaking study finds" in *The Washington Post*. **https://wapo.st/3bmPa2y**

Prof. Michal Lipson's group's paper, "2D beam steerer based on metalens on silicon photonics," was named an *Optics Express* Top Download in both January and February 2021. **doi.org/10.1364/OE.409711**

Prof. Carlos Paz-Soldan, a co-author of a new *Physical Review Letters* article, "Quasisymmetric Optimization of Nonaxisymmetry in Tokamaks," was featured in numerous media outlets, including *ScienceDaily*, *Medium*, *Newswise*, *Florida News Times*, and *Newsmag365*, among others. "The process designed to harvest on Earth the fusion energy that powers the sun and stars can sometimes be tricked. Researchers at the U.S. Department of Energy's (DOE) Princeton Plasma Physics laboratory have derived and demonstrated a bit of slight-of-hand called "quasi-symmetry" that could accelerate the development of fusion energy as a safe, clean and virtually limitless source of power for generating electricity." **doi: 10.1103/PhysRevLett.126.125001**

Prof. Chris Wiggins was featured in the article, "Bayes' Theorem Helps Us Nail Down Probabilities", by: Mark Mancini on *How Stuff Works*. **https://bit.ly/33Doqq8**

Coming Home to Math - Problems & Solutions



Last year, Prof. Irving Herman published a semi-popular book for adults, *Coming Home to Math*. The purpose of his book is to make adults with little technical training more comfortable with math, in using it and enjoying it, and to allay their fears of math, enable their numerical thinking, and convince them that math is fun. A range of important math concepts are presented and explained in simple terms, mostly by using arithmetic, with frequent connections to the real world of personal financial matters, health, gambling, and popular culture.

Problems are posed and solved in each chapter of Coming Home to Math, but because it is not a textbook there are no problems at the end of each chapter. Prof. Herman has just uploaded problems and solutions at http://www.irvingpherman.com/coming-home-to-math/ that illustrate content in the book and that are designed to further math thinking and use; he will continually update them.

Yuan Yang Wins 3M Non-tenured Faculty Award

Yuan Yang

Yuan Yang, Associate Professor of Materials Science and Engineering, has won a 3M Non-tenured Faculty Award. This award recognizes outstanding new faculty who were nominated by 3M researchers and selected based on their research, experience, and academic leadership. Prof. Yang was recognized for his work in radiative cooling paints for thermal management. He received a $15,000 prize in April 2021 which he will use to support further development of high-performance radiative cooling paint.

Prof. Yang earned his PhD in Materials Science and Engineering from Stanford University in 2012 and then worked as Postdoctoral Associate in the Department of Mechanical Engineering at MIT until 2015. He joined the faculty in the APAM Department in Columbia Engineering in 2015 and was promoted to Associate Professor in 2020. He was named a 2019 Emerging Investigator by *Journal of Materials Chemistry*, received the 2019 Young Innovator Award by Nano Research, was named a 2017 Scialog Fellow for Advanced Energy Storage, and received a 2017 Research Initiatives for Science and Engineering (RISE) Award from Columbia University.

Katayun Barmak

Barmak Serves on Organizing Committee for SIAM Conference on Mathematical Aspects of Materials Science

Katayun Barmak, the Philips Electronics Professor of Applied Physics and Applied Mathematics and Materials Science and Engineering, served on the Organizing Committee of Society of Industrial and Applied Mathematics (SIAM) Conference on Mathematical Aspects of Materials Science MS21. The conference was to have taken place in Bilbao, Spain, in spring of 2020, but was cancelled as a result of the COVID-19 pandemic. Instead, the conference took place fully online from May 17-28, 2021. Barmak was also a co-organizer, together with Yekaterina Epshteyn of the Department of Mathematics, University of Utah, of the mini-symposium "MS03 – Polycrystalline Microstructures: Recent Advances and New Trends".

The conference website notes: "Since 1994, every 2-4 years the SIAM Materials Activity Group organizes the SIAM Conference on Mathematical Aspects of Materials Science. This conference focuses on interdisciplinary approaches that bridge mathematical and computational methods to the science and engineering of materials. It provides a forum to highlight significant advances as well as critical or promising challenges in mathematics and materials science and engineering. In keeping with tradition, the conference seeks diversity in people, disciplines, methods, theory, and applications." **http://www.bcamath.org/en/other/siam-ms20**

Technology Innovations for Urban Living in the Face of COVID-19

Kyle Mandli

Through an Urban Tech Pilot program in Columbia Engineering, **Kyle Mandli** and collaborators within Civil Engineering and IEOR, along with researchers at the Mailman School of Public Health within the National Center for Disaster Preparedness, have been researching how to best prepare for how a pandemic and the next super-storm might collide and how we might best prepare for it.

This is, of course, not theoretical. In 2020 alone, 22 natural disasters caused a billion dollars of estimated damage or more. In New York City, making decisions as to how to best evacuate and shelter people due to an incoming hurricane, while also keeping them socially distanced, is, unfortunately, often a contradictory goal. The researchers hope to find ways to mitigate this problem and other natural disasters by both considering modeling the events themselves and keeping people as distributed as possible.

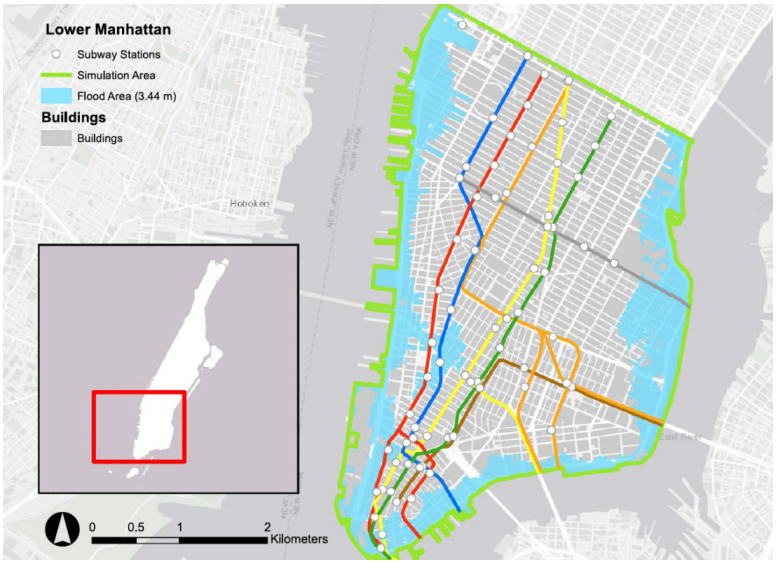


Image of the NYC subway system, flooding areas, and simulations areas

Determining the Best Protection from Sea Level Rise and Storm Surge

Researchers led by Professor **Kyle Mandli** and colleagues, Professor George Deodatis in Civil Engineering and Professor **Daniel Bienstock** in IEOR/APAM, have published a paper that attempts to provide a way to determine the best way to protect coastlines from future storm surge and sea level rise.

Unique to the work, is the incorporation of NYC stake-holder input that was incorporated into the approach. This was made possible thanks to a tight collaboration with researchers at the National Center for Atmospheric Research (NCAR), Heather Lazrus and Rebecca Morss, who lead this aspect of the research. With this feedback, the strategies combined both quantitative results with qualitative information from a number of city and state agency and community leaders, hopefully leading to a more robust solution for all involved.

Miura, Y., Qureshi, H., Ryoo, C. et al. A methodological framework for determining an optimal coastal protection strategy against storm surges and sea level rise. *Nat Hazards* 107, 1821–1843 (2021). https://doi.org/10.1007/s11069-021-04661-5

Qiang Du Wins USACM Hughes Medal

The 2021 Hughes Medal honors Du's "numerous innovative contributions to computational physics and computational fluid mechanics, and unwavering service to the scientific computing community."

By Jesse Adams, Originally published by Columbia Engineering

Qiang Du, the Fu Foundation Professor of Applied Mathematics, has earned the prestigious Thomas J.R. Hughes Medal from the U.S. Association of Computational Mechanics (USACM).

Presented in recognition of outstanding contributions to the field of computational field dynamics, the 2021 Hughes Medal honors Du's "numerous innovative contributions to computational physics and computational fluid mechanics, and unwavering service to the scientific computing community." He will receive the award during USACM's U.S. National Congress on Computational Mechanics in July.

As the faculty leader of the Computational Mathematics and Multiscale Modeling (CM3) group in the Department of Applied Physics and Applied Mathematics, Du conducts research at the interface of mathematical, computational, and data sciences through collaboration with experts across a broad range of fields. His work involves modeling, analysis, and algorithms with applications in physical, biological, materials, and information sciences. At Columbia, Du is also affiliated with the Data Science Institute and now co-chairs the Center for Computing Systems for Data-Driven Science. Previously, he co-chaired the Center for Foundations of Data Science from 2017 to 2019, and chaired the applied mathematics program from 2015 to 2020.

Du has previously earned numerous honors, including the Feng Kang prize in Scientific Computing and both the Outstanding Paper prize and SIGEST Award from the Society for Industrial and Applied Mathematics (SIAM). He is also a fellow of SIAM, the American Association for the Advancement of Science (AAAS) and the American Mathematical Society (AMS). Currently, Du is the editor-in-chief of the *SIAM Journal of Applied Mathematics* and the founding co-editor-in-chief of *Communications of the American Mathematical Society*, while serving on the editorial board of more than a dozen international journals.

Du Appointed Editor-in-Chief of *SIAM Journal on Applied Mathematics* & is Founding Co-Editor-in-Chief of New AMS Journal, *Communications of the American Mathematical Society*

Qiang Du has been appointed the Editor-in-Chief of the *SIAM Journal on Applied Mathematics* (SIAP). "SIAP is an interdisciplinary journal containing research articles that treat scientific problems using methods that are of mathematical interest and it is the founding journal of the Society for Industrial and Applied Mathematics (SIAM). The first volume of the journal appeared in 1953 and the foundations and evolution of applied mathematics can be found within its pages." (SIAM.org)

He is also the founding co-Editor-in-Chief of the American Mathematical Society's new journal, *Communications of the American Mathematical Society*. "The journal will be a natural home for both pure and applied mathematics, presenting a window into a holistic view of mathematics and its applications to a wide range of disciplines. In support of emerging research from mathematicians around the world, the journal will be published via the Diamond Open Access model." (AMS.org blog)

Du Appointed to SIAM Committee on Science Policy

Prof. Du has been appointed to the SIAM Committee on Science Policy. The Committee serves to assist SIAM in their efforts to "provide timely information to its membership regarding science policy and funding" and to provide "information to policy makers regarding issues of interest to its members when SIAM member's expertise offers something to contribute to the discussions. SIAM maintains links with several organizations whose role is to coordinate science policy or to advocate for science funding. Among those organizations are the Joint Policy Board for Mathematics (JPBM) and the Computing Research Association (CRA)." (Originally published on siam.org)

Soft Matter and Biomaterials on the Nanoscale

Oleg Gang (pictured on the left), professor of chemical engineering and of of applied physics and materials science, is editor-in-chief of World Scientific's recently published 4-volume set on *Soft Matter and Biomaterials on the Nanoscale* - the WSPC Reference on Functional Nanomaterials (Part I).

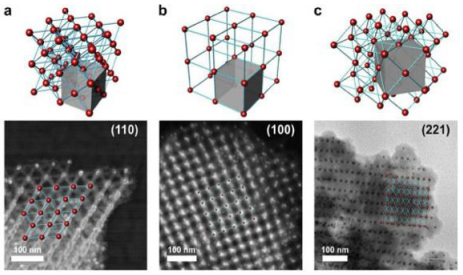
https://doi.org/10.1142/11763

Volume 1: Soft Matter under Geometrical Confinement: From Fundamentals at Planar Surfaces and Interfaces to Functionalities of Nanoporous Materials
Volume 2: Polymers on the Nanoscale: Nano-structured Polymers and Their Applications
Volume 3: Bio-Inspired Nanomaterials: Nanomaterials Built from Biomolecules and Using Bio-derived Principles
Volume 4: Nanomedicine: Nanoscale Materials in Nano/Bio Medicine

Building Tough 3D Nanomaterials with DNA

Columbia Engineers use DNA nanotechnology to create highly resilient synthetic nanoparticle-based materials that can be processed through conventional nanofabrication methods; new technique should lead to significant advances in mechanics, electronics, plasmonics, photonics, superconductivity, and energy materials

By Holly Evarts, Originally published by Columbia Engineering



Images: Different types of nanoscale lattices formed with polyhedra DNA nano-frames (tetrahedra, cubes, and octahedra) & gold nanoparticle are mineralized with controllable silica coating thicknesses (from about 5nm to a full space-filling).

Columbia Engineering researchers, working with Brookhaven National Laboratory, reported hat they have built designed nanoparticle-based 3D materials that can withstand a vacuum, high temperatures, high pressure, and high radiation. This new fabrication process results in robust and fully engineered nanoscale frameworks that not only can accommodate a variety of functional nanoparticle types but also can be quickly processed with conventional nanofabrication methods.

"These self-assembled nanoparticles-based materials are so resilient that they could fly in space," says **Oleg Gang, professor of chemical engineering and of of applied physics and materials science**, who led the study published by *Science Advances*. "We were able to transition 3D DNA-nanoparticle architectures from liquid state—and from being a pliable material—to solid state, where silica re-enforces DNA struts. This new material fully maintains its original framework architecture of DNA-nanoparticle lattice, essentially creating a 3D inorganic replica. This allowed us to explore—for the first time—how these nanomaterials can battle harsh conditions, how they form, and what their properties are."

Material properties are different at the nanoscale and researchers have long been exploring how to use these tiny materials—1,000 to 10,000 times smaller than the thickness of a human hair—in all kinds of applications, from making sensors for phones to building faster chips for laptops. Fabrication techniques, however, have been challenging in realizing 3D nano-architectures. DNA nanotechnology enables the creation of complexly organized materials from nanoparticles through self-assembly, but given the soft and environment-dependent nature of DNA, such materials might be stable under only a narrow range of conditions. In contrast, the newly formed materials can now be used in a broad range of applications where these engineered structures are required. While conventional nanofabrication excels in creating planar structures, Gang's new method allows for fabrication of 3D nanomaterials that are becoming essential to so many electronic, optical, and energy applications.

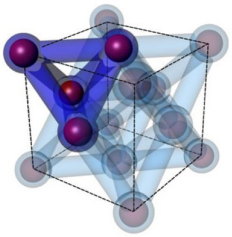


Image: Mineralization of 3D lattice formed by DNA tetrahedra (about 30 nm) and gold nanoparticle into all-inorganic 3D silica-Au replicas with preserved architecture.

Gang, who holds a joint appointment as group leader of the Soft and Bio Nanomaterials Group at Brookhaven Lab's Center for Functional Nanomaterials, is at the forefront of DNA nanotechnology, which relies on folding DNA chain into desired two and three-dimensional nanostructures. These nanostructures become building blocks that can be programmed via Watson-Crick interactions to self-assemble into 3D architectures. His group designs and forms these DNA nanostructures, integrates them with nanoparticles and directs the assembly of targeted nanoparticle-based materials. And, now, with this new technique, the team can transition these materials from being soft and fragile to solid and robust.

This new study demonstrates an efficient method for converting 3D DNA-nanoparticle lattices into silica replicas, while maintaining the topology of the interparticle connections by DNA struts and the integrity of the nanoparticle organization. Silica works well because it helps retain the nanostructure of the parent DNA lattice, forms a robust cast of the underlying DNA and does not affect nanoparticles arrangements.

"The DNA in such lattices takes on the properties of silica," says **Aaron Michelson,** a PhD student from Gang's group. "It becomes stable in air and can be dried and allows for 3D nanoscale analysis of the material for the first time in real space. Moreover, silica provides strength and chemical stability, it's low-cost and can be modified as needed—it's a very convenient material."

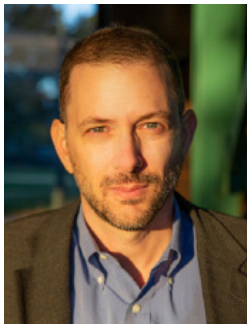
To learn more about the properties of their nanostructures, the team exposed the converted to silica DNA-nanoparticles lattices to extreme conditions: high temperatures above 1,000C and high mechanical stresses over 8GPa (about 80,000 times more than atmosphere pressure, or 80 times more than at the deepest ocean place, the Mariana trench), and studied these processes in-situ. To gauge the structures' viability for applications and further processing steps, the researchers also exposed them to high doses of radiation and focused ion beams.

"Our analysis of the applicability of these structures to couple with traditional nanofabrication techniques demonstrates a truly robust platform for generating resilient nanomaterials via DNA-based approaches for discovering their novel properties," Gang notes. "This is a big step forward, as these specific properties mean that we can use our 3D nanomaterial assembly and still access the full range of conventional materials processing steps. This integration of novel and conventional nanofabrication methods is needed to achieve advances in mechanics, electronics, plasmonics, photonics, superconductivity, and energy materials."

Collaborations based on Gang's work have already led to novel superconductivity and conversion of the silica to conductive and semiconductive media for further processing. These include an earlier study published by Nature Communications and one recently published by Nano Letters. The researchers are also planning to modify the structure to make a broad range of materials with highly desirable mechanical and optical properties.

"Computers have been made with silicon for over 40 years," Gang adds. "It took four decades to push the fabrication down to about 10 nm for planar structures and devices. Now we can make and assemble nanoobjects in a test tube in a couple of hours without expensive tools. Eight billion connections on a single lattice can now be orchestrated to self-assemble through nanoscale processes that we can engineer. Each connection could be a transistor, a sensor, or an optical emitter—each can be a bit of data stored. While Moore's law is slowing, the programmability of DNA assembly approaches is there to carry us forward for solving problems in novel materials and nanomanufacturing. While this has been extremely challenging for current methods, it is enormously important for emerging technologies."

"Resilient three-dimensional ordered architectures assembled from nanoparticles by DNA," Pawel W. Majewski, Aaron Michelson, Marco A. L. Cordeiro, Cheng Tian, Chunli Ma, Kim Kisslinger, Ye Tian, Wenyan Liu, Eric A. Stach, Kevin G. Yager, Oleg Gang. *Science Advances* 19 Mar 2021: eabf0617, DOI: 10.1126/sciadv.abf0617



Adam Sobel

Revitalize the Sciences

Three goals for the Biden administration as it seeks to put science-based responses at the center of its policy initiatives.

By Adam Sobel, Originally published by *Columbia News*

The Biden-Harris administration takes office in the wake of the most anti-science administration in memory. Indeed, the assault on science under Donald Trump—like the one on the media—has served to promote autocracy, by delegitimizing an institution that is an independent arbiter of truth. It also served to promote private profit over public well-being, by clearing the path for extreme deregulation of polluting industries. The new administration should move quickly to re-establish that science is essential to both democracy and ethical governance.

The early signs are very promising. Biden has named an unprecedentedly strong "climate team" and announced that his science adviser, geneticist Eric Lander, will be elevated to the Cabinet. Perhaps even more exciting, he has appointed social scientist Alondra Nelson (a Columbia faculty member from 2009-2019) as the Office of Science and Technology Policy's Deputy Director for Science and Society, a newly created position. Someone with Nelson's expertise in the connections between science, technology, medicine, and social inequality has, to my knowledge, not been this high up in U.S. government before. Science will be in good hands for the next four years. Here are three broad goals I hope the new administration will pursue.

1. Rebuild the Agencies: Critical agencies have been decimated under Trump. Government entities with missions that bear most directly on policy—and that are most essential to addressing ongoing crises—such as the Environmental Protection Agency and Center for Disease Control, have been hardest hit by censorship, political interference, budget cuts, and staff losses. Besides working to reverse the damage agency-by-agency, Biden could define and publicize a federal policy on the role of science. Key points should include that scientists can communicate freely with the media, that political appointees will not meddle in research, and that the content of scientific reports from agencies, advisory boards, and the like will not be subject to political oversight. Such a policy could underscore a strong hiring program to draw new scientific talent to demoralized and understaffed agencies.

2. Put the Public Interest First: While the private sector has an important role to play in many science-related public policy issues, government's first priority should be to look out for the public interest, defined broadly and inclusively. Trump's steps at disbanding scientific advisory panels in favor of industry-friendly committees selected by political appointees should be reversed. This concern applies most acutely to regulation of polluting industries—including, of course, the fossil fuel industry. But in addition to protecting the public from pollution, the government should resist privatization of key public goods: observational data used by government for weather and climate research and forecasting, as just one example, should remain free and open.

3. Justice at the Forefront: Harms from the COVID-19 pandemic, air and water pollution, climate change, and artificial intelligence are distributed unequally along racial and economic lines. Solutions that don't acknowledge these inequities will be unjust. Nelson's appointment shows that Biden recognizes this; now we can ask to see it manifest in policy. In the context of climate change, the emerging "standards, investments, and justice" framework, already endorsed by Biden, offers new hope for progress where the idea of an economy-wide carbon price (long viewed as theoretically preferable by economists) has largely failed. More broadly, government should "listen to the science," but also recognize that the most critical scientific issues before it are actually trans-scientific—meaning that science must be coupled to democratic values to best serve the public. At a time when much of the population believes in conspiracy theories and lies—not least about Biden's own election—governing on this basis will be challenging. On the other hand, truth and justice have never been more urgently needed.

Sobel on Earth Day, Riots, Climate Change, & More

Adam Sobel, professor of applied physics and applied mathematics and of earth and environmental sciences, studies weather and climate, with a focus on extreme weather events and a particular interest in the tropics. He was recently featured in the following journals and news outlets.

Why we need to take back Earth Day | *Bulletin of the Atomic Sciences* | **https://bit.ly/3o93Zeb**

Making the transition to a green economy: What is our responsibility as citizens? | *Bulletin of the Atomic Sciences* | **https://bit.ly/3o8CHoc**

The Science of Climate: A High Degree of Difficulty | *STEM Spots Podcast,* KSMU Radio | **https://bit.ly/3faYtFL**

The phony blame game on Texas weather | *CNN Opinion* | **https://cnn.it/3lDxvrr**

Riots in the Capitol. Is this who we are? | *Bulletin of the Atomic Scientists* | **https://bit.ly/3o4oOHU**

Usable climate science is adaptation science," *Climatic Change*, Springer, Vol. 166(1), pps 1-11, May. | **DOI: 10.1007/s10584-021-03108-x**

DEEP CONVECTION

Deep Convection Podcast - Season 2

Check out Season 2 of **Deep Convection**, a podcast created by **Prof. Sobel** and **Dr. Melanie Bieli** (PhD '19, Applied Mathematics). The show features real conversations between climate scientists and those working in areas adjacent to climate science.
https://deep-convection.org/

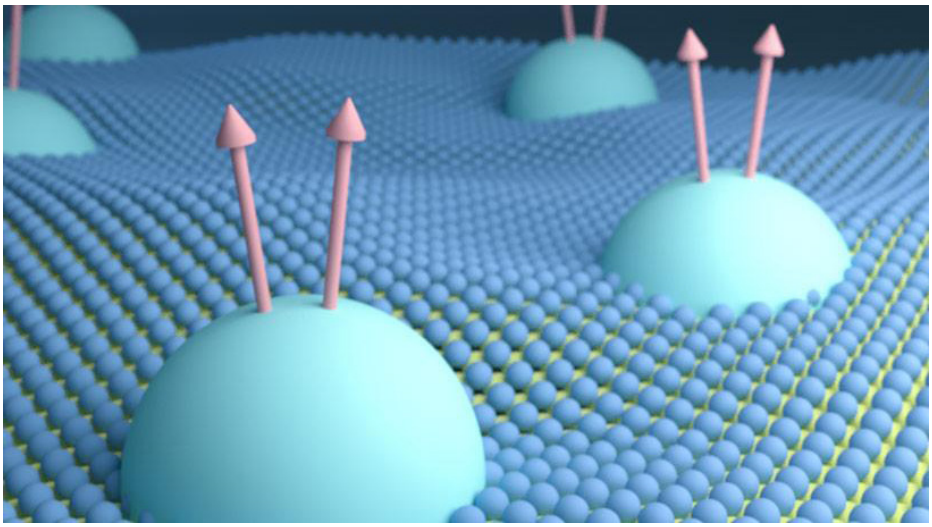


Image: Monolayer WSe2 hosting "composite fermions," a quasi-particle that forms due to strong interactions between electrons and is responsible for the sequence of fractional quantum Hall states.

Quantum Leaps

Originally published by
Columbia Engineering Magazine

There's much excitement about how quantum computers will transform communications technology. They may also very well hold a key to combating climate change. With their unparalleled computing power, quantum machines could allow researchers to finally construct the kind of supercharged simulations needed to develop the most energy efficient systems, by, say, vastly improving superconductors or better replicating natural processes. But to build scalable quantum computers—by nature a staggeringly delicate operation—we first must build a whole new material base for computing. Recently, faculty in mechanical engineering reported three such breakthroughs in 2D materials.

In a first, James Schuck and colleagues demonstrated a method for creating highly tunable single-photon emitters, which are functional even at room temperature (critical for many quantum-computation approaches). James Hone's group devised a new method for creating atomically thin layers stackable in any desired order and orientation. Hone also co-discovered a quantum fluid in a 2D semiconductor, establishing 2D conductors as a unique testbed for future applications.

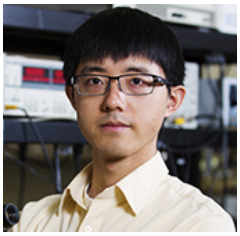
Engineering our way from fundamental science to networking devices is an intensively collaborative endeavor. Among the first class selected for federal quantum research funding since announcement of the National Quantum Initiative, our faculty earned two NSF grants to expand what's possible in partnership with university physicists.

Alexander L. Gaeta and **Michal Lipson** of applied physics and electrical engineering are helping pursue a new approach to attaining highly entangled photon states, while **Nanfang Yu** of applied physics is part of a team that could deliver a paradigm shift in interfacing light with complex 3D atomic lattices.

Such progress is spurred by new intellectual infrastructure. Recently, the university was named a partner in the Co-design Center for Quantum Advantage, which seeks to develop materials, devices, software, and applications that will serve as a platform for the next-generation of quantum computing capabilities.

Alexander Gaeta

Michal Lipson



Nanfang Yu

The university also joined forces with the Flatiron Institute and Germany's Max Planck Society to establish the Max Planck – New York City Center for Nonequilibrium Quantum Phenomena. With joint research appointments for faculty, postdocs, and graduate students, the center leverages Columbia's world class capabilities in materials synthesis and optics. By manipulating unstable quantum states and controlling these phenomena in complex, customizable materials, we can revolutionize not just computing, but also sensing, cryptography, and a host of technologies yet to be dreamt of.

Yoshi Okawachi

OSA Fellow Okawachi is Chair-Elect for Integrated Photonics Technical Group

Dr. Yoshitomo Okawachi, a Research Scientist working in **Prof. Alexander Gaeta's** Quantum and Nonlinear Photonics group, was named a 2021 Fellow of The Optical Society (OSA) "for pioneering contributions to slow light based on stimulated scattering and chip-based optical frequency combs." The OSA website states that this distinction was awarded to "118 OSA members, from 24 countries, for their significant contributions to the advancement of optics and photonics through education, research, engineering, business leadership and service."

Dr. Okawachi is also Chair-Elect for the Optical Society's Integrated Photonics Technical Group.

"OSA Technical Groups are vibrant and active communities that connect OSA members with colleagues and leaders within specialized topic areas from around the world. Individuals will serve as chair-elect of their group through December 2021 and will then serve as chair for a three-year term starting in 2022. Elected by their fellow members, these individuals will be responsible for selecting an executive committee to collaborate with to foster the sense of community among the members of their group. Working together, they will organize special events featuring tailored programming, host webinars on hot topics, and share information on the latest developments in their field on throughout their three-year terms." (The Optical Society)

Diversity, Equity, & Inclusion Awareness & Training

The APAM Department hosted a Diversity, Equity, and Inclusion (DEI) Awareness and Training Workshop for APAM faculty, staff, students, and researchers on Friday, November 6, 2020, as part of Dean Mary Boyce's DEI Strategic Action Plan for Columbia Engineering. The goal of the workshop was to generate discussion on topics of diversity, equity, and inclusion, that informed and guided the next steps to advance Columbia Engineering's DEI activities and efforts.

The Columbia Engineering DEI commission (which included committee member Renata Wentzcovitch, Professor of Applied Physics and Applied Mathematics), recently prepared a draft Commission report with a detailed action plan and recommendations. The Commission has identified the following priority DEI impact areas.

- **Faculty/Students: strengthening the pipeline for student and faculty recruiting would lead to a more diverse and inclusive environment.**
- **Environment: prioritizing a welcoming culture for students of all backgrounds would attract more talent to the School and aid in recruitment.**
- **Integration: better integration of DEI across research, education, and innovation would create the type of infrastructure to support all of our DEI efforts.**

Read the full report at: https://www.engineering.columbia.edu/diversity-equity-inclusion-commission

Inclusion & Belonging at Columbia University

Check Columbia University's Office of University Life website for more resources.
https://universitylife.columbia.edu/inclusion-belonging

- **Columbia's Commitment to Anti-Racism**
- **Resources for Promoting Racial Justice and Combating Bias**
- **The Task Force on Inclusion and Belonging at Columbia**
- **Working Group on Inclusive Public Safety**
- **The Graduate Initiative for Inclusion and Engagement**
- **DACA and Undocumented Students**
- **Racial Justice Mini-Grant Program**
- **LGBTQ Community at Columbia**
- **Campus Conversations,**
- **Religious Community at Columbia**

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**

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Eileen Barosso, Simon Billinge, Columbia Engineering, Columbia Engineering Magazine, Kyle Mandli, CJ Wright