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# APAM NEWS

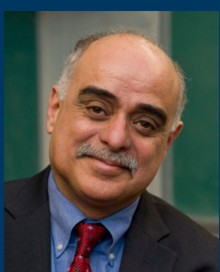
## THE DEPARTMENT OF APPLIED PHYSICS & APPLIED MATHEMATICS

THE FU FOUNDATION SCHOOL OF ENGINEERING & APPLIED SCIENCE, COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK





Featured Faculty: Kyle Mandli, Qiang Du, Mort Friedman, Adam Sobel, and Nanfang Yu



Dear Colleagues,
Students, Alumni,
& Friends of APAM,

In 2014 we had good and bad news. Our Applied Mathematics Program was strengthened by the arrivals of Professors Qiang Du and Kyle Mandli. We were able to successfully recruit Professor Alex Gaeta from Cornell University to join our Condensed Matter/Optics program. He will be coming on board in 2015. Our Materials Science Program is renovating its teaching laboratories and is in the process of revising its undergraduate and graduate curriculum. Our new transmission electron microscope is on schedule to be delivered on December 18th. We are also in the process of searching for a faculty member who is an expert in materials synthesis, who, we hope, will join us next year. We are, thus, entering 2015 with optimism. On the other hand, we are saddened by the loss our beloved colleague Professor Morton B. Friedman who was the co-founder of our Applied Mathematics Program. We will truly miss him.

I wish all of you Happy Holidays and a Wonderful New Year.

Best regards,

I. Cevdet Noyan
Chair, APAM

## In This Issue

Haris Durrani

## Focus on APAM Egleston Scholars

**Haris Durrani, a Senior in Applied Physics, was featured in the article "Meet the Future - Bold & Dynamic Students of SEAS" in Columbia Engineering by Elaine Rooney**

Whether it's pioneering space law, writing science fiction novels, or fighting for the rights of disenfranchised communities, **Haris Durrani's** ambitions are as big and bold as his already stellar collection of achievements. His résumé boasts a list of heady accomplishments: award-winning author, editor, Egleston Scholar, cofounder and co-creator of the Muslim Protagonist Symposium, founder of a FIRST Tech Challenge Robotics Team, and the list goes on. Famous authors have lauded his work; he has been published and thrice interviewed on NPR's *The Takeaway*. He has received countless awards and honors, including a Creativity and Citizenship Award from the Center for Constitutional Rights and a National Gold Medal Portfolio from Scholastic Art and Writing Awards, and he was named a Minority Undergraduate Physics Major Scholar by the APS. To amass all this over the course of a lifetime would be duly impressive. But Durrani, a college senior, has not even graduated yet.

Durrani's passion for engineering and science stems from childhood, beginning with building with LEGOs and playing with science kits. In high school, he established his hometown's FIRST LEGO League and FIRST Tech Challenge teams in Westport, CT. Within 3 years he led the teams to 1$^{st}$ place finishes at the World Championship. He understood the power of robotics.

He knew early on what set engineering apart for him. "Most fields are fascinating in theory," he says. "Engineering is a field that I love from the meta to the nitty-gritty."

What is especially impressive about Durrani is his pan-disciplinary thirst for the interesting and his ability to let his various interests inform one another. An Applied Physics major at SEAS, Durrani also is a talented writer. He uses literature as an outlet for exploration—a vehicle to contextualize science, engineering, space—and a means to examine his identity as a Dominican, Pakistani American Muslim.

"Literature helped me understand that engineering and science exist in their social contexts and that an understanding of social, political, and moral implications is just as important—if not more important—as engineering formulae and methods." It was this social consciousness that drew Durrani to Columbia Engineering. "SEAS had an emphasis on social responsibility and humanities that I didn't see elsewhere," he says.

Durrani is committed to the pursuit of social justice, and it underlines all he achieves. It was the impetus for his cofounding the Muslim Protagonist Symposium, with Barnard alumna Mirzya Syed, at Columbia to "use literature as an agent of social, intellectual, and spiritual change." It is also the catalyst for his interest in space law.

Last year, Durrani participated in an independent study with NASA astronaut and Columbia Engineering professor, Michael Massimino BS'84, where he investigated the political and legal implications related to space debris and policy. "I believe that if we invest the time in forming the law now, we can make sure the final frontier is a feasible one. It's a field that I feel I can go into, helping to form its paradigms rather than merely improving what has already been done before." For Durrani, who is by nature a builder, whether of robots or of stories, being able to craft something from its infancy has always been an attractive prospect.

Fittingly, what's exciting to Durrani about his future isn't the realization of one particular goal but the sum force of all his passions being realized. Sharing a quote of one of his favorite authors, fellow Columbian Isaac Asimov, Durrani says, "Knowledge is indivisible. When people grow wise in one direction, they are sure to make it easier for themselves to grow wise in other directions as well." Indeed, Durrani embodies this principle by looking for the connectivity in all he pursues.

**Congratulations to our outstanding student award winners!**

**Undergraduate Egleston Scholars:**
Sean Ballinger (AP), Haris Durrani (AP),
Antón Baleato Lizancos (AP), Ari Turkiewicz (AP)

**Graduate Student Award Winners:**
Melissa Abler (PP) - Provost's Diversity Fellowship
Soham Banerjee (MSE) - DOD NDSEG Fellow
Eric Isaacs (SS) - DOE CSGF Fellow
Michael Jenkinson (AM) - NSF IGERT Fellow
Mordechai Kornbluth (SS) - Presidential Fellow
Dennis Wang (SS) - NSF IGERT Fellow

**Sean Ballinger** is majoring in Applied Physics with a minor in Computer Science. Before graduating from Phillips Academy, Sean conducted research on a nanoparticle catalyst for hydrogen fuel cells at SBU, and was a semifinalist in the Intel Science Talent Search competition. He has also worked as a software intern at the German Aerospace Center in Göttingen, implementing pressure-sensitive paint for aerodynamics testing.

Sean has been involved in the High-Beta Tokamak fusion experiment at Columbia's Plasma Physics Lab, where he helped with the construction of a new coil and is writing code to calculate plasma currents. As an intern at the Advanced Supercomputing Division of NASA's Ames Research Center, he ran simulations of the D8 "Double Bubble" aircraft concept on the Pleiades supercomputer, and as a National Undergraduate Fellow at General Atomics last summer, Sean worked to characterize plasma controllability in superconducting tokamaks and built on the TokSys simulation model to automate plasma control system configuration.

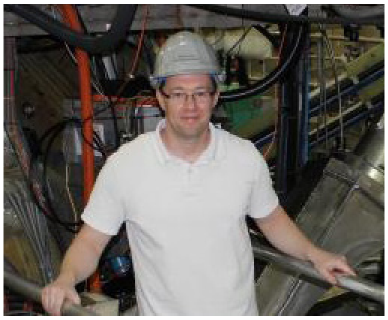
He serves as an associate editor for the *Columbia Undergraduate Science Journal*, and recently received the Outstanding Undergraduate Poster Presentation Award from the APS Division of Plasma Physics during the 56th Annual Meeting in New Orleans.

**Antón Baleato Lizancos** was born and raised in Galicia, Spain. He spent two years before coming to Columbia living and studying at Lester B. Pearson United World College near Victoria, BC. There, he was part of a high school community of 160 people from over 90 different countries, all of them on full scholarship, living under the premises of international understanding, celebration of difference, sustainability and change through action. This experience deeply inspired him and shaped the way he sees the world today.

At Columbia, Antón has been able to satisfy his scientific curiosity through the study of Applied Physics with a minor in Applied Math. He is a research assistant at the Columbia Experimental Cosmology Lab, where he has joined efforts in the development of new detectors to observe the Cosmic Microwave Background. He is currently working on a project concerning unique, high-resolution, stratospheric observations of polar mesospheric clouds.

He hopes to have a career in Astrophysics or Cosmology, where he can harness the elegant tools offered by mathematics to probe the inner workings of the universe. His interest in Astrophysics was strengthened during the summer of 2014, when he interned at the department of Physics at Oxford University, searching for Supernova remnants in very low radio frequency data from the Low Frequency Array (LOFAR) under the supervision of Dr. Anderson and Dr. Broderick.

**Ari Turkiewicz**, an Applied Physics senior from Plainview, NY, focuses on solid-state physics and organometallic chemistry. He hopes to unite these fields by using synthetic chemistry to build functionality into bulk materials. During his first two years at Columbia, he worked in the lab of Prof. Colin Nuckolls, studying the electronics of single molecular clusters. Since then, he has worked with Prof. Xavier Roy, synthesizing electromagnetically active, solid-state materials using clusters as building blocks, and recently published his research in the *Journal of the American Chemical Society*. Ari is currently a contributor and content reviewer for the *Columbia Science Review*, as well as a member of the Columbia Ski Club.



## Grierson '09 Wins DOE Early Career Research Program Grant

**By John Greenwald**
**courtesy of the Princeton Plasma Physics Laboratory**

Physicist **Brian Grierson (Ph.D. '09, Plasma Physics)** of the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) has won a highly competitive Early Career Research Program award sponsored by the DOE's Office of Science. The 5-year grant will total some $2.5 million and will fund exploration of the mechanisms that govern the formation and maintenance of the hot edge of fusion plasmas — the electrically charged gas that results in fusion reactions in facilities called tokamaks. The work will be carried out on the DIII-D National Fusion Facility in San Diego.

Understanding and controlling the edge of hot fusion plasma is crucial for achieving high performance in devices like the ITER tokamak, the world's largest fusion experiment currently under construction in the south of France.

The award for Grierson, who is on long-term assignment to the DIII-D National Fusion Facility operated by General Atomics for the DOE, marks the second Early Career grant to PPPL physicists in as many years. Ahmed Diallo, who serves as deputy boundary-group leader for PPPL's National Spherical Torus Experiment (NSTX), won a 5-year award for research on the plasma edge last year.

**Exceptional ability**: The Early Career grants fund scientists who have demonstrated exceptional ability. This year's awards went to 35 researchers who were chosen from among some 750 applicants from across the country. "By supporting our most creative and productive researchers early in their careers, this program is helping to build and sustain America's scientific workforce," said Patricia M. Dehmer, Acting Director of DOE's Office of Science.

Grierson's research focuses on a thin, roughly thumb-wide slice of the plasma edge called the "pedestal" in which conditions change very rapidly, becoming far hotter and denser toward the plasma core. "It's like going from the surface atmosphere to the bottom of the sea," Grierson said of the transition, "only this change happens in a very small distance."

Conditions within the little-understood pedestal can strongly affect the core of the plasma where fusion reactions take place. Comprehending what happens in the pedestal can thus lead to better confinement, greater stability and more fusion power in tokamak plasmas.

Funds from the Early Career award will enable Grierson to install new diagnostic equipment on the DIII-D tokamak and bring in 2 postdoctoral fellows to assist with the research. Included in the new equipment will be 16 fiber-optic lines to relay light from the edge of the plasma to new spectrometers — devices that measure and record shifts in the spectrum of light — and to high-speed scientific cameras. Grierson will work closely with researchers from General Atomics, Oak Ridge National Laboratory, Lawrence Livermore National Laboratory and several U.S. universities to leverage this new measurement capability towards an improved understanding of the pedestal region.

**Testing computer models**: Results of Grierson's experiments will test computer models that seek to predict conditions such as the temperature and pressure of the deuterium atomic nuclei, or ions, the main fusion fuel. The behavior of these fueling ions has proven far more difficult to measure than the behavior of impurities that enter the edge of the plasma from the walls of a tokamak and have been studied in detail. "Our research combines diagnostic development with model validation," Grierson said.

Current methods infer the behavior of the main fueling ions from the properties of impurity ions. However, there is significant uncertainty in these inferences because of the complexity of the physics at the plasma edge. So direct measurement of the fueling ions is essential to advance understanding of edge-plasma physics and to test emerging plasma models.

Those building edge models include theorists from PPPL and General Atomics who are developing complex, large-scale simulation codes to run on supercomputers. "There's a lot of theoretical work out there and the question is how to tie it all together with state-of-the-art measurements," noted PPPL physicist Richard Hawryluk, who oversees the Laboratory's collaboration with General Atomics on DIII-D.

Grierson's new research will employ techniques that he previously developed to measure the properties of main ions in the plasma core. "The challenges at the core were overcome by comprehensive modeling and detailed spectral analysis," he said. "As we get to the edge there will be new challenges as well."

While such challenges could be great, the scientific results could be greater. Combining measurement of the main ions with validation of models of the plasma edge could help pave the way for high-performance operation of ITER and future tokamaks, Grierson said.

**Photo: Grierson at the DIII-D tokamak**
**(General Atomics, Lisa Petrillo, Strategic Communications)**

## Alumni Reports *(Columbia Engineering News)*

**John Doorish, (M.S. '85, Applied Physics) president and founder of Doorish Ophthalmic Technologies, recently opened the Doorish Research in Science and Technology Institute and the Annunciata Doorish Foundation for Animal Welfare. Doorish Ophthalmic Technologies uses the Artificial Retinal epiProsthesis to restore sight to blind humans and animals. The Research Institute aims to investigate different applications of this technology, both in medical and non-medical fields. The Annunciata Foundation is being established as a private, nonprofit animal welfare organization dedicated to the health and well-being of all animals.**

**Suzanne Keilson (M.S. '87, Ph.D. '91 Applied Physics) is an associate dean of Loyola College at Loyola University Maryland's school of arts and sciences. She teaches in the Engineering Department and enjoys STEM outreach. She is also involved with the American Society for Engineering Education and will serve on the national board for the next two years.**

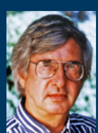
## Faculty Updates

**Simon Billinge was featured in the *Columbia Engineering Magazine* article, "Studying the Tiniest of Details." By learning how these ultrafine particles between 1 and 100 nanometers in size behave within nanomaterials measured in billionths of a meter, Billinge hopes to optimize their performance and utility in biomedical, optical, and electronic applications.**

**In recognition of his 70th birthday, the Lamont-Doherty Earth Observatory hosted "The Tropics Rule: A Symposium Honoring Mark Cane's Contribution to Climate Science," from October 20-21.**

**Cane was also featured in the *New York Times'* article, "In the Parching West, It's Beginning to Feel like 1159," by Andrew Revkin. The article highlights research from the paper, "North American Drought: Reconstructions, Causes, and Consequences," by Cook, Seagar, Cane, and Stahle (*Earth-Science Reviews*, 2007).**

**Lorenzo Polvani was named a Fellow of the American Meteorological Society. Fellows are chosen for "outstanding contributions to the atmospheric or related oceanic or hydrologic sciences or their applications during a substantial number of years."**



**Chris Scholz released his new novel, *Stick-Slip*, about a retired earthquake expert who predicts that a magnitude-nine earthquake is going to rock the Pacific Northwest.**

**Prof. Chris Wiggins was recently featured in the *Fast Company* article, "Most Creative People: *New York Times* Chief Data Scientist Chris Wiggins on the Way We Create and Consume Content Now," by Leah Hunter. "At The *New York Times*, we produce a lot of content every day, but we also have a lot of data about the way people engage with that content," Wiggins says. "[*The Times*] wanted to build out a data science function not only to curate and make available those data, but to learn from those data.**

Nanfang Yu

## Yu Wins NSF Grant

Nanfang Yu, Assistant Professor of Applied Physics, leads a team of researchers who have won a $400k three-year grant from the NSF Physics of Living Systems (PoLS) program. Their project, "Perception and Use of Infrared Radiation by Insects," aims to understand the physical mechanisms underlying the ability of insects to perceive infrared light and to learn engineering lessons that can be used to create novel infrared materials, devices, and systems.

The project will investigate some long-standing mysteries regarding the ability of insects to perceive and respond to infrared radiation, which has a wavelength ranging from 0.7 to 20 micrometers. While many studies have focused on the physical optics of living systems in the UV and visible spectral range, an understanding of the role of infrared light in the lives of insects and other animals is rather limited. A number of compelling examples support the hypothesis that insects can perceive and respond to broadband thermal infrared radiation with high sensitivity, or narrowband "fingerprint" infrared radiation with high specificity. The objective of the project is to understand the physical mechanisms underlying the ability of insects to perceive broadband or narrowband infrared radiation.

The team include physicists lead by Prof. Yu from APAM and biologists lead by Prof. Naomi Pierce from the Organismic and Evolutionary Biology Dept. and the Museum of Comparative Zoology at Harvard University. The research groups will bring in their expertise in insect ecology, animal behavior, optical science, and electrical engineering to conduct this highly interdisciplinary research.

## New Applied Mathematics Faculty Members

Qiange Du

### Qiang Du

Dr. Qiang Du is the Fu Foundation Professor of Applied Mathematics. He is also an affiliated member of the Institute for Data Sciences.

Professor Du earned his Ph.D. in Mathematics (1988) from Carnegie Mellon University, after which he has held faculty positions at University of Chicago, Michigan State University, Iowa State University, and Hong Kong University of Science and Technology. Dr. Du was most recently the Verne M. Willaman Professor of Mathematics and Professor of Materials Science and Engineering at Penn State University.

Recognitions include the Frame Faculty Teaching Award (1992) at Michigan State University, the Liberal Arts and Sciences Award for outreach/extension (2000), the Feng Kang prize in scientific computing (2005), the Eberly College of Science Medal (2007) from Penn State University, and his selection as a 2013 SIAM Fellow for contributions to applied and computational mathematics with applications in materials science, computational geometry, and biology.

His research interests are numerical analysis, mathematical modeling and scientific computation with selected applications in physical, biological, materials, data and information sciences.

Kyle Mandli

### Kyle Mandli

Dr. Kyle Mandli is an Assistant Professor of Applied Mathematics.

Professor Mandli comes to Columbia from the University of Texas at Austin where he was a Research Associate at the Institute for Computational and Engineering Sciences working in the computational hydraulics group. He received his Ph.D. in Applied Mathematics in 2011 from the University of Washington studying multi-layered flow as it applies to storm-surge simulation.

His research interests involve the computational and analytical aspects of geophysical shallow mass flows such as tsunamis, debris-flow and storm-surge. This also includes the development of advanced computational approaches, such as adaptive mesh refinement, leveraging new computational technologies, such as accelerators, and the application of good software development practices as applied more generally to scientific software.

## Tippett & Sobel Sign Contract with FM Global

Prof. Michael Tippett (lead PI) & Prof. Adam Sobel (co-PI) recently signed a research contract with FM Global to support the project "Development & analysis of environmental indices for the spatial distribution of hail occurrence & size."

The project has completed its first phase ($34K) and is about to move forward with the second phase of the research ($45K). Postdoc, John Allen, is carrying out the work.

## Marianetti & Isaacs Featured in BNL Newsroom

**"Supercomputers Reveal Strange, Stress-Induced Transformations in World's Thinnest Materials: Columbia researchers used Brookhaven Lab supercomputer simulations to map and compare the transformations and breaking points of graphene and other promising monolayers" by Justin Eure**

Interested in an ultra-fast, unbreakable, and flexible smart phone that recharges in a matter of seconds? Monolayer materials may make it possible. These atom-thin sheets—including the famed super material graphene—feature exceptional and untapped mechanical and electronic properties. But to fully exploit these atomically tailored wonder materials, scientists must pry free the secrets of how and why they bend and break under stress.

Fortunately, researchers have now pinpointed the breaking mechanism of several monolayer materials hundreds of times stronger than steel with exotic properties that could revolutionize everything from armor to electronics. A Columbia University team used supercomputers at the U.S. Department of Energy's Brookhaven National Laboratory to simulate and probe quantum mechanical processes that would be extremely difficult to explore experimentally.

They discovered that straining the materials induced a novel phase transition—a restructuring in their near-perfect crystalline structures that leads to instability and failure. Surprisingly, the phenomenon persisted across several different materials with disparate electronic properties, suggesting that monolayers may have intrinsic instabilities to be either overcome or exploited. The results were published in the journal *Physical Review B*.

"Our calculations exposed these monolayer materials' fundamental shifts in structure and character when stressed," said study coauthor and Ph.D. candidate Eric Isaacs. "To see the beautiful patterns exhibited by these materials at their breaking points for the first time was enormously exciting—and important for future applications."

The team virtually examined this exotic phase transition in graphene, boron nitride, molybdenum disulfide, and graphane—all promising monolayer materials.

### Simulated Shattering

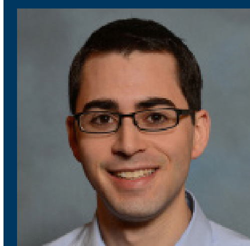
Monolayer materials experience strain on atomic scales, demanding different investigative expertise than that of the average demolition crew. Isaacs and his collaborators turned to a mathematical framework called density functional theory (DFT) to describe the quantum mechanical processes unfolding in the materials.

"DFT lets us study materials directly from fundamental laws of physics, the results of which can be directly compared to experimental data," said Chris Marianetti, a professor of materials science and coauthor of the study. "We supply the fundamental constants and the material's nuclei, and using DFT we can closely approximate real characteristics of the material under different conditions."

In this study, DFT calculations revealed the materials' atomic structures, stress values, vibrational properties, and whether they acted as metals, semiconductors, or insulators under strain. Toggling between or sustaining those conductive properties are particularly important for future applications in microelectronics.

"Testing all the different atomic configurations for each material under strain boils down to a tremendous amount of computation," Isaacs said. "Without the highly parallel supercomputing resources and expertise at Brookhaven, it would have been nearly impossible to pinpoint this transition in strained monolayers."

Co-authors,
Prof. Chris Marianetti
& Ph.D. candidate,
Eric Isaacs

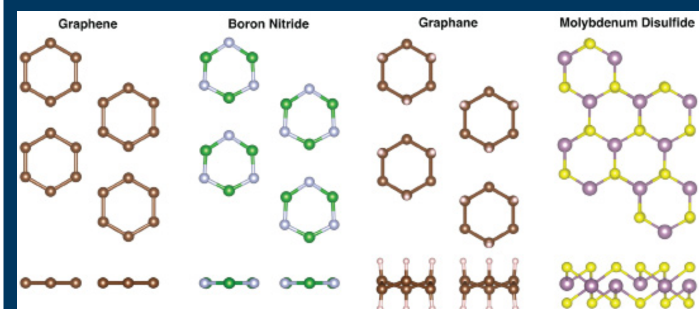


**Graphene and other monolayer materials feature exotic electronic and mechanical properties—atomically thin, ultra light, and stronger than steel. But how do these promising materials transform and fail under strain?**

**What did the scientists learn? They pinpointed the breaking points and failure mechanisms for these atom-thin super materials. When stressed, so-called "soft mode" instabilities emerge that cause characteristic atomic reconfigurations—surprisingly, this behavior persisted across different monolayer materials.**

**How did they do it? Using quantum mechanical laws and supercomputers, they simulated the atomic structure and vibrational modes of materials under different degrees of duress. Scientists strained and stressed these monolayer materials to the point of breaking—all virtually.**

**What's the impact? Everything from microelectronics to powerful, lightweight armor might be advanced by understanding how monolayer materials perform under stress.**




**(Image) Top and side views of soft mode instabilities in strained monolayer materials. In graphene, boron nitride, and graphane the backbone distorts towards isolated six-atom rings, while molybdenum disulfide undergoes a distinct distortion towards trigonal pyramidal coordination.**

### Twisted Atomic Half-Pipe

Everything breaks under enough stress, of course, but not everything meaningfully transforms along the way. A bending oak branch, for example, doesn't enter a strange transition phase as it creeps toward its breaking point—it simply snaps. Monolayer materials, it turns out, play by very different rules.

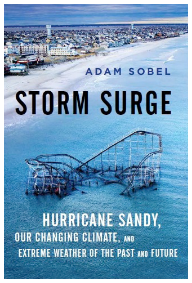
Within the honeycomb-like lattices of monolayers like graphene, boron nitride, and graphane, the atoms rapidly vibrate in place. Different vibrational states, which dictate many of the mechanical properties of the material, are called "modes." As the perfect hexagonal structures of such monolayers are strained, they enter a subtle "soft mode"—the vibrating atoms slip free of their original configurations and distort towards new structures as the materials break.

"Imagine a skateboarder in a half-pipe," Isaacs said. "Normally, the skater glides back and forth but remains centered over the bottom. But if we twist and deform that half-pipe enough, the skateboarder rolls out and never returns—that's like this soft mode where the vibrating atoms move away from their positions in the lattice."

### Softly Breaking

The researchers found that this vibrational soft mode caused lingering, unstable distortions in most of the known monolayer materials. In the case of graphene, boron nitride, and graphane, the backbone of the perfect crystalline lattice distorted toward isolated hexagonal rings. The soft mode distortion ended up breaking graphene, boron nitride, and molybdenum disulfide. **(continued on p.6 )**

## FOCUS ON FACULTY ACTIVITIES: ADAM SOBEL




# Adam Sobel: Storm Surge

**Prof. Adam Sobel's first book, *Storm Surge: Our Changing Climate, and Extreme Weather of the Past and Future*, was published by Harper-Collins on October 14, 2014. His book focuses on Hurricane Sandy and related issues, such as climate change, the science behind both weather forecasts and climate projections, and how we as human beings and societies cope with environmental risks.**

Was Hurricane Sandy a freak event—or a harbinger of things to come? Was climate change responsible? What connects the spiraling clouds our satellites saw from space, the brackish water that rose up over the city's seawalls, and the slow simmer of greenhouse gases? Why weren't we better prepared?

In this fascinating and accessible work of popular science, atmospheric scientist and Columbia University professor Adam Sobel addresses these questions, giving us insight into the sophisticated science that led to the forecasts of the storm before it hit, as well as an understanding of why our meteorological vocabulary failed our leaders in warning us about this "Superstorm"—part hurricane, part winter-type nor'easter.

*Storm Surge* brings together the melting glaciers, the shifting jet streams, and the warming oceans to make clear how our changing climate will make New York and other cities more vulnerable than ever to huge storms—and how we can hope to mitigate the damage. Sobel's book provokes us to rethink the future of our climate and how we can better prepare for the storms to come.

**2014 AGU Atmospheric Sciences Ascent Award**: Prof. Adam Sobel has been awarded the 2014 AGU Atmospheric Sciences Ascent Award. Established in 2012, the Atmospheric Sciences Ascent Award aims to reward exceptional mid-career scientists in the fields of the atmospheric and climate sciences. The award recognizes excellence in research and leadership in this field. The award will be presented at the Atmospheric Sciences Banquet on Tuesday evening, December 16, during the AGU Fall meeting in San Francisco.

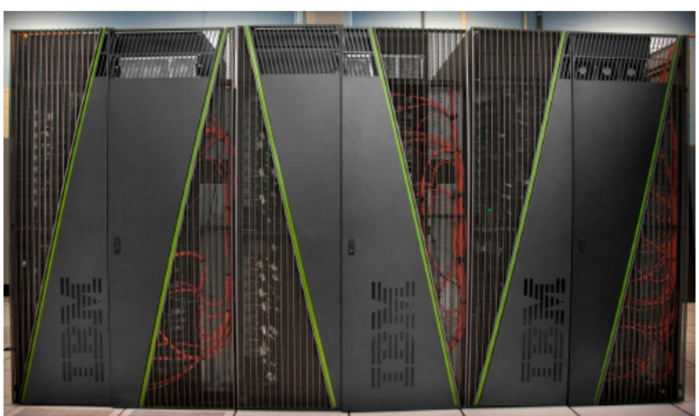
Follow Prof. Sobel on Twitter **@profadamsobel**, Facebook **https://www.facebook.com/adam.sobel**, or on his blog **http://adamsobel.org/**

## Medical Physics Faculty Honored

The American Association of Physicists in Medicine (AAPM) awarded Prof. Howard I. Amols and Prof. Edward L. Nickoloff its Edith H. Quimby Lifetime Achievement Award in Medical Physics. This prestigious award recognizes AAPM members whose careers have been notable based on their outstanding achievements. Recipients must be participating AAPM fellows who have made significant scientific achievements in medical physics, had a considerable influence on the career development of other medical physicists, or shown leadership in national and/or international organizations.

Prof. Amols, a founding member of Columbia's M.S. Program in Medical Physics, is currently teaching advanced radiation therapy. Prof. Nickoloff retired in 2012 after teaching diagnostic radiology for 20 years to students in the Medical Physics Program.

Prof. Amols and Prof. Nickoloff were honored at the AAPM Awards and Honors Ceremony during the 56th Annual Meeting in Austin, TX in July 2014. Prof. Lawrence Rothenberg was so honored in 2007.



**IBM supercomputer Blue Gene/Q, the latest addition to the New York Center for Computational Sciences**

**Marianetti & Isaacs Featured in BNL Newsroom,** **continued from p. 5**

## Monolayer Renovations

Armed with this knowledge, researchers may now be able to figure out how to delay the onset of the newly characterized instabilities and improve the strength of existing monolayers. Beyond that, scientists may even be able to engineer new ultra-strong materials that anticipate and overcome the soft mode weakness.

"Beyond the thrill of the discovery, this work is immediately useful to a large community of researchers excited to learn about and exploit graphene and its cousins," Isaacs said. "For example, we've been working with Columbia experimentalists who use a technique called 'nanoindentation' to experimentally measure some of what we simulated."

The work was supported by the National Science Foundation (Grant No. CMMI-0927891) and the New York Center for Computational Sciences, a joint venture between Brookhaven Lab and Stony Brook University that is supported by the U.S. Department of Energy and the State of New York.

Brookhaven Lab is supported by the Office of Science of the U.S. Department of Energy. The Office of Science is the single largest supporter of basic research in the physical sciences in the United States, and is working to address some of the most pressing challenges of our time.

**"Supercomputers Reveal Strange, Stress-Induced Transformations in World's Thinnest Materials", by Justin Eure, was published on July 15, 2015. Article and photos reprinted by permission. Special thanks to the Brookhaven Newsroom. For more information, please visit science.energy.gov.**

## In Memoriam: Morton B. Friedman

Morton B. Friedman, Professor of Civil Engineering and Engineering Mechanics and of Applied Physics and Applied Mathematics and Senior Vice Dean Emeritus at Columbia Engineering, died June 3, 2014 in Caanan, CT. A longtime Columbia Engineering faculty member and dedicated senior administrator, Professor Friedman was 86 at the time of his death.

Professor Friedman joined the Engineering School in 1956, beginning a lifelong academic and professional career there that spanned seven decades. After receiving his B.S., M.S., and Eng.Sc.D. degrees from New York University, Professor Friedman began his career as a research associate at NYU. In 1956, he was appointed assistant professor in Columbia's Department of Civil Engineering and Engineering Mechanics. In 1966, he was appointed full professor, a position he held for more than 40 years. In 1995, he was appointed Vice Dean, Senior Vice Dean in 2010, and Senior Vice Dean Emeritus in 2012.

George Deodatis, chair of the Department of Civil Engineering and Engineering Mechanics, remembers Professor Friedman as the first person he met at Columbia when he arrived as a graduate student in August, 1983. At that time, Professor Friedman was the chair of the Department.

"I was pleasantly surprised that the chair would be willing to see a new graduate student without a formal appointment," said Professor Deodatis. "He was spirited and jovial and, from the very first moment, he succeeded in making me feel comfortable and welcome. He continued to be exactly like this for the next 31 years! He was a brilliant mathematician, a very funny person, an endless source of knowledge for all things related to Columbia, but most important of all, always genuinely caring."

During his career at Columbia, Professor Friedman founded the Division of Mathematical Methods, the precursor to the applied mathematics component of what is now the Department of Applied Physics and Applied Mathematics. One of his earliest students in this program was Nobel Laureate Robert C. Merton BS'66. Professor Friedman specialized in the application of advanced mathematical techniques to problems in applied mechanics. He and his students were the earliest developers of the so-called boundary element methods that have found widespread applications in many engineering disciplines.

As vice dean, he was in the vanguard of engineering education leaders and helped shape the curriculum for many decades, from bringing engineering education into the first-year curriculum with project-based design and discipline-specific professional courses to creating a minors program in more than 20 liberal arts subjects, and from encouraging service learning to providing undergraduate research opportunities with junior and senior faculty. From 1981 to 1995, he served as Chair of the Department of Civil Engineering and Engineering Mechanics and, from 1980 to 1991, also held the post of Associate Dean for Instruction and Research. In addition, he chaired the Executive Committee of the University Senate for several years.

A former Fulbright Professor in Applied Mathematics and Field Instrumentation Scholar for the American Institute for Physics, he was recognized for his outstanding teaching by the Society of Columbia Graduates, which honored him with its Great Teacher Award in 1978. In 2012, Professor Friedman was honored for his lifelong devotion as a professor and senior vice dean at the School's Annual Faculty Excellence Awards program, and the meeting space on the fifth floor of the S.W. Mudd Building was dedicated as the Morton B. Friedman Conference Room.

Professor Friedman is survived by his devoted and treasured wife of 58 years, Sandy; his loving children, Robert (Linda) and Lori (Jim Goldfinger); and three beloved grandchildren, Chason, Asher, and Daden Goldfinger.

A public memorial service was held on September 22, 2014, in St. Paul's Chapel at Columbia University.

## Keller Receives Honorary Degree

Joseph B. Keller, Professor Emeritus of Mathematics and Mechanical Engineering at Stanford University, was conferred an Honorary Doctor of Science degree at the 2014 Columbia University Commencement. Prof. Michael Weinstein of APAM commented, "Joe Keller has been an inspiration to generations of mathematicians, and fundamental and applied scientists. His work is characterized by deep creativity and startlingly elegant formulations with profound impact. This is combined with a sense of playfulness and joy in thinking mathematically about the world, as in his studies of the pouring qualities of teapots and the dynamics of dice-throwing." Prof. Keller was nominated by Prof. Weinstein who was an NSF postdoctoral fellow with Prof. Keller from 1982 to 1984. Keller is also a long-time friend and colleague of Prof. C.K. Chu.

## Townes Celebrates 99th Birthday

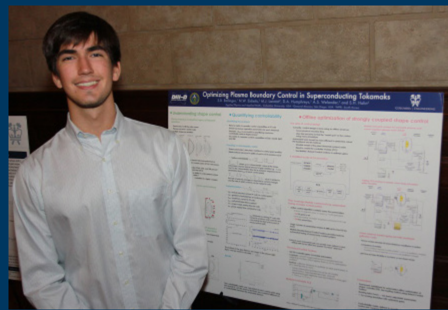
**The University of California, Berkeley hosted a special celebration for Charles Townes' 99th birthday on July 28, 2014. Townes accepted a faculty position at Columbia University in 1948 and was appointed provost and professor at MIT in 1961. From 1966 -1970 he served as the chair for the NASA Science Advisory Committee for the Apollo lunar landing program and in 1967, he was named a Professor-at-large at the University of California, Berkeley. Career highlights include a 1964 Nobel Prize in Physics, which he shared with Aleksandr M. Prokhorov and Nicolai G. Basov, 38 awards, and 31 honorary degrees.**

**For the full story, please see: www.universityofcalifornia.edu/news/birthday-bash-celebrate-laser-inventor-charles-townes'-99th**

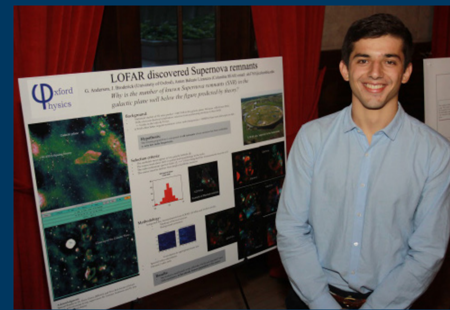
## SEAS 2014 Undergrad Summer Research Symposium

**Several APAM undergraduate students presented posters at the third annual SEAS Undergraduate Summer Research Symposium on Tuesday, October 7, 2014, in the Teatro Italiano.**

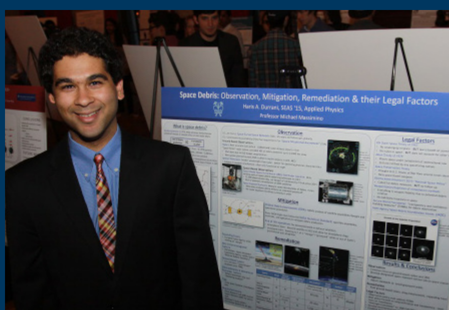
**This event was hosted by SEAS Undergraduate Student Affairs & Global Programs, the Engineering Student Council, and the Columbia Undergraduate Scholars Program.**



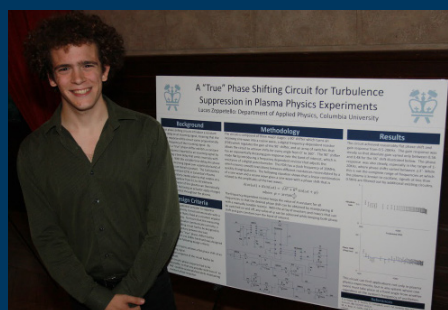
**Sean Ballinger, Applied Physics '16, Egleston Scholar - "Optimizing Plasma Boundary Control in Superconducting Tokamaks" (Supervised by David Humphreys, General Atomics)**



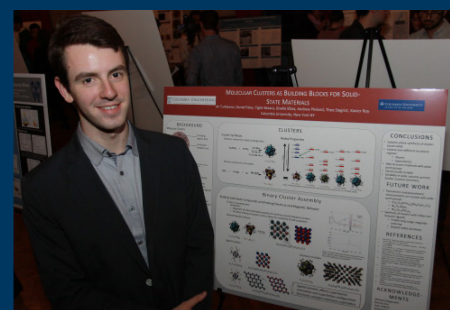

**Anton Baleato Lizancos, Applied Physics '16, Egleston Scholar - "LOFAR-discovered Supernova remnants" (Supervised by Gemma Anderson, Jess Broderick, & Rob Fender, Physics, Univ. of Oxford)**




**Haris A. Durrani, Applied Physics '15, Egleston Scholar - "Space Debris: Observation, Mitigation, Remediation & their Legal Factors" (Supervised by Michael Massimino, Mechanical Engineering)**




**Lucas Zeppetello, Applied Physics '16 - "A 'True' Phase Shifting Circuit for Turbulence Suppression in Plasma Physics Experiments" (Supervised by Francesco Volpe, Applied Physics)**



**Ari Turkiewicz, Applied Physics '14, Egleston Scholar - "Molecular Clusters as Building Blocks for Solid-State Materials" (Supervised by Xavier Roy, Chemistry)**

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