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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

Dear Alumni and Other Friends of APAM:

We once again celebrate another superb year!

In this issue we highlight the wonderful graduates of our undergraduate and graduate programs and note those who won departmental prizes and have received other forms of recognition!

We also report on many exciting recent activities in APAM. We welcome faculty who joined us in January, Andrew Cole and Francesco Volpe. We highlight the major awards and accomplishments of Dirk Englund, Chris Marianetti, Richard Osgood, Adam Sobel, and Chris Wiggins, as well as two of our adjunct faculty, Stephen Ostrow and Matthew Putman.

In July we will welcome a new chair to APAM, Cev Noyan. I am so very proud to have served as department chair for these past six years. I deeply thank all of our faculty, staff, and students for helping us excel and grow in so many ways (as archived in past APAM Newsletters). In particular, I want to extend a heartfelt thank you in deep appreciation to our fabulous staff: Dina Amin, Kostya Chernavsky, Marlene Arbo, Darya Dotsenko, Montserrat Fernandez-Pinkley, Christina Rohm, Mike Garcia, Wesley Hattan, and Alex Horelick. Thank you so very much!

Please stay in contact, and follow us on Facebook and Twitter!

Best,

Irving P. Herman
Chair, APAM

Faculty Featured in this Issue: (Above, left-right) I. Cevdet Noyan, Andrew Cole, Francesco Volpe, & Richard Osgood, Jr. (Below, left-right) Adam Sobel, Chris Marianetti, Stephen Ostrow, & Matthew Putman

In This Issue

2012 Simon Prize Winner: Maria Kamenetska

(left-right) Aron Pinczuk, Jane Faggen, Irving Herman, Masha Kamenetska & Latha Venkataraman

The Robert Simon Memorial Prize is awarded annually by the APAM Department to the graduate student who has completed the most outstanding dissertation. Dr. Maria (Masha) Kamenetska was the recipient of this year's award.

Masha received a B.S. degree in physics from the Massachusetts Institute of Technology in May 2005. After graduation, she took a year off traveling and working for a financial software start-up. She started her studies as a Ph.D. student in the APAM Department at Columbia in September 2006 and completed her M.S. degree in February 2008. She joined the lab of Prof. Latha Venkataraman in May 2007 to study electron transport across single molecule-metal junctions.

In her Ph.D. thesis "Single Molecule Junction Conductance and Binding Geometry" Masha addressed the fundamental problem of controlling transport through a metal-organic interface by studying electronic and mechanical properties of single organic molecule-metal junctions. She used a scanning tunneling microscope to image, probe energy-level alignment and perform break junction measurements on molecules bound to a gold metal surfaces. She demonstrated that control of the conductance of a circuit, which consists of a single molecule attached to two metal electrodes, is possible through a choice of metal-molecule binding chemistry and by sub-nanometer positioning. Masha showed that single gold-molecule-gold junctions formed with pyridine could be used to create a single-molecule switch as these junctions had two distinct conductance values. These experiments point to a new paradigm for attaining reproducible electrical characteristics of metal-organic devices, which involves controlling linker-metal chemistry rather than fabricating identically structured metal-molecule interfaces. By choosing a linker group which is either insensitive to or responds reproducibly to changes in metal-molecule configuration, one can design single molecule devices with functionality more complex than a simple resistor.

While at Columbia, Masha published four first author papers, including one in *Physical Review Letters* and in the *Journal of the American Chemical Society*, with members of Prof. Venkataraman's lab and collaborators and contributed to eight others. In 2011, she was awarded the National Science Foundation Postdoctoral Fellowship to pursue research at the intersection of physics and biology after graduation. She is currently at Yale University, in the Departments of Physics and Molecular Biophysics & Biochemistry.

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 in 1949. From 1941-44, he was a Lieutenant in the U.S. 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. He 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 U.S. Between 1969-73, 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 1972-81 and a founder and member of the board of Leasing Technologies International, Inc. from 1983 until his retirement in 1995.*

Undergraduate Student Award Winners

Outstanding seniors were recognized at the APAM Senior Dinner on May 4. Award winners received a plaque and a check for $500, have their names inscribed on plaques in the Department, and are listed on the APAM web site.

William Decker Neiswanger
Applied Mathematics Faculty Award

Willie Neiswanger is a graduating senior majoring in applied mathematics with a minor in computer science. At Columbia, he worked with the Wiggins Lab doing machine learning research. He has also worked with Prof. Frank Wood researching statistical machine learning and developing new machine vision techniques, and with Vivek Mayya at the Michael Dustin Lab at NYU making computational tools to help study T-cell behavior. His research on this project won him 1st place in the KAUST International Research Poster Competition for Undergraduates. (See page 3 for more details.)

Next year, he will attend Carnegie Mellon University to pursue a Ph.D. in Machine Learning.

Sky Chance Cheung
Applied Physics Faculty Award

Sky pursued a rigorous academic program spanning applied mathematics, applied physics, pure physics, and statistics. After this semester, he will have completed 148.5 points and maintained a 4.0 GPA. At Columbia, he assisted with research on the HBT-EP Tokamak experiment. Over the summers, he was involved in multiple Air and Missile Defense Department research projects at the Johns Hopkins University Applied Physics Laboratory. Sky also implemented numerous simulations for innovative calorimeters being considered for the PHENIX experiment upgrade at the Relativistic High Ion Collider at Brookhaven National Laboratory. After graduation, he will be returning to Columbia to enter a doctoral program in condensed matter physics.

(left-right) Sky Cheung, Suraj Cheema, Prof. Irving Herman, & William Neiswanger

Suraj Singh Cheema
Materials Science and Engineering
Francis B.F. Rhodes Prize

Suraj has completed 167.5 points with 3.90 GPA as a materials science and engineering major with a pre-medical concentration and a minor in applied mathematics.

He plans to spend year at Philips and then enter an M.D./Ph.D. program.

2012 Commencement Photos are online at www.apam.columbia.edu/directory/announcements.html

Willie Neiswanger

Neiswanger Wins International Poster Contest

William Decker Neiswanger's winning entry in a poster contest won him a free trip to Saudi Arabia.

Neiswanger (B.S. 2012, Applied Mathematics) researched machine learning in APAM and worked on a minor in computer science. In January, he presented his paper that accompanied the poster – "Computational Tools for T Cell Motility" – at the King Abdullah University of Science & Technology (KAUST) Undergraduate Poster Competition in Saudi Arabia.

"My research involves developing computational tools for studying the behavior of organisms. This poster focused on making machine vision tools to study T cell motility."

Neiswanger was one of 2 first-prize winners and among 40 other poster presenters flown last month from around the world to the KAUST campus, about 50 miles north of Jeddah. The competition, which called for posters on energy, water, food, and the environment, is part of the university's first annual Winter Enrichment Program.

"I had a great time meeting other undergraduates throughout the country and world," Neiswanger says. "Some are doing similar work to mine, and I hope to see or collaborate with some of them in graduate school."

He is especially grateful to his supervisor Chris Wiggins, associate professor of applied mathematics, and Vivek Mayya of the Michael Dustin Laboratory at NYU, both of whom helped him on the project. **Originally published by *Columbia Engineering News***

2011-2012 APAM GRADUATES

October 2011

B.S. Bruce Garro (AM)

M.S. Sarkis Chakardjian (AM/CVN), Pubudu Galwaduge (AP), Lihua Ming (MP), Hande Ozturk (MSE), Trevor Twyford (AP), Xiaohao Yang (MSE)

M.Phil. Cheng Cheng (MSE), Min Hwan Choi (MSE), Li Li (MSE), Weiwei Shen (AM)

Ph.D. Owen Clancey (MP), Timur Davis (MSE), Anil Raj (AM)

February 2012

M.S. Christopher Buckley (AP/CVN), Lester Corrian (AM), Carl Philipp Gaebler (MP), Patrick Gremban (AM), Tatsuya Hada (AM), Wen-Ya Hsu (MP), Elizabeth Hutchinson (MP) Frederick Jesseph (MP), Jaclyn Kain (MP), Amisha Khona (MP), Jiaxing Liu (AP), Jason Mastbaum (AP), Angela Ran Meng (MP), Michelle Savacool (MP), Songjian Shi (MSE), Christopher Stoafer (PP), Fengqian Sun (MSE), Hrishikesh Tiwari (MSE), Kurt Vetter (AP/CVN), Yunyi Wang (MSE), Kimberly Wiederkehr (AM/CVN), Bingying Xu (MSE), Fang Yuan (MSE)

M.Phil. Catherine Lee (MSE), Jeffrey Levesque (PP), Nikolaus Rath (PP), Daisuke Shiraki (PP)

Ph.D. Austin Akey (MSE), Benjamin Diehl (Atmos), Teresa Fazio (MSE), Michael Frei (SS), Ophir Gaathon (SS), Jie Gao (SS), Maria Kamenetska (SS), Li Li (MSE), Michael Vidne (AM), Yutian Wu (Atmos)

May 2012

B.S. Ian Allen (AP), James Allen (AM), David Broxmeyer (AM), Raina Chandiramani (AM), Leon Chang (AM), Suraj Cheema (MSE), Sky Cheung (AP), Min Hyun Cho (MSE), Srikanth Damera (AM), Kyle Depew (AM), Di Fu (AM), Michael Fusella (AP), Zimeng Gao (AM), Alexander Haugland (AP), Julio Herrera Estrada (AM), Mikhail Horne (AM), Dana Ibarra (AM), Vladimir Ilic (MSE), Joanne Jordan (AP), Teresa Kao (AP), Victoria Lee (AM), Ilana Lefkovitz (AM), Antonio Levy (AP), Thomas Miner (AP), Arjun Mudan (AM), William Neiswanger (AM), Michael Reed (AM), Mathew Samimi (AP), Jonathan Sisti (AM), Samuel Smock (AP), Ryan Sun (AM), Jessica Wu (AM), Hongming Xiao (AM), Yuan Yuan (AM), Geoffrey Zoehfeld (AM)

M.S. Olgun Adak (SS), Dean Alderucci (AM/CVN), Austin Cheng (SS), Aditi Dandapani (AM), Maxence Delorme (AP), Wecan Jin (SS), James Lee-Thorp (AM), Kyle Teamey (MSE/CVN), Jin Wang (MSE), Sheng Wang (SS), Yichen Yang (AM), Datong Zhang (SS)

M.Phil. Matthew Davis (PP), John Dwyer (Atmos), Sean Harnett (AM), Neil Tandon (Atmos), Mikhail Treger (MSE), Yan Yan (AM)

Ph.D. Sean Berry (MP), Francois Monard (AM), Daisuke Shiraki (PP), Qi Wu (AM)

Alumni Updates

Jie Gao (Ph.D. 2012, Applied Physics) is an Assistant Professor in the Mechanical and Aerospace Engineering Department at the Missouri University of Science and Technology.

Stacey Hirsch (B.S. 2006, Applied Physics) is currently a Ph.D. candidate at the University of Sydney, Australia. She was awarded the Ken Doolan Memorial Prize ($1,000) by the Australian Institute of Physics (AIP). Stacey received the prize for her research demonstrating the use of a novel, linker-free covalent immobilization method for the controlled immobilization of protein mixtures. Adsorption from protein mixtures is difficult to control because competitive protein exchange results in undesired layer instabilities both in the structure and composition of the surface adsorbed protein layer. Overcoming this problem, she demonstrated that rapid linker-free covalent binding provided with surface activation from plasma treatment enables the control of the attached protein composition through a combination of parameters, including the manipulation of the protein flux to surface and the covalent binding time. The proteins are also attached in their native conformation, which preserves their function when immobilized on the surface. She also showed industrial applications of controlled protein mixture immobilization, including bioreactors for ethanol fuel production from cellulose waste resources (cardboard and agricultural waste) and medical devices with improved biocompatibility. This work has been published in *Langmuir* and the *Journal of Materials Chemistry*.

Timothy M. Merlis (B.S. 2006, Applied Mathematics) presented a talk at the SEAS Colloquium in Climate Science on January 26 on the "Response of Tropical Climate to Greenhouse Gas Changes and Orbital Forcing". He completed his Ph.D. in Environmental Science and Engineering at the California Institute of Technology and is currently a postdoctoral fellow at the Princeton Center for Theoretical Science and Geophysical Fluid Dynamics Laboratory.

William T. Sha's (Eng.Sc.D. 1964, Nuclear Engineering) book, *Novel Porous Media Formulation for Multiphase Flow Conservation Equations*, was published by Cambridge University Press in September 2011. Dr. Sha was a senior scientist at the Argonne National Laboratory and the former Director of the Analytic Thermal Hydraulic Research Program and the Multiphase Flow Research Institute. He has published over 290 papers, primarily in the field of thermal hydraulics. He is the recipient of many awards, including the 2005 Technical Achievement Award from the Thermal Hydraulic Division (THD) of the American Nuclear Society (ANS), the 2006 Glenn T. Seaborg Medal, the 2007 Samuel Untermyer II Medal and the 2008 Reactor Technology Award, all from the ANS. **(Continued on page 7)**

(Above) Isolated tropical cumulus cloud with rain shaft over Addu Atoll, November 19, 2011, just before onset of the MJO active phase (Below, left-right) Adam Sobel, Daehyun Kim, & Shuguang Wang

Dynamics of the Madden-Julian Oscillation (DYNAMO)

by Prof. Adam Sobel

Prof. Sobel and Dr. Shuguang Wang (APAM), along with Dr. Daehyun Kim (LDEO) and colleagues from Colorado State University and Harvard University, were part of an international team of scientists who participated in a 6-month data-gathering effort in the Indian Ocean to try and unravel the workings of the Madden-Julian Oscillation.

The Madden-Julian Oscillation (MJO) is a natural fluctuation of the weather in the tropics. On a time scale of 30-60 days, the MJO causes the weather to alternate between a rainy regime with westerly (west to east) winds, and a drier regime with easterly winds. Each regime covers thousands of km in the east-west direction, and the changes progress slowly from west to east. The MJO most strongly affects the weather over the tropical Indian and western Pacific oceans and the tropical land masses adjacent to them, but also influences places far from there including higher latitudes (even New York). Despite several decades of study, we don't understand the basic physics of the MJO – what makes it happen at all? It's a major outstanding problem in atmospheric and climate science.

In the fall of 2011-2012, there was a large multinational field campaign in the Indian ocean to study the MJO, called Dynamics of the Madden-Julian Oscillation (DYNAMO). The location was the tropical Indian ocean, with most people on two island bases - Addu Atoll in the Maldives, and Diego Garcia – and two ships. Observations were taken by radars, radiosondes (aka weather balloons) and many other instruments based on the islands, the ships, and two aircrafts. **(Continued on page 7)**

New Faculty Members: Andrew J. Cole & Francesco A. Volpe

Andrew J. Cole

Andrew J. Cole is a new Assistant Professor of Applied Physics. Prof. Cole studies the influence of symmetry-breaking magnetic fields on rotation in toroidal fusion plasmas. Magnetic perturbations with spatial variation and field line curvature induce forces on plasma particles which collectively drive a viscous stress. In toroidal geometry this produces a torque which has the interesting ability to drive the bulk plasma rotation to a value proportional to the ion temperature gradient. In particular, plasmas with little or no rotation can be accelerated up to the ion temperature gradient rotation rate.

Rotation is generally stabilizing against a host of plasma instabilities, and magnetic torques offer an inexpensive and attractive means to induce rotation. A general spectrum of applied fields will naturally have some components which are resonant within the plasma. These perturbations have long been known to drive plasma tearing-modes, named for their ability to tear and reconnect magnetic field lines. This magnetic reconnection produces potentially large "magnetic islands" that allow heat and particles from the hot fusion core to contact cooler edge plasma. Magnetic islands limit fusion performance, and if large enough, can trigger a complete loss of plasma confinement.

Prof. Cole's research into magnetic field-driven torques spans both non-resonant bulk plasma viscosity and resonant torques, the latter resembling AC-induction motor behavior and confined to their respective resonance surface. Interest in plasma torques is motivated by the need to generate stabilizing rotation in future plasma devices which will lack present costly methods of injecting angular momentum.

He received his Ph.D. in Physics from the University of Texas under the supervision of Prof. Richard Fitzpatrick, studying two-fluid effects on magnetic reconnection. More recent work at the University of Wisconsin as a postdoctoral fellow, and later assistant research scientist, involved studying the effect of non-resonant viscosity on magnetic reconnection and developing analytic connection formulas for non-resonant viscosity over a wide range of plasma parameters. This work was in collaboration with APAM alumnus, Prof. Chris Hegna (Ph.D. 1989, Plasma Physics), and Prof. James Callen.

Francesco A. Volpe

Francesco A. Volpe is a new Assistant Professor of Applied Physics. He joined the faculty in January 2012 from the University of Wisconsin, Madison, where he was an assistant professor in Engineering Physics. His research interests include plasma physics and nuclear fusion in toroidal magnetic confinement devices such as tokamaks and stellarators. In particular, Volpe focuses on two aspects which are key to fusion energy. The first consists in keeping the plasma sufficiently hot for the ions to fuse (and thus liberate energy) in spite of their Coulomb repulsion. The second aim is to keep the plasma in a high-pressure state (yielding high fusion power) and prevent it from degenerating in a reduced pressure state or, worse, to be deconfined. Such a rapid and complete loss of confinement is called disruption. It is not dangerous for people but can damage the tokamak device. Volpe uses microwaves both for the purpose of heating the plasma as well as for the purpose of suppressing or preventing structures called magnetic islands, which lower the plasma pressure and often lead to disruptions. He also uses magnetic fields to control the rotation of such islands, or reposition them, if they stop rotating in a position which is inaccessible to the microwave beams. As a complement to the injection of high-power microwaves in the plasma for the sake of heating, he also analyzes spontaneous low-power emission from the plasma, and so infers its temperature, especially in high-density regimes when this would not be possible, normally. For this, he uses special waves called Electron Bernstein Waves. Surprisingly, the underlying mechanisms of all these techniques are not very different from the principles by which a microwave oven heats water and a compass is steered by a magnet, and we can tell the temperature of the surface of the Sun by analyzing its emission.

Volpe is a recipient of the Otto Hahn Medal of the Max Planck Society and of the Early Career Award of the DOE. He received his laurea in Physics from the University of Pisa, Italy, writing a dissertation on undergraduate research carried out at ENEA Frascati. He obtained his Ph.D. in Experimental Physics in 2003 from the University of Greifswald, Germany, carrying out his thesis research at the Max-Planck Institut in Garching. Between these two experiences **(Continued on page 6)**

Chris Marianetti

Marianetti Wins NSF Career Award

Chris Marianetti, Assistant Professor of Materials Science and Engineering, has been awarded a National Science Foundation (NSF) Faculty Early Career Development (CAREER) Award for his research on using quantum mechanical simulations to engineer thin film materials via strain, "Computational Nanoengineering of Few-Layer Systems via Strain." He will receive a $400,000 five-year grant to advance his work on few-layer systems, materials like graphene and boron nitride that range in thickness from the nanoscale to a single atomic layer.

"I'm really honored to receive this award," says Marianetti. "Few-layer systems often exhibit unusual properties due to their low dimensionality and high surface-to-volume ratios, including both mechanical and electronic behavior. With nanotechnology becoming increasingly ubiquitous, understanding the electromechanical behavior in these systems is ever more important for developing all kinds of novel devices such as mechanical mass sensors and electronic circuit elements. This Career award will help us push the forefront in this rapidly moving field."

Marianetti has already figured out the weakness of graphene, the world's strongest material, using quantum theory and supercomputers to reveal the mechanisms of mechanical failure of pure graphene under tensile stress. "We think strain may be a means to engineer the properties of graphene, and therefore understanding its limits is critical - it's likely that this novel failure mechanism is not exclusive to graphene but may be prevalent in other very thin materials."

Marianetti's research interests lie in the use of classical and quantum mechanics to model the behavior of materials at the atomic scale. In particular, he is focused on applying these techniques to materials with potential for energy storage and conversion. Current applications in his research program range from nuclear materials such as uranium to rechargeable battery materials such as cobalt oxides.

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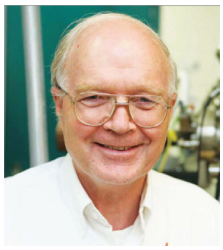


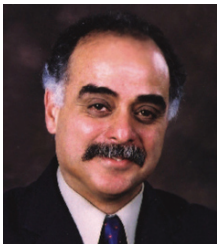
Richard Osgood, Jr.

Air Force Extends Grant for Graphene Research Led by Osgood

The Air Force Office of Scientific Research has extended Columbia's Multidisciplinary University Research Initiative (MURI) grant for "Graphene Materials for Microsystem Devices" for two option years with an additional $3 million. This grant is a collaboration with Columbia Engineering, the Graduate School of Arts and Sciences at Columbia, and Cornell University's Electronic Materials group, with Michael G. Spencer, professor of electrical and computer engineering, as their coordinator.

"Having this grant extended is great news," says Richard Osgood, Higgins Professor of Electrical Engineering and Professor of Applied Physics and Applied Mathematics, the lead principal investigator of the MURI. "Our MURI program is providing the cutting-edge work in graphene in the U.S."

The researchers are working on developing new growth and fabrication technologies for graphene that, **(Continued on page 7)**



I. Cevdet Noyan

I. Cevdet Noyan Elected APAM Chair

I. Cevdet Noyan, Professor of Materials Science and Engineering, has been elected the chair of the APAM Department. His appointment begins on July 1, 2012.

Prof. Noyan works on x-ray and neutron diffraction analysis and mechanical behavior of materials. He has been a professor in APAM since July 1, 2004 and has been vice-chair of the Department since 2006. He also has a nonbudgeted faculty position in the Department of Earth and Environmental Engineering. Prof. Noyan is affiliated with the IBM Research Division, T. J. Watson Laboratory on a part-time basis.

Prof. Noyan received his Bachelor of Science of Engineering degree in Metallurgical Engineering from the Middle East Technical University, Ankara, Turkey, in 1978, and a Ph.D. in Materials Science and Engineering from Northwestern University, Evanston, Illinois, in 1984. He has served as Research Staff Member and Research Manager at the IBM Research Division, T.J. Watson Laboratory, where he conducted and directed research on chip packaging, reliability of microelectronic interconnection structures and x-ray microdiffraction. Until 2004, while working at IBM, he taught various Materials Science and Engineering courses at Columbia University as an adjunct professor.

Prof. Noyan received the Adjunct Faculty Award for Excellence in Teaching from Columbia University's School of Engineering and Applied Science in 1993. He received two IBM Outstanding Technical Achievement Awards and an IBM Research Division Award for research and development of computer and packaging structures, on which topics he is the co-inventor of more than twenty patents. He is co-editor of Advances in X-Ray Analysis and a Fellow of American Physical Society. He is the author (with J. Cohen) of the book, *Residual Stress: Measurement by Diffraction and Interpretation*, published by Springer-Verlag.

The APAM Department warmly welcomes Prof. Noyan and bids a fond farewell to Prof. Irving Herman. Prof. Herman has served as the APAM chair since July 2006 and the Department kindly thanks him for his many years of service and dedication.

Dirk Englund, Assistant Professor of Electrical Engineering and Applied Physics, was granted a DARPA Young Faculty Award for a new effort on "Chip-Integrated Timing and Inertial Measurements." Englund, along with Jonathan Owen (Chemistry) and Rafael Yuste (Biology), received a $1M Keck grant for their joint project "Watching the Brain at Work: Imaging Neuronal Activity with Diamond Nanoprobes." He is also part of a 7-university team which was awarded a 5-year $8.5 million MURI by the U.S. Air Force Office of Scientific Research (AFOSR) for developing optimal approaches to create scalable quantum networks.

Chris Wiggins, Associate Professor of Applied Mathematics, was interviewed by Brian Lehrer (CUNY TV) and was featured in the *Columbia Spectator* article, "HackNY's Christopher Wiggins Talks Startups and Hacking" by Ved Tanavde. Wiggins was also interviewed by *DealBook* for the article "Wall Street's Latest Campus Recruiting Crisis" by Kevin Roose in *The New York Times* and was featured in the article "Greg Smith, Former Goldman Sachs Director, Shouldn't Expect 'Warm And Fuzzy' Support From Ivy League" by Tyler Kingkade in *The Huffington Post*.

SPECIAL FOCUS ON ADJUNCT FACULTY ACTIVITIES

In this issue, we are proud to highlight the achievements of two of our adjunct faculty members, Stephen L. Ostrow and Matthew Putman.

Stephen Ostrow

Stephen L. Ostrow

Adjunct Professor, Medical Physics

Dr. Ostrow is a long-serving Adjunct Professor in the APAM Department, teaching Introduction to Nuclear Science, and is also a member of the Medical Physics faculty. He obtained his B.S. (1968), M.S. (1970), and Ph.D. (1978) degrees in Applied Physics and Nuclear Engineering from the predecessor of the current APAM Department; he also received an MBA degree from New York University (1986). While still at Columbia, he joined Ebasco Services, Inc., a large architect-engineering company deeply involved in the design and construction of nuclear power plants. He focused on developing and using applications of radiation transport theory in leading a team designing radiation shielding and other radiation protection features for the experimental Tokamak Fusion Test Reactor (TFTR) at Princeton Plasma Physics Laboratory (PPPL). At Ebasco and its successor companies (including Raytheon Engineers & Constructors and Washington Group) he held a number of positions, including Manager and Chief Engineer of Nuclear Engineering and Manager of Advanced Technology. He performed and led studies in various nuclear engineering areas, including radiation protection, criticality analysis, radiation shielding, dose assessment, radiation transport and streaming, design basis and severe accident analysis, ALARA, and radiation monitoring.

At Raytheon, he established a program to evaluate new advanced technologies in support of programs, initiatives, and projects throughout the company and worked in various advanced technology areas, such as superconducting Magnetic Energy Storage (SMES) and other electromagnetics programs and projects, including fusion magnet coil design, and directing engineering design services for development of the International Thermonuclear Experimental Reactor (ITER) Project.

Dr. Ostrow joined SC&A, Inc., a Vienna Virginia-headquartered radiological and environmental consulting firm, in 2002, where he is currently Senior Vice President of Advanced Technology. His focus has been on developing advanced technology systems for defense and homeland security applications for standoff detection of explosives, toxic chemicals, and nuclear materials. He has also been a major participant in SC&A's nuclear and radiological assessment projects, such as for the Centers for Disease Control and Prevention, National Institute for Occupational Safety & Health, where, under a federal compensation program, the project evaluates claims of workers who may have developed cancer from exposure to radiation while employed at DOE or government contractor nuclear facilities engaged in the nation's nuclear weapons program. Analyses include biokinetics, ICRP compartment models, pathways analyses, internal dosimetry, external dosimetry, medical exposures, environmental exposures, and consideration of a very wide range of radioactive sources. He is also currently engaged in a project for the Nuclear Regulatory Commission to assess the potential operational impact of reduced occupational radiation dose limits to NRC and Agreement State licensees. He is leading the effort related to medical personnel, and has contracted with the Columbia University Radiation Safety Office to provide and analyze personnel radiation exposure data as well as other material.

He is a member of the American Nuclear Society, Tau Beta Pi, and Sigma Xi.

Matthew Putman

Matthew Putman

Adjunct Assistant Professor,
Materials Science and Engineering

I recently told the students of the Introduction to Polymers class that I am teaching that I come from a strange background. What I meant by this was purely in the scientific and industrial sense. My family is from Akron, Ohio, and I grew up with parents and grandparents who worked and were entrepreneurs in the rubber industry. So I grew up in rubber factories, and later polymer research labs, where besides being covered in carbon black, I learned through observation, then practical training about polymer testing and processing. I eventually went on to run my family business called Tech Pro, which was as much a software company as a polymeric instrumentation company. We made rheology instruments, and mechanical testing instruments, but also software for quality control evaluation, and even some modeling. So before earning my Ph.D. as an Applied Physicist, and spending time in France studying with the leaders in the field of polymer rheology, I had spent a lifetime looking at properties like modulus, and trying to understand how it applied to the creation of new processes and materials.

2012 is an incredible time to be doing science, and to have a technology company, both of which I am lucky enough to be doing. My company, Nanotronics Imaging, is not polymer specific at all, though the inspiration for it came from a time not long ago when polymer compounds began using nanofillers. This made high throughput imaging a challenge, as electron microscopy and AFM were impractical for large scale inspection. The idea behind Nanotronics was to fix that through an algorithm which reconstructs images using a unique method of subpixilization. We are doing this and more with the company, but almost exclusively for fields I did not grow up with. We sell to compound semiconductor companies and bio science labs. So much of my research into nanofillers in polymers is left to work I do here at Columbia in the rheology lab in Engineering Terrace, which my family donated, or on my own. There is a fortunate convergence of all of this however, which is taking me and these ideas to new places.

One such area of research is in regenerative medicine. Regenerative medicine is the process of growing new organs to replace missing or damaged ones. One way in which this is done is by using Extra Cellular Membrane (ECM), which is biological connective tissue, cleaned of all cells, and implanting it in the body to replace everything from bladder, to muscles to an esophagus. Most of this is cutting edge stuff, and mostly medical researchers work on it. It seems though that they do have a need for a polymer rheologist, and the pool of us is rather small, especially when it comes to those that can also do ground breaking testing. I presented a paper at the American Chemical Society meeting in March about the mechanical properties of these scaffolds, which I am treating like other polymers.

So the scope of polymer rheology with the inclusion of nanoparticles, and with bioscience in need of many of our methods has provided for excellent research opportunities. I am glad I am here at Columbia to explore these ideas with colleagues and students.

New Faculty: Francesco A. Volpe **(continued from page 4)**

and subsequent postdoctoral training in the U.K. and in California, and collaborations with Sweden and Japan, he gained experience in all major approaches to toroidal confinement (tokamak, spherical tokamak, stellarator and reversed field pinches), and participated in modeling for ITER, the large international tokamak under construction in France, which is expected to produce net fusion power for the first time.

Prof. Volpe will continue his collaboration with the DIII-D national facility in San Diego; will establish a local research program on small university-scale plasma experiments; and will coordinate the development, at Columbia, of innovative plasma diagnostics to be deployed in local and external plasma confinement devices.

Dynamics of the Madden-Julian Oscillation (DYNAMO)

(Continued from page 4)

I participated in DYNAMO, along with two postdocs here at Columbia, Shuguang Wang and Daehyun Kim, as well as colleagues Zhiming Kuang (Harvard) and Eric Maloney (Colorado State). Each of us spent 2-3 weeks on Gan island. As members of the modeling team for DYNAMO, our real job in the project was to do computer simulations, not make measurements. As such we didn't have to go in the field, and most modelers don't. I knew from previous field experiments, though, that one learns a great deal by going. I encouraged everyone from our team to go, and they eagerly did. We phased our visits in sequence so that one of us was there for most of the intensive phase, October-November 2011. We spent our days looking at all the data coming in, and doing our best to make ourselves useful to the scientists operating the instruments.

The experiment went phenomenally well. The atmosphere cooperated, providing several strong MJO events in rapid succession. There were no major instrument failures. A huge amount of data was gathered, and will be analyzed for years now. For our group, it was a chance to see first hand the atmospheric phenomenon we have studied for years on the computer. The Maldives is also a wonderful place to visit.

The only dark part of the story came near the end of the experiment, after all of our own group was long gone but a skeleton crew remained gathering a few last observations. In February, the first democratic government of the Maldives was overthrown in a coup by a faction representing the previous government. This brought an end to the experiment, and brought turmoil to this small island nation.

Read the blog:
maddenjulianconversation.blogspot.com

Lamont press release:
www.ldeo.columbia.edu/news-events/investigating-tropical-weather-pattern-global-reach

NCAR online magazine story:
www2.ucar.edu/atmosnews/features/6356/between-weather-and-climate

Prof. Sobel was also interviewed by CBS News in the story "Scientists closer to season-long tornado forecasts" by Jim Axelrod on March 16, 2012.

Air Force Extends Grant for Graphene Research Led by Osgood

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when coupled with improved understanding of the material's critical underlying physical properties, will enable novel device concepts, including ultrafast FETs (field-effect transistors that amplify weak signals) and tunable acoustic resonators, which can generate or modify sounds by enhancing particular frequencies. Working closely with governmental agencies like the Air Force Research Laboratory and with industry, they are focusing on three types of advanced electronic and nanoscale electromechanical devices that demonstrate the potential for new or dramatically enhanced functionality: electrical, optical, and mechanical.

Across the University, the MURI team includes Louis Brus (Samuel Latham Mitchell Professor of Chemistry at Columbia University and professor of chemical engineering at Columbia Engineering), George Flynn (Higgins Professor of Chemistry at Columbia University and professor of chemical engineering at Columbia Engineering), Tony Heinz (David M. Rickey Professor of Optical Communications at Columbia Engineering and professor of physics at Columbia University), Jim Hone (associate professor of mechanical engineering at Columbia Engineering), **Philip Kim (professor of physics at Columbia University and applied physics at Columbia Engineering), Richard Osgood (Higgins Professor of Electrical Engineering and professor of applied physics and applied mathematics at Columbia Engineering)**, and Ken Shepard (professor of electrical engineering at Columbia Engineering). The group is collaborating with Cornell on this program, which began October 2010 and was originally funded for $4.5 million. **Originally published by *Columbia Engineering News***

Alumni Updates (Continued from page 3)

Gideon Simpon (Ph.D. 2009, Applied Mathematics) presented a talk at the Applied Mathematics Colloquium on February 21 on the "Analysis of Parallel Replica Dynamics". He was a postdoctoral fellow in the Department of Mathematics at the University of Toronto and is currently a PIRE/DOE Postdoctoral Fellow at the School of Mathematics in the College of Science and Engineering at the University of Minnesota.

Ramon Verastegui (Ph.D. 2006, Applied Mathematics) spoke about his experience as a student and alumnus at a special reception for doctoral degree students, alumni, and postsdocs on October 3, hosted by Columbia Engineering as part of the "Graduate Engineers Connect" initiatives.

Save the date! The Columbia Engineering Reunion will take place Thursday, May 31- Sunday, June 3, 2012. For more information, see: **alumni.engineering.columbia.edu/reunion**

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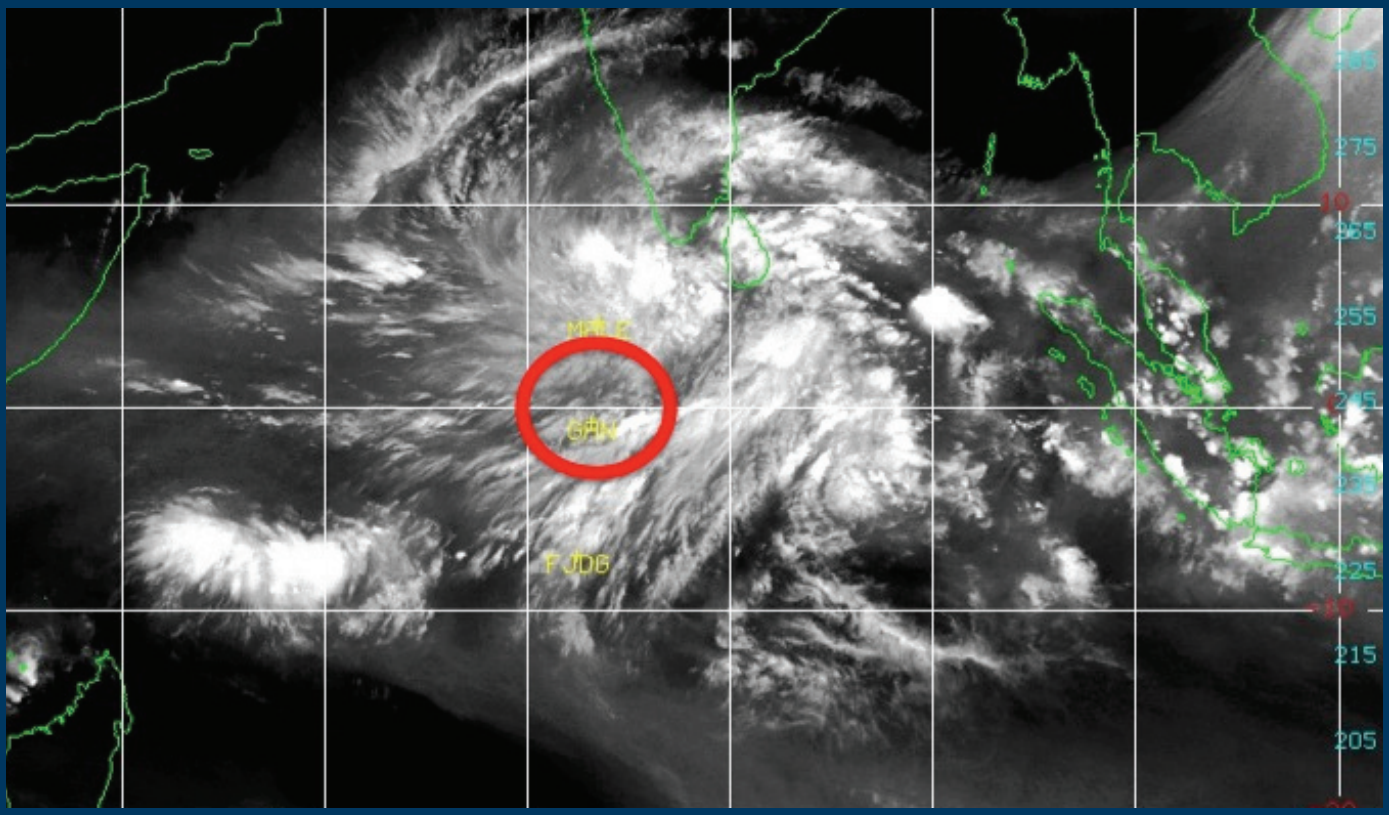

Dynamics of the Madden-Julian Oscillation (DYNAMO): Infrared satellite image from November 25, 2011, showing the clouds over the Indian Ocean during an active (rainy) phase of the Madden-Julian Oscillation (MJO). The red circle encloses Addu Atoll, where Prof. Adam Sobel's team was based during DYNAMO. Read more about the project on page 4.

Contact Us

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

Please stay in touch. Send your news to:
seasinfo.apam@columbia.edu

Find us on Facebook at:
Applied Physics & Applied Mathematics Department, Columbia University

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Editors: Irving Herman, Dina Amin, Christina Rohm

Contributing Authors: Sky Chance Cheung, Andrew Cole, *Columbia Engineering News*, Holly Evarts, Irving Herman, Masha Kamenetska, Chris Marianetti, William Neiswanger, I. Cevdet Noyan, Stephen Ostrow, Matthew Putman, Adam Sobel, Francesco Volpe

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