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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

In this Issue

Students After the Medical Physics Comprehensive Exam: (*top)* Owen Clancery, Allison Powers, Elizabeth Dennis (*bottom)* Brian Quinn, Alex Kowalski, Bradley Pollard, Aaron Svoboda, Stephen Glennon

Dear Alumni and Other Friends of APAM:

This has been a very eventful and exciting spring! We graduated our largest senior class ever. Aron Pinczuk and David Keyes received major School awards at Commencement Class Day. Gertrude Neumark received an Honorary Doctor of Science Degree at Commencement and her patent on blue-green lasers led to the establishment of a new endowed chaired professorship in the department. Simon Billinge joined our faculty. Chris Wiggins was profiled in *Scientific American*. Latha Venkataraman won an NSF Career Award. One of our students, Lisa Chen, received a Fulbright Award.

In this issue, we report on these very exciting developments and much more! Our students report on their activities in aeronautics and astronautics on campus and also describe the NASA Glory Mission, including the interactions of the NASA Goddard Institute for Space Studies and APAM in this program. We also proudly profile the undergraduate and graduate students who won major departmental awards this year.

Thank you so much to our alumni and other friends of the department for keeping in touch and letting us know what you are doing!

Best,

Irving P. Herman
Chair, APAM

2008 Simon Prize Winner: Yongfeng Guan


(left-right) Prof. William Bailey, Dr. Jane Faggen, Dr. Yongfeng Guan, and Prof. Michael Mauel

The Robert Simon Memorial Prize is awarded annually by the APAM Department to the graduate student who has completed the most outstanding dissertation. This year's recipient was Dr. Yongfeng Guan.

Robert Simon (1919-2001) 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 1969-1973, he was a partner with American Science Associates, a venture capital firm. He as a founder and VP of Intech Capital Corporation, served on its board from 1972-1981, and was a founder and member of the board of Leasing Technologies International, Inc. from 1983-1995. The prize was established in 2001 by Dr. Jane Faggen with additional support from friends and relatives of Mr. Simon.

Dr. Guan received his B.S. in Materials Physics from the University of Science and Technology of China (USTC) in 2002, where he was awarded the First-Class Outstanding Student Scholarship and the Zhenxiong Industry Scholarship. He spent one year as a Ph.D. candidate in the Department of Physics at the University of Colorado, Boulder, from 2002-2003, and transferred to the APAM Department at Columbia University in Fall 2003. Shortly thereafter, he started his Ph.D. dissertation research in Prof. William Bailey's group in Materials Science and Engineering.

In his Ph.D. dissertation research, "Ultrafast magnetization dynamics in ferromagnetic ultrathin films and heterostructures," he developed, in collaboration with synchrotron scientists at Brookhaven National Laboratory, a powerful new technique to measure the high-speed response of ultrathin magnetic films used in magnetic information storage technology. The technique relies on x-ray magnetic circular dichroism (XMCD), a soft x-ray spectroscopic measurement available at national synchrotron facilities, to measure magnetization at elemental sites (such as Fe and Ni sites in the magnetically soft alloy $Ni_{81}Fe_{19}$). He has extended XMCD into the ultrafast time domain, demonstrating element- and layer-specific magnetization dynamics measurements at world-record temporal (2 ps) and rotational resolution (0.05 deg), enabling studies of energy loss mechanisms. His work, carried out at the Advanced Photon Source, Argonne National Laboratory, is a collaboration with synchrotron scientists at Brookhaven National Laboratory, and has appeared in *Physical Review B*, *Journal of Applied Physics*, *Review of Scientific Instruments*, and *Journal of Magnetism and Magnetic Materials*. During his Ph.D. dissertation research, he was primary author on 5 and secondary author on 2 peer-reviewed publications in archival journals, and was the recipient of the 2006 Materials Research Society Spring Meeting Graduate Student Award (Silver Medal). He is presently a postdoctoral researcher in the magnetic random access memory (M-RAM) Group at the IBM Thomas J. Watson Research Center in Yorktown Heights, NY.

Undergraduate Awards Winners

Prof. Irving Herman distributed 4 undergraduate awards to outstanding seniors in Applied Mathematics, Applied Physics, and Materials Science and Engineering at the annual SEAS Senior Awards Dinner on April 29, 2008 in the Low Rotunda.

Applied Mathematics Faculty Award Winner

Tian Xie

The Applied Mathematics Faculty Award is awarded to an outstanding senior in the Applied Mathematics program.

This year's award winner, Tian Xie, was born in 1986 in Beijing, China and moved to Boston, Massachusetts with his family in 1989. He has been deeply involved with many student groups, most notably the Asian American Alliance, of which he was Chair 2006-2007, and the Columbia University Chapter of the Society of Industrial and Applied Mathematicians (SIAM), of which he was President 2007-2008. He has also spent time studying abroad in both Beijing and Shanghai. He plans to stay in New York City where he will be working at the investment management firm BlackRock.

Applied Physics Faculty Award Winners

Yoni BenTov & Dennis Boyle

The Applied Physics Faculty Award is usually awarded to an outstanding graduating senior in the Applied Physics program. This year it was awarded to two outstanding graduating seniors.

Yoni BenTov is interested in a wide range of theory in physics. He has taken a series of advanced courses in physics and mathematics and has excelled in them. This term he volunteered, without pay, to be the teaching assistant in the challenging biophysics modeling course he had taken earlier. He will be studying particle physics theory in the doctoral program at UCSB.

Dennis Boyle graduated from Verona High School in 2004 and then started at Columbia University. He has taken a broad selection of applied physics and applied math classes, including several advanced graduate classes in plasma physics, and he excelled in all of them. He has conducted research on the Columbia Non-neutral Torus plasma physics experiment since 2005. He spent last summer at Princeton studying ways to detect dust in large fusion experiments. He will be entering the doctoral program in plasma physics at Princeton.

Materials Science & Engineering Francis B. F. Rhodes Prize Winner

Stephen Choy

The Francis B. F. Rhodes Prize was established in 1926 by Eben Erskine Olcott of the Engineering Class of 1874, in memory of his classmate, Francis Bell Forsyth Rhodes, School of Mines, 1874, and is awarded from time to time to the member of the graduating class in materials science and metallurgical engineering who has shown the greatest proficiency in his or her course of study.

This year's winner, Stephen Choy, graduated from Upper Canada College in 2004 before matriculating at Columbia. He pursued a major in Materials Science and Engineering program and maintained a 4.0 average, while setting his sights for medicine. Aside from focusing on his studies, he pursued research interests in the Materials Science program under the direction of Prof. I.C. Noyan and at the NY State Psychiatric Institute Molecular Imaging Division. He also served as a member and later as president of the Chinese Students Club. He plans to pursue his MD degree at Mount Sinai School of Medicine.

STUDENT NEWS

Manav Malhotra, Blake Rego, & Prof. Irving Herman

E. Renee Stroebel & Prof. Thomas Pedersen

Yoni BenTov & Family

Jeff Fineberg & Prof. Marc Spiegelman

Lisa Chen & Prof. I. C. Noyan

Congratulations 2007-2008 Graduates!

OCTOBER 2007

B.S.
Eric Culkin (MSE), Daniel Gant (AM)

M.S.
Owen Clancey (MP), Darra Conti (MP), Elizabeth Dennis (MP), Ophir Gaathon (SS), Charles Geraghty (MP), Steven Glennon (MP), Abhishek Jain (MSE), Jason Ostenson (MP), Allison Powers (MP), Aaron Svoboda (MP), Jospeph Synoradzki (MSE/CVN),Yushi Yang (AM)

M.Phil.
Charlton Chen (MSE), Zhuoying Chen (MSE), Melinda Han (SS), Jeremy Hanson (PP), Chad Husko (SS), Kirk Knobelspiesse (AM), Yizhou Li (SS), Shouzheng Liu (AM), Abby Shaw-Krauss (AM), Mutian Zhang (MP)

Ph.D.
Tamar Albert-Andelman (MSE), Eugenio Ortiz (PP), Kyrylo Shmatov (AM)

FEBRUARY 2008

B.S.
William Amspacher (AM)

M.S.
Ted Chang (MSE/CVN), Nicholas Hoell (AM), Wenjia Jing (AM), Masha Kamenetska (SS), Michelle Reilly (AM), Elizabeth Roberts (AM), Yutian Wu (AM)

M.Phil.
Brian Grierson (PP), Rodolfo Hermans (SS), Michael Vidne (AM), Matthew Worstell (PP), Sioan Zohar (SS)

Ph.D.
Yongfeng Guan (SS), Quinn Marksteiner (PP), Ron Schmitt (PP)

MAY 2008

B.S.
Vikram Ashok (AM), Bobak Atefi (AM), Yoni BenTov (AP), Dennis Boyle (AP), Diana Chang (AM), Nicholas Chelmu (AP), Lisa Chen (MSE), Jordan Chetrit (AM), Edmond Cheung (AP), Stephen Choy (MSE), Tadeusz Ciszak (AM), William Clark (AM), Marlene De Oliveira (AP), Shaun deLacy (AP), Jeffrey Fineberg (AM), Daniel Friedman (AM), Wenhao Gai (AP), Adam Gall (AM), James Gambino (AM), Vladimir Gorbaty (AM), Jason Gordon (MSE), Ky Harlin (AM), Steven Hoehner (AM), Nima Karamooz (MSE), David Katz (AM), Nicholas Kavoussi (AM), Daniel Kearney (AP), Allison Knupp (AM), Eugene Kogan (AM), Alex Landau (AM), Eric Larson (MSE), Grigori Levit (AM), Manav Malhotra (AP), Michael Nakazawa (MSE), Julian Ng (AM), Oleg Otlivanchik (MSE), Pablo Prieto-Munoz (AP), Blake Rego (AP), Kaustubh Samant (AM), Sahasra Sambamoorthi (AM), Monica Sarangdhar (AM), Kristie Sarkar (AM), Thomas Schweitzer (AM), Stacey Shi (AM), Kenneth Sikes (AP), Tanoy Sinha (AP), Matthew Steiner (AP), Andrew Stern (AM), Emily Stroebel (AP), Michelle Sung (AM), Pranita Suvarna (AM), Aasha Swamy (MSE), Gold Truong (AM), Paul Tsuji (AP), Christine White (AM), Tian Xie (AM)

M.S.
Austin Akey (MSE), Zeshan Azam (CVN/AM), Iskender Bilge (CVN/MSE), Benjamin Diehl (AM), Monica Deep (MSE), Noriko Hotchi (AM), Joseph Jailer-Coley (AM), Kelley Litzner (AP), Francois Monard (AM), Xabier Sarasola Martin (PP), Devaki Shah (AM), Weiwei Shen (SS), Roman Sunitsky (CVN/MSE), Jonathan Widawsky (SS), Yuan Zhou (CVN/AM)

M.Phil.
Aron Ahmadia (AM), Michael Hahn (AP), Zhang Jia (MSE), Pratap Ranade (AP), Ting Rao (AM), Andrew Ying (MSE)

Ph.D.
Zhuoying Chen (MSE), Shengguo Jia (SS), Mutian Zhang (MP)

Prof. William Bailey, Stephen Choy, & Prof. I.C. Noyan

Allison Knupp & Prof. Marc Spiegelman

Prof. Siu-Wai Chan & Eric Larson

Wenjia Jing & Noriko Hotchi

Prof. Marc Spiegelman, Alex Landau Vikram Ashok, & James Gambino

Lisa Chen Receives A Fulbright Award

Lisa YingYing Chen is a senior majoring in Materials Science and Engineering with a minor in German. In early April, she was awarded a Fulbright Fellowship to conduct research at the Technische Universität Berlin during the 2008-2009 academic year.

Under the advisory of Prof. Walter Reimers, she will be analyzing the stress behavior of metal matrix nanocomposites (MMNCs) through in situ x-ray diffraction. The MMNCs under study will consist of ceramic nanoparticles imbedded in a metal matrix, and the use of x-rays will yield details pertaining to the deformation behavior of MMNCs that cannot be observed by tensile testing alone. While tensile testing may be used to develop initial stress behavior models, proper observation of the microscopic behavior can not only support or disprove the use of these models but also provide insight into other strongly contributing factors. The complex interplay between residual stress, particle distribution, and interface relationships, as well as their respective contribution to load transfer and distribution will be an integral part of her research.

For the success of her application she would like to thank the following faculty members: Prof. Kelly Barry of the German Languages Department, who first proposed the idea; Prof. I.C. Noyan of the APAM Department, without whom the application would be non-existent; and Prof. Stephen O'Brien of the APAM Department, whose support helped make this possible.

"The CU AirLion" 2008 Team

Columbia's Student Branch of the American Institute of Aeronautics and Astronautics

by E. Renee Stroebel

(above and below)
"Lion in the Sky" 2006 Team

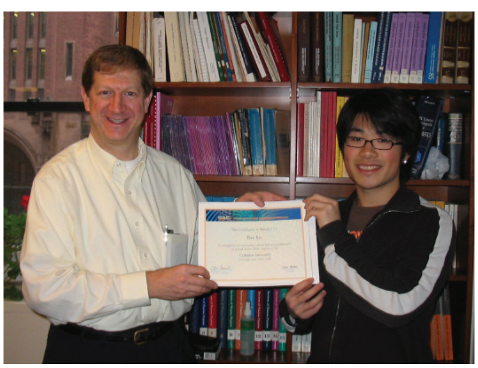
Columbia's student branch of the American Institute of Aeronautics and Astronautics is, in my opinion, one of the engineering school's best kept secrets – and I should know. My name is Renee Stroebel and I have been a part of the team for the last four years and have been on the executive board for the last three. We are a small tightly knit group mainly concerned with the design and construction of a model aircraft to compete in AIAA's Annual Design-Build-Fly competition. This avionics competition is highly competitive and attracts teams from top engineering schools both nationally and internationally. We design the plane from scratch each year, as the missions change annually. At the end of the year we travel to the competition site (which is generally either in Kansas sponsored by Cessna or in Arizona sponsored by Raytheon) and demonstrate that our airplane can accomplish the flight missions.

Blake Rego, serving as President, and I, serving as Treasurer, are the two senior members of the group. As applied physics majors we get down and dirty during construction just as well and as often as many of the mechanical engineers. Many of the teams that we compete against each year have memberships comprised of mainly aeronautical engineering majors coupled with a solid base of mechanical engineers. While our team this year did have four mechanical engineers, our core group also included two members with majors yet to be determined and more surprisingly, two of the fundamental positions of the group were held by two applied physics majors: Blake and myself.

(below)
"A Hard Day's Flight" 2007 Team

We are a young club looking to expand, and this is a learning process for everyone involved. If you're curious about getting involved as a member, sponsor, or a technical advisor, please e-mail one of us or show up for one of our meetings which are held every Tuesday at 8:30 PM, during the academic year, in 833 Mudd. Many of our competitors boast of faculty advisors, and we are looking for a professor or technical professional here to step up to the challenge for Columbia University AIAA. If you have any questions, feel free to reach someone on the board. All are welcome and no prior experience is necessary. All we require is a passion for aircrafts and aeronautics - we'll teach you all you need to know.

To learn more about Columbia's student branch of the American Institute of Aeronautics and Astronautics, please see:
http://www.columbia.edu/cu/aiaa/



Chapter President Tian Xie (right) receives a certificate of appreciation for distinguished service from SIAM, presented by faculty advisor, David Keyes (left)

SIAM Student Chapter Leaders Graduate and Pass the Reins

by David Keyes and Maja Vuksic

Columbia's student chapter of the Society for Industrial and Applied Mathematics (SIAM) is one of the few such chapters worldwide run by undergraduates. SIAM is an international organization of over 10,000 members, including mathematicians, computer scientists, and scientists and engineers whose interests and responsibilities lay primarily in mathematical modeling and the analytical and computational techniques that support modeling. They reside in academia, industry, and government laboratories. Columbia's student chapter owes its undergraduate focus to its founding President, Pearl Flath, then a Rabi scholar, and now a doctoral candidate at the University of Texas-Austin in the Institute for Computational Engineering and Science. Flath founded the Columbia chapter in Fall 2004. (Upon joining Texas and finding it without a SIAM student chapter, she founded another one there!)

The graduating executive board members are all APAM seniors: Tian Xie (pictured), James Gambino, Pranita Suvarna, Kristie Sarkar, Paul Tsuji and Nicholas Kavoussi. As they launch promising careers, with initial venues ranging from Manhattan financial firms to doctoral studies at Princeton, new officers take the reins: Jivan Kurinec, Michael Lo, and Maja Vuksic. Maja will represent Columbia at the Annual Meeting of the Society in San Diego in July, to brainstorm with other chapter leaders about how the chapter can best serve both its members and the student body at Columbia. CU-SIAM currently serves by organizing student-led tutoring and lectures from external speakers designed to provide insight on careers not otherwise modeled on the campus, e.g., in mathematical consulting or industry. This year, for instance, CU-SIAM hosted a talk by Dr. William Browning, the founder and CEO of Applied Mathematics, Inc. This talk was very well attended and stimulated a few of the students to consider careers in naval science. On the tutoring side, our MATLAB help room is designed to supplement for various undergraduate classes, as many students expressed a desire for extra instruction in this interactive mathematical language and graphic toolkit.

NASA Glory Mission

by Kirk Knobelspiesse

Global climate change has been has attracted considerable interest lately. Much of the attention is about the role of greenhouse gases, about which there is a high degree of scientific certainty. However, the global climate is a very complicated system, and some components are much less well understood. Once such component is particulate matter in the atmosphere, also known as aerosols[1].

Current global climate models are unable to fully account for all aerosol radiative effects. This inability, in turn, is due to the lack of comprehensive measurements of aerosols in the atmosphere. Unlike greenhouse gases, which persist in the atmosphere for decades or centuries, aerosols only remain aloft for days. They also have a variety of both natural and anthropogenic (human) sources, such as desert dust, forest fire smoke, and oxidation of industrial sulfur dioxide emissions. This means their global distribution is highly heterogeneous, requiring measurements from orbit in order to fully comprehend the potential climate effects on a global scale.

Remote sensing technology has advanced dramatically in the past three decades, but the current set of orbital instruments are not capable of measuring all the aerosol descriptive parameters that are required for climate modeling[2]. This is partly because the radiative effects of aerosols are quite complicated, involving both 'direct' radiative forcing (simple reflection or absorption of radiation by aerosols) and 'indirect' forcing (the potentially large influence on the lifetime and optical nature of clouds). For this reason, climate models require not only the quantity of aerosols, but also information about their size distribution, index of refraction and shape. Over the years, NASA and other organizations have launched a variety of remote sensing instruments. Aerosol property retrieval generally involves optimizing atmospheric radiative transfer models to match satellite observations. However, this process is often underdetermined, and requires assumptions about components of the radiative transfer system. Therefore, increasing the quantity of observations about a parcel of the atmosphere can lead to retrieval of more accurate climate relevant parameters.

The NASA Glory mission, due to be launched in December, intends to reduce the uncertainty associated with aerosols with its Aerosol Polarimetry Sensor (APS). The APS observes the earth at a variety of view angles in nine spectral channels, and is also sensitive to polarization. This combination offers the potential to reduce aerosol uncertainties by reducing assumptions. For example, land surface reflectance, which is often a large source uncertainty with other aerosol remote sensing instruments, can be determined directly from APS measurements. In addition to aerosol retrievals, the APS sensor will measure cloud properties. Another instrument on Glory, the Total Irradiance Monitor (TIM), will measure the total solar irradiance reaching the earth, whose variability is another source of climate change uncertainty[3].

The Department of Applied Physics and Applied Mathematics at Columbia is involved with the NASA Glory mission in its collaboration with the NASA Goddard Institute of Space Studies (GISS). Several research scientists have joint appointments with APAM and GISS, and the department occasionally sends graduate students to do their research at NASA.

As one of those graduate students, I am developing surface radiative transfer models that will be used for the retrieval of aerosol properties. These models are based upon numerical solutions of Maxwell's equations for scattering from arbitrarily shaped objects (such as the wax crystals on the surface of leaves). Long wavelength observations, where aerosol effects are minimal, will the used to identify the appropriate surface model for a scene. This information will be used to constrain the surface reflectance at shorter wavelengths during the atmospheric model optimization used for aerosol retrieval.

Lift-off of the Jetstream-31 aircraft during a research flight in Veracruz, Mexico. The Research Scanning Polarimeter is located in the tail of the aircraft.

As part of this model development effort, I have had the opportunity to participate in several field campaigns with an airborne APS prototype, called the Research Scanning Polarimeter (RSP). Field campaigns often have many research objects, but I was able to make observations of reflectance over a variety of surface types, which will prove invaluable when validating surface reflectance models. I have traveled to the plains of central Oklahoma, the gulf coast of Mexico, and will depart again later this summer for the Canadian Arctic. So, my experience as a graduate student has certainly been in synch with APAM's interdisciplinary nature. I have been combining radiative transfer and computational mathematics for the purposes of understanding atmospheric aerosols, and ultimately, climate change. All while I get to ride around in small airplanes!

[1] IPCC. Climate Change 2007 - The Physical Science Basis: Contribution of the Working Group I to the Fourth Assessment Report of the IPCC. Cambridge University Press, New York, NY, 2007.

[2] M. Mishchenko, I. Geogdzhayev, B. Cairns, B. Carlson, J. Chowdhary, A. Lacis, L. Liu, W. Rossow, and L. Travis. Past, present, and future of global aerosol climatologies derived from satellite observations: A perspective. J. Quant. Spectrosc. Radiat. Transfer, 106:325–347, 2007.

[3] M. Mishchenko, B. Cairns, G. Kopp, C. Schueler, B. Fafaul, J. Hansen, R. Hooker, T. Itchkawich, H. Maring, and L. Travis. Accurate monitoring of terrestrial aerosols and total solar irradiance: introducing the Glory mission. Bull. Amer. Meteorol. Soc, 88, 2007.

Stephen L. Ostrow (M.S. '70, Eng.Sc.D. '78, Nuclear Engineering) received his doctorate in Applied Physics & Nuclear Engineering and an MBA from Columbia and joined the nuclear industry performing radiation analyses for nuclear reactors and other facilities in an architect-engineering firm where he was Manager of Applied Physics and Chief Engineer of Nuclear Engineering. He later became Manager of Advanced Technology, specializing in energy and superconductivity projects. The past few years he has been working for SC&A, Inc., a Vienna, VA, engineering consulting firm, where he (working out of New York) is Senior Vice President of Advanced Technology. His primary focus is developing technologies for homeland security and defense to detect explosives and toxic chemicals from a distance. He is also an Adjunct Professor in APAM where he is teaching APPH E4010: Nuclear Physics, the same course he took in the same department many years ago. He is married to Arlette, who graduated from the Sorbonne and Teachers College and teaches French in a local private school. They live on the upper east side of Manhattan and have 3 children.

Ralph Izzo (M.S. '79, Ph.D., Plasma Physics '81) has been chairman, president and CEO of Public Service Enterprise Group Incorporated (PSEG) since April, 2007. He had served as president and chief operating officer of PSEG since October, 2006 when he was also elected to the Board of Directors. Earlier, he was president and chief operating officer of Public Service Electric and Gas Company.

Since joining PSE&G in 1992, Izzo was elected to several executive positions within PSEG's family of companies, including PSE&G senior vice president (utility operations), PSE&G vice president (appliance service), PSEG vice president (corporate planning), Energis Incorporated senior vice president (finance and information services), and PSE&G vice president (electric ventures). In these capacities, he broadened his experience in the areas of general management, strategic planning and finance.

Izzo is a well-known leader within the utility industry, as well as the public policy arena. His public policy experience includes service as an American Physical Society Congressional Science Fellow, in the office of U.S. Senator Bill Bradley. He also served 4 years as a senior policy advisor in the Office of New Jersey Governor Thomas H. Kean, specializing in energy, science and technology.

His career began as a research scientist at the Princeton Plasma Physics Laboratory, performing numerical simulations of fusion energy experiments. He has published or presented over 35 papers on magnetohydrodynamic modeling. He received his Bachelor of Science and Master of Science degrees in mechanical engineering and his Doctor of Philosophy degree in applied physics (plasma physics) from Columbia. He also completed the requirements for a Master of Business Administration degree, with a concentration in finance from the Rutgers Graduate School of Management. He is listed in numerous editions of Who's Who and has been the recipient of national fellowships and awards. Izzo serves on the board of directors for the Electric Power Research Institute, the New Jersey Chamber of Commerce, the American Gas Association, the New Jersey Utilities Association, the Edison Electric Institute (EEI), and the Nuclear Energy Institute (NEI). He is chairman of New Jersey After 3 Inc., the Drumthwacket Foundation, and the Capital Campaign for the PSE&G Children's Specialized Hospital. Izzo also serves as electric utility sector chairman of the Infrastructure Advisory Committee in the Attorney General's Office of Counter-terrorism, and is on the board of trustees for the New Jersey Network Foundation and Rutgers Business School.

Steffen Kaldor (M.S. '98, Ph.D. '02, Materials Science & Engineering) is currently a process engineering manager at IBM's 300mm semiconductor development and manufacturing facility in East Fishkill, NY. He and his wife, Lu Ann, have a 2 1/2 year old son, Sebastian, and are expecting their second child.

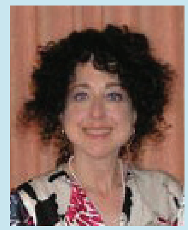
Jonathan Spanier (Ph.D. '01, Solid State Physics) was among 58 researchers from across the nation who received a Presidential Early Career Award for Scientists and Engineers (PECASE). The PECASE is the nation's highest honor for professionals at the outset of their independent research careers.

According to John H. Marburger III, director of the Office of Science & Technology Policy, "Selection for this award is based on the combination of innovative research at the frontiers of science and technology and community service demonstrated through scientific leadership and community outreach." Nominated by the Department of Defense, Spanier is cited for "innovative research in materials science and engineering to improve synthesis strategies to produce novel and advanced hybrid nanostructures with specific properties and multifunctional capabilities," Spanier is also cited "for his exceptional teaching of graduate and undergraduate students from diverse backgrounds." Nine federal departments and agencies annually nominate beginning scientists and engineers whose work shows exceptional promise for leadership at the frontiers of scientific knowledge. PECASE awardees receive funding for up to 5 years to further their research in support of critical government missions.

Spanier is an assistant professor of materials science and engineering (MSE) at Drexel University. In addition to his faculty appointment, he serves as the associate department head of MSE, and is an affiliated faculty member in Drexel's department of electrical and computer engineering. He is the first assistant professor at Drexel to be selected for this recognition since the inception of the program in 1996.

Bonnie Wilensky (B.S. '97, Applied Mathematics) attended the 10-year Columbia reunion with her husband, David Silvera (Law and Business School, 1996). They have a 9-month old daughter, Bianca.

IN MEMORIAM



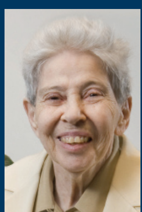
Elizabeth Selcow-Stein (Ph.D. '84 Plasma Physics) died September 19, 2007 in Los Alamos, NM, after a long illness.

She received her bachelor, master of science, master of philosophy, and doctor of philosophy degrees in nuclear engineering from Columbia SEAS. While at SEAS, her advisors were Dean Robert Gross and Prof. Leon Lidofsky.

Dr. Selcow began her career as an engineer with the Grumman Corporation, where she was responsible for nuclear analysis for space propulsion, plasma physics and fusion compact ignition Tokamak designs. In 1989, she joined Brookhaven National Laboratory, where she performed Monte Carlo analyses for boron neutron capture therapy (BNCT), space propulsion systems and spallation target testing for the BNL synchrotron. She served as a visiting research scientist at M.I.T., working on BNCT treatment planning. In 1998, she joined Westinghouse Savannah River Co., where she collaborated with Los Alamos National Laboratory as part of the Accelerator Production of Tritium Spallation Physics design team. In 1999, she joined Los Alamos National Laboratory to work with the Monte Carlo code development team, providing user support, teaching MCNP classes at LANL, and international training conferences with NEA OECD. She also worked with the LANL Shavano Project, part of the Advanced Scientific Computing Initiative (ASCI) program, intended to address the need for high-fidelity weapons computer codes in the absence of nuclear testing. She was the author of numerous published technical reports, journal articles, and conference papers on MCNP transport methods for weapons testing simulations, neutron and particle transport, medical physics and BNCT applications.

Prof. Siu-Wai Chan was elected by the Panel of Fellows of the American Ceramic Society Board of Directors at its April 25, 2008 meeting to the grade of Fellow. Her election to Fellow will be recognized at the ACerS Honors and Awards Banquet at their 110th Annual Meeting, on October 6, 2008 in Pittsburgh, PA.

Prof. David Keyes was honored with the "Great Teacher Award" during the SEAS Class Day ceremony on Monday, May 19, 2008. Prof. Keyes teaches APMA E2101y Introduction to Applied Mathematics for undergraduates.



Prof. Gertrude Neumark was recently featured on Fox Business News. The interview of the Fox Business Video: Patent Pleading is available online at:

http://www.apam.columbia.edu/announcements/neumark_news/index.html

Prof. Ed Nickoloff (Professor of Radiology and part of the Medical Physics faculty), received the Marvin M. D. Williams Award at the American College of Medical Physics annual meeting in Seattle on May 2, 2008 and was the keynote speaker at the Award Banquet. This award is the highest award given by the ACMP for Lifetime Professional Achievement in the field of medical physics. There have only been 19 other recipients of this award given by the ACMP. Only 2 other physicists who received this award were in Diagnostic Radiology; the other physicists were all in Radiation Oncology. He has been Chairman, Secretary and Board member of the ACMP and has served the medical physics community in many other ways.

Prof. Aron Pinczuk was named the 2008 recipient of the Janette and Armen Avanessians Diversity Award. Nominations were received from both undergraduate and graduate students noting his encouragement of women scientists in the classroom and laboratory. He was honored with this award during the SEAS Class Day ceremony.

Prof. Latha Venkataraman was awarded an NSF CAREER Award for $600,000 to study "Electronic & Mechanical Properties of Single Metal-Molecule-Metal Junctions."

"The size of components in the integrated circuit industry is fast approaching the nanometer scale, requiring a detailed understanding of the fundamental properties at the single molecule level," says Venkataraman. "With the development of scanning probe tools over the last few decades, we now have the ability to investigate physical properties at the atomic level."

Her focus will be to reveal and understand properties of single molecules attached to metal electrodes while educating students about the interplay of physics, chemistry and engineering at the nanoscale. Her group will build a high-resolution conducting atomic force microscope to simultaneously measure the rate at which electrons are transferred across a single molecule junction, as well as the forces required to break the junction apart. Measurements of different molecular systems will lead to an understanding, at the single molecule level, of the mechanical forces required to break bonds as well as their electronic properties, a prerequisite to developing electronic circuitry at the molecular scale.

New Faculty Member: Simon Billinge

Prof. Simon Billinge

Prof. Simon J. L. Billinge joined the faculty during the 2008-2009 academic year, coming from the department of Physics and Astronomy at Michigan State University (MSU) where he was University Distinguished Professor. One of the current frontiers in materials science and nanotechnology is the "nanostructure problem," the fact that our existing tools for probing the atomic arrangement in materials break down for nanoscale structures. Prof. Billinge is both defining this problem and proposing solutions that utilize advanced x-ray and neutron scattering methods. The experiments make use of the unprecedented power of modern x-ray and neutron facilities at national laboratories. However, brighter, more intense beams are not enough. The algorithms used to analyze the data to obtain the atomic arrangements need to be reworked. Prof. Billinge has said "the APAM Department at Columbia is a beautiful fit. To solve the nanostructure problem we need to combine advances in algorithms, computing and experimental facilities, just the expertise and capabilities that are here." Prof. Billinge's appointment brings closer Columbia's connections to the nearby Brookhaven National Laboratory where he holds a joint appointment. Brookhaven has a powerful x-ray synchrotron source, the National Synchrotron Light Source, where Prof. Billinge is building a beamline for nanostructure studies. The world's brightest x-ray synchrotron source is under construction at Brookhaven, and due for completion in 2015. This one billion dollar national user facility is targeted towards nano-science research and will be a tool of unprecedented power for the study of nanomaterials.

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Billinge's background is in Materials Science, with a BA degree from Oxford University in the UK, and a Ph.D from University of Pennsylvania with a period of post-doctoral research at Los Alamos National Laboratory before he joined MSU. Recent papers from his group include the first demonstration of ab-initio nanostructure determination from x-ray scattering data described in a March 2006 edition of *Nature* and a description of the nanostructure problem, and a road map for solving it, published in *Science* in April 2007. The methods these studies develop are applied to range of materials with nanoscale structures including electrode materials used in batteries and fuel cells, materials for hydrogen production and storage, and fluorescent tags for use in medical applications as well as answering basic science questions in strongly correlated electron materials such as high-Tc superconductors.

The full promise of nanotechnology, the control and design of materials on the nanoscale, will only be realized when we can characterize nanoscale structure quantitatively and robustly. Columbia and APAM will play an important role in these developments in the upcoming years.

Neumark Receives an Honorary Doctor of Science Degree

Gertrude Neumark, Howe Professor Emerita of Materials Science and Engineering, received an Honorary Doctor of Science Degree from Columbia at the University's Commencement ceremonies on Wednesday, May 21, 2008. She is one of the world's foremost experts on doping wide band-gap semiconductors and is the first woman to hold a named chair in The Fu Foundation School of Engineering and Applied Science.

"Gertrude Neumark is truly one of the pioneers who has helped build our legacy and it is a fitting tribute to her that she will receive this honor from Columbia," said Gerald A. Navratil, Interim Dean of SEAS. "We are grateful to her for her intellectual and academic contributions and her many years of commitment and support of the School."

Prof. Neumark graduated summa cum laude from Barnard College in 1948, received an M.S. in chemistry from Radcliffe in 1949, and, in 1951, received a Ph.D. in chemistry from Columbia's Graduate School of Arts and Sciences. Prof. Neumark was recently selected as a recipient of Barnard's Distinguished Alumna Award for 2008 for her outstanding achievements in materials science and engineering. She was elected a Fellow of the American Physical Society in 1982, and has been a panelist for the National Research Council. She is one of 83 women whose work appears on the archival website maintained by UCLA entitled, "Contributions of 20th Century Women to Physics." She is also listed in Who's Who in America, Who's Who in Science and Engineering, and American Men and Women of Science. She is the author of more than 140 publications and a contributor to McGraw-Hill Yearbook of Science and Technology.

"Gertrude Neumark is truly one of the pioneers who has helped build our legacy"

Philips Electronics Professorship

Prof. Neumark is the reason a new professorship is being established at the School. Philips, the international electronics company headquartered in The Netherlands, established an endowed fund, the newly-created Philips Electronics Professorship Fund, in the School's Department of Applied Physics and Applied Mathematics in honor of Professor Neumark's pioneering role as a woman scientist and engineer. She was employed by Philips Laboratories in Briarcliff Manor, NY, between 1960 and 1985.

The Philips Electronics Professorship is to be held by a tenured faculty member and consideration will be given to a member who is from a group that is underrepresented on the SEAS faculty with a view toward increasing the diversity of the School, as Prof. Neumark did at the time of her appointment as Howe Professor of Materials Science in 1999. Dean Navratil said, "We know the incumbent will be inspired by the example of Gertrude Neumark."

Prof. Neumark said, "I am particularly pleased that the Philips Electronics Professorship will give one member of an underrepresented group an opportunity to receive tenure." Prof. Neumark is one of the world's foremost experts on doping wide band-gap semiconductors. It was during her research work at SEAS that she conceived the doping process that has been the basis for devices improving the quality of consumer products ranging from flat screen TVs to mobile phone screens.

"Columbia revitalized my research and really gave me a second career," says Neumark, currently a research scientist and Howe Professor emerita. "I find the environment extremely stimulating." She credits Columbia with providing the creative environment that led to her patents in doping wide band-gap semiconductors.

Doping is the process of adding impurities to semiconductors to provide better conductivity. There are two types of dopants, one with one more valence electron than the host (donors), and the other with one fewer (acceptors). Prof. Neumark realized that better doping could be obtained by "tricking" the semiconductor by incorporating both types of dopants together, but selecting the type that was not desired to be a relatively mobile impurity, and then subsequently removing it.

Moreover, she also realized that this method would be applicable to any wide band-gap material. It was precisely this approach that resulted in the successful development of green and shorter-wavelength lasers and LEDs using gallium nitride and related nitrides. For a number of years, obtaining efficient blue and green light emissions from semiconductor devices was regarded as the "holy grail" in this area.

Commercial uses for blue and shorter-wavelength lasers range from increasing sharpness of a laser printer to increasing the information storage capacity of a DVD. The significant advantage of these diode lasers lies in their wavelength. "The space needed to store information is proportional to the square of the wavelength," said Neumark, "so the shorter the wavelength, the greater the information that can be stored in the same space."

In addition to these lasers, her patented processes led to blue and ultraviolet LEDs (light-emitting diodes), which are now used for computers, traffic lights, instrument panels, as the background color for mobile-phone screens, in multicolor displays, flat screens and in numerous other lighting applications.

The article above was adapted from "Philips Electronics Honors Professor Gertrude Neumark" in the Spring 2008 issue of The Fu Foundation School of Engineering and Applied Science's *Engineering News*. Special thanks to Margaret Kelly for granting us permission to reproduce this article, as well as the announcement of Prof. Neumark's honorary degree.

Chris Wiggins featured in *Scientific American*

Prof. Chris Wiggins

Prof. Chris H. Wiggins was profiled in the April 2008 edition of *Scientific American*. The article states that by using machine learning, Wiggins hopes to develop models that can predict how all of an organism's genes behave under any circumstance - and thereby explain precisely why some cells become sick or cancerous. Adapted with permission from 'At the Edge of Life's Code,' by Thania Benos. Copyright ©2008 by *Scientific American, Inc.* All rights reserved.

On an airport shuttle bus to the Kavli Institute for Theoretical Physics in Santa Barbara, Calif., Chris Wiggins opened a spreadsheet of data, representing the amount of messenger RNA (mRNA) expressed by all 6,200 genes of the yeast over the course of its reproductive cycle. "It was the first time I ever saw anything like this," Wiggins recalls of that spring day in 2002. "How do you begin to make sense of all these data?"

Instead of shirking from this question, Wiggins embraced it - and now has an answer. Wiggins and his colleagues have now brought machine learning to the natural sciences to model gene regulation.

The impetus for this work began in the late 1990s, when high-throughput techniques generated more mRNA expression profiles and DNA sequences than ever before, "opening up a completely different way of thinking about biological phenomena," Wiggins says. Key among these techniques were DNA microarrays, chips that provide a panoramic view of the activity of genes and their expression levels in any cell type, simultaneously and under myriad conditions. As noisy and incomplete as the data were, biologists could now query which genes turn on or off in different cells and determine the collection of proteins that give rise to a cell's characteristic features-healthy or diseased.

Finding these rules requires inferring interaction between genes and the proteins that regulate them. Physicists often view statistics as an anathema: "If your experiment requires statistics," British physicist Ernest Rutherford once said, "you ought to have done a better experiment." But in working with microarrays, "the experiment has been done without you," Wiggins explains. "And biology doesn't hand you a model to make sense of the data." "You are trying to find something compelling about the natural world in a context where you don't know very much," says William Bialek, a biophysicist at Princeton University. "You're forced to be agnostic."

At the Kavli Institute, Wiggins began building a model of a gene regulatory network in yeast--the set of rules by which genes and regulators collectively orchestrate how vigorously DNA is transcribed into mRNA. Wiggins and his colleagues can now go much further than yeast. Recently they have shown that their model can accurately build predictive models of gene regulatory networks in higher organisms such as worms as well as in several cell lines, including those of human lymphocytes. In a cancer cell line, the team can determine which genes increase their activity when they should decrease it, and vice versa. The ultimate goal, however, is to understand their coordinated activity and infer, with statistics, which interactions lead to a diseased cell.

To address modeling limitations, researchers must not only continue to cross disciplines but also be willing to adopt their tools. "I would say that machine learning hasn't taken off like wildfire in the physics community," remarks Alex Hartemink, a machine-learning expert at Duke University. "But Chris seems to be most comfortable reaching out and learning about techniques from other places. And I think we need people that are going to do that--foray out into the forest, find new resources and bring them back to the tribe and say, 'Hey, guys, check this out--this is great stuff.'"

Prof. Chris Wiggins was also featured in the article "Beauty by numbers" in *Columbia Magazine* for his work with a former student, Amy Gansell '98BC. As part of her Harvard dissertation, she scrutinized female figures depicted in hundreds of decorative ivories from first-millennial BCE Mesopotamia. She recruited Wiggins to examine the 32,000 resulting pieces of data. Wiggins employed a new, high-powered type of statistical analysis called "machine learning," which can reveal hidden patterns and associations amid huge data sets.

DEPARTMENT NEWS: We are pleased to announce the promotion of Constantine Chernyavsky to the position of Business Manager. Constantine first came to APAM in November 2006 as the Financial Analyst, and as such proved himself to be not only a very capable accountant but also an adept manager. APAM's new Financial Analyst is Darya Shcherbanyuk. Darya is a recent graduate of CUNY Honors College at Baruch and she holds a Bachelor's in Business Administration.

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