

# APAM NEWS

THE DEPARTMENT OF APPLIED PHYSICS & APPLIED MATHEMATICS

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



Dear Alumni and Other Friends of APAM:

These are exciting times for our department. Our undergraduate and graduate programs in Applied Physics, Applied Mathematics, and Materials Science and Engineering are vibrant and expanding. Our Medical Physics masters program continues to produce many leaders in the medical diagnostics community each year. Our department has evermore beacons of intellectual excellence and displays an amazing degree of interconnect- edness in research. We have also grown and now have over 100 undergraduate students and over 100 graduate students.

This is the inaugural issue of the APAM Newsletter. Twice a year, the newsletter will celebrate the exciting recent devel- opments in our department. What are the recent achieve- ments of our alumni? What special distinctions have our stu- dents and faculty earned? What is the latest in department research?

This newsletter is another vehicle for keeping us all in touch with our alumni and other friends of the department. What are you doing? Please let us know!

In this issue, the spotlight on faculty activities is on Prof. Da- vid Keyes and his highly prominent activities promoting large- scale simulation in science and engineering science through his key role in a series of recent high-level panels. His activi- ties in this area illustrate the amazing interconnectedness in our department. Large-scale simulation is clearly an impor- tant feature of our Applied Mathematics effort. Furthermore, one of his reports addresses simulating fusion, a mainstay of Applied Physics; another addresses theory and modeling in nanoscience, which are key activities in Materials Science and Engineering and in Applied Physics; and a third addresses advanced nuclear engineering systems, which impacts each part of our department.

In closing, I would like to warmly thank Ms. Christina Rohm for so expertly spearheading the concept and establishment of this Newsletter. This is the beginning of yet another fine tradition in APAM.

Best,

Irving P. Herman  
Chair, APAM



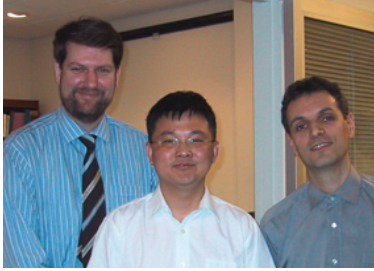
A glowing nitrogen plasma in the CNT experiment, visualizing CNT's magnetic topology. Prof. Thomas Pedersen's graphic of the Columbia Non-neutral Torus was featured in the 2006 American Physical Society (APS) Calendar.

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The APAM Newsletter is published twice a year. To request a hard copy of this issue, please contact the APAM Department (see page 10).

## Kui Ren Wins the Simon Prize



(left to right) Prof. Hielscher, Dr. Kui Ren, & Prof. Guillaume Bal

Dr. Kui Ren received the Robert Simon Memorial Prize for the most outstanding dissertation in the APAM Department. He received his Ph.D. with distinction in May 2006. He was advised by Prof. Guillaume Bal and his area of research is the theoretical and numerical analysis of inverse transport problems. Dr. Ren also worked closely with Prof. Andreas Hielscher in the Department of Biomedical Engineering where he learned about and solved important practical problems arising in medical imaging. In 2002, Dr. Ren was awarded an Excellent Teaching Assistant Award from SEAS.

His achievements in the application of inverse transport theory to medical imaging included the implementation of two and three dimensional algorithms and PDE-constrained optimization to the reconstruction of optical parameters in small animals.

Dr. Ren received his B.S. in Mathematics from Nanjing University in 1998 and his M.S. from Peking University in 2001 where he received the Proctor and Gamble (P&G) Award for Outstanding Graduate Student. Later in 2001, he entered Columbia University as a graduate student in Applied Mathematics and the following year started his thesis work in under the supervision of Prof. Bal. While at Columbia, he was first author on three articles in *Optics Letters*, *Applied Optics*, and the *SIAM Journal on Scientific Computing*, and he was a contributing author on four other papers.

Dr. Ren will continue his research at Columbia University where he presently holds a post-doctoral position and is working in collaboration with Prof. Bal.

## Undergraduate Awards



Isaac Greenbaum  
SEAS Valedictorian

Congratulations to the winners of our 2005-2006 undergraduate student awards!

**Emily Hwang: Francis B. F. Rhodes Prize in Materials Science & Engineering for a senior displaying the greatest proficiency in MSE course studies.** Emily received her B.S. in Materials Science and Engineering in May 2006 and is now attending Harvard Dental School.

**Arthur Lipstein: Applied Physics Faculty Award for an outstanding senior.** Arthur was a double major in Applied Physics and Applied Mathematics. He earned his B.S. degree in May 2006 and is pursuing his graduate studies in Physics at the California Institute of Technology.

**Isaac Greenbaum: Applied Mathematics Faculty Award for an outstanding senior.** Isaac completed his B.S. degree and was named the SEAS valedictorian in May 2006. He is currently employed by Citigroup and plans to continue his studies in graduate school.

**Timothy Merlis: Wendell Memorial Medal for a senior best exemplifying ideals of character, scholarship, and service.** The American Geophysical Union (AGU) also awarded him the honor of "best student paper" for the undergraduate research project he conducted with Prof. David Keyes and Dr. Samar Khatiwala. He earned his B.S. in Applied Mathematics in May 2006 and is currently pursuing his graduate studies at California Institute of Technology.



Timothy Merlis  
Wendell Memorial Award Winner



## CONGRATULATIONS GRADUATES

2005-2006

### APPLIED MATHEMATICS, B.S.

Astha Bakhru, Negissa Balluku, David Berman, Colby Blitz, Ricardo Calmon, Eitan Chatav, Matthew Dinusson, Negar Dolatabadi, Stephen Estes, Marvin Hildago, Isaac Greenbaum, Lai On Leon Ho, Eli Kamara, Hoyoon Kang, Timothy Kang, Arthur Lipstein, Timothy Merlis, Fai Ming, Heling Shen, Robert Spinella, Henry Stanley, Jiatao Wang, Tian Wang, Courtney Walker, Montgomery Wilensky

### APPLIED PHYSICS, B.S.

Aron Angerami, Charles Biddle-Snead, Andrew Coppock, Stacey Hirsch, Elliot Kaplan, Cornwall Lau, Daniel Lesky, Akiva Reckson, Titus Sgro, Jeff Waksman

### MATERIALS SCIENCE & ENG., B.S.

Emily Hwang, Robert Kule, Adrian Podpirka, Zamir Pollak, Brian Ruby

### APPLIED MATHEMATICS, M.S.

Edwin Lee, Braxton Osting, Anil Raj, Ryan Rowe, Abby Shaw-Krauss, Michael Vidne

### APPLIED PHYSICS, M.S.

Michael Hahn (PP), Jaime Farrington (PP), Charles Gomez (SS), David Graff (MP), Glenn Jennings (MP) Ozgur Kalenci (SS), Whasil Lee (SS), Huan-Yung Liao Robert Masino (MP), Pratap Ranade (SS), Ting Rao (SS), Sioan Zohar (SS)

### MATERIALS SCIENCE & ENG., M.S.

Hsing-Yun Cheng, Chieh Chu, Yikang Deng, Yu-Ming Hung, Yong Koo Kyoung, Ji Yong Noh, Tora Unuvar, Andrew Ying

### APPLIED MATHEMATICS, Ph.D.

Samuel Burns, Deborah Herceg, Kui Ren, Ramon Verastegui

### APPLIED PHYSICS, Ph.D.

Tulika Bose (AP), Cory Cates (PP), Noelle Ibrahim (SS), Alexander Klein (PP), Yuhong Liu (PP), Zuoming Zhu (QE)

### MATERIALS SCIENCE & ENG., Ph.D.

Lili Cheng, Jae Beo Choi, June Lau, Stephanie Grancharov, Hanfei Yan



## Spotlight on Current Students

### **Blake Rego, Applied Physics Undergraduate Student, Junior**

Last summer he participated in a Research Experience for Undergraduates (REU) program at the University of Pennsylvania and was the recipient of the E. W. Plummer Award. This award was given to the student who wrote the best engineering paper in the REU program.

### **Kirk Knobelspiesse, Applied Math Graduate Student**

He presented the poster entitled "Surface Polarized Reflectance Characterization for the Research Scanning Polarimeter (RSP)" at the 2006 American Geophysical Union (AGU) and "Using the NPOESS Aerosol Polarimetry Sensor to Retrieve Aerosol Environmental Data Records" at the 2005 AGU meeting. He also participated in the INTEX-B/MILAGRO field campaign in Veracruz, Mexico in March 2006 where he helped operate the Research Scanning Polarimeter (RSP) in an aircraft as part of a large, international atmospheric science field campaign. Also, he participated in the "Aerosol Lidar Validation Experiment" (ALIVE) in Ponca City, Oklahoma in September 2005 where he helped operate the RSP

in an aircraft as part of a joint NASA-DOE atmospheric science field campaign.

### **Matthew Lanctot, Plasma Physics Graduate Student**

He was awarded a DOE Fusion Energy Science Fellowship for '05-'06 and it was renewed for the '06-'07 academic year. This past summer he spent twelve weeks at the DIII-D National Fusion Facility, a division of General Atomics. He also presented a poster entitled "Measurement of Plasma Displacement Due to Resonant Field Amplification in High Beta DIII-D Plasmas Using CER Spectroscopy" at the American Physical Society (Division of Plasma Physics).

### **Jenna Pike, Materials Science and Engineering Graduate Student**

She attended the Pan-American Advanced Studies Institute (PASI) on Transmission Electron Microscopy in Materials Science in Santiago, Chile, from July 9-23, 2006 (funded by NSF). She was a contributing author on the following paper: P.-Y. Wu, J. Pike, F. Zhang, S.-W. Chan, "Low Temperature Synthesis of Nano-ZnO with Controlled Size and Shape," *International Journal of Applied Ceramic Technology*, v. 3, p. 272, 2006.

## ALUMNI NEWS

**Andrew Charlton** (Postdoc '06, Applied Mathematics), won a prestigious Fellowship from the Natural Environment Research Council (UK) and is now a NERC Postdoctoral fellow, in the Department of Meteorology, University of Reading. His research focuses on coupling between the Stratosphere and Troposphere on timescales between ten days and many years. His most recent work has examined the simulation of Stratospheric Sudden Warmings in a series of Stratosphere-resolving GCMs and he is currently working on making forecasts of the troposphere on extended-range timescales using stratospheric information.

**Lili Cheng** (Ph.D. '05, Materials Science & Engineering) is working at Los Alamos National Lab in New Mexico.

**James Cho** (Ph.D. '96, Applied Mathematics) was recently appointed as a Lecturer in Astrophysics and Planetary Science at Queen Mary College (University of London). He is currently working on understanding the flow and temperature structure of atmospheres on extrasolar planets, via computer simulations and analytical calculations. He also studied turbulence, vortex, and mixing issues, arising from giant impacts and dynamics in protoplanetary disks related to planet formation.

**Jae Beom Choi** (Ph.D. '06, Materials Science & Engineering) is working in Korea at Samsung Electronics.

**Chieh (Joseph) Chu** (M.S. '04, Materials Science & Engineering) is working in Taiwan at DuPont.

**Irene Dujovne** (Ph.D. '05, Applied Physics: Concentration in Solid State Physics & 2005 Simon Prize Winner): After graduating from Columbia two years ago, she took a postdoctoral position in the Molecular biophysics group, headed by Cees Dekker at TU Delft. She is focusing on developing a new optical set-up designed to probe sub-nanometer scale processes with fast temporal resolution. This will enable her group to explore in great accuracy fundamental molecular processes, such as protein-DNA interactions and movement of motor proteins along filaments. She is currently looking for faculty position, and hopes to continue this line of biologically-inspired research in the future.

**Yu-Ming (Henry) Hung** (M.S. '04, Materials Science & Engineering) is working in Taiwan at 3M.

**Alexander Klein** (Ph.D. '06, Applied Physics: Concentration in Plasma Physics) joined a collaboration between MIT, CRPP in Lausanne,

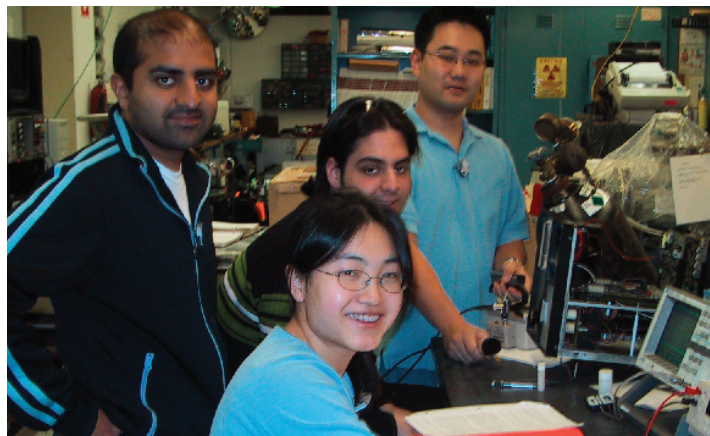
and JET to investigate damping rates for medium N numbered toroidal Alfvén Eigenmodes (TAEs) on the JET tokamak using an active MHD diagnostic. The TAEs are excited via externally driven antennas, and the plasma response is observed in various sensors and damping rates deduced from this. Medium N numbered TAEs have been predicted to be unstable in ITER and could potentially destabilize alpha particle confinement. Data might indicate a) if this will be so, and b) what parameters will make these modes stable so that ITER can work. Alex returned to Columbia to present a talk titled the "Active MHD spectroscopy on the Joint European Torus" at the Plasma Physics Colloquium on October 27.

**George Vunni** (DES '06, Materials Science & Engineering) is working with the Army Research Laboratory in Aberdeen, MD.

**Alicia Wagner** (B.S. '04, Applied Physics) is currently pursuing graduate students at the University of Nebraska program is in architectural engineering, specializing in Architectural Acoustics.

**Matthew Witten** (Ph.D. '04, Applied Physics: Concentration in Medical Physics) was a featured speaker in the Spring 2006 Medical Physics Seminar Series. He is currently the Chief Physicist and Director of Cyberknife Radiosurgery at Winthrop-University Hospital.

**HanFei Yan** (Ph.D. '06, Materials Science & Engineering) is working at the Argonne National Center for Nanoscale Materials in Illinois.



*Alumni, please send your news to:*  
[seasinfo.apam@columbia.edu](mailto:seasinfo.apam@columbia.edu)

## New APAM Faculty Members



**David E. Keyes**

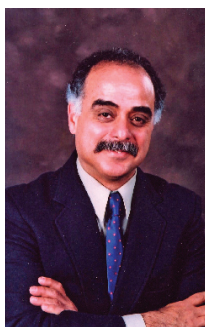
Fu Foundation  
Professor of  
Applied Mathematics

**David E. Keyes**, the Fu Foundation Professor of Applied Mathematics at Columbia University, is an affiliate of the Computational Science Center (CSC) at Brookhaven National Laboratory and fraction-time Acting Director of Institute for Scientific Computing Research (ISCR) at the Lawrence Livermore National Laboratory.

With backgrounds in engineering, applied mathematics, and computer science, Keyes works at the algorithmic interface between parallel computing and the numerical analysis of partial differential equations, across a spectrum of aerodynamic, geophysical, chemically reacting, and magnetohydrodynamic flows. He currently leads a nine-institution Integrated Software Infrastructure Center (ISIC) under the Department of Energy's Scientific Discovery through Advanced Computing (SciDAC) initiative.

Among Keyes's awards are: the Gordon Bell Prize for High Performance Computing, Special Category (shared), 1999; the Yale College Prize for Teaching Excellence in the Natural Sciences, 1991; a National Science Foundation Presidential Young Investigator Award, 1989; and a Harvard-Danforth Certificate for Excellence in Teaching, 1982.

Keyes graduated summa cum laude with a B.S.E. in Aerospace and Mechanical Sciences and a Certificate in Engineering Physics from Princeton in 1978. He received his Ph.D. in Applied Mathematics from Harvard in 1984. He then post-doc'ed in the Computer Science Department at Yale and taught at Yale as Assistant and Associate Professor prior to joining the Institute for Computer Applications in Science & Engineering (ICASE) at the NASA Langley Research Center and Old Dominion University in 1993. At Old Dominion, Keyes was the Richard F. Barry Professor of Mathematics & Statistics and Founding Director of the Center for Computational Science.



**I.C. Noyan**

Professor of  
Materials Science  
& Engineering

**I.C. Noyan**, Professor of Materials Science and Engineering at Columbia University, works on x-ray and neutron diffraction analysis and mechanical behavior of materials. He 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 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.

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-author of more than twenty patents. He is co-editor of *Advances in X-Ray Analysis* and a Fellow of American Physical Society.



**Michael I. Weinstein**

Professor of  
Applied Mathematics

**Michael I. Weinstein**, is a Professor of Applied Mathematics at Columbia University and is also affiliated with the Mathematical Sciences Research Center at Bell Laboratories - Lucent Technologies.

Professor Weinstein's research is in the fields of nonlinear partial differential equations, analysis and dynamical systems and their application to complex wave phenomena in nonlinear, inhomogeneous and random media. The techniques developed find wide application to problems in nonlinear optics of communication systems and optical devices, quantum physics and fluid dynamics.

Weinstein completed his undergraduate work (B.A. summa cum laude) at Union College in 1977. In 1982 he received his Ph.D. from the Courant Institute of Mathematical Sciences at New York University. He was an NSF Postdoctoral Fellow at Stanford University and then Assistant Professor of Mathematics at Princeton University before joining the faculty of the University of Michigan, Ann Arbor, as Associate Professor (1988-1993) and Professor of Mathematics (1993-2000). From 1998 to 2003 he was a member of the Fundamental Mathematics Research Department at Bell Laboratories - Lucent Technologies, and returned to academia in January of 2004 as Professor of Applied Mathematics at Columbia.

Weinstein has also been a visiting Professor at the Institute for Advanced Study in Princeton, the Hebrew University of Jerusalem, and the University of Paris. He was an invited speaker at the U.S. National Academy of Sciences 2001 Frontiers in Science Symposium, an organizer of the U.S. National Academy's First Middle Eastern Frontiers in Science Symposium in Istanbul, 2003, as well as a plenary speaker at the 2004 SIAM Conference on Nonlinear Waves.

The Department also welcomes Dr. Harish Bhat as the new non-tenure-track Assistant Professor of Applied Mathematics. Dr. Bhat recently earned his Ph.D. in Control and Dynamical Systems from the California Institute of Technology under the direction of Prof. Jerrold Marsden. His research specialties include analysis, geometry, and numerical simulation of nonlinear wave equations; singularity formation; and averaging of multiscale Hamiltonian/Lagrangian dynamical systems.

## Prof. C. K. Chu Receives Honorary Doctorate



Prof. C.K. Chu (above) and with Prof. D.E. Keyes, Prof. M.E. Mauel (below)



Prof. C. K. Chu, professor emeritus of applied mathematics, received an honorary doctor of science degree at the 2006 commencement ceremony. Early in his career, Chu recognized the power and necessity of computation in understanding fluid dynamics. He developed approximations to the differential equations of fluid dynamics and coined the term “computational fluid dynamics.”

Chu’s teaching and service to Columbia University spans more than four decades. His leadership during the steady growth and definition of applied mathematics at Columbia is perhaps his greatest educational legacy. Because of his devoted vision, University undergraduates can major in applied mathematics and participate in a vital and coherent program of active scholars heavily involved in interdisciplinary research and education. Chu received Columbia’s “Great Teaching Award” in 1985.

### Doctor of Science, honoris causa - May 17, 2006 Citation

*You are one of the great pioneers of computational mathematics and a visionary leader for applied mathematics within Columbia University. Your work in fluid dynamics, magnetohydrodynamics, and shock waves is internationally recognized. You have also been the spiritual force driving the growth of applied mathematics at Columbia University and a beloved and founding leader of the Department of Applied Physics and Applied Mathematics. Your warm and engaging personality has inspired your colleagues to interdisciplinary, departmental harmony, and devotion to the University. By way of personal example in both teaching and service, you have been a pivotal resource to hundreds of undergraduate and graduate students. In recognition of your untiring leadership and remarkable vision in helping to secure the lasting success of applied mathematics within the Fu Foundation School of Engineering and Applied Science, Columbia University presents you with the degree of Doctor of Science, honoris causa.*

To see more photos of Prof. Chu’s award ceremony and Prof. Marshall’s retirement party, please visit [http://www.apam.columbia.edu/misc-pages/2006\\_news.html](http://www.apam.columbia.edu/misc-pages/2006_news.html)

## Prof. Thomas C. Marshall Retires

Prof. Thomas C. Marshall received his Ph.D. in physics from the University of Illinois in 1960 and joined Columbia University in 1962 as a professor in the Department of Electrical Engineering. He became a Professor of Engineering Science in 1970 and was a member of the Plasma Physics Committee where he launched ground breaking experimental research into the physics of plasmas, relativistic electron beams, and free electron lasers. Prof. Marshall was one of the nine founding faculty members of the Department in 1978, becoming one of Columbia’s first Professors of Applied Physics. He was awarded Columbia’s Great Teacher Award in 1995. During his forty-four years at Columbia University, he has supervised or co-supervised 44 doctoral students. During the past decade, Prof. Marshall was the dedicated faculty advisor to our students in the Medical Physics Program.

Working with his students and colleague Prof. Perry Schlesinger, Prof. Marshall pioneered the development of free electron lasers (FEL), which have been shown to generate very large amounts of power, tunable in bands from the microwave to the visible spectrum and beyond. In the 1970’s, the first FEL in the Raman regime was demonstrated in Marshall’s Lab. Prof. Marshall’s research also included FEL photonics and led to the production of TW-level ultra-short pulses of radiation. In 1985, he published *Free Electron Lasers*, which provided the first integrated treatment of the operation and characterization of the free-electron laser. Between 1985-87, he served on the APS Study Group on the Science and Technology of Directed Energy Weapons. Called by many “the most important APS study ever done”, this study provided a clear technical assessment of the severe limitations of existing candidates for DEWs such as high intensity lasers and energetic particle beams.



Prof. Thomas C. Marshall

FEL physics has a close relationship with laser and accelerator physics, and his present research focus is innovation accelerator physics. In recent years, Marshall has been exploring new methods of accelerating particles using Brookhaven’s Accelerator Test Facility (ATF). In 1999, Marshall proposed the dielectric wake field accelerator. Working with his colleague, Jay Hirshfield, Tom Marshall continues his research at the ATF where he is establishing the fundamental physics of dielectric wake field acceleration. Although retiring from academic duties, Professor Emeritus T. C. Marshall will continue to apply his insights and pursue his remarkable discoveries in beam and accelerator physics.

## Gerald Navratil Presents the 2006 Con Edison Lecture

Gerald A. Navratil was appointed the Thomas Alva Edison Professor of Applied Physics in July of 2005 in The Fu Foundation School of Engineering and Applied Science and has been a member of the Columbia University faculty for 27 years. He presented the 2006 Con Edison Lecture: "Bold Step by the World to Fusion Energy: ITER" in Davis Auditorium on March 21, 2006.

Prof. Navratil is internationally known for his work in the field of plasma physics applied to the development of fusion energy. He directs \$1.6 million in annual research on fusion energy science funded by the U.S. Department of Energy that includes the HBT-EP tokamak experimental facility in the Columbia Plasma Physics Laboratory as well as off-campus collaborations at the DIII-D National Tokamak Facility in San Diego and the NSTX Experiment at the Princeton Plasma Physics Laboratory. He was named a Fellow of the American Physical Society in 1989 and an Alfred P. Sloan Research Fellow in Physics in 1984.

In 1977, Prof. Navratil joined Columbia University as an assistant professor in Mechanical Engineering and in 1978 was a founding member of what is now the Department of Applied Physics and Applied Mathematics, serving as department chair for over 10 years from 1988 to 1994 and from 1997 to 2000, as well as acting Vice-Dean in 1995.

Prof. Navratil is President of the University Fusion Association for 2005-2006 and since 1998 has been a member of the U.S. Department of Energy Fusion Energy Advisory Committee appointed by the Secretary of Energy. He was also co-chair of the 2002 Fusion Energy Sciences Summer Study held at Snowmass, CO, which carried out a technical assessment of approaches to a next step burning plasma experiment for the U.S. which ultimately was used to support the U.S. joining the ITER fusion project. Prof. Navratil currently serves as a member of the U.S. ITER Project Advisory Committee.

Prof. Navratil received his bachelor's degree in physics from the California Institute of Technology in 1973 and his Ph.D. in plasma physics from the University of Wisconsin in 1976.

Prof. Navratil is the second professor in the APAM Department to be named the Thomas Alva Edison Professor of Applied Physics. In 1984, Prof. Herbert Goldstein was the first professor to hold the title in the university and he presented the first Con Edison Lecture in 1985 titled "Nuclear Waste Disposal in Prehistoric Times."

[http://www.apam.columbia.edu/newsevents/Con\\_Ed\\_2006.html](http://www.apam.columbia.edu/newsevents/Con_Ed_2006.html)




Left: Prof. G.A. Navratil presents the 2006 Con Ed Lecture in Davis Auditorium on March 21, 2006.

Below: (left to right) M. E. Mauel, Professor of Applied Physics; C. Olert, Asst. Director, Media Relations, Con Edison; G. A. Navratil, Thomas Alva Edison Professor of Applied Physics; J. C. Isecke, Chief Engineer, Equipment and Field Eng., Con Edison, and Zvi Galil, Dean of the SEAS.



*The 2006 Con Edison Lecture*

**BOLD STEP BY THE WORLD TO FUSION ENERGY: ITER**



Prof. Navratil's lecture will focus on the quest for fusion energy, and will describe the plan by an international consortium to jointly build an experiment ITER to achieve the world's first controlled fusion "burn" for energy production.


Open to the public.  
Reception immediately following

will be delivered by  
**GERALD A. NAVRATIL**  
Thomas Alva Edison Professor of Applied Physics  
Columbia University

Tuesday, March 21, 2006  
5:00 PM  
Davis Auditorium  
CEPSR Building, First Floor

*The 1985 Con Edison Lecture*

**NUCLEAR WASTE DISPOSAL IN PREHISTORIC TIMES**



Dr. Goldstein's lecture will focus on the development of geologic isolation for disposal of nuclear waste, and will compare the one-third of a million-year-old natural fissure system in Africa.

Open to the public.  
Reception immediately following the lecture

will be delivered by  
**HERBERT GOLDSTEIN**  
Thomas Alva Edison Professor of Nuclear Science and Engineering  
Columbia University

Monday, March 4  
7:30 p.m.  
The Kellogg Conference Center  
International Affairs Building,  
Fifteenth Floor

Right: Posters from the 2006 Con Ed Lecture, "Bold Step by the World to Fusion Energy: ITER", presented by Prof. G.A. Navratil and the 1985 Con Ed Lecture, "Nuclear Waste Disposal in Prehistoric Times", presented by the late Prof. Herbert Goldstein.

## Faculty Updates

**Applied Physics Faculty Search:** The department invites applications for a tenure-track Assistant Professor position in experimental applied physics with focus on the areas of condensed matter, lasers and interactions, biophysics, or nanoscale structures.

**Applied Mathematics Faculty Search:** The department invites applications for a non-tenure-track Assistant Professor position in the area of applied and computational mathematics. A Ph.D. in mathematical sciences or related fields and extraordinary promise in research and teaching are required. This position begins July 1, 2007 and is a two-year, term position with competitive salary and reduced teaching.

**Prof. Gerald A. Navratil wins the 2006 Fusion Power Associate Leadership Award.** In selecting Dr. Navratil, the Board recognizes both his many outstanding scientific contributions to fusion research and his community leadership. They especially note his role in founding and continuing to guide the University Fusion Association (UFA), his roles in organizing the fusion Snowmass meetings and the series of UFA-sponsored burning plasma workshops, his role in advocating burning plasma physics within the framework of the National Academies, and his role in defending a broad-based domestic fusion research program.

**Prof. Siu-Wai Chan** was elected as the Chair of the Electronics Division of American Ceramic Society for 2006-2007 and officially took office on Oct 17, 2006.

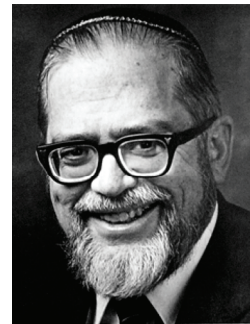
**Congratulations to Prof. Siu-Wai Chan, Dr. Feng Zhang, Prof. Herman, Dr. Richard Robinson, and Joan Raitano** for being featured in "Science Highlights" on the NSLS webpage for their recent paper entitled "Phases in ceria-zirconia binary oxide  $(1-x)\text{CeO}_2-x\text{ZrO}_2$  nanoparticles: the effects of particle size, the redox environment and the  $\text{Ce}^{3+}$  concentration."

**Congratulations to Prof. Chris Wiggins, Dr. Shalom Wind** and all contributors to the new NanoMedicine Center for Mechanical Biology, a multi-disciplinary initiative aimed at developing new technologies for regenerative medicine and treating human diseases that involve mechanical malfunction, such as cancer. The ultimate goal of the Center is to create an understanding of cellular mechanical biology which could lead to a pioneering operations manual for cell mechanical function.

**Congratulations to Prof. Stephen O'Brien, his superlattice group, and all MRSEC collaborators:** New bimodal nanocrystal superlattices were reported for the first time in the journal *Nature*. The findings of Prof. O'Brien, professor of Materials Science and Engineering and a key member of the Materials Research Science and Engineering Center (MRSEC) at Columbia, along with Columbia postdoctoral research scientist Dr. Elena Shevchenko, were published in the Jan. 5, 2006, issue of *Nature*. MRSEC is an interdisciplinary team of university, industry and national laboratory scientists working together to develop new types of nanocrystals and ways of assembling them into thin films. The work on new structures was conducted in conjunction with Drs. Dmitri Talapin and Christopher Murray at the IBM Watson Research Center in Yorktown Heights, New York, and was supported by the National Science Foundation and the New York State Office of Science, Technology and Academic Research. This work was also highlighted in *Chemical and Engineering News*.

## In Memoriam

**Herbert Goldstein, Professor Emeritus of Nuclear Science and Engineering** at Columbia, died on January 12, 2005. He was 82.



**Prof. Herbert Goldstein, Emeritus**

Prof. Goldstein was long recognized for his scholarship in classical mechanics, neutron and photon transport theory, and reactor shielding, and was the author of the graduate textbook, *Classical Mechanics*. The book has been a standard text since it first appeared 50 years ago and has been translated into nine languages. Goldstein's contributions to nuclear energy were honored by the U.S. Department of Energy, which awarded him the E.O. Lawrence Memorial Award in 1962. In 1977, he was the recipient of the Distinguished Service Award from the shielding division of the American Nuclear Society.

Goldstein was a professor of nuclear science and engineering at the Fu Foundation School of Engineering and Applied Science since 1961. He received the Great Teacher Award, given by the Society of Columbia Graduates, in 1976. In 1984, Goldstein was the first to hold the Thomas Alva Edison Professorship at the University. In addition to research, Goldstein devoted time to promoting scientific literacy by teaching undergraduate courses. In 1977, he taught a course he designed to increase scientific understanding of energy issues "Nuclear Energy: A Semi-technical View for the Non scientist." He was also one of the faculty members instrumental in developing an innovative science course for non-scientists, "The Theory and Practice of Science," at the College.

Goldstein was a consultant for Oak Ridge National Laboratory and Brookhaven National Laboratory. He was a fellow of the American Physical Society, the American Nuclear Society, the New York Academy of Sciences and the American Association for the Advancement of Science. Goldstein also was a member of the American Association of Physics Teachers and was a founding member and president of the Association of Orthodox Jewish Scientists. He received a B.S. from City College of New York in 1940 and a Ph.D. from Massachusetts Institute of Technology in 1943.

He is survived by his wife, Channa; his children, Penina, Aaron Meir and Shoshanna; and 10 grandchildren.

**Xiao-hong (Charles) Wang (PhD. '89, Plasma Physics)** passed away on July 18, 2006.

He was the Associate Director of Clinical Medical Physics, leading a group of more than ten medical physics staff to provide technical support to Radiation Oncology Department in Stony Brook University Hospital.

He is survived by his wife, Li Shen and his son, Adam D. Wang. In his memory, a fund has been established for the educational expenses of his son, Adam (age 7 years). For more information, please contact the family at (631) 360-2113.

## Prof. David E. Keyes: “Simulation Tsunami”

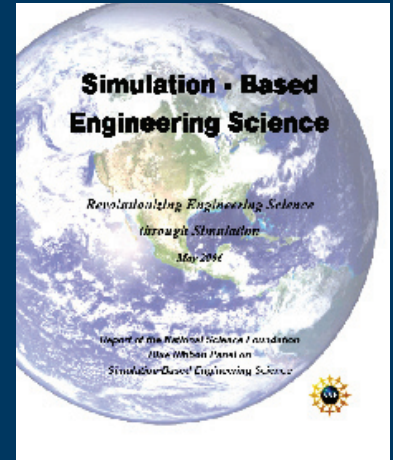
“When I was a young faculty member,” relates Fu Foundation Professor of Applied Mathematics David E. Keyes, “I used to search proposal solicitations from federal agencies for those to which I could apply for research sponsorship. I never gave thought to whatever oracle dictates the research priorities of the government. Now I know too well where grant proposals begin – in reports to the agencies from academics like me. I co-author about one such report per year.”

The covers of some of the major reports to which Keyes has contributed are pictured here. The most comprehensive is the two-volume *Science-based Case for Large-scale Simulation* (nicknamed “SCaLeS”) report, which was written for the U.S. Department of Energy (DOE). Volume 1, which is a 70-page overview, was issued in July 2003, following a two-day workshop in Washington, DC, organized by Keyes and attended by 315 computational scientists from around the country, split between federal institutions, universities, and private industry. Volume 2, consisting of 300 pages, followed a year later to provide a short chapter for each of 27 areas of research investment by the Office of Science of the DOE. It highlights inter-relationships between science application areas, such as astrophysics or quantum chemistry, and “enabling technologies” in mathematics, such as mesh generation or solution algorithms, and in computer science, such as software architecture or data visualization. Its organization roughly mirrors that of the Scientific Discovery from Advanced Computing (or “SciDAC”) initiative of the DOE, under which Keyes leads a 9-institution project to develop solver software that scales to the world’s largest-scale parallel computers, which receives more than \$3M/year in funding.

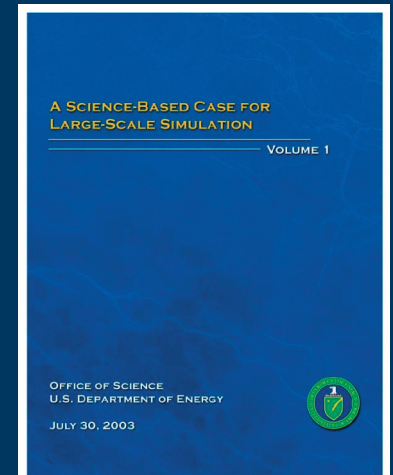
Due to the importance of scalable solver software to many other mission areas of the DOE, Keyes has been involved in other discipline-specific reports, including: *Theory and Modeling in Nanoscience* (2002), the 2-volume *Fusion Simulation Project* (2003), and *Simulation and Modeling for Advanced Nuclear Energy Systems* (2006). The fusion simulation report will be freshly revisited in 2007 due to the re-entry of the United States into the International Thermonuclear Experimental Reactor (ITER) project, and Keyes is one of the “enabling technologists” deputized to the body of plasma physicists and materials scientists that will update that research charter for magnetically confined plasma fusion.

Keyes was also a member of the blue ribbon panel that wrote *Simulation-based Engineering Science: Revolutionizing Engineering Science through Simulation* for the National Science Foundation (2006), which gives guidance to the Engineering Directorate of the NSF on how to participate in the agency-wide Cyberinfrastructure initiative, expected to be one of the Foundation’s growth areas in coming years.

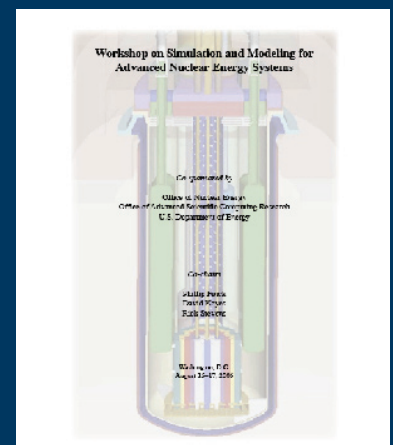
Perhaps one of the reasons Keyes is often asked to advise federal agencies by writing reports and participating in panels is that he is an unusually amphibious researcher. For the past eight years, he has directed (on a one-third to one-half time basis) the Institute for Scientific Computing Research (ISCR) at Lawrence Livermore National Laboratory (LLNL). This is an academic outreach institute of LLNL, which operates the world’s fastest computer and three of the Top 10 internationally. Keyes has also consulted for several simulation-intensive corporations, in the aerospace, automotive, and manufacturing sectors. He is currently the Vice President of the Society for Industrial and Applied Mathematics (SIAM), the leading international professional society for applied and computational mathematics, where he takes a special interest in the Committee on Science Policy, which visits Washington twice annually to meet with agency heads and lobby Congressional staffers. The Committee interprets the often invisible role of mathematics in advances in areas such as medicine, energy, transportation, and information technology, which have a much higher profile in Congress. In 2006, he was appointed to the Subcommittee on Networking and Information Technology of the Presidential Council of Advisors in Science & Technology (PCAST), and was recently invited by Tony F. Chan, the new chief of the Division of Mathematics and Physical Sciences at NSF to serve on his personal advisory board as one of two members-at-large representing Cyberinfrastructure.



**Simulation-Based Engineering Science: Revolutionizing Engineering Science through Simulation, NSF, 2006.**



**A Science-Based Case for Large-Scale Simulation, Vol. 1, Office of Science, U.S. Department of Energy, 2003.**

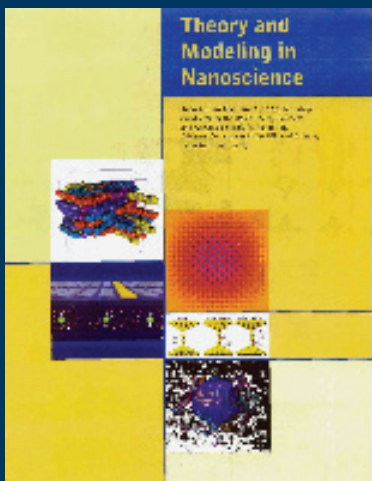


**Workshop on Simulation & Modeling for Advanced Nuclear Energy Systems, 2006.**





**Fusion Simulation Project: Integrated Simulation & Optimization of Fusion Systems, Final Report of the FESAC ISOFS Subcommittee, 2002.**



**Theory & Modeling in Nanoscience, Report of the Workshop conducted by the Basic Energy Sciences & Advanced Scientific Computing Advisory Committees to the Office of Science, Department of Energy, 2002.**

**“Simulation Tsunami” continued**

Keyes is currently the Chair of the International Scientific Committee on Domain Decomposition Methods, an organization that sponsors an annual conference on a specialized class of algorithms for simulating differential equations on parallel computers. This is just one of several scientific meetings that he co-organizes each year. In June 2007, he will chair the annual meeting of the DOE SciDAC program, in Boston. During the past year, he chaired the Gordon Bell Prize committee for the ACM and IEEE, a committee on which he has served ever since winning the award, himself, in 1999. Rounding out his birds-eye view on the state of large-scale scientific and engineering simulation, Keyes is on the editorial board of several journals in the area, serving as co-editor-in chief of the *International Journal for High Performance Computing and Applications*.

“Considering the funds that the DOE and the NSF provide to support my students and post-docs at Columbia and the connections that our projects give us to leading scientists with computational applications,” explains Keyes, “writing reports is the least that these agencies can expect in return. Someday, I will update them all and sew them together into a book – on the role of computer simulation as a partner with theory and experiment as one of the three investigative modalities in science and engineering.”

**Department News**

We welcome Ria Miranda as the new Department Administrator and Montserrat Fernandez-Pinkley as the new Student Services Coordinator. Marlene Arbo is now working part-time, in phased retirement, and currently serves as the Assistant to the Chair.

Also, after 28 years in our department, Lydia Argote has moved to the Physics Department to become their new Director of Budget Operations. Kathleen Cordero is the new APAM Business Manager and Konstyantyn Chernyavsky joins us as our new Financial Analyst.

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[seasinfo.apam@columbia.edu](mailto:seasinfo.apam@columbia.edu)

APAM Department  
Phone: 212-854-4457  
Fax: 212-854-8257  
[www.apam.columbia.edu](http://www.apam.columbia.edu)

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Contributing Authors: Guillaume Bal, Irving Herman, David Keyes,  
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Photos/Images: Eileen Barroso & Chad Gurley

Design: Christina Rohm

Applied Physics & Applied Mathematics Department  
Fu Foundation School of Engineering & Applied Science  
Columbia University  
500 W. 120th Street, Room 200 Mudd, MC 4701  
New York, NY 10027