Spring 2010, Vol. 4 Issue 2

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



2010 Graduation: (left to right) Photo 1: Applied Physics B.S. Dragos Velicanu & Peter Traverso; Photo 2: Materials Science & Engineering B.S. Grace Chen, Tian Luan, Min Hua Chen, Zachary Bullard, Yu-Hsuan Wang, Chad Gurley, and Yin Ju; Photo 3: Medical Physics M.S. Jo-Ann Provenchar & Alena Tsioplaya

Dear Alumni and Other Friends of APAM:

This term we celebrate the wonderful graduates of our undergraduate and graduate programs, and note those who won departmental prizes!

We are so very proud that APAM graduated the class salutatorian last year, Stanley Snelson, and the class valedictorian this year, Seth Davidovits.

In this issue we also profile the many exciting recent activities in APAM. We highlight the major awards and recognition received by Simon Billinge, Allen Boozer, Latha Venkataraman, Michael Weinstein and Steve Sabbagh. We report on the spectacular success of Michael Mauel's levitated dipole plasma physics experiment. We also note the articles in the Columbia press and general science media written about and by our faculty members Chris Wiggins and Simon Billinge.

We in APAM are very pleased to extend a warm hello to our alumni and other friends of the department.

Please let us know of important events in your lives!

Best,

Irving P. Herman
Chair, APAM

In This Issue

(left-right) Aron Pinczuk, Irving Herman, Jeremy Hanson, David Maurer, Jane Faggen, Michael Mauel, C.K. Chu

2010 Simon Prize Award Winner: Jeremy Hanson

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, Dr. Jeremy Hanson, was the recipient of this award.

Dr. Hanson received a B.Sci. degree in Applied Mathematics, Engineering, and Physics from the Univ. of Wisconsin (Madison) in May 2004. In September 2004 he started his Ph.D. studies in APAM. He received his M.S. degree in May 2005 and was also recognized with the SEAS Extraordinary Teaching Assistant Award in 2005. He joined the High Beta Tokamak Research Group in the Columbia Plasma Physics Laboratory, led by Profs. G. A. Navratil, M. E. Mauel, and T. S. Pedersen, as a Graduate Research Assistant in June 2005.

In his Ph.D. thesis, "*A Kalman Filter for Active Feedback on Rotating External Kink Instabilities in a Tokamak Plasma*," Dr. Hanson reported for the first time the simulation and experimental optimization of a Kalman filter active feedback control algorithm for n=1 tokamak external kink modes. The external kink is one of the key instabilities that limit the performance of future fusion energy tokamak systems, and active feedback control of this instability will be essential. The feedback control algorithms employed need to distinguish the unstable kink mode from noise due to other magnetohydrodynamic (MHD) activity. The Kalman filter contains an internal model that captures the dynamics of a rotating, growing n=1 kink mode. This model is actively compared with real-time measurements to produce an optimal estimate for the mode's amplitude and phase. The feedback system with the Kalman filter is able to suppress the kink mode over a broad range of phase angles between the sensed mode and applied control field.

While at Columbia, Dr. Hanson published two journal papers as the first author in *Physics of Plasmas* (2008 & 2009), one as first author in *Review of Scientific Instruments* (2009), and one as a contributor in Nuclear Fusion (2008). He also presented an Invited Paper at the 2008 American Physical Society Division of Plasma Physics Annual Meeting. Dr. Hanson was selected in a U.S. Department of Energy national competition as a Fusion Energy Science Postdoctoral Fellow for the period of 2009-2011.

Robert Simon (1919-2001) received a B.A. degree cum laude in Classics from the City College of New York in 1941, where he was elected to Phi Beta Kappa, and an M.A. in Mathematics from Columbia University in 1949. From 1941-1944, he was a Lieutenant in the U.S. Armed forces serving in England, France, and Italy. He participated in the D-Day operation as a navigator for a plane that dropped paratroopers in the vicinity of Omaha Beach. General Dwight Eisenhower personally shook his hand and wished him well the night before the D-Day assault. Mr. Simon, who was born and lived in NYC, 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. Mr. Simon was a founder and Vice President of Intech Capital Corporation and served on its board from 1972-1981 and a founder and member of the board of Leasing Technologies International, Inc. from 1983 until his retirement in 1995.

The Simon Prize was established in 2001 by Dr. Jane Faggen with additional support from friends and relatives of Mr. Simon.

Undergraduate Awards

Prof. Irving Herman presented undergraduate awards to three outstanding seniors in Applied Mathematics, Applied Physics, and Materials Science and Engineering at the annual SEAS Senior Awards Dinner on May 4, 2010 in the Low Rotunda. Winners received a plaque and a check for $250, have their names inscribed on plaques in the department headquarters, and are listed on the department web site.

Applied Physics Faculty Award Winner
Seth Davidovits

Seth is one of the best students we have had in our Applied Physics program. He worked in Prof. T. S. Pedersen's CNT lab, where he made MiniCNT glow brighter than ever and explained some puzzling data from that device which had perplexed other bright students. He has been the SciCortex APAM cluster administrator for over a year, has served as Vice President of the CU Engineers Without Borders, and has been on the Dean's list every semester. He was accepted at several top graduate schools and will enter the Ph.D. program in Princeton where he plans to study computational plasma physics. Seth is the recipient of the SEAS Illig Medal, a prestigious Department of Energy Computational Science Graduate Fellowship, and is this year's SEAS class valedictorian! For more information, see: **http://www.apam.columbia.edu/announcements/10_Valedictorian.html**

Applied Mathematics Faculty Award Winner
Wayne Shu

Wayne has a GPA of 3.98 and has been on the Dean's list every semester in his tenure at Columbia. His applied mathematics presentation was on "Data Compression and Gambling." He will start working at Google this summer, and has promised to return to present a seminar about his life in industry in an effort to promote "math" being "applied."

Materials Science and Engineering: Francis B. F. Rhodes Prize Winner
Grace Chen

Grace is an accomplished pianist and flautist and has performed with the CU Wind Ensemble. She has worked with Prof. I. C. Noyan's group on the theory of line broadening for the past four semesters, which evolved into her senior thesis. She loves mathematics and was awarded a scholarship to attend the Institute for Pure and Applied Mathematics at UCLA in the summer of 2009. She has been on the Dean's list every semester in her tenure at Columbia. After graduation she will be attending the University of Southern California Gould School of Law. She hopes to specialize in patent law.

2009-2010 APAM GRADUATES

October 2009

B.S.: Margarita Eremeyev (AM)

M.S.: Mark Curtice (CVN/MSE), Virginia Faustino (CVN/MSE), John Gimm (MP), Pantea Kadkhodazadeh (MP), Alex Kowalski (AP), Jaclyn Marcel (MP), Chirag Mehta (MP), Artur Olszanski (MP), Shinkyu Park (AP), Bradley Pollard (MP), Brian Quinn (AP)

M.Phil.: Austin Akey (MSE), Paul Brenner (AP), Benoit Durand de Gevigney (AP), Teresa Fazio (MSE), Michael Frei (AP), Maria Kamenetska (AP), Avishai Ofan (AP), Qi Wu (AM), Yuri Zuev (AP)

Ph.D.: Rachel Steiner (MSE)

February 2010

B.S.: Jungwon Bae (AM), Seth Davidovits (AP), David Harrison (AM), Casey Johnston (AP), Elsa Schneiders (AM), Wayne Shu (AM), Dragos Velicanu (AP)

M.S.: Jerrod Ankenman (CVN/AM), Henry Beveridge (AM), Kenneth Brodeur (CVN/AM), Cheng Cheng (MSE), Dong Joon Han (AM), Shao-Ying Huang (MSE), Yin Ju (MSE), Shao-Kang Juan (MP), Hao-Hung Kuan (MSE), Benjamin Landon (CVN/AM), Hsin-Yu Lee (MSE), Sarah Lewin (MP), Yue-Yong Lu (AM), Fang Mei (MSE), Jo-Ann Provencher (MP), Jinfu Ruan (AM), Wendy Siman (MP), Adam White (CVN/AP), Lei Yao (AM)

M.Phil.: Benjamin Diehl (AM), Ophir Gaathon (AP), Gabriel Ganot (MSE), Yutian Wu (AM), Xuefei Yuan (AM)

Ph.D.: Yuan He (AM), Rodolfo Hermans (AP), Abby Shaw-Krauss (AM)

May 2010

B.S.: Joffre Andrade (AM), Pradeep Bandaru (AM), Carly Becker (AM), Aisha Bien-Aime (AM), Nicolas Borensztein (AM), Zachary Bullard (MSE), Alexander Chang (AM), Grace Chen (MSE), Min-Hua Chen (MSE), Jae Chung (AM), Emma Cramer (AP), Megan deBettencourt (AM), Valla Fatemi (AP), Yiliany Fernandez (AM), Boris Grinshpun (AM), Adrian Haimovich (AM), Derek Hernandez (AP), Mason Jiang (AP), Wakana Kirihata (AM), Samuel Lee (AM), Tian Luan (MSE), Cherie Meyer (AM), Marilyn Meza (AM), David Murphy (AM), Amar Patel (AM), Carolyn Popplewell (AM), Claire Popplewell (AM), Ariel Reinish (AM), Jacob Tadros (AM), Shea Thomas (AM), Peter Traverso (AP), Victoria Tsang (AM), Jin Wang (AM), Zhe Wang (AM)

M.S.: Ryan Bonaparte (MSE), Rachel Carr (AP), Ko-Lun Chao (MSE), Kate Eckerle (AM), Clayton Fowler (MP), Lili Gu (AM), Tanbir Haque (CVN/AM), David Harrison (AM), Shih-Hung Hsu (MSE), Ting Li (MSE), Shyam Srinivasan (AP), Kerry Stevens (AM), Jim Tai (AM), Alfredo Tognoni (CVN/MSE), Iva Vukicevic (AM), Yu-Hsuan Wang (MSE), Feng Xiang (CVN/AM), Tsung-Han Yang (MSE), Ningyao Zhang (AM), Sen Lei Zhang (AP)

Certificate of Professional Achievement in Medical Physics: Carl Elliston, Lucy Nedialkova

M.Phil.: Monica Deep (MSE), Wenjia Jing (AM), Xabier Sarasola-Martin (AP)

Ph.D.: Aron Ahmadia (AM), Melinda Han (AP), Xiao Wei (AP), Sioan Zohar (AP)

Jin Wang, Lorenzo Polvani, and Jacob Tadros

APAM Ph.D.s

(left-right) Aron Pinczuk, Melinda Han, & Irving Herman

Eight APAM doctoral students celebrated their graduation during this year's Graduate School of Arts and Sciences (GSAS) Convocation on May 15. The May 2010 Convocation is the first to be held on the South Lawn and the first in many years recognizing the graduating Ph.D.s from the entire University. Our graduating Doctors of Philosophy were Aron Ahmadia (Advisor: D.E. Keyes), Melinda Han (Advisor: P. Kim), Yuan He (Advisor: D.E. Keyes), Rodolfo Hermans (Advisor: J.M. Fernandez), Abby Shaw-Krauss (Advisor: M.I. Weinstein), Rachel Steiner (Advisor: J.T. Yardley), Xiao Wei (Advisor: A.K. Sen), and Sioan Zohar (Advisor: W.E. Bailey).

The faculty address was given by Prof. Walter Frisch (Department of Music), who encouraged graduates never to loose sight of their "First Loves" in research. (Prof.Frisch's first love is the Broadway musical.) APAM's own Prof. M.E. Mauel had the honor to be the first to congratulate the new Ph.D.s by announcing the names of the candidates at the Convocation.

Alumni Updates

Michael Bykhovsky (B.A. '83, Applied Physics) and **Bahram Jalali** (Ph.D. '89, Solid State Physics) visited APAM on April 14 as representatives of the Dean's Board of Visitors. Board members meet yearly with current students and faculty in order to advise and assist the Trustees, the Faculty of Engineering and Applied Science, and the Dean in the development of the School. Michael is the President and CEO of Applied Financial Technology and Bahram is a Professor of Electrical Engineering at UCLA.

Megan deBettencourt (B.S. '10, Applied Mathematics) was featured in a video on SEAS TV. **http://tv.seas.columbia.edu/**

Isaac Greenbaum (B.S. '06, Applied Mathematics) and **Adrian Haimovich** (B.S. '10, Applied Mathematics) were featured in the article "Math Professor Works to Keep Students Off 'The Street'" in *The Record*. **(See page 4 to read the full article.)**

Jay Kesner (Ph.D. '70, Plasma Physics), M.I.T.'s physics research group leader for the Levitated Dipole Experiment, and **Stewart Prager** (Ph.D. '75, Plasma Physics), director of the Princeton Plasma Physics Laboratory, were featured in the *Columbia News* article: Levitating Magnet May Yield New Approach to Clean Energy. **(See page 6 for details.)**

Wendy Siman (M.S. '10, Medical Physics) was offered a two-year imaging physics residency at the University of Texas M.D. Anderson Cancer Center.

Plasma Physics Reunion Dinner

This year's Plasma Physics reunion dinner was held at the French American Brasserie in Atlanta, GA on Thursday, November 5, 2009. The dinner took place during the 51st Annual Meeting of the Division of Plasma Physics (DPP) at the Hyatt Regency Atlanta from November 2-6, 2009. Current APAM faculty and staff, including Prof. M. E. Mauel, Prof. G. A. Navratil, Prof. T. S. Pedersen, Prof. A. K. Sen, Dr. Darren Garnier, and Dr. Holger Reimerdes, and graduate students, Matt Davis, Bryan DeBono, Benoit Durand de Gevigney, Matthew Lanctot, Jeff Levesque, Nikolaus Rath, Xabier Sarasola-Martin, Aaron Senter, Daisuke Shiraki, and Matt Worstell, attended the dinner. Alumni in attendance were Dennis Boyle (B.S. '08), Dylan Brennan (M.S. '97), Jennifer Ellsworth (B.S. '02), Dr. Andrea Garofalo (Ph.D. '97), Dr. David Gates (Ph.D. '94), Dr. Brian Grierson (Ph.D. '09), Dr. Jeremy Hanson (Ph.D. '09), Dr. Chris Hegna (Ph.D. '89), Dr. Ilon Joseph (Ph.D. '05), Elliot Kaplan (B.S. '06), Dr. Oksana Katsuro-Hopkins (Ph.D. '07), Mark Kendall (B.S. '05), Dr. Jay Kesner (Ph.D. '70), Dr. David Maurer (Ph.D. '00), Dr. Ron Schmitt (Ph.D. '08), Katherine Velas (B.S. '05), Jeff Waksman (B.S. '06), and John Wright (B.S. '91). **(See page 8 for photos of the dinner.)**

Chris Wiggins
(Image courtesy of
Eileen Barroso)

Math Professor Works to Keep Students Off "The Street"

Reprinted from *The Record*
by Anna Kuchment

For years, Chris Wiggins has observed a common trend in the post-Columbia career paths of his top math students: they join Wall Street banks. "They're resigned to becoming quants," says Wiggins, 39, a professor of applied mathematics at the Fu Foundation School of Engineering and Applied Science. "They don't know about other options."

Chris Wiggins, professor of applied math, hopes more of his students look beyond Wall Street for career options and consider job opportunities in New York's nascent tech start-up space.

> ***"I want young people to realize the creative things they can do with math"***

If Wiggins had his way, more of his students would join New York City's burgeoning tech start-up scene. The payoffs, he says, would be huge. The influx of new talent would expand the city's technology sector, the brain drain of math and engineering students to West Coast schools and companies would ebb, and New York City's intellectual environment would be enriched. "I want young people to realize the creative things they can do with math," he says.

To broaden his students' career options, Wiggins teamed up with Huffington Post website co-founder Jonah Peretti two years ago to organize a series of on-campus meet-ups between Internet developers and Columbia's math community in which the scientists present real-world quantitative problems, and Columbians help solve them.

The success of these gatherings has since led to another initiative: Wiggins, along with Evan Korth, a New York University professor, and Hilary Mason, a scientist at a local start-up, has organized a summer internship program that will place New York City college students at high-tech companies beginning this year.

At a March 3 Startup-Math Collaborative meeting, nearly 100 Columbia faculty and students heard presentations from developers about their mathematical and computational challenges. Mark Angelillo, chief technology officer of the wine site Snooth, offered examples of how engineers use quantitative methods to decipher lengthy wine names and recommend new wines to users. Tom Quisel, a software engineer from the dating site OkCupid, took the stage to ask for ideas about tracking matches. "Getting an outside perspective on how we design things for OkCupid was really valuable," said Quisel following the event. Among the suggestions offered by students was tracking which users exchange phone numbers or e-mail addresses and following up to find out whether they went on a date.

Isaac Greenbaum (B.S. '06, Applied Mathematics and M.S. '10, Computer Science) said the event gave him new ideas about how to apply his degrees. An applied math major, he was valedictorian of his class and went to work at Citigroup after graduation. He recently returned to Columbia to complete his master's in computer science. "One of the reasons I came back to school was to get into the start-up field," he said. "This really gave me a good opportunity to see how I could take the skills I have learned, and hope to continue to learn, and implement them in the real world."

Adrian Haimovich (B.S. '10, Applied Mathematics) said he appreciated hearing from entrepreneurs that math was essential to their success. "You don't want to think about math as this abstract thing you've studied for four years," he says. "These meetings are a great way to see how math is affecting a whole culture."

The summer internship process started by Wiggins, Korth and Mason kicked off with a 24-hour "Hackathon" at NYU on April 2 and 3. "It is a chance for start-ups to meet students who are interested," says Wiggins. High-tech companies will bring code and datasets; students will develop new code and come up with new ways of exploiting and organizing the data.

"I see this as an opportunity for academics in New York to contribute to start-up culture," says Wiggins, referring to the pivotal role that Stanford's dean of engineering, Frederick Terman, played in the rise of Silicon Valley. "I think it takes people from academia, who are used to thinking on a decade or two-decade time frame, to realize that sort of culture change."

Wiggins Featured in *Scientific American* and *Columbia Engineering News*

Prof. Wiggins was interviewed for a March 2010 article by John Matson in *Scientific American* on "Keeping math whizzes off the street - off Wall Street, that is." He was also featured in the Fall 2009 edition of *Columbia Engineering News* in the article "Making an Impact: Turning off Cancer Genes". Links to both articles can be found at: **http://www.apam.columbia.edu/announcements/Wiggins_2010.html**

Faculty Updates

Prof. Simon Billinge's article "The Nanostructure Problem" was featured as a Viewpoint piece on the American Physics Society (APS) website. http://physics.aps.org/articles/v3/25

Prof. Siu-Wai Chan visited Columbia University's new Global Center in Beijing last June to present seminars as a visiting professor at the China University of Mining and Technology.

Prof. Irving Herman's textbook *Physics of the Human Body*, part of the Biological and Medical Physics, Biomedical Engineering Series by Springer, was published in Japanese and Greek.

Simon Billinge

Billinge Receives the 2010 Hanawalt Award

Prof. Simon Billinge is a recipient of the 2010 J.D. Hanawalt Award.

The J.D. Hanawalt Award is named for Prof. J. Donald Hanawalt, whose pioneering work in the 1930's led to the development of the PDF database structure and search/match procedures still in use today. The award is presented every three years by the International Centre for Diffraction Data for an important, recent contribution to the field of powder diffraction. Award recipients are invited to submit an abstract and present a paper on the work being recognized at an appropriate powder diffraction/crystallographic meeting.

The Hanawalt Committee, comprised of former Hanawalt award winners, unanimously decided to recognize Billinge's and co-winner Takeshi Egami's endeavors and groundbreaking results at the interpretation of diffuse scattering in terms of pair-distribution-distributions, especially by extending the experimental possibilities to large q ranges.

Latha Venkataraman

Venkataraman Receives the 2010 SEAS Kim Award

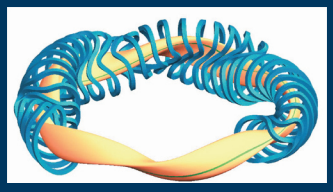
Prof. Latha Venkataraman was the recipient of the 2010 SEAS Kim Award for Faculty Involvement. The award recognizes a faculty member who has been exceptionally involved in the academic and co-curricular life of students in SEAS.

Sabbagh Receives the Nuclear Fusion Award

Steve Sabbagh

The International Atomic Energy Agency awarded the 2009 Nuclear Fusion Award to Steven Sabbagh (Adjunct Professor of Applied Physics and APAM Alumnus, Ph.D. '90, Plasma Physics), et al., for the paper "Resistive wall stabilized operation in rotating high beta NSTX plasmas".

The authors, working on the National Spherical Torus Experiment (NSTX), have demonstrated the advantages of low aspect ratio geometry in accessing high toroidal and normalized plasma beta. This is a landmark paper, which not only reports record parameters of beta in a large spherical torus plasma, but also presents a thorough investigation of the physics of Resistive Wall Mode (RWM) instability beyond the no-wall limit. Sabbagh (et al.) observed the RWM instability with toroidal mode number up to 3, determined that Bondeson-Chu theory on kinetic damping of RWM described the experimental observation, tested the observed rotation damping against neoclassical theory, and documented resonant field amplification at high beta. The paper addresses an issue of critical importance, using a spherical torus, with direct relevance to conventional tokamaks. The fusion power in the technology phase of ITER will depend on the degree of RWM stabilization that can be achieved, which underlines the importance of the authors' contribution. Based on citation performance and with recommendations and discussion by the journal's Board of Editors, 11 papers were short-listed as finalists for the award. The winning paper, judged to make the greatest scientific impact, was then determined by secret ballot of the Board. IOP Publishing has generously made a contribution of $2500 to be presented to Dr. Sabbagh.



Allen Boozer & the W7-X stellarator: the coils that produce the magnetic field are in blue, the plasma are in yellow, and one magnetic field line is in green. (Image courtesy of Prof. Boozer)

Boozer Receives the 2010 Alfvén Prize

Prof. Allen Boozer has won the best-known European award in plasma physics.

Boozer is one of two recipients of this year's prize, which will be awarded at the June conference of the Plasma Physics Division of the European Physical Society. The other is his colleague Jürgen Nührenberg, from the Max Planck Institute for Plasma Physics, Greifswald, Germany.

The Society cited them for "outstanding work in the formulation of criteria allowing stellarators to improve fast particle and neoclassical confinement." The result of their work is considered important for magnetic fusion energy, in which isotopes of hydrogen (deuterium and tritium) fuse to release energy while confined in a magnetic field at a high temperature.

Boozer demonstrated that if the magnetic field strength has symmetry then, even if the plasma shape does not have that symmetry, the trajectories of the plasma particles would act as if it did. The proof involved the development of what are now called "Boozer coordinates," which are used in many studies of magnetically confined plasmas. Nührenberg carried out numerical optimization studies that demonstrated that such magnetic fields could be realized in practical stellarator designs.

These ideas have been tested on the Helically Symmetric Experiment (HSX) at the University of Wisconsin and will be tested on W7-X, which is a stellarator being built at Greifswald, Germany at a cost of approximately a billion dollars.

Michael Weinstein

Weinstein Named 2010 SIAM Fellow

Prof. Michael Weinstein was selected as a Fellow of the Society for Industrial and Applied Mathematics (SIAM).

The SIAM press release stated that *"The 2010 class of Fellows is the first nominated by the SIAM community. It includes a diverse group of men and women who have made significant contributions to the fields of applied mathematics and computational science. These individuals have, among other things, shown excellence in research, industrial work, educational activities, or other activities directly related to the goals of SIAM. By honoring them as Fellows, SIAM acknowledges them as leaders in their fields."*

Weinstein, one of 34 new fellows, was selected for his "contributions to the analysis and applications of nonlinear waves". He will be recognized in July during the 2010 SIAM Annual Meeting in Pittsburgh, PA. 2010 SIAM Fellows and citations can be found at: **http://fellows.siam.org**

Michael Mauel

Michael Mauel: Levitating Magnet May Yield New Approach to Clean Energy

Achieving nuclear fusion in the laboratory has been a cherished goal of physicists and energy researchers for more than 50 years. That's because it offers the possibility of nearly endless supplies of energy with no carbon emissions and far less radioactive waste than that produced by today's nuclear plants, which are based on fission, the splitting of atoms (the opposite of fusion, which involves fusing two atoms together). But developing a fusion reactor that produces a net output of energy has proved to be more challenging than initially thought.

In findings published in the journal *Nature Physics*, a team at Columbia University and the Massachusetts Institute of Technology (M.I.T.) reports on a unique approach that may allow scientists to generate clean energy from fusion.

"Fusion energy could provide a long-term solution to the planet's energy needs without contributing to global warming," said Prof. Michael E. Mauel.

The new results come from an experimental device, inspired by observations from space made by satellites. Called the Levitated Dipole Experiment, or LDX, a joint project of M.I.T. and Columbia University, it uses a half-ton donut-shaped magnet about the size and shape of a large truck tire, made of superconducting wire coiled inside a stainless steel vessel. This magnet is suspended by a powerful electromagnetic field, and is used to control the motion of the 10-million-degree-hot electrically charged gas, or plasma, contained within its 16-foot-diameter outer chamber.

The results confirm the prediction that inside the device's magnetic chamber, random turbulence causes the plasma to become more densely concentrated - a crucial step to getting atoms to fuse together - instead of becoming more spread out, as usually happens with turbulence. This "turbulent pinching" of the plasma has been observed in the way plasmas in space interact with the Earth's and Jupiter's magnetic fields, but has never before been recreated in the laboratory.

"It's the first experiment of its kind," said M.I.T. senior scientist Jay Kesner (APAM Alumnus, Ph.D. '70, Plasma Physics), M.I.T.'s physics research group leader for LDX, who co-directs the project with Mauel.

The results of the experiment show that this approach "could produce an alternative path to fusion," Kesner said, though more research will be needed to determine whether it would be practical.

The whole concept, he said, was inspired by observations of planetary magnetic fields made by interplanetary spacecraft. In turn, he said, for planetary research the experiments in LDX can yield "a lot more subtle detail than you can get by launching satellites, and more cheaply."

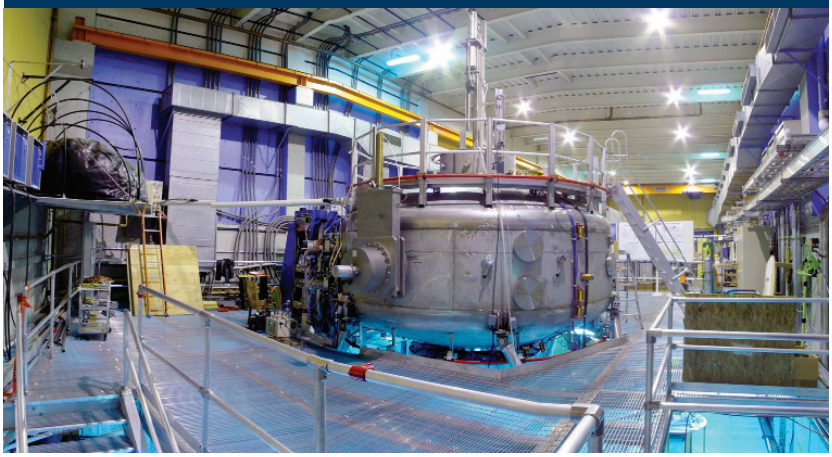
The M.I.T. and Columbia scientists say that if the turbulence-induced density enhancement exhibited by the LDX could be scaled up to larger devices, it might enable them to recreate the conditions necessary to sustain fusion reactions, and thus may point the way toward abundant and sustainable production of fusion energy.

The LDX project, housed on the M.I.T. campus and funded by the U.S. Department of Energy, has been through more than 10 years of design, construction and testing, and produced its first experimental results in its levitated configuration last year, which are being reported in the analysis published this week. Darren Garnier, a research scientist at Columbia who directs the project's experimental operations, last month received the Rose Award for Excellence in Fusion Engineering for his work on LDX.

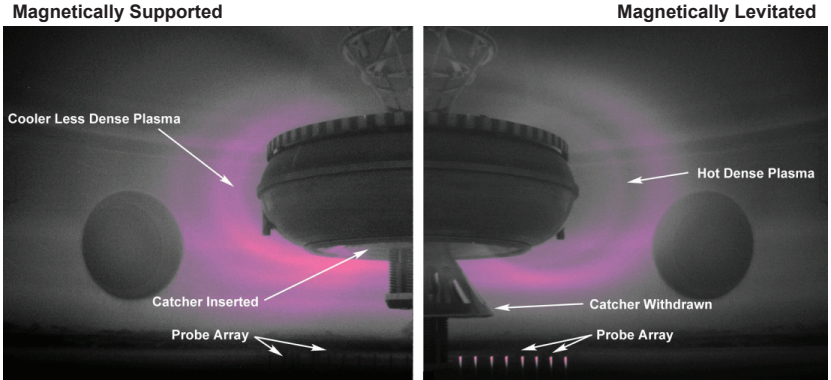
"LDX is one of the most novel fusion plasma physics experiments underway today," said Stewart Prager, director of the Princeton Plasma Physics Laboratory and APAM Alumnus (Ph.D. '75, Plasma Physics). Because of the unique geometry of the system, he says, "theoretical predictions indicate that the confinement of energy might be very favorable" for producing practical fusion power, but the theory needs to be confirmed in practice. "For these benefits to be realized, the somewhat bold theoretical predictions must be realized experimentally," he said.

Reprinted from *Columbia News:* **http://news.columbia.edu/research/1883**

The Levitated Dipole Experiment (LDX) reactor, on the campus of M.I.T. (Image credit: LDX team)



Magnetically Supported **Magnetically Levitated**



http://www.nature.com/nphys/journal/v6/n3/full/nphys1510.html

In Memoriam: Praveen Chaudhari

Praveen Chaudhari

Prof. Praveen Chaudhari passed away on January 13, 2010 at his home in Briarcliff Manor, New York, after a battle with cancer. He received his Bachelor's degree from I.I.T. (Kharagpur, 1961) and a Doctoral degree from M.I.T. in 1966, both in Physical Metallurgy. He joined IBM in 1966 and he held various research and management responsibilities for three decades in scientific research and technology development. He was appointed Director in 1981, and Vice-President of Science in 1982. During his stewardship, IBM scientists were awarded Nobel Prizes for two consecutive years and the science programs at the IBM research laboratories across the globe grew significantly.

After retiring from IBM in March 2003, he became the Director of Brookhaven National Laboratory, a position he held until April 2006. With the help of Senator Schumer, Senator Clinton, and Congressman Bishop, and with private funding by Jim Simons and his colleagues at Renaissance Technology, he enabled the Laboratory to implement a new vision and set itself on a growth curve that continues to this day. After 2006, he continued to work at Brookhaven part-time as a research scientist. He also joined Columbia University as an Adjunct Professor in the Materials Science Program of the Department of Applied Physics and Applied Mathematics.

He published over a hundred and sixty scientific papers, and held over three dozen patents. He was a member of the National Academy of Sciences and of the National Academy of Engineering; he was also a Fellow of the American Academy of Arts and Sciences and of the American Physical Society. His many awards include the National Medal of Technology, awarded to him and two colleagues in 1995 by President Clinton for "the discovery and development of a new class of materials - the amorphous magnetic materials - that are the basis of erasable, read-write, optical storage technology, now the foundation of the worldwide magnetic-optic disk industry."

Dr. Chaudhari was active in many committees nationwide and internationally, including the Physics Policy Committee of the American Physical Society, the Governing Board of the New York Academy of Sciences, the Advisory Board of the Mathematical and Physical Sciences of the National Science Foundation, and the Scientific Advisory Council of the International Center for Theoretical Physics. He served as the Executive Secretary of President Reagan's Advisory Council on Superconductivity, and was a member of the National Commission on Superconductivity that reported its findings to President Bush. In 1988 he reported to Prime Minister Rajiv Gandhi of India on science and technology, and in 1993, at the request of the Indian Minister for Sciences and Technology, he led an IBM group to evaluate the Indian parallel computer activities.

Dr. Chaudhari had great enthusiasm for science and set extremely high standards for himself and those lucky enough to work with him. He will be sorely missed. He is survived by his wife, Karin, and his two children, Ashok and Pia.

Postdoc/Research Scientist News: Sarbajit Banerjee

Sarbajit Banerjee, a former postdoc who worked with Prof. Irving Herman, was awarded the 2010 Exxon-Mobil Solid State Chemistry Award for young investigators by the American Chemical Society. The award recognizes young scientists who have made substantial contributions to the discipline of solid-state chemistry and have the potential to emerge as leaders in the field. Dr. Banerjee is currently an Assistant Professor of Chemistry at Buffalo University-SUNY.

APAM STAFF NEWS: We bid a fond farewell to Chad Gurley and Jennifer Cho. Chad has worked as the Assistant to the Director of Materials Science & Engineering since 2001 and Jennifer served as the IGERT Program Coordinator since 2006. We are so grateful for your service, dedication, and camaraderie. You will be greatly missed!

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2009 Plasma Physics Reunion Dinner

(left, front-back) Matt Davis, David Gates '94, Jay Kesner '70, Dennis Boyle '08 *(right, front-back)* Jeremy Hanson '09, Brian Grierson '09, Matt Worstell

(left, front-back) David Maurer '00, Oksana Katsuro-Hopkins '07, Gerald Navratil, Darren Garnier *(right, front-back)* Ron Schmitt '08, Jennifer Ellsworth '02

(left, front-back) Bryran DeBono, Katherine Velas '05, Jeff Waksman '06, Jeff Levesque, Nikolaus Rath *(right, front-back)* Daisuke Shiraki, Benoit Durand De Gevigney, Elliot Kaplan '06, Aaron Senter, Xabier Sarasola-Martin

(left, front-back) Chris Hegna '89, Ilon Joseph '05, Holger Reimerdes *(right, front-back)* Andrea Garofalo '97, Thomas Pedersen, Dylan Brennan '97

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Photos/Images: Marlene Arbo, Eileen Barroso, Allen Boozer, Chad Gurley, Alex Horelick, LDX Team, Christina Rohm, Ron Schmitt

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