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HOTLINE

The Princeton Plasma Physics Laboratory is a United States Department of Energy Facility

They Had a Dream ...

NSTX Team Leaders Ono and Peng See the Culmination of Aspiration

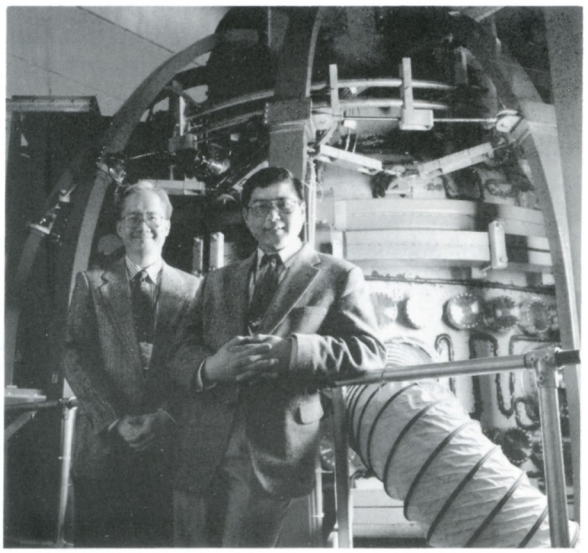
Some science projects require the direction of a superhuman. In the case of the National Spherical Torus Experiment (NSTX), the project needs — simply — "two enthusiastic scientists who have complementary backgrounds and are willing to work together," according to its co-heads. Project Director Masayuki Ono and Program Director Martin Peng presently co-head the national collaborative project, which began operating at PPPL in February. Below are their stories.

By Patti Wieser

When Masa Ono was growing up in Japan, he dreamed of becoming a medical research doctor so that he could help people.

"I wanted to become a scientist to cure diseases," said Ono, recalling his childhood idol, Hideo Noguchi, a Japanese medical pioneer.

Later, as a physics student at the California Institute of Technology, Ono discovered another avenue for helping others. It was plasma physics, which held the promise of benefiting humankind through the development of an alternative power source.



From left are Program Director Martin Peng and Project Director Masayuki Ono in front of the NSTX device.

"I was studying physics when I found out about fusion and it sounded very exciting," said Ono. "It has great potential for humankind and Princeton was the place to be."

After receiving a bachelor's degree in physics from CalTech in 1973 he came to PPPL as a graduate student and received a Ph.D. in plasma physics from Princeton University. He joined the research staff at PPPL in 1978. Today he is the Project Director for the National Spherical Torus Experiment (NSTX), a new, innovative fusion energy research device at PPPL.

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For Martin Peng, this year's start of the National Spherical Torus Experiment (NSTX) marks the culmination of a 15-year quest.

A decade and a half ago, Peng, now NSTX Program Director, developed the low aspect ratio "spherical" torus concept that is the basis for NSTX. This concept could ultimately simplify engineering and make fusion energy affordable and practical.

Peng came up with the idea when he began looking at how to increase plasma beta in tokamak plasmas. "I always had a bend for applications and knew that plasma beta was very important, and I began wondering about the best way to improve it in tokamaks. It became obvious at that time that beta would increase if the aspect ratio was reduced," said Peng, an Oak Ridge National Laboratory (ORNL) employee on a long-term assignment at PPPL.

Aspect ratio is the ratio of the plasma's major radius to its minor radius. The name spherical torus comes from the shape of the plasma. As the plasma's aspect ratio becomes smaller, the plasma elongates naturally and takes on a spherical shape instead of the donut-shape of

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Ono

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"I hope NSTX will be a successful physics machine and it will help the Lab and the fusion program to prosper — that this will ignite broad enthusiasm for fusion," said Ono. Scientists believe NSTX could lead to a less expensive path to fusion energy.

Ono, who moved to the U.S. as a young teenager, began his career at the Laboratory working on the Linear-4 machine, which was modified to become the Advanced Torus Concepts-I (ACT-I), a toroidal device that marked the start of Ono's design work.

By 1986, the seed for a spherical torus was planted. Ono met Martin Peng, now the Program Director for NSTX, when the latter was reviewing the Current Drive Experiment-Upgrade (CDX-U) design, which Ono had developed with PPPL graduate students.

Six years later, at an international meeting, Rob Goldston, now the Director of PPPL and then the head of the Research Council, suggested to Ono a larger spherical torus. Around the same time, the director of the Oak Ridge National Laboratory suggested to Peng, who was at Oak Ridge, a joint spherical torus project with PPPL.

"I started working with Martin in 1992 and Stan Kaye soon joined forces with us. Peng named it the Princeton Spherical Torus Experiment, but it became a larger project — a national effort — so the name became the National Spherical Torus Experiment," said Ono.

He continued to head the CDX-U project while collaborating on the design of NSTX and in 1996, CDX-U was transformed into a prototype of NSTX. CDX-U became a high harmonic fast wave heating experiment because fast wave heating appeared to be one of the few viable ways to heat NSTX plasmas to a very high temperature.

First Plasma

In February of this year, the construction of NSTX was completed and the machine produced its first plasma. Ono and Peng presently co-head NSTX. "Martin provides the vision and I help make it real," remarked Ono about his and Peng's roles. In other words, Peng works with many researchers in the fusion community to formulate the research plan and with experimental task leaders to cover the scientific elements of the research, while Ono manages the NSTX operations, working with a national team of physicists, engineers, and technicians to make the project and its experiments possible. PPPL Director Rob Goldston played a crucial role in the formulation of this arrangement.

For Peng and Ono, it has been a long road to fulfill their joint aspiration. "Since 1986, we have been working toward this kind of facility for PPPL and for the fusion community," said Ono.

Typical Day

A typical day for Ono begins with an 8:30 a.m. staff meeting, a check of his myriad e-mails to see what is planned, and then meeting after meeting, where potential problems are discussed and solved. "My job is making sure everyone communicates and that they all understand the scope of the work," said Ono, who also reports on the project's progress to the Department of Energy and upper management at PPPL.

It is a different hat than the one he donned as an experimentalist designing toroidal and spherical torus machines, running experiments, and analyzing data. Now he heads a team and "helps create an environment for researchers to be productive," he said.

Ono, an American Physical Society Fellow and PPPL Distinguished Research Fellow, lauded the NSTX team and described his job as "a lot of fun."

"I get to work with many people who have different skills, backgrounds, and knowledge. It is a busy but rewarding job," he said.

To unwind, Ono, the father of three sons and one daughter, often works out at the local gym with one of his sons, and is the self-described "handiman" at home, where he enjoys projects such as building a deck and installing new windows. Working with his hands gives him a break from his desk and meeting-bound job.

In addition, he is the president of the Princeton Community Japanese Language School, a non-profit entity created in 1980 to teach area children the Japanese language and culture. Ono's wife, Sakiko, is an administrator for the school.

"I'm interested in education. I like students and working with them because they are our future. They bring fresh perspectives and keep you young," said Ono, who also has worked with many graduate students at PPPL and is a Lecturer with the rank of Professor for the Program in Plasma Physics in Princeton University's Astrophysical Sciences Department.

Being fond of fresh perspectives is one of the things that drew Ono to the spherical torus. "I myself like new things so it is logical for me to go in the spherical torus direction. Fusion is complex and coming up with a good fusion reactor is a challenge. We should look at all the possibilities," he said.

He said seeing NSTX produce first plasma and participating in a ribbon cutting ceremony with Secretary of Energy Bill Richardson was "a great honor and great fun."

"I'm very happy and excited and privileged to be where I am," he said. ●

Peng

Continued from page 1

standard tokamak plasmas. A higher beta means that greater plasma pressure, thus more fusion output, is achieved in a given magnetic field; or conversely, that the same output can be achieved in a weaker field. "High plasma pressure well confined in a low magnetic field has always been our great dream," Peng said.

Natural Inclination to Tinker

Peng, whose engineering background prods him to approach physics puzzles with a practical bend, has always had a natural inclination to tinker with things. As a young boy growing up in Taiwan, he built small rockets from scratch and made airplane gliders using pieces of plastic for wings. During his teen years, he enjoyed repairing his car and went on to study engineering at the National Taiwan University, receiving a bachelor's degree in electrical engineering. In 1974, he received a Ph.D. in applied physics from Stanford University and joined the research staff at ORNL.

By the early 1980s, Peng became involved in studying fusion power plant designs and future devices at ORNL, as well as the International Tokamak Reactor (INTOR), the predecessor to the International Thermonuclear Experimental Reactor (ITER). The assessments drew him to investigate how to qualitatively improve beta. "I believe engineering serves the goal of research and if this goal is to increase beta, then we had to look at the engineering approach that would allow us to go to a very low-aspect ratio," he said.

Peng worked out the theoretical calculations for low-aspect ratio by the mid-eighties. Toward the end of the decade, he worked with colleagues to propose a spherical torus experiment.

"What pushed me to continue over the years was the prospect of an order of magnitude increase in beta and an order of magnitude reduction in the magnetic field strengths in a spherical torus," he said. While serving on a review panel in the late 1980s, Peng encouraged researchers to upgrade PPPL's Current Drive Experiment (CDX) to a low-aspect ratio configuration. During this time, he met Masayuki Ono, then Head of CDX and presently Project Director of NSTX.

Peng went on to work with the Russian researchers at the Ioffe Institute and with British researchers at Culham Laboratory, where the Small Tight Aspect Ratio Tokamak (START), a spherical torus, was eventually constructed.

By the mid-nineties, the restructured U.S. fusion program emphasized concept innovation, as well as national collaboration. Peng began regularly coming to PPPL to work with Rob Goldston, Ono, and Stan Kaye on the Princeton Spherical Torus Experiment, which evolved into the National Spherical Torus Experiment.

NSTX is truly a national collaborative effort that brings Peng and Ono together as co-directors of the project. Said Peng of his work with Ono, "We are very fortunate to have hit on an arrangement in which we have a complementary dual role. We constantly talk about what we are doing and know what we have to do separately, in concert, to make this research program successful."

As Program Director, Peng works with many researchers in the fusion community to formulate the research plan for NSTX and with experimental task leaders to cover the scientific elements of the research.

The project leaves little time for outside activities. "Right now my life evolves around work and family," said Peng, the father of three.

When not traveling, he typically arrives at the Lab around 8 a.m. and works until 7 p.m. His days at PPPL and on the road are filled with meetings, e-mails, and interaction with researchers from 13 other institutions across the U.S. who are collaborating on the project. In addition, Peng is in frequent contact with DOE officials and leaders in fusion research.

His schedules poses one particular difficulty — finding time to work on outside scientific endeavors. "One of the problems we all face is that there are so many ideas we would like to test out. You must be diligent about getting things accomplished to be successful at work and then, once in a while, squeeze in something extra," said Peng.

Fusion Power Source for NASA

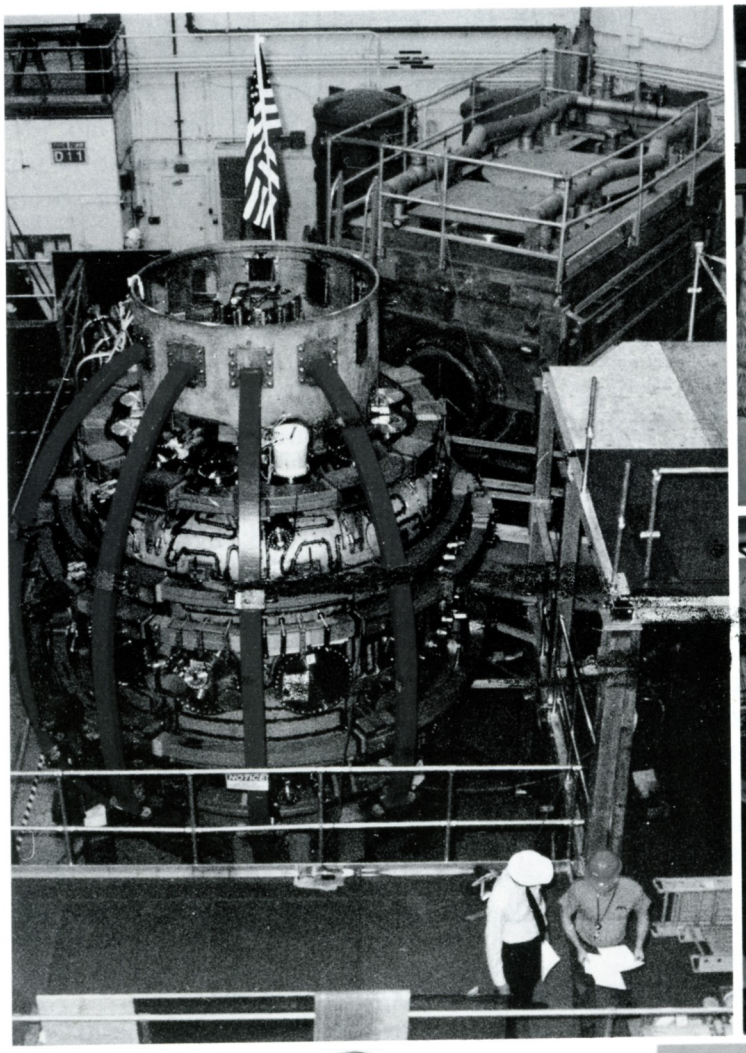
One of these "extras" is developing a spherical torus power source for NASA's Deep Space Manned Mission. Fusion energy is the only power source capable of sending a manned mission to Jupiter, noted Peng. A chemical source of fuel for rockets is sufficient for closer missions, but would be so large for a vehicle to Jupiter that it would become impractical. Fusion power is 450 times more powerful than a chemical source. Presently, Peng is involved in a small study funded by NASA to investigate a process for extracting fusion energy from an advanced fuel power source directly into thrust.

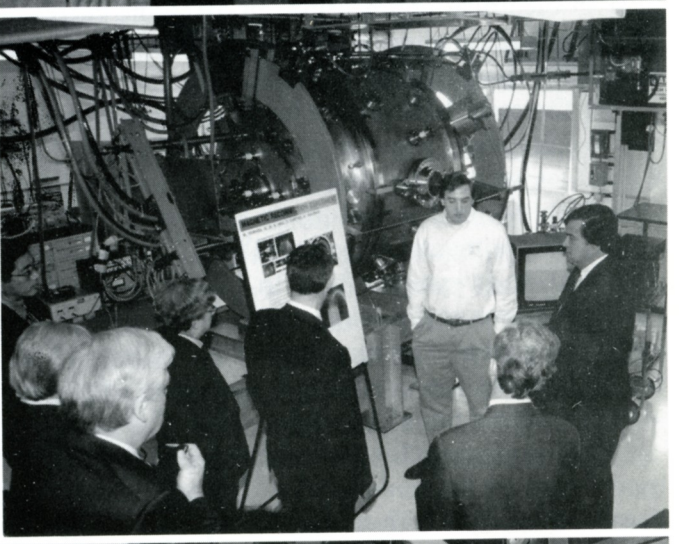
Mostly, though, Peng spends his time on the new fusion project at PPPL.

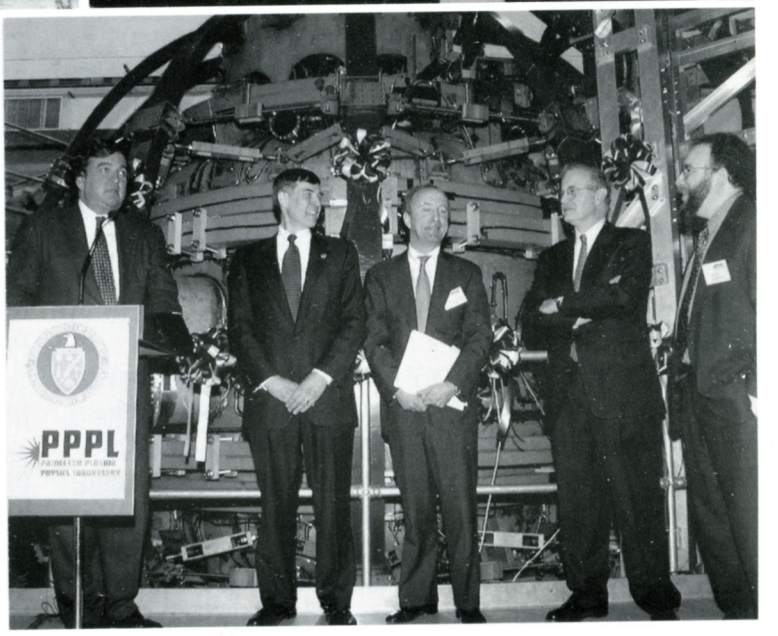
"The goal of NSTX is to find a way to do fusion much better. Magnetic fusion is complex. I hope the spherical torus will give us a scientific basis to do fusion less expensively and more compactly," said Peng. "We are very fortunate to have NSTX, and are just beginning our work." ●

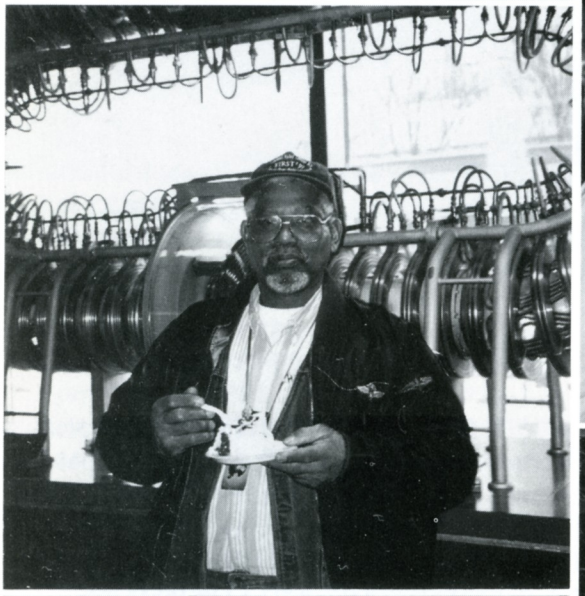
NSTX Makes a Splash

Ribbon Cutting Ceremony and Staff Bash Celebrate Machine's First Plasma









PPPL Hosts Regional Science Bowl®; Montgomery Wins Final Round Moderated by Congressman Holt

Competing against twenty other high school teams from New Jersey and Pennsylvania, Montgomery High School, Team A, won first place at the New Jersey Regional Competition of the National Science Bowl® on Saturday, February 27. The double-elimination tournament took place at PPPL.

PPPL Science Bowl Coordinator James Morgan said, "Science Bowl raises the visibility of academic achievement in the sciences. The program has been successful in placing these young people on a par with their peers who excel in athletics."

U.S. Representative Rush Holt, a Democrat representing New Jersey's 12th Congressional District, served as a guest moderator during the final round in which Montgomery defeated East Brunswick High School. Congressman Holt is a physicist and former assistant director of the Laboratory.

Montgomery High School Team A won the New Jersey Regional Competition of the National Science Bowl®, which was held at PPPL on Saturday, February 27. From left are team members Brian Wong and Kathy Scott, PPPL Science Bowl Coordinator James Morgan, team members Chris Conlon and Bing Luke, U.S. Representative Rush Holt, team coach Ray Olschewski, and team member Brice Daniels.

From left, PPPL's Pamela Lucas and Darin Stotler, Congressman Rush Holt, and PPPL Science Education Program Head Diane Carroll confer during the last rounds of the competition.

As the 1999 top winner of the regional competition, the Montgomery team received an all-expense paid trip to Washington, D.C., to participate in the Ninth Annual National Science Bowl® this spring. East Brunswick garnered second place and West Windsor-Plainsboro South High School placed third. The top three winners at the regional competition received trophies.

Competition Hosted by PPPL

Teams made up of four students, a student alternate, and a teacher who serves as an advisor and coach, participated in the competition hosted by PPPL. The students answered multiple choice or short answer questions in biology, chemistry, physics, astronomy, mathematics, and earth and computer sciences. Scientists from U.S. Department of Energy national laboratories made up the questions. The U.S. Department of Energy sponsors the regional competition. ●

PPPL's Al von Halle (left) and GFDL's Matthew Harrison serve as a science judge and moderator, respectively, during Science Bowl.

Thanks, Science Bowl Volunteers!

Dori Barnes, PPPL
George Barnes, PPPL
John Bennevich, PPPL
Richard Bitzer
Troy Carter, PPPL
Bill Davis, PPPL
Michael Del Corso
Princeton University
John DeLooper, PPPL
Elizabeth Foley, PPPL
Tom Gibney, PPPL
Rob Goldston, PPPL
Terry Greenburg, PPPL
Matthew Harrison, GFDL
Keith Harvest
Richard Hawryluk, PPPL
Margaret King, PPPL
Allen Lee
Tom McGeachen, PPPL
Tobin Munsat, PPPL
Masayuki Ono, PPPL
Franco Paoletti, PPPL
Carol Phillips, PPPL
Mike Pieja, PPPL
Adam Rosenberg, PPPL
Jeff Spaleta, PPPL
Daren Stotler, PPPL
Barbara Sarfaty, PPPL
Al von Halle, PPPL
Thomas von Halle
Gregg Wielage
Patti Wieser, PPPL
Irving Zatz, PPPL

Kaul Foundation Gives PPPL Additional $60,000

The Kaul Foundation recently gave $60,000 to PPPL to supplement the endowment for the Lab's "Prize for Excellence in Plasma Physics and Technology Development."

In a February 4 letter to PPPL Director Rob Goldston, James Kaul, Chairman of the Kaul Foundation's Board of Trustees, said, "It gives me great pleasure to advise you that the Board of Trustees of The Kaul Foundation has resolved to honor the Plasma Physics Laboratory of Princeton University with an enhancement grant... We are hopeful that this enhancement grant will support recognition of the scientists dedicated to fusion energy research at Princeton."

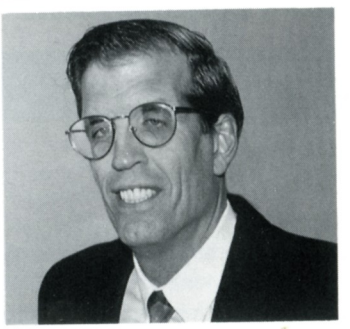
James Kaul is the son of Ralph Kaul, a Florida businessman who created the foundation in 1986 to encourage and reward excellence of national significance in scientific, public health and safety, literary, fine arts, and educational endeavors.

In 1993, the Kaul Foundation gave Ronald C. Davidson, then director of PPPL, its 1993 Award for Excellence in science, education and physics. The award was accompanied by a $100,000 check, of which Davidson turned over $40,000 to Princeton University to endow a "Prize for Excellence in Plasma Physics Research and Technology Development." This prize is awarded annually to a scientist or engineer at PPPL for outstanding technical achievement.

Goldston said of the recent supplement, "It is a great honor for us to be recognized by the Kaul Foundation. This year's prize was awarded to experimentalist Dr. Raffi Nazikian and theorist Dr. Guo-Yong Fu for their collaborative groundbreaking work in alpha-particle physics in the Tokamak Fusion Test Reactor. It is a real pleasure to be able to reward such excellent scientific work with special recognition, and we thank the Kaul Foundation for providing this opportunity to us." ●

Larson Receives University Award

PPPL's Scott Larson was among 70 honorees awarded by the President's Standing Committee on the Status of Women at Princeton University for "making a difference in the lives of women at Princeton." Those awarded received certificates during a March reception in their honor at Prospect House. Larson was cited for "enriching the lives of those on campus, for encouraging the achievement of each person's full potential, and for making Princeton University a more welcoming environment for women to live, learn, and work. ●



Scott Larson

Preston Talk Concludes Science on Saturday Series

Princeton author Richard Preston captivated a standing room only crowd at PPPL with his discussion about "The Shadow of Biological Weapons" on March 20 during the Lab's final talk for the 1999 Science on Saturday lecture series.

"Biological weapons are more powerful pound for pound than a hydrogen bomb," said Preston, citing anthrax, the Black Death, and smallpox as examples of such weapons.

Preston is a journalist and the author of the best selling nonfiction book, *The Hot Zone*, a true story about an outbreak of the Ebola virus near Washington, D.C. The author's newest release, *The Cobra Event* (Random House—November 1997), a thriller about biological weapons and terrorism, is also on the bestseller lists. Preston spent three years researching *Cobra*, and his sources include top government officials and scientists who invented and tested strategic bioweapons.

Above, Preston signs books in PPPL's Lobby following his talk. At top right, the author discusses his work in the MBG Auditorium.

The author, who brought a sterilized microscopic sample of the Ebola virus to show during the talk, discussed both books.

Science on Saturday is a series of eight free lectures geared toward high school students, but open to everyone. The lectures are given by scientists and other professionals who are leaders in their fields. This year's series was organized by PPPL's Norton Bretz, Janardhan Manickam, and Chris Ritter. ●

HOTLINE

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