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HOTLINE

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

NSTX Produces One Megampere Plasma Current Ahead of Schedule

Milestone is Reached Nine Months Early

By Anthony DeMeo

On December 14, the National Spherical Torus Experiment (NSTX) at PPPL produced a one million ampere plasma current — a new world record for a spherical torus device. Producing this plasma current sets the stage for the Laboratory to create and study plasma conditions that are relevant to the production of fusion energy.

Secretary of Energy Bill Richardson said, "I'm delighted that the NSTX experiment has met this technical milestone nine months ahead of schedule. We can now begin the scientific investigations that the machine is designed to do."

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—Bill Richardson

One million amperes is the highest plasma current ever produced in a spherical torus device. The previous record is 310,000 amperes achieved in a smaller spherical torus called START — the Small Tight Aspect Ratio Tokamak — built by Culham Fusion Laboratory of U.K.

PPPL Director Rob Goldston lauded staff for achieving the milestone early. "This is a great example of the physics and engineering teams working closely together to bring about an important milestone well ahead of schedule. It is also a great example of PPPL and collaborating researchers working together closely for the success of the project. My congratulations to all involved," said Goldston.

Shaped Like a Sphere

NSTX, which began operating in February, is designed to test the physics principles of spherical torus plasmas. It produces a plasma that is shaped like a sphere with a hole through its center. This configuration may have several advantages, a major one being the ability to confine a higher plasma pressure for a given magnetic field strength. This could lead to a less expensive development path for fusion energy.

A large current flows inside the NSTX plasma and heats the plasma in the same way the current heats an electric toaster or light bulb. This plasma current also produces a magnetic field so that the resulting magnetic field line spirals around inside the plasma. The spherical torus provides a special shape in these magnetic field lines that is calculated to contain high-temperature plasmas efficiently.

The production of a one-million-ampere plasma current on NSTX required the appropriate plasma shaping, such as the width and height of the cross section of the plasma torus. Proper plasma shaping helps eliminate plasma instabilities. By October of 1999, the NSTX team had produced all of the desirable plasma shapes that they plan to use on NSTX, also a key aspect of preparation for research.

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Sauthoff Elected President of IEEE-USA

Ned Sauthoff, Head of PPPL's Off-site Research Department, is the President-Elect of the Institute of Electrical and Electronic Engineers-USA (IEEE-USA) for the year 2000.

Ned Sauthoff

Sauthoff becomes the fourth IEEE-USA President directly elected by the IEEE's U.S. members. His post is a three-year assignment to the IEEE's Board of Directors: President-Elect in 2000, President in 2001, and Past-President in 2002.

Goals as President-Elect

Sauthoff said among his goals as President-Elect, he will work to enhance the effectiveness of IEEE-USA's member services and career products; advocate portable pensions, continuing education, and intellectual property protection; oppose employment discrimination; and exploit the breadth and depth of IEEE perspectives to synthesize balanced IEEE-USA positions in both career and technology policy areas.

"This position gives me an opportunity to serve and to help the members of IEEE-USA make a difference," he said.

During his campaign, Sauthoff stated, "The IEEE-USA must serve the U.S. members within IEEE's global context, enabling U.S. members to achieve life-long career vitality and contributing to the development of sound U.S. public policy. Its member services and activities in non-technical professional development, careers, and technology policy complement IEEE's position as the preeminent source of electrotechnology information."

Sauthoff has participated in many activities and served in several capacities at IEEE-USA, the most recent being as a member of the group's Board of Directors and as IEEE-USA Vice Chairman of Technology Policy Activities.

Came to PPPL in 1975

Sauthoff came to PPPL in 1975 after receiving a Ph.D. in astrophysics from Princeton University. He received a master's degree in nuclear engineering in 1972 and a bachelor's degree in physics in 1971, both from the Massachusetts Institute of Technology. Prior to his present position, Sauthoff had been Head of the Laboratory's Plasma Science and Technology Department. He is a Princeton resident.

PPPL Director Rob Goldston said, "Dr. Sauthoff has a superb record of scientific and managerial accomplishment at PPPL. I am glad that his capabilities have been recognized by the IEEE-USA, and I am sure that he will make very important contributions, while continuing to contribute to the Laboratory."

Congratulations, Ned! ●

Megampere

Continued from page 1

NSTX is a proof-of-principle experiment — a relatively inexpensive device, which will create conditions suitable for the study of fusion-energy-relevant plasma behavior and advanced plasma heating and current-drive techniques. It is not planned to produce significant fusion energy in this device.

NSTX Program Director Martin Peng said, "The goals of the next few years of research on NSTX are to produce high-quality scientific results and excellent plasma performance. If successful, NSTX will have an impact on the design of future devices. These machines would extend the temperatures, densities, and other plasma parameters to the levels necessary for fusion energy production." ●

HOTLINE

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On the Road...with PPPL's Robert Budny

When European and Asian scientists analyze data from experiments on tokamak fusion machines, they often call upon American collaborators for assistance.

One of these collaborators is PPPL physicist Robert Budny. Budny is presently analyzing data from the Joint European Torus (JET) in England. "JET is a very interesting opportunity for us because it is one of the largest fusion experiments in the world and the researchers there have done an extensive deuterium-tritium (D-T) campaign. The Tokamak Fusion Test Reactor, which operated at PPPL from 1982 to 1997, is the only other fusion machine to do experiments using D-T as the fuel, so there is a natural affinity between TFTR and JET," says Budny, adding that another similarity between JET and TFTR is both produce high-temperature plasmas.

Budny, who has collaborated on tokamak research around the globe, shares his special expertise in code analysis that he has culled from years of experience on TFTR. "I model tokamak plasmas to understand what makes them tick. I use a computer code that inputs many different measurements, and calculates various quantities that we cannot measure. This allows us to check the consistency of the data, for instance to see if quantities that physics tells us must be conserved actually are. If not, this tells us that there may be a problem with the data, so the measuring system needs to be checked. Also, the results from the code are used as a bridge between the experimental data and theories," he explains.

For the past two years, Budny has made six trips to England annually, spending three weeks at a stretch there. "I go to JET, talk to people, get data, and bring it back to PPPL, where I run the analysis. When I get the results, I send them back to England for use in publications and further analysis," he says, relying on e-mail and telephone calls for communication between his visits.

Robert Budny

Budny has also spent considerable time in France analyzing data from the Tore-Supra tokamak, as well as in Japan working with researchers on the JT-60U fusion machine, and with scientists at the TEXTOR tokamak in Jülich, Germany. In addition, while at PPPL he has worked with various foreign visitors. "I set up operations for a Chinese researcher to do simulations of the HL-2A tokamak in China," says Budny, who eventually co-authored a paper with the visitor.

Budny is one of several collaborators from PPPL. The DOE funds the collaborative efforts. ●

PPPL Science Exhibit is a Big Draw in Seattle

PPPL's John DeLooper (right) discusses science with visitors at the Plasma Sciences Expo during the American Physical Society-Division of Plasma Physics (APS-DPP) meeting held last November in Seattle. The Expo, which featured presentations, hands-on displays, and exhibits, as well as a chance to talk to fusion scientists, was conducted by the APS-DPP and coincided with the organization's annual conference on plasma physics. ●

Photo by James Morgan

Experimental Balloon Tested at PPPL's High Bay

In December, it looked as if you could embark on a trip "around the world in 180 days" at the motor generator high bay area of PPPL's D-site.

At one end stood a gigantic balloon — eight-and-a-half meters in diameter — made of 36 nylon panels and inflated with helium for testing.

The balloon, fabricated at Princeton University, will eventually be transported to Italy for the new Borexino Solar Neutrino Experiment at the Laboratori Nazionali del Gran Sasso. The Princeton University Nuclear Physics Group has a major role in the development of this experiment, which is designed to detect low-energy solar neutrinos, in real time, using 300 tons of liquid scintillator in an unsegmented detector. Neutrinos are elusive, subatomic particles.

Members of the borexino team brought the balloon to PPPL to test it for leaks, measure distortion, and check out its geometry.The Borexino experiment involves about 100 collaborators from several institutions. Researchers are from three countries, the U.S., Germany, and Italy. Ernst de Haas, a former PPPL'er on the project team, suggested D-site for testing the balloon because of the large, open space available there.

"They needed a place that had a crane and was free from any wind," noted PPPL's Gene Baker.

Said Princeton University graduate student Laura Cadonati, "The main goal of Borexino is to measure the flux of neutrinos from the electron-capture decay of 7Be in the Sun. This is one of the thermonuclear fusion reactions that produce the Sun's energy." The number of these neutrinos emanating from the Sun is lower than expected. Scientists are attempting to understand why.

"The balloon will be filled with a liquid scintillator at the project site in Italy. It will be the first of its kind able to detect low-energy solar neutrinos in real-time," said Allan Nelson, a member of the Princeton team.

Cadonati noted that the liquid scintillator being used in Borexino is pseudocumene, a benzene-like organic liquid, doped with fluorescent compounds. "This mixture produces light when hit by a particle such as a neutrino; this light is then detected by an array of photomultiplier tubes," she said.

The balloon will go inside a larger balloon that will be placed into a stainless steel sphere. Pointing to the balloon at D-site, Princeton University Physics Professor Tom Shutt said, "This will be the center of the experiment."

The balloon tested at PPPL is a prototype. It or a new balloon is expected to go to Italy for futher tests sometime before the spring.

A special thanks goes to everyone at PPPL who assisted with the effort by lending tools, giving the team training on equipment, and conducting safety checks. PPPL staff who assisted with the effort are: Mounir Awad, Gene Baker, Larry Dudek, Chris Gilton, Bob Horner, Jerry Levine, Colin McFarlane, Lewis Meixler, Bob Parsells, Bill Slavin, and Mike Viola.

Borexino Group

The Borexino Group at Princeton University includes Jay Benziger, Frank Calaprice, Laura Cadonati, Mark Chen, Tom Shutt, Ernst de Haas, Richard Fernholz, Richard Ford, Cristiano Galbiati, Beth Harding, Aldo Ianni, Steve Kidner, Paul LaMarche (project manager), Fred Loeser, Allan Nelson, Andrea Pocar, James Semler, Andrew Sonnenschein, and Charles Sule. ●

From left in front of the balloon are Laura Cadonati, Princeton University graduate student; Tom Shutt, Princeton University physics professor; Allan Nelson, technical staff member at Princeton University; and Richard Fernholz, Princeton University engineer.

PPPL Offers Science on Saturday Series

The bleak days of winter are being brightened by the annual "Science on Saturday" series at PPPL. Through the series, which began January 15, you can find out about the relationship between art and math, see how physics contributes to the art of dance, gain a better understanding of the universe, and discover more about the movement of continents, among other topics.

Seven Free Lectures

Science on Saturday is a series of seven free lectures geared toward high school students, but open to everyone. In the past, attendees have ranged in age from 8 to 80. The lectures are given by scientists and other professionals who are leaders in their fields. Started as a grass-roots effort 16 years ago at PPPL, Science on Saturday now attracts more than 300 people each Saturday. This year's series is organized by PPPL physicists Norton Bretz and Janardhan Manickam, and PPPL Science Education Program staff members James Morgan and Chris Ritter.

"The new millenium Science on Saturday program will feature both creative and academic aspects of science. As science becomes more intertwined with all parts of our lives, from art and writing to entertainment and design, we have tried to keep our audience up-to-date," said Bretz.

The first two lectures focus on computers, mathemetics, and art from the perspectives of an academic, Professor George Chaikin, who holds a joint appointment in the Mathematics and Art Departments at City University of New York's Herbert Lehman College, and of a successful clothing designer, Ms. Jhane Barnes, who is President and Designer for Jhane Barnes, Inc. in New York.

Other lectures concentrate on our understanding of the universe, plate tectonics, and how science is perceived by the public and by lawmakers. "The Virtual Juggler" presentation by Ph.D. student Benjamin Vigoda is a product of a contract between The Flying Karamazov Brothers and the Media Lab at the Massachusetts Institute of Technology.

The lectures begin at 9:30 A.M. and usually last about two hours. There is no fee for the program. Registration is on-site prior to each session. Seating is on a first come, first-served basis.

Below is the schedule for the 2000 Science on Saturday series:

January 15	**"Art, Geometry, and Thought: Computer Graphics and Artificial Intelligence"** Professor George Chaikin, Herbert Lehman College, City University of New York
January 22	**SATs — No Program**
January 29	**"Mathematics and Art"** Jhane Barnes, President and Designer, Jhanes Barnes, Inc., New York, New York
February 5	**"The Oldest Photons in the Universe: Measuring Cosmic Fingerprints"** Professor Suzanne Staggs, Department of Astrophysics, Princeton University
February 12	**"The Virtual Juggler"** Benjamin Vigoda, Media Lab, Massachusetts Institute of Technology
February 19	**"Physics and the Dancer — a Fertile Dialogue"** Professor Kenneth Laws, Department of Physics, Dickinson College, Carlisle, Pennsylvania
February 26	**New Jersey Regional Science Bowl® — No Program**
March 4	**"Voodoo Science: How Strange is the Universe?"** Professor Robert Park, American Physical Society, Washington, D.C.
March 11	**"New Frontiers in Plate Tectonics"** Ms. Laurel P. Goodell, Department of Geosciences, Princeton University

PPPL's "Green Machines" Awarded

Several PPPL'ers were named "Green Machines" for their recycling efforts during a presentation in the Auditorium for America Recycles Day (ARD) in November. From left are honorees Penny Neuman, Lisa Carlucci, Dolores Lawson, Jeff Makiel, Dianne Nunes, Mike Byrne and Rich Gallagher, who accepted on behalf of Jules Nemeth. Award recipients not pictured are Erik Perry, Larry Sutton, Keith Rule, Sandy Schmidt, and Jules Nemeth. The ARD activities at the Laboratory also included presentations about the Laboratory's recycling efforts, area exhibitors, and a nation-wide Environmental Protection Agency satellite broadcast, "Buying Recycled: The Real Story about Cost, Availability, and Quality." The goal of ARD is to increase the purchase of recycled content products and recycling throughout America. "The Lab has greatly improved in recycling and buying recycled products during the last two years. We look forward to Earth Day 2000 in April," said Tom McGeachen, PPPL pollution prevention and waste minimization coordinator. McGeachen and PPPL's Margaret Kevin-King organized the ARD activities in November and are presently developing a program for Earth Day events.

PPPL Women Discuss Their Careers with Students

Earlier this month, PPPL's Andrew Post-Zwicker hosted a group of students from The Foxcroft School, an all-girls high school in Middleburg, Virginia. The day-long visit included a tour of experimental areas, hands-on experiments in plasma physics, and a small-group discussion with PPPL women about careers in science and engineering. The discussion was led by Science Education Program Acting Head Pamela Lucas and facilitated by Environmental Compliance Head Virginia Finley and NSTX software engineer Gretchen Zimmer. At left, Finley (middle) talks with the young visitors about how and when she made her career choice of environmental studies.

PPPL's Recent United Way Campaign is a Success

From left, PPPL United Way Campaign Committee members Sonja Patterson and Joanne Bianco hand out raffle tickets to PPPL Deputy Director Rich Hawryluk and Science Education Program Acting Head Pamela Lucas during the campaign's meeting for supervisors.

From left are Grand Prize winner John Gennuso and PPPL United Way Chairperson Mary Ann Brown.

Special visitor "Christopher Columbus" entertains staff during the PPPL United Way Campaign meeting.

From left, Princeton University's Bob Durkee and Karen Woodbridge enjoy the United Way program at PPPL with the United Way's Janice Carson.

PPPL employees deserve a hearty thanks for their outstanding support of the United Way. The Lab's 1999 fundraising campaign netted a total of $25, 240! This is an increase of $4,000 over the previous year's campaign. More than 37 percent of the staff participated in this annual event.

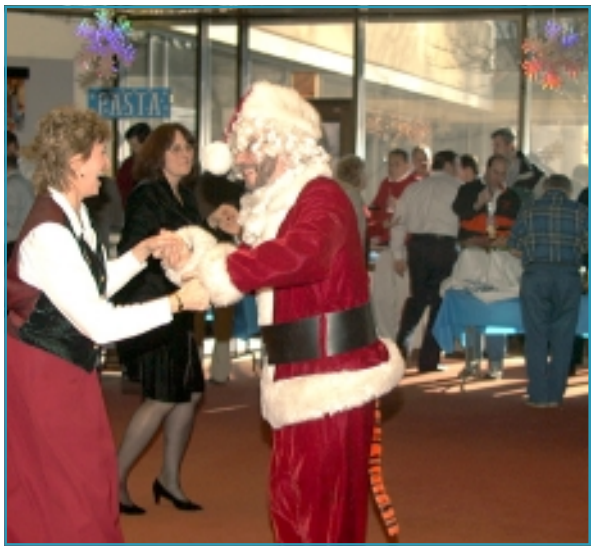
PPPL United Way Campaign Chairperson Mary Ann Brown said, "I would like to thank everyone for supporting our United Way Campaign and being so generous — we had a *very* successful campaign — raising more than $25,000 and beating last year's campaign by $4,000."

The United Way meeting at PPPL was held on November 30 and included information about United Way programs, door prizes, and entertainment. In December, the grand prize was drawn. John Gennusso won the top prize, $300 for travel. In addition, Carl Scimeca won a ladies' wrist watch; Scott Larson and Mike Kalish each won a tennis racquet; and Mary Ann Brown received an overnight stay and breakfast for two at the Princeton Marriott Forrestal Village.

Thank you for your generosity, staff! ●

PPPL Holiday Bash

Photos by John Bennevich and Elle Starkman



On December 22, PPPL staff enjoyed an afternoon holiday celebration, complete with food, entertainment, dancing, and prizes in the LSB Lobby and Cafeteria. Happy 2000!