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PPPL NEWS

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

PPPL's Johnson Leads U.S. ITER Diagnostics Team

PPPL's Dave Johnson has been named the U.S. ITER Diagnostics Team Leader. In this newly created position, he manages the design and procurement of the diagnostic devices supplied to ITER by the U.S. team.

ITER is a joint international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power. The ITER partners are the U.S., the European Union, Japan, China, India, South Korea, and the Russian Federation. ITER will be constructed in Cadarache, France.

Johnson had been the U.S. ITER Diagnostics Area Coordinator and the U.S. Delegate to the Diagnostics Working Group. U.S. ITER Project Office Head Ned Sauthoff said, "We are very pleased to have such a skilled person as Dave within our system of partner laboratories: Dave is a world-class authority in the design of diagnostics instruments, effective in the management and implementation of such systems, and experienced in the complex multi-cultural environment of ITER."

Dave Johnson

As Team Leader, his first responsibility was to pull together the cost estimates for the ITER diagnostics. In addition, he has been involved in international working groups considering how to procure diagnostic devices and shield plugs that provide the devices with access to the plasma and also provide a radiation shield for the surrounding areas. Diagnostic devices measure plasma characteristics in experiments. ITER will employ a myriad of these devices.

Two years ago, Johnson began serving as U.S. Delegate to the Diagnostics Working Group, charged with designing diagnostic procurement packages and proposing a plan for allocating diagnostics to the ITER parties. The feasibility of repackaging the diagnostics came up then. At the time of the ITER final design review five years ago, the procurement of the diagnostic systems was separate from that of the shield plugs. The international diagnostics group recognized that an important part of the diagnostic systems includes how the systems fit into the shielding plugs. "One can't design port plugs without knowing or designing the diagnostics that fit into these plugs," said Johnson. The working group suggested repackaging designs so the diagnostics and their related plugs would be developed together to ensure compatibility.

"We looked at how to repackage and then divide the diagnostics," Johnson said. Now the party responsible for a particular diagnostic is also responsible for its corresponding port plug.

"The U.S. is allocated 16 percent of the total diagnostics responsibility for ITER — a significant role

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PPPL Staff to the Rescue

Photo by Rob Sheneman

PPPL Emergencency Services Captain Dave Neuman (front) and PPPL's Darren Thompson respond to a tractor-trailor accident on U.S.Route 1 in May, which closed off traffic on the major roadway for several hours. ***(SEE STORY AND MORE PHOTOS ON PAGE 3.)***

Stellarator Vacuum Vessel Segment Arrives

On May 9, the first of three vacuum vessel parts for the National Compact Stellarator Experiment (NCSX) rolled into PPPL. Covered with a protective cloth, the metal hunk — weighing more than 6,000 pounds and filled with holes that made it resemble a silvery twist of Swiss cheese — arrived on a flat-bed.

Major Tool and Machine, Inc., of Indianapolis, manufactured the vessel segment, with its three largest diagnostic ports installed. Twenty-four additional port extensions will be installed at PPPL. Ports provide access for plasma heating and diagnostic devices. The vacuum vessel segment is made of Inconel 625, an alloy with high electrical resistivity to suppress electrical currents that could interfere with plasma confinement.

The next two segments will be delivered this summer. During final assembly in the NCSX Test Cell, the three segments will be welded together to make a 25,000-pound chamber that looks like a hollow French cruller with only three twists. The completed vessel will have a total of 84 ports.

Staff, using a crane and rigging, place the vacuum vessel segment in the NSCX Coil Winding Facility.

NCSX is under construction as the centerpiece of the U.S. effort to develop the physics and determine the attractiveness of the compact stellarator as the basis for a fusion power reactor. NCSX is being built at PPPL in partnership with Oak Ridge National Laboratory. The experiment is scheduled to begin operations in 2009. ●

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in diagnostics. We have the second largest role next to Europe's," said Johnson. The U.S. portion includes six instrumentation packages and five port plugs. There are generally between two and six diagnostics in each plug.

With a career devoted to diagnostics, Johnson seems well prepared for the tasks ahead. "I've always really enjoyed developing new measurements," he said.

Since 1997, he has served as Division Head responsible for diagnostic development in support of PPPL experimental activities in fusion facilities at PPPL and around the world. Johnson has managed diagnostic development for the National Spherical Torus Experiment (NSTX) at PPPL, typically implementing several new diagnostics each year, many in collaboration with researchers from other institutions. He has led the planning for diagnostics for the National Compact Stellarator Experiment (NCSX), which is being constructed at PPPL. Over the years, he also has participated in the collaborative development of diagnostics for experiments in the U.S., as well as in Japan, Korea, and England, and has been heavily involved with the development of ITER diagnostics.

Johnson praised the cooperative spirit of the international group. "I'm encouraged by our participation with the other parties. It has been very collaborative," he said. ●

PPPL NEWS

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PPPL Staff Respond to Major Route 1 Accident

Photo by Dietmar Krause

When PPPL's Mike Viola and Erik Perry arrived, they found a modular office on its side, basically intact. The cab of the tractor-trailor hauling the modular unit had jumped the median and was face-down on the southbound side of Route 1 just off Forrestal Campus. "I talked to the truck driver, who was shaken, but unhurt," recalled Viola.

Viola and Perry were among PPPL staff who responded to the May 18 accident, which happened shortly after lunch. Laboratory personnel from the Engineering Department, Environmental Services, and Materiel Services groups assisted PPPL's Emergency Services Unit (ESU), New Jersey State Police, the Plainsboro Township Police and Fire Departments, and the Middlesex County Hazardous Materials Unit in responding to the single-vehicle accident. The driver had reportedly lost control of the vehicle when another vehicle was passing. No one was injured and no other vehicles were affected.

The trailer and modular unit blocked the entire northbound lane in front of the Forrestal Campus in Plainsboro and closed off traffic in both directions for several hours. The tractor straddled the road divider with its ruptured fuel tank hanging into the southbound lane, leaking about 275 gallons of diesel fuel onto the roadway. The PPPL Hazmat team swung into action to assist with the containment and cleanup of the fuel spill.

Photo by Elle Starkman

"The first priority was to control the hazard of the spilled diesel fuel," said ESU Captain Dave Neuman, who along with ESU's Darren Thompson and Sean Donohue joined PPPL's Hazmat team to control and clean up the spill. "The second was to safely move the office trailer and get the roadway opened."

The ESU team used a Holmatro power wedge to pry the trailer up enough to allow forklift forks under the modular unit. "I was impressed with the way all the agencies involved worked together and I was proud to be part of the Lab's effort. Once it was determined there were no injuries, we prioritized what needed to be done," Neuman said.

The PPPL Tech Shop rigging crew used a 15-ton forklift to gently pry the unit up to allow cribbing to be placed. Then slings were pushed under it and PPPL's 35-ton Grove crane lifted the unit up and to the side of the road. The PPPL group had decided to use the crane when Viola learned the gross load weight was 26,000 pounds. The crane load indicator showed that the modular unit actually weighed only 16,000 pounds. Viola had used calculations for the slings and positioned them to spread the load. "We had 50 feet of sling on each of the two basket configurations," he said. The lift was safely and successfully executed and U.S. Route 1 reopened before rush hour. Neuman said, "To have a major accident on an artery like the Route 1 corridor controlled, cleaned up, and reopened to traffic for the evening rush hour was a great accomplishment and a credit to all involved."

In an e-mail, Perry lauded those involved, "Your skills and ability to handle the situation safely and efficiently were praised by the local police, fire departments, the Middlesex County Hazmat unit, the Mercer County Emergency Operations Center, and especially the New Jersey Department of Transportation." ●

PPPL Develops Internet-Based Simulation Capabilities

By Anthony R. DeMeo

Two years ago Raffi Nazikian, Deputy Head of PPPL's Off-site Research Department, worried about traffic jams. He wasn't concerned about the kind of bottlenecks that develop along Route 1, but about roadblocks to the accessibility of plasma simulation tools by fusion researchers. He observed that the users of these computer codes were nearly always the software's developers themselves.

"If the developers of Microsoft Word were the only folks who knew how to use it, there might be no more than 100 people in the world running Word. You would have to be a software engineer," said Nazikian. He expressed his concern to Doug McCune of PPPL's Computational Plasma Physics Group (CPPG). This interaction, and subsequent efforts of the CPPG and Ernie Valeo of PPPL's Theory Department, led to an unprecedented improvement in accessibility and the use of plasma codes on the horizon.

Currently, if researchers want to use a plasma simulation code such as TRANSP, they seek the assistance of a computational specialist with the detailed knowledge required to access and run the program. But the code experts are often overloaded with demand, resulting in a huge backlog. "So we ration the applications of these tools, resulting in major bottlenecks in the interpretation and understanding of experimental data and the planning for future experiments," said Nazikian.

It's not surprising that Nazikian and his associates, who share the world's fusion facilities and software remotely, would be the first to realize this problem. "On a small scale, we are dealing with the very same issues that the broader fusion community will face on ITER. A large number of scientists around the world will work remotely on this one facility, conducting a relatively small number of experiments. To do this efficiently, they're going to have to design experiments in excruciating detail before they run them. Consequently, ITER researchers will have to simulate these experiments thoroughly beforehand, so they're going to need easy access and use of simulation codes," Nazikian explained.

Now, innovative work by McCune and fellow computational scientist Eliot Feibush may solve this problem well in advance of ITER by providing plasma physicists with web-based access to powerful computer codes. "Plasma physics has a lot of immensely complicated codes that are labor intensive to move around to different labs. There is considerable engineering cost to get these humongous programs to run correctly on different, incompatible computers. It would be great if folks who are not at PPPL could use our simulation programs via the web, and if we could access their software, without us all having to download and install the large codes on our individual computers," noted McCune. Physicists who are not code developers would interact with shorter, simpler web-based interfaces that communicate with computer servers at various laboratories.

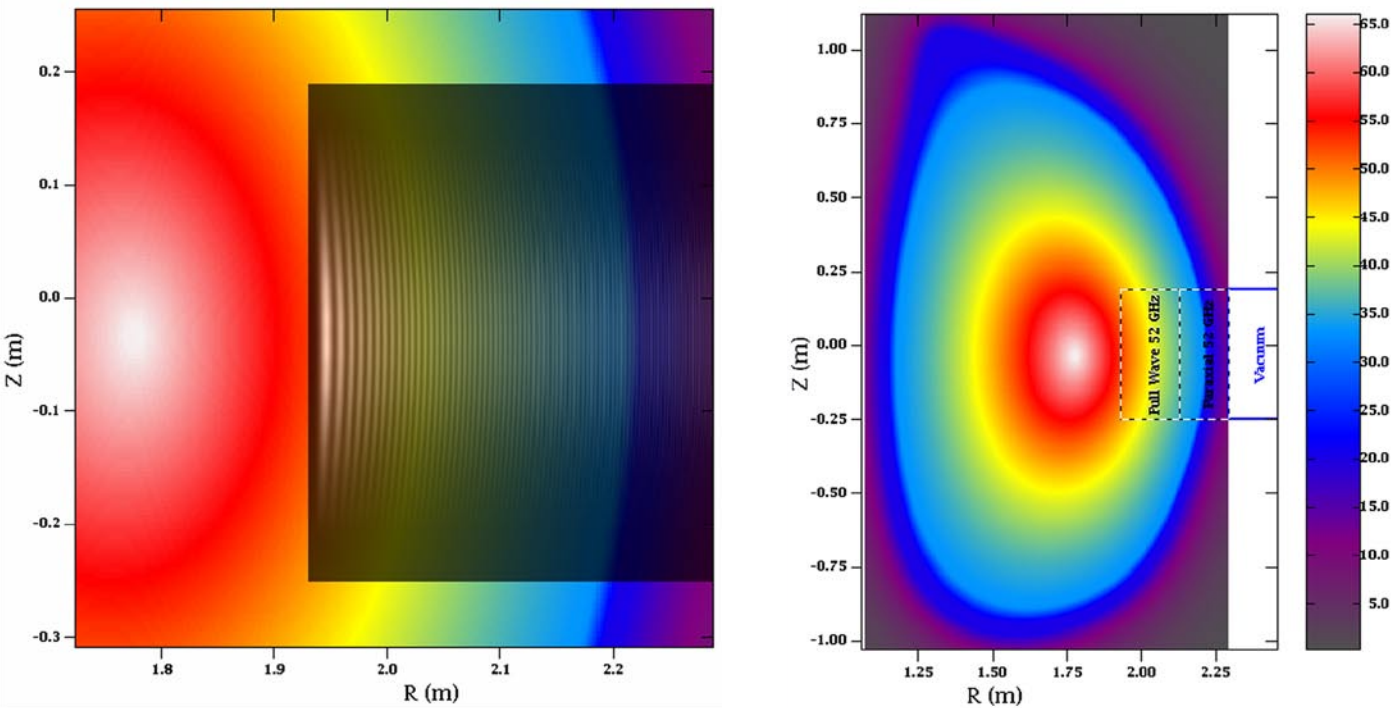
To this end Eliot Feibush is working on a web-based graphical user interface for the simulation of reflectometer measurements in plasmas. These simulations run codes developed by PPPL's Gerrit Kramer and Ernie Valeo. PPPL researchers and their collaborators worldwide build and install reflectometers as diagnostic tools that measure plasma turbulence. The reflectometer sends a radio-frequency wave field into the plasma, which is reflected at a specific location. The interference pattern that comes back to the reflectometer is indicative of the turbulence at that location.

Graphical Interface

Feibush's graphical interface allows users to access and input real experimental data, including various plasma parameters such as electron density and temperature and magnetic field strength into their simulations, yielding realistic results. Physicists will be able to test specific reflectometer designs before the devices are built, saving time and money. Web access will enable effective collaboration in reflectometry by permitting colleagues at other labs to use the advanced simulation capability developed and hosted at PPPL. Users always will have the latest version of the software at their disposal, with no worries about compatibility.

The graphical user interface program under development at PPPL is Java-based. Programs written in this language can run on either PCs or Macs, eliminating the need for distinct versions of software for each platform, such as required for Fortran, C++, and other compiled languages. Furthermore, Java has built-in graphical and user interface components, such as buttons and sliders. It was designed for the Internet and currently is used extensively for selling merchandise on the web.

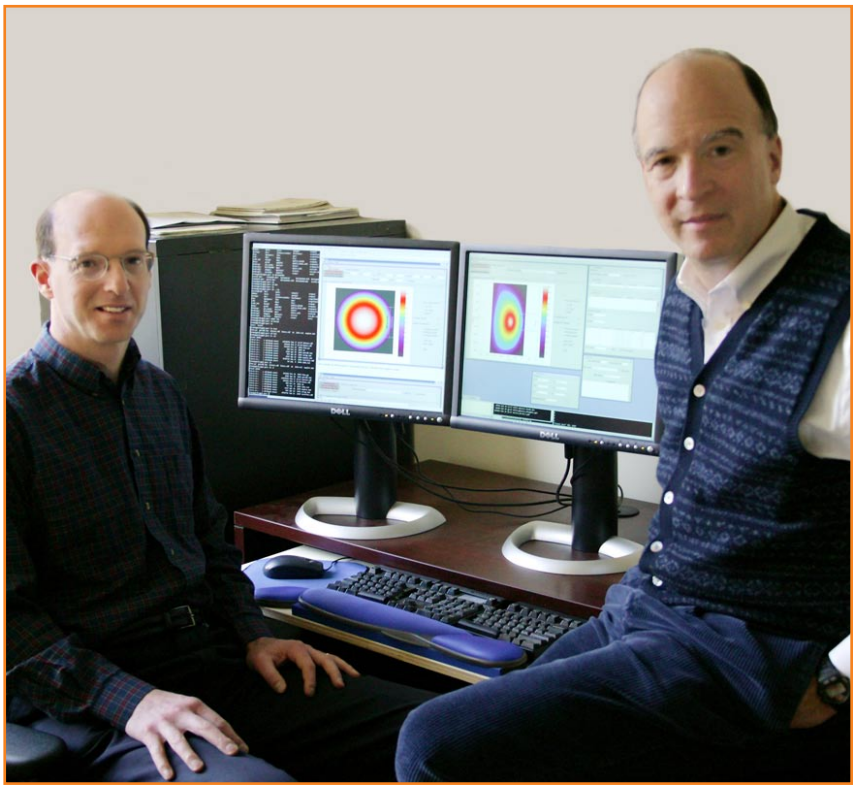
But scientific applications are much more complicated than accessing an on-line catalog to buy a pair of shoes or clothing. Feibush said, "After setting up the input parameters and starting a run, the interface software monitors a simulation that performs much more computation than typical commerce programs. Visualizations of the results enable the physicists to evaluate the effectiveness



Above is a graphic depicting a cross-section of a DIII-D plasma at General Atomics in San Diego. This graphic was created using a reflectometer code developed by Ernie Valeo and uses actual experimental data processed by the TRANSP code. The colors indicate the distance radio-frequency waves of various frequencies will penetrate into the plasma before they are reflected. The color code (right) indicates that higher frequency waves will penetrate further into the plasma. The graphic at left shows the simulated reflection of a 52-GHz wave within the DIII-D plasma.

of simulated reflectometers. The challenge is to develop quality scientific graphics applications in Java that work over the web with existing physics codes."

As a result of Feibush's work, PPPL will soon unveil to the fusion community a robust web-browser-based user interface for the reflectometer code that comes packaged with sophisticated graphics capability. The interface will allow physicists to run simulations of complex, sophisticated experiments effectively without having to learn about the underlying code's file structures, subroutines, directories, platforms, and naming conventions. "We are now trying to come up with a standard for duplicating this interface tool for any plasma simulation code. We have an idea of how this is going to translate generically to make other codes available to the broad user community. I think this is the beginning of a major sea change in our way of thinking about computational tools in the fusion community and how we use them," said Nazikian. ●



PPPL scientists Eliot Feibush (left) and Doug McCune.

What's Happening at PPPL?

Photo by Alexandra Budny

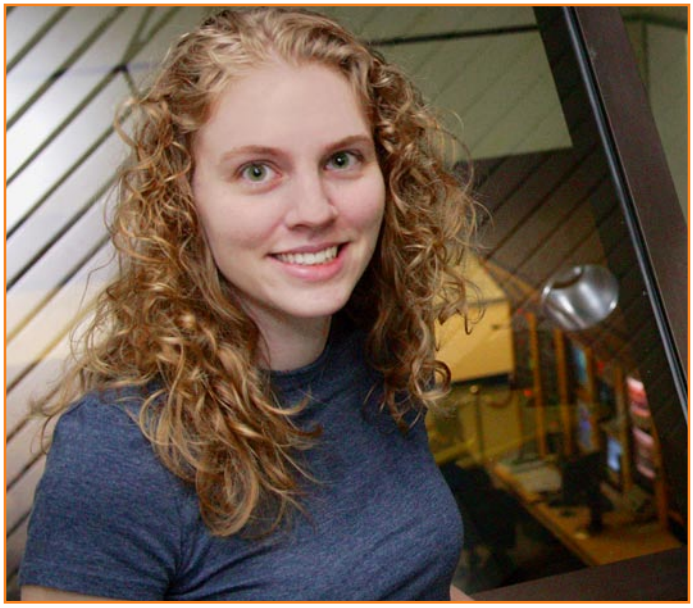
On April 29, PPPL participated in Communiversity, a town-gown community arts festival in downtown Princeton that drew several thousand people. PPPL physicist Robert Budny discusses fusion at the PPPL exhibit.

Rutgers University Genetics Professor Jody Hey delivers a talk, "The Evolution of Species: Insights from Fish, Chimpanzees and Humans," at PPPL as part of the Lab's 2006 Science-on-Saturday lecture series this winter.

DOE Office of Science Director Ray Orbach (at right) discussed the American Competitiveness Initiative and the Advanced Energy Initiative, in which fusion plays a role, during an "all hands" meeting in PPPL's Auditorium on April 25. Orbach and DOE Secretary Samuel Bodman were principal architects of the American Competitiveness Initiative. The initiative lays out a plan for the doubling of funding to the DOE Office of Science over the next decade, starting with a substantial increase next year. This plan makes it possible for the U.S. to participate in the construction of ITER and also to have a robust program of domestic fusion research. Prior to addressing PPPL staff and collaborators at the meeting, Orbach toured the National Compact Stellarator Experiment Coil Winding Facility. ●

PPPL hosted the New Jersey Regional Competition of the National Middle School Science Bowl® on April 1. Seven teams participated in the Jeopardy!-like tournament, which included two portions — a model hydrogen fuel-cell car competition and a fast-paced academic question-and-answer contest covering earth, physical, life, and general sciences, and math. Joyce Kilmer Elementary School won first place in the event sponsored by the U.S. Department of Energy. Above, a middle school student participates in the model hydrogen fuel-cell car competition. PPPL also hosted a regional competition in February for high school students from New Jersey and eastern Pennsylvania.

Grad Students at PPPL Receive Accolades



PPPL graduate student Steffi Diem received the Thomas H. Stix '54 Plasma Physics Prize last spring as a second-year graduate student in Princeton University's Program in Plasma Physics. She is the third recipient; Prateek Sharma won in 2003 and Wei Liu won in 2004. Diem used the $2,000 prize for travel expenses to visit the Culham Science Centre in the U.K. outside Oxford.

Presently, Diem is working on the National Spherical Torus Experiment at PPPL with physicists Gary Taylor and Cynthia Phillips. She came to Princeton University to pursue graduate studies in plasma physics after receiving a bachelor's degree in nuclear engineering from the University of Wisconsin in Madison in 2004.

Stix, who died in 2001, was the founder and longtime director of graduate studies for the University's Program in Plasma Physics and a leader in the development of plasma physics. In 2002, a fund was created in his memory to establish a prize for first and second-year graduate students studying plasma-related topics. The prize would enable international travel for conferences or research. ●

Princeton University graduate student Prateek Sharma is the recipient of the 2006 Ray Grimm Memorial Prize in Computational Physics. The award recognizes Sharma for his "outstanding research achievements, academic merit, and creativity."

He was awarded the Grimm graduate fellowship "in recognition of his novel numerical methods for simulating the dynamics of low-density astrophysical plasmas, and on the basis of strong letters of recommendation." He works on numerical simulations of collisionless accretion flows around black holes.

The prize honors an advanced student in computational physics and includes an award of $5,000. It was established in 1985 in memory of Ray Grimm, a talented and popular scientist and teacher.

Sharma is receiving a Ph.D. in astrophysical sciences, program in plasma physics, this summer. Upon graduation, Sharma is joining the Astronomy Department at the University of California, Berkeley, as a postdoctoral research fellow. ●

DOE Pulse

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Works of Artsy PPPL'ers Exhibited at University

At the reception for the opening of this year's Art of Science exhibition at Princeton University are, from left, PPPL's Andrew Post-Zwicker, Michael Burin, and Elle Starkman, whose works are included.

The work of four PPPL artists and a "sculpture" from the Lab made it into Princeton University's second annual "Art of Science" exhibition at the Friend Center.

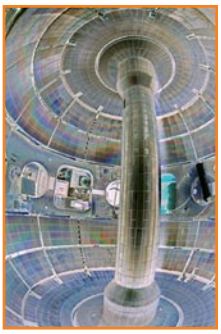
The juried show, highlighted by three winning student entries, features prints, videos, poetry, paintings, and sculptures — 55 works in all — produced in the course of scientific or technical research by faculty, staff and students in more than a dozen different departments. Works by PPPL's Michael Burin, Charles Skinner, Elle Starkman, and Andrew Post-Zwicker are included. Last year, Starkman and Post-Zwicker took first place for their joint entry, "Plasma Table."

"It was a pleasant surprise to win last year, especially since it was the first competition. I didn't expect to win again this year, but I was happy that two of my collaborative entries were selected for the exhibition," said Starkman, PPPL's photographer.

The exhibited works were selected from more than 150 submissions. One of the most unusual pieces in the exhibit — a solicited work that was not entered into the competition — is a 3-ton "sculpture" that was found in a scrap heap at PPPL. The sculpture is a prototype of a winding form for an electromagnetic coil for the National Compact Stellarator Experiment (NCSX), an experimental fusion device being built at the Lab. Exhibition organizers noted that the shape of the winding form is a kind of mirror image to a sculpture by the famous artist Henry Moore near West College on the Princeton campus.

"When I saw it at the scrap yard over at PPPL it seemed to serendipitously reflect upon the University's Henry Moore sculpture, 'Oval with Points,' so I thought it would be perfect for the Art of Science show," said Andrew Moore, a photographer and filmmaker who is a lecturer in the Program in Visual Arts and one of the exhibition's organizers. "It fits with the whole theme of the exhibit — that science has this incredible aesthetic component to it."

The pieces by PPPL staff in the show are: above left, Fjord Wake by Michael J. Burin; at right, Jumpstart by Elle Starkman and Andrew Post-Zwicker; below left, Interior Vacuum Vessel, NSTX, by Elle Starkman and Charles Skinner.



Moore spotted it outside the TFTR Building while touring PPPL with Post-Zwicker. Post-Zwicker was instrumental in getting the piece to main campus, where it is at an entrance to the Friend Center. "It was a beautiful thing to see on campus.The sculpture shows the wonderful aesthetics of one of our technological achievements," said Post-Zwicker.

The exhibition opened May 10 and is expected to be on display from 9 a.m. to 6 p.m. weekdays for a year. A virtual gallery, which includes captions describing the work of the researchers who created the images, is available online at http://www.princeton.edu/artofscience/. ●

Andrew Post-Zwicker poses next to the PPPL sculpture outside the Friend Center.