DOE Princeton Plasma Physics Laboratory

VOL. 7, NO. 2 • SPRING 2003

PPPL NEWS

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

Energy Secretary Abraham Visits

Secretary Announces U.S. to Join ITER Negotiations

At left, PPPL Director Rob Goldston shows the National Spherical Torus Experiment to (from left) U.S. Congressman Rush Holt, Energy Secretary Spencer Abraham, U.S. Congressman Rodney Frelinghuysen, DOE Office of Science Director Raymond Orbach, and Princeton University President Shirley Tilghman. At right, Secretary Abraham addresses PPPL staff in the Gottlieb Auditorium.

Energy Secretary Spencer Abraham came to PPPL on January 30 with exciting news for the entire fusion community: the U.S. is joining the negotiations for the ITER project. ITER is a major international magnetic fusion research project with a mission to demonstrate the scientific and technological feasibility of nuclear fusion as a source of energy.

"Now is the time to expand our scope and embrace international efforts to realize the promise of fusion energy. Now it is time to take the next step on the way to having fusion deliver electricity to the grid. Therefore, I am pleased to announce that President Bush has decided the United States will join the international negotiations on ITER," said Secretary Abraham.

PPPL staff, filling the MBG Auditorium to capacity, greeted the news with enthusiasm, giving the Secretary a round of applause. Also in the audience were Department of Energy and Princeton University officials, dignitaries

Continued on page 2

Interview with U.S. ITER Planning Officer and PPPL physicist Ned Sauthoff — Page 4

Abraham

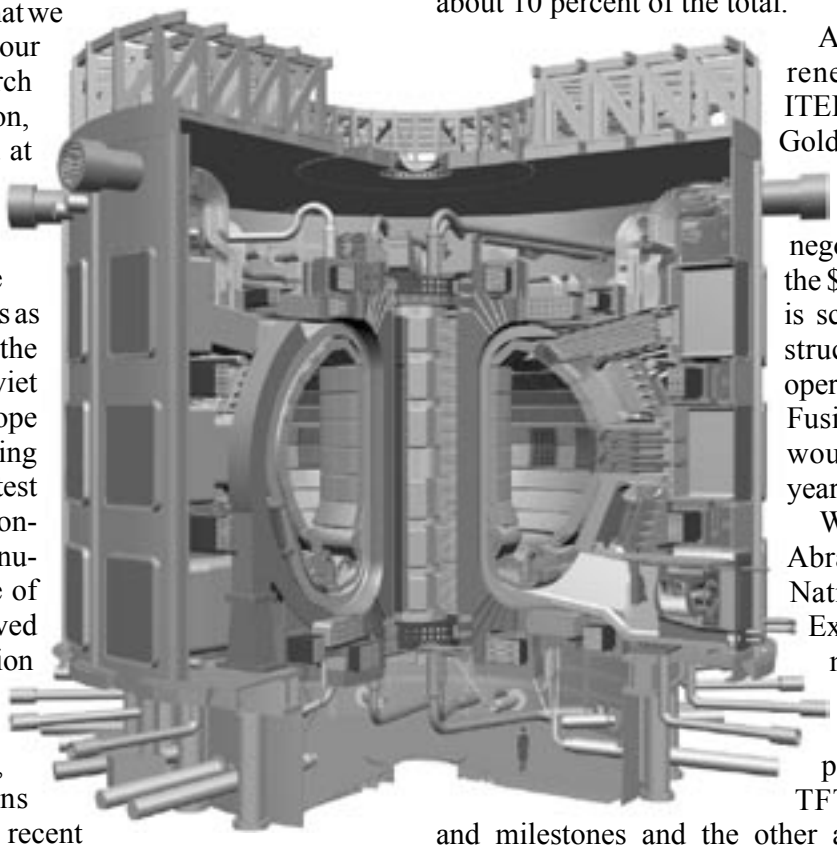
Continued from page 1

from Japan, Germany, Spain, France, Russia, the United Kingdom, Italy, Canada, the European Union, and China, as well as U.S. Congressmen Rodney Frelinghuysen and Rush Holt.

The Secretary stressed that the decision to join ITER does not mean a lesser role for the domestic fusion program. "It is imperative that we maintain and enhance our strong domestic research program — at Princeton, at the Universities, and at our other labs."

The Way

ITER (Latin for "the way") began in the 1980s as a collaboration among the United States, the Soviet Union, Japan, and Europe with the goal of designing and building a fusion test reactor that would demonstrate the feasibility of nuclear fusion as a source of energy. The U.S. removed itself from the collaboration in 1998. A National Research Council panel concluded in 2002, however, that revisions in the ITER plan and recent advances in fusion science warranted rejoining the effort, which presently involves Canada, Europe, Japan, and the Russian Federation. China has recently joined the negotiations as well. Canada, the European Union, and Japan have offered sites for the projects. The selection will be part of the negotiation and governmental decision making progress.



The U.S. proposes to provide a number of hardware components for ITER construction, to be involved in the project construction management, and to participate in the ITER scientific research and technology development. The nature and details of the U.S. participation and contributions would be determined during the negotiations. The U.S. share of the construction cost is expected to be about 10 percent of the total.

As the first step in our renewed commitment to ITER, PPPL Director Rob Goldston and DOE officials went to Russia in February to participate in negotiations over plans for the $5 billion project, which is scheduled to begin construction in 2006 and be operational by about 2014. Fusion research on ITER would last for up to 20 years.

While at PPPL, Secretary Abraham also toured the National Spherical Torus Experiment and the former Tokamak Fusion Test Reactor (TFTR), where he unveiled two plaques — one noting TFTR accomplishments and milestones and the other an award for the safe decontamination and decommissioning (D&D) of the machine. He also talked to PPPL project heads in the Lobby before addressing staff in the Auditorium, where he lauded PPPL's accomplishments and ability to join the

Continued on page 3

Image of ITER above published with kind permission of ITER.

PPPL NEWS

Information Services Head:	**Anthony R. DeMeo**	**Photographer:**	**Elle Starkman**
Editor/Writer:	**Patti Wieser**	**Layout and Graphics:**	**Gregory J. Czechowicz and Patti Wieser**

The PPPL NEWS is issued by the Princeton Plasma Physics Laboratory, a research facility supported by the United States Department of Energy and managed by Princeton University. Correspondence and requests to reprint material should be directed to: Information Services, Princeton Plasma Physics Laboratory, P.O. Box 451, Princeton, NJ 08543; telephone 609-243-2750; fax 609-243-2751; e-mail pppl_info@pppl.gov .

PPPL Student Named Congressional Science Fellow

Adam Rosenberg, a research assistant at PPPL, has been awarded the American Physical Society (APS) Congressional Science Fellowship.

Rosenberg begins the one-year fellowship this September in Washington, D.C. He plans on receiving a Ph.D. from Princeton University's Department of Astrophysical Sciences, Program in Plasma Physics, this summer.

PPPL physicist David Gates, who supervised Rosenberg's second-year theory project, said, "In the course of his work, Adam interacted with many scientists from institutions across the U.S., including the University of Wisconsin and Los Alamos National Laboratory, as well as with those at PPPL. He held his own and is now well established as a serious contributor to an important subfield of fusion plasma physics." Gates went on to describe Rosenberg as a good communicator who is an excellent choice for the APS award.

Rosenberg said his interest in science policy — which is driven by a strong desire to make a positive contribution to society — compelled him to apply for the Congressional fellowship. "I am particularly concerned with the expanding energy needs of the world, as it is clear to me that fossil fuels are in limited supply, detrimental to the environment, and a major source of geopolitical unrest," said Rosenberg. He sought a doctorate in plasma physics studying nuclear fusion because he believes fusion is an attractive alternative that addresses each of these concerns.

As a Congressional Fellow, he also looks forward to investigating and guiding policy in various other types of power generation, as well as in other areas of science, in the hope of encouraging options that lead to a cleaner, safer world. "I'd like to improve our nation's energy independence and security through a variety of means. I really hope I can have a positive impact on science policy," said Rosenberg.

Rosenberg received a bachelor's degree in applied and engineering physics in 1998 from Cornell University. Prior to coming to PPPL as a research assistant and Princeton University as a doctoral candidate in 1998, he was an intern at Lawrence Livermore National Laboratory in California and at Argonne National Laboratory in Illinois. He is a coauthor of eight papers and a 1998 recipient of Princeton University's Merit Prize. Rosenberg was a member of the Princeton delegation for Washington Fusion Day and of the New Jersey delegation for the APS Convocation Lobbying Day, both in 2003, and a participant in the Princeton University Scholars in Schools Program in 2002-2003.

Adam Rosenberg

Rosenberg is a resident of Princeton. He grew up in Saratoga Springs, New York.

The APS Congressional Science Fellowships were established to provide a public service by making available individuals with scientific knowledge and skills to Members of Congress, few of whom have a technical background. In turn, the program enables scientists to broaden their experience through direct involvement with the legislative and political processes. Following interviews on the Hill, Fellows choose a congressional office — personal or committee staff — where they wish to serve. ●

Abraham

Continued from page 2

best basic science with the best management. "It [PPPL] is a model for all our DOE labs. Let me congratulate all of you on a job well done," he told staff.

In a follow-up note to staff, Director Goldston praised the announcement and the support for the domestic fusion program. "I was very pleased that in addition to announcing that the U.S. will join the ITER negotiations, the Secretary also called for a strong domestic research program in parallel with ITER," he said. "The combination of joining our allies on ITER and enhancing research at home is what I believe is required for the U.S. to have a leadership role in the eventual commercialization of practical fusion energy." ●

ITER Negotiations Are Underway

On January 30, Secretary of Energy Spencer Abraham announced that the U.S. was joining the negotiations for the construction and operation of ITER, a major international magnetic fusion research project with a mission to demonstrate the scientific and technological feasibility of nuclear fusion as a source of energy. In early March, Dr. N. Anne Davies, Department of Energy Associate Director of Science for Fusion Energy Sciences, named PPPL's Ned Sauthoff as U.S. ITER Planning Officer. ***PPPL News*** *spoke with Ned to learn about the opportunities for U.S. researchers, challenges facing the U.S. ITER Team, and the progress expected during the next few years as the international project makes the transition from negotiations to construction.*

Edited by Anthony DeMeo

What, in your opinion, is the U.S. seeking to gain from its participation in the ITER project?

The main reason for U.S. participation in ITER is to conduct research on burning plasmas, according to the Fusion Energy Sciences Advisory Committee (FESAC) Burning Plasma Strategy Report issued last September. As described in that report, our first priority in joining ITER is to assure that U.S. researchers will have an opportunity to conduct leading research in the science and technology of burning plasmas.

Ned Sauthoff

A second but important priority is to advance enabling technologies in areas that directly support the first objective, such as the development of ITER diagnostics and plasma control systems. These plasma control areas include ion cyclotron heating, electron cyclotron heating and current drive, lower hybrid current drive, and fueling.

The next FESAC priority is in areas of fusion technology in which the U.S. has a strong interest and capability. At the moment we are pursuing magnet, as well as divertor design and construction. U.S. researchers see magnets and diverters as key fusion technologies in which the U.S. played a leading role during the ITER Engineering Design Activities. Consequently, the U.S. is well positioned to perform cost estimates and planning in those specific areas, thereby enabling possible U.S. offers of contributions in these areas.

How will the U.S. program be organized, i.e., what do you see as the roles for the various U.S. fusion labs? When will these roles be decided upon?

The organization of the U.S. ITER team will be multi-institutional and will be structured in a way that invites participation by the full U.S. fusion community. The team likely will have teams for specific technical areas in which the U.S. has strong roles. The U.S. team's project managers will serve as liaisons between the U.S. and the international ITER organization.

At this point, the specific roles and scope for U.S. participation are still under discussion. Dr. N. Anne Davies, DOE's Associate Director of Science for Fusion Energy Sciences, has asked us to set up a tentative organization to work in support of negotiations. The organization will evolve to address activities as they arise during various stages of the project.

Do you have a sense for the number of U.S. fusion physicists and engineers who will be involved in the ITER project?

The simple answer is that I hope they all will be involved. Fusion physicists and engineers should see ITER as an opportunity to pursue the study of burning plasmas and to advance fusion technology. We are attempting to assure that the U.S. fusion community can pursue its interests on ITER.

As a first step in this process, we are working with the University Fusion Association to hold the first U.S.-ITER Forum in Maryland May 8-9. The agenda has not been finalized, but we have invited the U.S. fusion community to state its interests in the areas of ITER physics and technology. This information will be used to formulate desired U.S. roles and to present possible U.S. implementations of those roles in the form of U.S. offers of ITER components.

We will also use this information, and the FESAC Burning Plasma Strategy Report, to assure that the ITER agreement gives the U.S. rights to participate in ITER research. It is important that the ITER agreement assures the U.S. access to the data and the device, the right to propose experiments,

and a seat at the table in planning the evolution of the ITER facility and its research program.

As the newly named U.S. ITER Planning Officer, what is your first charge in moving the U.S. forward in participating in ITER negotiations?

Our first charge is to assist our negotiators in preparations for upcoming meetings that will involve planning for ITER management structure and processes, procurement allocations and systems, and the planning for project staffing. Also in the near term, we must determine what "in-kind" contributions the U.S. might offer initially during negotiations. "In-kind" contributions mean that the U.S. provides specific subsystems rather than cash. This will involve balancing the cost of contributing this hardware with programmatic benefits and the resulting value credited to the U.S. for the contribution. So we have assembled a multi-institutional team of experts in the areas of diagnostics, heating and current drive systems, magnets, and divertors. They will develop cost estimates for the R&D, design and fabrication of various subsystem contributions to ITER by U.S. industry, laboratories, and universities. This information will then be used by U.S. negotiators to identify specific U.S. offers to the ITER project.

How will the ITER participants arrive at a consensus on the value of a particular subsystem to the ITER Project?

For the past several years, the European, Japanese, and Russian parties conducted industrial cost estimation exercises for 85 procurement packages, which constitute the main ITER facility. Their national cost estimates were then submitted to the international ITER team, which evaluated them and came up with a consistent cost estimate that is being used as a basis for negotiations; their evaluated costs estimates are the basis for determining the relative value of various systems, which is in some ways related to the amount of "credit" a party would earn by providing that system. The percentage values of the subsystems of the machine add up to 100 percent and are, in fact, the currency for the negotiation over in-kind contributions.

For instance, the party that provides a magnet would get a certain amount of credit or value. A party who provides components of a divertor would get credit for those specific values. Each party is expected to sign up to provide a particular value to the ITER Project. Parties don't sign up for a certain amount of money; they sign up for a certain value. It must be done this way because costs to individual parties depend strongly on the labor rates and other conditions in the various countries.

For example, if labor rates in the U.S. were twice that of Russia, the U.S. might have to pay significantly more to provide a specific ITER magnet based on U.S. manufacturing costs than would the Russians. But shouldn't the Russians get the same amount of credit for providing the magnet as the U.S., even though it might cost the Russians less in equivalent currency? Hence, the negotiation is done on the basis of the relative values of the components, not on the basis of the costs to an individual party.

We are in the process of trying to determine what it would cost for the U.S. to provide specific components, giving us an indication of how many dollars it would cost to provide a certain amount of value. If the U.S. were to offer 10 percent of ITER's value, we would then know roughly how many dollars that would likely cost.

When will the various parties determine their contributions?

The ITER parties are currently submitting initial lists of components they are interested in providing; these will evolve considerably. At this point, many parties are interested in high-tech areas such as diagnostics, heating and current drive systems, and magnets and divertor components. Very few parties are interested in providing relatively mundane items. Everyone wants to put money into high-tech items, which match their party's interests. Right now there are still holes in coverage of the machine and supporting facilities. All the components have not been covered. This is why the parties must negotiate. We must build on the shared interest in getting the machine built to motivate complete coverage of the facility's systems.

When will negotiations begin?

Negotiations are ongoing, and U.S. participation has begun. For example, earlier this year, U.S. DOE and State Department officials, as well as PPPL Director Rob Goldston, participated in a negotiations meeting in Russia. A political-preparation meeting is scheduled for April in Japan and the negotiations preparation meeting is scheduled for May in Germany. The progression to a political level is a sign that the parties are ready to negotiate over the really important issues. At the upcoming political-level meeting, the terms and conditions for cost sharing and the selection process for the ITER site will be discussed by people who are empowered to make offers on behalf of their governments. Hopefully, this meeting will be the beginning of a process resulting in announcements by the Heads of State at the U.N. General Assembly meeting in September.

In what year do you envision the need for substantial budget increases in the U.S. fusion program as the ITER Project moves on toward final design and construction?

The FESAC Burning Plasma Strategy Report stated that U.S. participation in ITER was contingent on an increase

Continued on page 6

Continued from page 5

in the U.S. fusion program budget. The U.S. ITER activity will have to be paced by the availability of money and also by the progress within the ITER schedule. In 2003, we have a very limited budget to support negotiations, mostly in the form of U.S. cost estimates for possible offers. In 2004 and 2005, prior to the start of construction, we will be strongly participating in negotiations and preparations for construction, but our ability to participate in long lead-time procurements will depend on the level of funding.

After the start of construction, roughly in 2006, U.S. participation in ITER activities would demand a significant increase in the fusion budget and the magnitudes of these increases are indicated in the development path report recently approved by FESAC after being prepared by a committee chaired by PPPL Director Rob Goldston.

When will the site for ITER be selected?

At this point, the Russian, Japanese, European, and Canadian parties have participated in a joint assessment of four sites, which are in Canada, France, Japan, and Spain. The joint assessment of sites is on the web at www.iter.org/jass. This report has a six-page overview and roughly 50 pages on each of the four sites, comparing the capabilities of the sites regarding electric power access, cooling water access, seismic activity, accessibility by water for shipping of large components, and the like. The judgment is that all four sites can meet the ITER requirements, but that there are differences.

The site selection will be part of the overall negotiation on the values that the various parties will provide, as I described earlier. The host country will be expected to provide additional value, since it will have the ITER facility on its land and the ITER activities contributing to the local economy and high-tech infrastructure of its country. The host will also have to provide infrastructure and make compensations as determined by their site characteristics. For example, a seismically active site will demand that the entire test cell be placed on "super-springs" to isolate the ITER machine from the ground motions. Similarly, another site might not be as accessible for shipment of very large components because it does not have a port nearby. So the host party has to make up for these things, and this will cost the host money. The site selection will involve not only the site characteristics, but also the total packages that are offered by the four sites, as well as political considerations that may have to be worked out. There's a real possibility that political process will result in a site selection and agreement on cost sharing by September.

What if things can't be worked out in a reasonable time frame?

The FESAC strategy calls for an assessment in July 2004 of the probability that ITER will proceed in a timely fashion on terms and conditions agreeable to the U.S. At that time the U.S. will make a decision whether to continue with ITER or to engage in the domestic program, the Fusion Ignition Research Experiment (FIRE), a smaller burning plasma advanced tokamak whose planning is led by PPPL's Dale Meade.

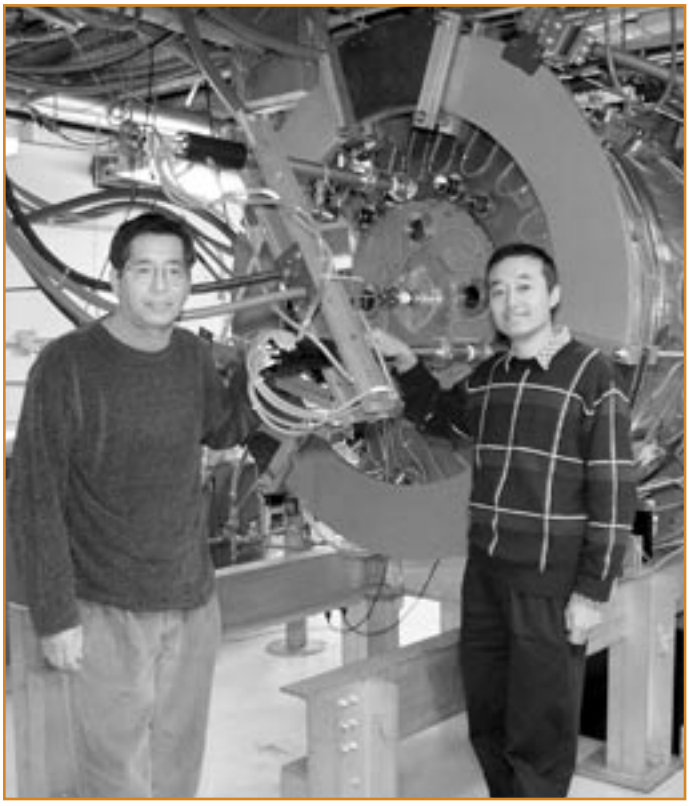
Assuming ITER proceeds as planned, what are some of the formidable scheduling challenges to be faced?

In the current plan, the license to construct the ITER facility will be obtained at the beginning of 2006. Looking at the construction schedule, there are two systems that are on the critical path. One is the set of superconducting magnets and the other is the collection of buildings; close behind are some parts of the vacuum vessel. Since the U.S. is not proposing to be the ITER host, we need not be concerned about the buildings. However, we would be expected to participate in the procurement of the superconducting magnets, which is the longest lead item of the ITER components. Consequently, we must conduct prototype studies with U.S. manufacturers so that, when the license is granted, U.S. vendors with the ability to produce the needed superconducting material for the magnets will have been identified and will be able to start production of superconducting materials and cables quickly. This will require the U.S. to fund industry in the superconducting strand area prior to facility construction. Such investments prior to the granting of a construction license are a risk, and the parties will have to make a judgment about their levels of investment prior to achievement of that milestone in the interest of schedule. The actual pace that the U.S. takes in this area is a matter of strategy and risks. Should we make a significant investment prior to the granting of a construction license in the interest of accelerating the schedule? Or should we be cautious and not make such investments until a licensed site is assured? All the ITER parties will be making such judgment calls.

What is the best way to keep up with the status of the ITER Project?

PPPL's Dori Barnes is working with me to assemble a web site, www.iter-us.org. We intend to post ITER information that would be useful to the entire fusion community, not just individuals directly involved in ITER. The site should also be of interest to members of the public who follow the development of fusion. We expect a rudimentary web site to be up before the end of April. In the meantime, interested persons can get information on ITER at the international ITER web site (www.iter.org) and on the burning plasma program at the FIRE web site (fire.pppl.gov). ●

✷Awards✷Awards✷Awards✷Awards✷Awards✷



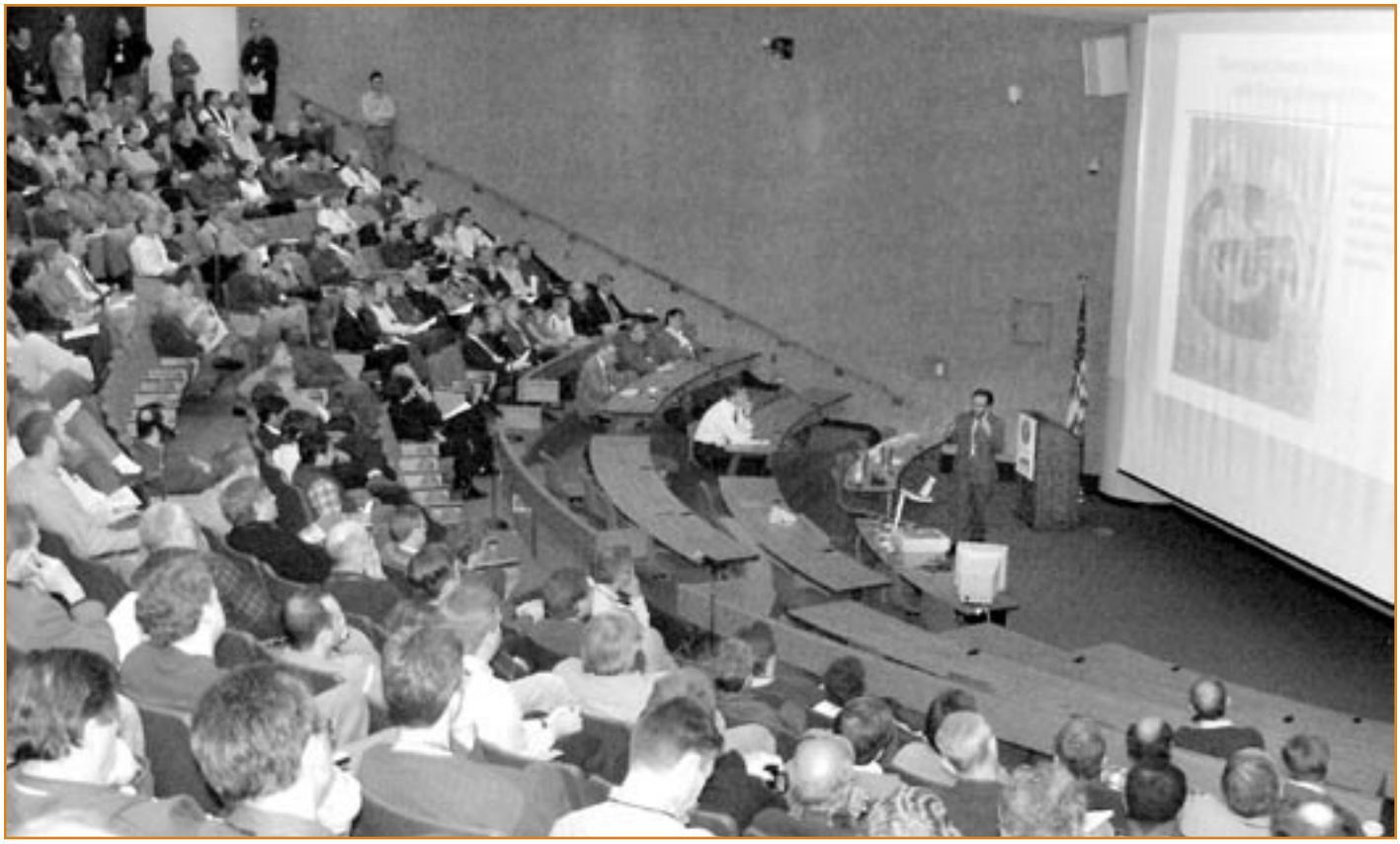
PPPL scientists Masaaki Yamada and Hantao Ji recently received the American Physical Society's (APS) 2002 Award for Excellence in Plasma Physics Research. The award recognizes a recent outstanding achievement in plasma physics research. Yamada and Ji, along with former PPPL graduate students Troy Carter and Scott Hsu, were cited "for the experimental investigation of driven magnetic reconnection in a laboratory plasma." Yamada (left) and Ji are in front of the Magnetic Reconnection Experiment at PPPL.

PPPL's Stan Kaye was named a Fellow of the American Physical Society (APS) during the APS-Division of Plasma Physics meeting in November. Kaye, a principal research physicist at the Lab, was cited for his pioneering investigation of the characteristics of strongly heated plasmas confined by magnetic fields.

PPPL engineer Bob Simmons has received the first Engineering and Technology Management Leadership Award of the American Society of Mechanical Engineers in recognition of his "extraordinary leadership in raising the value and significance of engineering and technology management."

Princeton University physics professor and University Research Board Chair Will Happer and PPPL Director Rob Goldston presented the PPPL Distinguished Research and Engineering Fellow Awards and the Kaul Foundation Prize for Excellence in Plasma Physics and Technology Development following Goldston's State-of-the-Lab talk to staff in December. From left are Happer, Engineering Fellow recipient Robert Parsells, Goldston, Kaul Prize recipients Erik Perry and Ronald Strykowsky, and Distinguished Fellow recipient John Krommes.

Goldston Gives State-of-the-Lab Talk



In December, PPPL Director Rob Goldston delivered the annual State-of-the-Lab talk to staff in PPPL's Auditorium. He discussed PPPL's scientific programs, internal operations, and the future, and thanked the Lab's line of "great supporters" in Congress, the Department of Energy, and the White House. The Director said the Lab is producing wonderful scientific results and concluded by thanking everyone at PPPL for their tremendous support. "We have a great team ...The good ship fusion sails forward," said Goldston.

Science on Saturday Celebrates Nineteenth Year

For the nineteenth winter, PPPL hosted the annual Science-on-Saturday lectures. This year's series kicked off in January and concluded March 15. Given by scientists and other professionals who are leaders in their field, the free talks were geared toward high school students, but open to everyone. This year's series was co-organized by PPPL's Ronald Hatcher, Janardhan Manickam, and James Morgan. Above left are members of the audience and above right are Manickam (at left) and Professor Dmitri "Mitya" Chklovskii, of Cold Spring Harbor Laboratory, who spoke about "How Evolution Engineered a Brain."