

# HOTLINE

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

## PPPL to Phase Out NCSX,

### Upgrade National Spherical Torus Experiment

**P**PPPL will phase out construction of the National Compact Stellarator Experiment (NCSX) and instead ensure the Lab's future as a world-leading center of fusion energy and plasma sciences by enhancing its flagship program, the National Spherical Torus Experiment (NSTX). The new approach is being implemented at the direction of the U.S. Department of Energy (DOE).

The Laboratory began construction of the stellarator in April of 2003, with the goal of developing the physics for and determining the attractiveness of the compact stellarator as the basis for a fusion power reactor.

However, the complex and precise assembly process for the first-of-its-kind research facility resulted in an underestimation of its cost and a more prolonged construction process. An 18-month series of project reviews by the University, the Lab, and the DOE determined that the stellarator experiment could not be completed at its approved initial project cost of \$102 million or on schedule to be operational by July of 2009.

"We are gratified that NCSX consistently received positive reviews from DOE's Fusion Energy Sciences Advisory Committee for its scientific promise, but recognize that extreme challenges of this complex scientific instrument had not been fully appreciated when the initial cost was established," said A.J. Stewart Smith, the University's Dean for Research. "The decision to focus on NSTX will strengthen PPPL's position as a world leader in fusion science, and enables the Lab to work with the world community on the cutting edge of fusion research."

The Lab's currently operating spherical torus experiment is the most powerful device of its kind in the world. Since it began operation in 1999, NSTX has demonstrated the effectiveness of the spherical plasma geometry, coupled with innovative plasma heating and current-drive techniques. This may result in smaller, more powerful fusion reactors.

In a statement released May 22 by Under Secretary for Science and DOE Office of Science Director Raymond L. Orbach (see page 2), he confirmed that focusing efforts on the spherical torus experiment will help assure the continued vitality of "a proven, productive, world-leading scientific facility."

"The highest priority of the U.S. fusion program is participation in the international ITER burning plasma experiment, which is based on the tokamak concept," said Orbach. "The spherical torus is closely related to the tokamak, and experiments planned for the next several years in the NSTX facility promise many exciting discoveries that should directly have an impact on our ability to understand the new plasma regimes expected in ITER."

According to the DOE, the Lab will spend the remaining part of this fiscal year, ending Sept. 30, completing work on some special coils that make up parts of the stellarator design. Also, the research and development efforts of the project will be documented to allow revisiting this particular design if future developments in the fusion program warrant it.

This process will ultimately be managed by a new director of PPPL, as a University search is under way to replace Director Robert Goldston, who announced in December that he would step down to pursue policy and research initiatives after more than 10 years leading the Lab.

The University has managed PPPL since the beginning of the Lab in 1951, when plasma physics pioneer Lyman Spitzer initiated the study of fusion at Princeton.

"As part of our commitment to the future of PPPL's research program, we continue to be actively engaged in the broad range of strategic planning discussions taking place in the fusion community," Smith said. "The University is strengthening our involvement with the Laboratory as part of our commitment to the future of plasma research."

Orbach affirmed in his statement that the decision about the lab's new direction "reflects our strong commitment to the future of PPPL as a center of scientific excellence, including the prospect that it will compete successfully for opportunities to extend its work in plasma and fusion science in a number of important and promising new directions."

DOE Office of Fusion Energy Science Head Ray Fonck addressed PPPL staff May 23, answering questions and explaining DOE's decision to phase out NCSX and upgrade NSTX. Discussing the plan for PPPL, Fonck said, "This charts a bright future."

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## Stellarator

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PPPL Director Rob Goldston participated in the meeting by phone since he was traveling following ITER meetings in France. "This was a difficult decision for DOE, and I believe that it was made with the best interests of the Laboratory and the fusion program in mind. In consultation with the NCSX and NSTX leadership teams, we provided DOE with technical and budget information, and just as importantly, with detailed lists of arguments for the value of NCSX and NSTX to the fusion program and to the Laboratory. This was a difficult decision because both projects are extremely valuable," said Goldston. "Ray Fonck characterized the NCSX engineering effort as 'phenomenal' and of its scientific goals as 'compelling.' I concur. He is also correct that the Spherical Torus has a great deal more to contribute to the development of fusion, and with appropriate upgrades NSTX can continue to lead the world in the area. Indeed, as he noted, in an ideal world, we would be able to pursue both in parallel."

Toward the end of the staff meeting, Smith read a statement by PPPL Deputy Director Rich Hawryluk, who was also traveling from France.

"During the past eleven years, I had the pleasure to work with two highly dedicated groups of physicists and engineers on NSTX and NCSX. Both were motivated by seeking not only to understand fusion plasmas but to find ways to improve how we confine the plasma. The NCSX team took the technically more challenging route of building a three-dimensional system with all the engineering and scientific complexities that entailed. As a result of their creativity and dedication they solved one difficult technical problem after another and earned my admiration. Unfortunately, yesterday while in France attending an ITER meeting, I heard that DOE has decided to close the NCSX Project. I am saddened because we may not learn what benefits the compact stellarator has to offer, unless DOE were to reinstate NCSX in the future.

The NSTX team during this time set one world record for STs after another while exploring the physics of low aspect ratio tokamaks and made a series of major scientific advances. What we take for granted today in terms of confining high pressure plasmas in low magnetic fields on NSTX is truly remarkable compared with what we knew before NSTX came online and a credit to the team. DOE's decision today will enable them to continue their world-class research, which will provide in the future the scientific basis for high heat flux and nuclear component testing facilities. I am heartened that the proposed NSTX upgrades will enable this team to be preeminent for years to come and NSTX continues to provide the Laboratory with a major experimental facility to be proud of.

I know that this was a difficult decision for DOE and for many of us. DOE's decision was guided by enabling the Laboratory to continue to do world-class research. Now it is our responsibility to take advantage of this and ensure that PPPL continues to be a center for major new discoveries." ●

– Cass Cliatt, Tony DeMeo and Patti Wieser contributed to this article.

### Statement by Dr. Raymond L. Orbach Under Secretary for Science and Director, Office of Science U.S. Department of Energy – May 22, 2008

#### *FUTURE OF THE PRINCETON PLASMA PHYSICS LABORATORY (PPPL)*

*In late 2006, it became clear that National Compact Stellarator Experiment (NCSX) construction project would not be able to meet its approved baseline total project cost of \$102M or its completion date of July 2009. Since then, DOE, Princeton University, and PPPL have worked extensively together to understand the issues and plot a course of action that maximizes the benefits for the scientific community and the taxpayers, and ensures an exciting path for PPPL research well into the future. Following several internal and external reviews over the past 18 months, it has been concluded that the budget increases, schedule delays and continuing uncertainties of the NCSX construction project necessitate its closure, and that PPPL's future as a world-leading center of fusion energy and plasma sciences is more assured by a renewed focus on the successful Spherical Torus confinement concept.*

*The Office of Science always weighs the scientific benefits to be obtained from facilities against the cost to the taxpayer – in this case the escalating costs and remaining uncertainties make continuation of the construction project untenable. The latest cost estimate is \$170M with an August 2013 scheduled completion. An Office of Science review (April 2008) concluded that the project has not yet met the requirements needed to approve a new baseline cost and schedule. This puts the future of research at PPPL in unnecessary peril, and increases the burden on the DOE fusion energy sciences program. It would require the premature closure of the Spherical Torus experiment (NSTX), a proven, productive, world-leading scientific facility, while creating an uncertain gap in research capabilities at PPPL. This would result in a loss of opportunities for a large number of collaborators in the research community and constrain the ability to start new initiatives during the ITER era.*

*The highest priority of the U.S. fusion program is participation in the international ITER burning plasma experiment, which is based on the tokamak concept. The Spherical Torus is closely related to the tokamak, and experiments planned for the next several years in the NSTX facility promise many exciting discoveries that should directly impact our ability to understand the new plasma regimes expected in ITER. The Spherical Torus may also prove to be a prototype for the next step for the U.S. domestic fusion program. Proposed upgrades for the Spherical Torus experiment at PPPL can keep this facility at the forefront of fusion science research in the world well into the future. As such, a concentration on the Spherical Torus better positions PPPL to remain a center of excellence for fusion energy and plasma sciences, and thereby compete for new areas of leadership in the future fusion program.*

*Closure of the Compact Stellarator construction effort will be managed to capture many benefits of the project. PPPL will complete the special modular and toroidal field coils in FY 2008. A modest engineering effort will document the R&D achievements to date, and continue to retire remaining risks of the Compact Stellarator design to allow revisiting this particular design if future developments in the fusion program warrant it. In addition, the U.S. fusion program will increase its investments in theory and smaller focused experiments on stellarator concepts to maintain its interest in future development of these exciting plasma confinement concepts.*

*We believe this decision is in the best interests of the American fusion program PPPL and Princeton University. Our decision reflects our strong commitment to the future of PPPL as a center of scientific excellence, including the prospect that it will compete successfully for opportunities to extend its work in plasma and fusion science in a number of important and promising new directions.*

## PPPL Site Access Reminders

### All Visitors

The Site Access Notification Form is required for all visitors to PPPL. When hosting a visitor to PPPL for any reason (casual or business), please remember to submit the on-line Site Access Notification Form found on the PPPL Employee Services Home Page (<http://www-local.pppl.gov/SiteAccess.html>). This form should be submitted a day or two in advance of the visit.

### Foreign National Visitors

The Unclassified Foreign National Visit/Assignment (UFNV&A) Form is required for foreign national visitors to PPPL. The level of documentation and approvals required for a visit to PPPL can vary depending on a number of factors. Therefore, it is important to submit the UFNVA form as early as possible. The UFNVA form may be found on the Forms and Manuals Page of the PPPL Employee Services Home Page (<http://www-local.pppl.gov/forms.html>).

### ID Badges

All PPPL staff members are required to have PPPL identification badges. Badges must be displayed at all times while on site, unless wearing a badge would jeopardize the employee's safety during a work-related activity. Badges should never be loaned to anyone. Faded or damaged ID Badges must be replaced immediately.

When entering an area that requires the use of a card-reader, all personnel must use their own badge to enter, even when gates and doors are opened by others; "piggybacking" is prohibited.

The PPPL Badge Office is open Monday through Friday from 9 A.M. to noon and from 1 P.M. to 2:30 P.M. in Module VI. It can provide identification badges, access privileges, parking decals and office keys.

*For questions concerning these reminders, please contact Dolores Stevenson at Ext. 3208 ([dstevens@pppl.gov](mailto:dstevens@pppl.gov)). Additional information may be found on the PPPL Site Protection Division Home Page (<http://siteprotection.pppl.gov/>).*

## New Smoking Policy

**N**o more smoking within 25 feet of any building entrance — that's the newly instituted addition to PPPL's Smoking Policy. In providing a smoke-free environment, smoking is not permitted in any Laboratory building, office meeting room or common area, near fresh air intakes, or in Laboratory vehicles, as well as within 25 feet of an entrance. Smoking is permitted in unrestricted areas outside on the PPPL campus.

Signs stating, "THIS IS A NON-SMOKING FACILITY. NO SMOKING WITHIN 25 FEET OF BUILDING ENTRANCE," will be placed at the main entrances to all Laboratory buildings. Large outdoor ashtrays will be provided in areas near building entrances.

To help smokers quit, the Occupational Medical Office and Human Resources will continue to lead an education campaign addressing the hazards of smoking and will periodically arrange programs to help employees break the smoking habit.

The Lab's Smoking Policy, which follows New Jersey laws to regulate smoking in the workplace, can be found on the Human Resources web site. ●

## HOTLINE

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## PPPL Drawings in Iron Man Movie

**T**he Iron Man film, released earlier this month and starring Robert Downey, Jr., and Gwyneth Paltrow, features some PPPL drawings in the background as set dressing and includes a fusion reactor inspired by a tokamak.

Movie-goers should pay close attention to the Las Vegas awards' ceremony scene. During a power point presentation, a photo of Howard Stark (father of the main character, Tony) shows him standing in front of a drawing (supplied by PPPL) printed in blue and pinned to a board. At the end of the movie, the climax happens at Stark Enterprises' fusion reactor. A member of the Iron Man Art Department said, "The reactor is based on the concept of a Tokamak — although, as is the case in movies, its appearance is more parts imagination than reality. The fact that we show Howard standing in front of a plan for a Tokamak (that Tony then builds after his father dies) is something that only we in the Art Department can spot. Our thought was to foreshadow the film's climax and tie Tony to his father's early, futuristic vision of clean energy ...It's not an idea that is explicit in the film, but it is there if you know to look for it."

Thanks to PPPL engineer Irving Zatz for help in locating and copying elevations of BPX and TPX for the production crew. PPPL also supplied general and historical information relating to fusion, plasmas, and tokamak devices, as well as images. ●



courtesy Paramount Pictures

# PPPL Hosts Middle School Science Bowl

## *Princeton's Witherspoon School Takes Overall Top Prize*

**M**odel car racing circled the track around science and math at PPPL on April 12 as 16 teams from 14 area schools competed in the New Jersey Regional Competition of the National Middle School Science Bowl®. The John Witherspoon Middle School team from Princeton won first place.

The bowl included two portions — a model hydrogen fuel-cell car competition and an academic, fast-paced question-and-answer contest in which students answered questions about earth, physical, life, and general sciences, and math. The car challenge tested the students' ability to design, build, and race model cars. Each team was made up of four students, a student alternate, and a teacher who served as an advisor and coach.

Princeton High School teacher Tim Anderson coached Witherspoon, which placed first in the academic portion and second in the model hydrogen fuel cell car competition, taking the overall top prize. As the winners, the team will receive an all-expenses paid trip to Golden, Colo., to compete with other regional winners in the National Science Bowl® for Middle School students in June.



*Witherspoon Middle School team members James Schure (green shirt) and David Wright race their model hydrogen fuel cell car at the New Jersey Regional Competition of the National Middle School Science Bowl® at PPPL on April 12.*

“We’ve had a great time preparing for this and working with a group of 11 team members from whom we picked our playing five. I’m hoping this opportunity for excitement in science leads my whole team to fulfilling careers in science and engineering. My team wanted to dump Gatorade on my head after our win, but they settled for a drenching in distilled water,” Anderson said.

The U.S. Department of Energy sponsors the regional middle school competition; this is the fifth year PPPL has organized it. PPPL’s Chris Ritter and James Morgan coordinated the event. Special thanks to all the volunteers who helped with the bowl. ●

## Success Marks 24th Year for Science-on-Saturday Series



**P**inceton University Professor Iain D. Couzin delivers a talk, “Collective Motion and Decision-making in Animal Groups,” on February 9 as part of PPPL’s 2008 Science-on-Saturday lecture series. The series, organized by PPPL’s Ronald Hatcher and James Morgan, included nine talks ranging from computation in astrophysics and wound healing to the science and art of population-based health care. Featured on several January through March Saturdays in the Lab’s Auditorium, the talks drew hundreds of students, teachers, parents, and community members each time.

The series marked its 24th consecutive year with an exciting collaboration with the Liberty Science Center, which offered four of the talks broadcast live from its Interactive Theater in the Jennifer A. Chalsty Center for Science Learning and Teaching. ●