

THIS WEEK

THROUGH DEC. 14

PPPL Food Drive
LSB Lobby

WEDNESDAY, DEC. 14

PPPL Colloquium
4:15 p.m. ♦ MBG Auditorium
[Princeton University's District Energy Approach and Implications for Improving Energy Efficiency](#)
Edward T. Borer, Princeton University

FRIDAY, DEC. 16

Public Tour
10 a.m. ♦ LSB Lobby

UPCOMING

WEDNESDAY, DEC. 21

PPPL Colloquium
4:15 p.m. ♦ MBG Auditorium
[Solving magnetic reconnection, one plasmoid at a time](#)
Nuno Laureiro, MIT

THURSDAY, DEC. 22

PPPL's Annual Holiday Luncheon
12 p.m. ♦ LSB Lobby

DEC. 23-26

Laboratory closed
Happy holidays!

DEC. 27-29

Laboratory open

DEC. 30-JAN. 2

Laboratory closed

INSIDE

Chemistry Council of New Jersey **2**

NSTX-U Recovery Project Team **3**

Max Planck Princeton Center **4**

Envision Conference **5**

Bangladeshi Rural Electric Society **5**

Young Inventors **6**

Princeton Research Day **6**

IOI Update **7**

Holiday Party **7**

Holiday Food Drive **7**

Flu Vaccine **7**

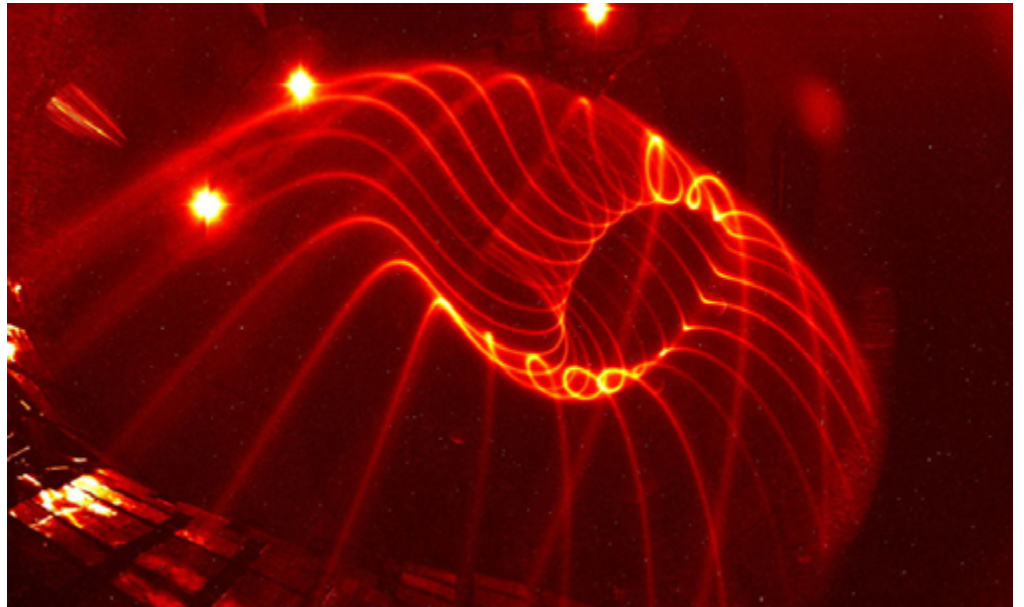
Colloquium **8**

Menu **8**

PPPL and Max Planck physicists confirm remarkable precision of magnetic fields in W7-X

By John Greenwald

P PPL physicist Sam Lazerson has teamed with German scientists to confirm that the [Wendelstein 7-X \(W7-X\)](#) fusion energy device called a stellarator in Greifswald, Germany, produces high-quality magnetic fields that are consistent with their complex design.



Experimental visualization of the field line on a magnetic surface.
(Photo courtesy of Nature Communications)

[continued on page 2](#)

NSTX-U Recovery Project team begins work

By Jeanne Jackson DeVoe

The Recovery Project team for the National Spherical Torus Experiment-Upgrade (NSTX-U) will be charged with analyzing each component of the device, including a failed coil that halted operations, to get a clear idea of the scope of work necessary to get the machine up and running.

Rich Hawryluk, the physicist heading the project, told a packed crowd of staff assigned to NSTX-U at the Dec. 2 meeting that the methodical analysis will be the first task of the Recovery Project.

“This is a critical and urgent first step,” Hawryluk told the audience. “What we’re trying to do is identify the issues with the machine. This is not a paper exercise. I expect people to actually look at the equipment in the field.”

Applause for Masa Ono

Also at the meeting, Masa Ono, the former NSTX-U project director and a PPPL staff member since 1978, announced that he is stepping down from that position. Ono said he will assist with the research and recovery effort and will focus on preparing the next five-year plan. He will also help with collaborations during the outage and will advance collaborations with fusion experiments in China, Japan and South Korea. Ono received three rounds of applause following the announcement.

[continued on page 3](#)

W7-X magnetic fields

continued from page 1

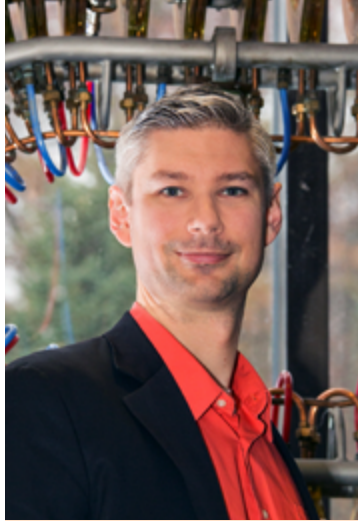
The findings, published in the November 30 issue of *Nature Communications*, revealed an error field — or deviation from the designed configuration — of less than one part in 100,000. Such results could become a key step toward verifying the feasibility of stellarators as models for future fusion reactors.

W7-X, for which PPPL is the leading U.S. collaborator, is the largest and most sophisticated stellarator in the world. Built by the [Max Planck Institute for Plasma Physics](#) in Greifswald, it was completed in 2015 as the vanguard of the stellarator design. Other collaborators on the U.S. team include DOE's Oak Ridge and Los Alamos National Laboratories, along with Auburn University, the Massachusetts Institute of Technology, the University of Wisconsin-Madison and Xanthos Technologies.

Stellarators confine the hot, charged gas, otherwise known as plasma, that fuels fusion reactions in twisty — or 3D — magnetic fields, compared with the symmetrical — or 2D — fields that the more widely used tokamaks create. The twisty configuration enables stellarators to control the plasma with no need for the current that tokamaks must induce in the gas to complete the magnetic field. Stellarator plasmas thus run little risk of disrupting, as can happen in tokamaks, causing the internal current to abruptly halt and fusion reactions to shut down.

PPPL has played key roles in the W7-X project. The Laboratory designed and delivered five barn door-sized trim coils that fine-tune the stellarator's magnetic fields and made their measurement possible. "We've confirmed that the magnetic cage that we've built works as designed," said

Lazerson, who led roughly half the experiments that validated the configuration of the field. "This reflects U.S. contributions to W7-X," he added, "and highlights PPPL's ability to conduct international collaborations." Support for this work comes from Euratom and the DOE Office of Science.



Sam Lazerson (Photo by Elle Starkman)

To measure the magnetic field, the scientists launched an electron beam along the field lines. They next obtained a cross-section of the entire magnetic surface by using a fluorescent rod to intersect and sweep through the lines, thereby inducing fluorescent light in the shape of the surface.

Results showed a remarkable fidelity to the design of the highly complex magnetic field. "To our knowledge," the authors write of the discrepancy of less than one part in 100,000, "this is an unprecedented accuracy, both in terms of the as-built engineering of a fusion device, as well as in the measurement of magnetic topology."

The W7-X is the most recent version of the stellarator concept, which Lyman Spitzer, a Princeton University astrophysicist and founder of PPPL, originated during the 1950s. Stellarators mostly gave way to tokamaks a decade later, since the doughnut-shaped facilities are simpler to design and build and generally confine plasma better. But recent advances in plasma theory and computational power have led to renewed interest in stellarators.

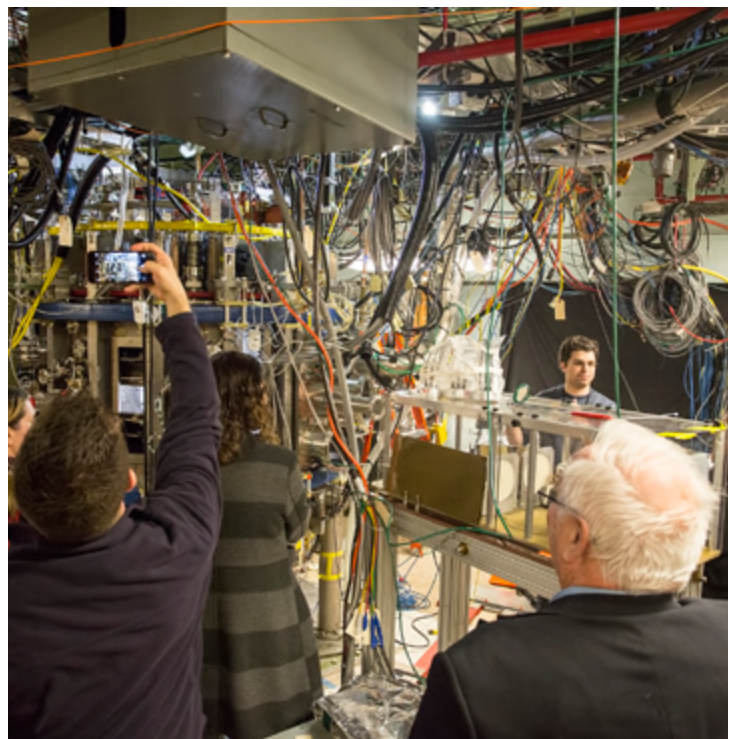
Such advances caused the authors to wonder if devices like the W7-X can provide an answer to the question of whether stellarators are the right concept for fusion energy. Years of plasma physics research will be needed to find out, they conclude, and "that task has just started." 📺

Group finds good chemistry on PPPL tour

About 35 members of the Chemistry Council of New Jersey toured the Laboratory on Dec. 6. The tours followed a day-long meeting of 100 members of the group in the MBG Auditorium. The tour guides were Atiba Brereton and Manish Kumar. Robert Kaita and Dennis Boyle showed the group the Lithium Tokamak Experiment. 📺



Tour guide Manish Kumar talks to the group in the LSB lobby. (Photo by Elle Starkman)



Dennis Boyle, rear right, shows visitors the Lithium Tokamak Experiment. (Photo by Elle Starkman)

NSTX-U Recovery Project

continued from page 1

At the end of June, NSTX-U staff discovered a problem with a water cooling line that is part of the PF1-A coil, a copper solenoid coil on the upper stack that helps to shape the magnetic field. Further analysis and testing indicated the coil was failing and there was evidence of internal coil damage. Operations stopped on July 21. A forensic team has since tested the coil extensively to identify the cause of the failure. Work has begun on the design of a new coil and a coil winding facility has been established in the C-Site high bay. The NSTX-U center stack was removed Nov. 17.

The NSTX-U Recovery Project plan springs from two priority issues or “notable outcomes” identified by the U.S. Department of Energy’s (DOE) Office of Fusion Energy Science in September in the wake of the coil failure. The first is an “extent of condition” review of NSTX-U to “identify all design, construction, and operational issues.” The newly-formed NSTX-U Recovery Project team will perform the review and use it to develop a corrective action plan that will be externally reviewed.

The second notable outcome is an “extent of cause” review of the policies and procedures related to the design, construction and operation of NSTX-U. That review is being headed by Les Hill, who is also head of PPPL’s \$26 million Infrastructure and Operational Improvements (IOI) project.

At the Dec. 2 meeting kicking off the Recovery Project, Hawryluk introduced a new design verification and validation review (DVVR) process to prepare for the external extent of condition corrective action plan review. The DVVR is aimed at identifying any gaps in the design and construction of NSTX-U. “It’s wide-ranging,” said Charlie Neumeyer, who is heading the engineering team.

Gathering hundreds of documents

A team of engineers under Neumeyer’s direction will first work on updating descriptions of the NSTX-U systems, Hawryluk said. To do this, they will assemble the design-related documents for various components of the machine, a process that potentially involves gathering hundreds of documents for each system.

If the engineers find there were modifications to a component and the original design or analysis was never updated, then they will have to identify it as an issue to investigate. Some of the designs will have to be updated and analyzed, Neumeyer explained.

The team is also developing processes to evaluate magnetic coils before they are installed, Neumeyer said. That would likely mean overseeing the manufacture of coils in the field and finding ways to test them before they are installed whenever possible, he said.

For the validation step, engineers will examine documents related to the manufacturing and installation of the components, conduct tests, and physically inspect the components for any issues.

Developing a corrective action plan

The team will develop a corrective action plan based on whether the DVVR found the design, function, and remaining life of the components to be acceptable. Components that are deemed unacceptable in any of those areas will be replaced, Neumeyer said.

The team’s findings and the corrective action plan will be reviewed by an external team and may be revised in response to their review. The revised corrective action plan will be sent to the DOE, Hawryluk said.

[continued on page 4](#)



The NSTX-U center stack in the D-Site south high bay. (Photo by Erik Perry)

NSTX-U Recovery Project names lead engineers

The NSTX-U Recovery Project has appointed a team of engineers under the direction of Rich Hawryluk as project director, Charlie Neumeyer as engineering director and Stefan Gerhardt as deputy director.

Working with the three leaders will be Les Hill, heading the extent of cause review; Frank Malinowski, heading Quality Assurance; Tom Egebo and Stephen Langish, heading Planning and Control; and Arlene White, the procurement liaison.

Neumeyer will head Systems Engineering and Integration and Pete Titus will head Integrated Design and Analysis. Al von Halle will head Operations, with Tim Stevenson as deputy head. Doug Loesser will be the Outage manager.

The responsible engineers under Neumeyer are:

Marc Sibilia: Vacuum Vessel & Internal Hardware
Steve Raftopoulos: Magnets
Bill Blanchard: Vacuum & Fueling Systems
Neway Atnafu: Cooling systems
John Dellas: Power Systems
Tim Stevenson: Heating Systems
Frank Hoffmann: Real Time Control & Protection
Greg Tchilinguirian: Central Instrument & Control
Bob Ellis: Diagnostics
Joseph Petrella: Bakeout Systems
Erik Perry: Test Cell

NSTX-U Recovery Project

continued from page 3


This initial process will help the team develop the scope, cost and schedule for the project, Hawryluk said. The Recovery Project is a wide-ranging project that will require the efforts of many people at the Lab, he added.

Safety comes first

Hawryluk emphasized that the work must be completed quickly but that safety must come first at all times. “We’re going to work quickly to do the job that needs to be done and do it expeditiously and safely. Safety must and will take precedence over scheduling pressures,” he said.

Hill, who is heading the “extent of cause” piece of the project, will focus primarily on the management systems and procedures needed to support the NSTX-U work. He has extensive experience with similar challenges at the Indian Point 3 Nuclear Power Plant in New York and Brookhaven National Laboratory.

Hill said the goal is to “improve the quality and consistency of outputs from our various work processes to better ensure that completed projects fully and reliably meet their performance targets.” His first task was to help establish a document control system that will be used by the NSTX-U team to collect all the documents related to the project in one place. He is also evaluating key processes and will assist the NSTX-U project team in making interim improvements to existing PPPL processes that are integral to the NSTX-U Recovery Project.


In the second phase of the extent of cause, Hill said he plans to bring in external review teams to help develop a corrective action plan. “A key takeaway is that the recovery and restart of NSTX-U is a Lab-wide institutional challenge and we all need to support getting this machine back up and running,” Hill said. “We’ll be burning the midnight oil to help the NSTX-U team because it’s our future.” 

Max Planck Princeton Center meets at Princeton University



The Max Planck Princeton Center held its sixth general meeting on plasma astrophysics and fusion plasma physics last week on the Princeton University main campus. Founded in 2012, the center combines the research capabilities of PPPL and Princeton with the Max Planck Society’s institutes for plasma physics, astrophysics and solar system research in Germany. The four-day meeting covered recent theoretical and experimental developments in the areas of magnetic reconnection, turbulence, energetic particles, and magnetorotational instability, and discussed projects for the coming year. The group next meets in September, 2017, in Greifswald, Germany. (Photo by Elle Starkman)

College students learn about the future of energy at PPPL

Some 100 college students from institutions all over the country attending an Envision Conference at Princeton University Dec. 2 to Dec. 4 kicked off the event with lectures and tours at PPPL on Dec. 2. Andrew Zwicker, head of the Office of Communications & Public Outreach, gave back-to-back lectures on fusion energy to two groups of about 50 students each. Tour guides Atiba Brereton, Soha Aslam, Arturo Dominguez, Erik Gilson, and Danny Cai took the group on a tour of the Laboratory that included the lobby and model stellarator, the NSTX-U Control Room and the NSTX-U test cell. 



Tour guide Soha Aslam discusses PPPL history in the LSB lobby. (Photo by Elle Starkman)



Andrew Zwicker speaks to Envision Conference attendees about fusion energy. (Photo by Elle Starkman)




Tour guide Atiba Brereton talks to the group in the D-Site tunnel. (Photo by Elle Starkman)

Bangladeshi Rural Electric Society Tours PPPL



Thirteen people from the Bangladeshi Rural Electric Society toured PPPL on Dec. 8 with tour guide Ray Camp. The group is taking management classes and is being hosted by the Fordham University Gabelli School of Business in New York, which arranged the tour. They visited the NSTX-U Control Room, the D-Site tunnel, the mock-up area, the NSTX-U test cell, and the D-Site motor generators, where they were hosted by Manish Kumar. (Photo by Raphael Rosen)

Young inventors visit PPPL

Area youngsters on the Circuit Breakers First Lego League team came to PPPL on the evening of Dec. 2 for a tour and a mock presentation of their invention for the state-level First Lego League Contest, which was scheduled Dec. 9 at Ewing High School. In addition to building a robot for the competition, the group created an invention on the theme “Animal Allies.” The students invented a “Deer Puck,” a device that would be installed on the top of a car. It would detect the deer based on their thermal radiation and notify the driver through the car’s Bluetooth or smart phone. The team presented their idea to judges Atiba Brereton, a mechanical engineer, and Kevin Lamb, a electrical technician and an inventor himself. 



Judges Atiba Brereton, center, and Kevin Lamb talk to Circuit Breakers First Lego team members about their invention. (Photo by Devang Parekh)



The young inventors in the National Spherical Torus Experiment-Upgrade test cell. (Photo by Atiba Brereton)



Devang Parekh, left, who hosted the group, with Kevin Lamb, center, Atiba Brereton, and the Circuit Breakers team in the Lyman Spitzer Building lobby. (Photo by Dinesh Doshi)

Application opens for presenters at 2017 Princeton Research Day

Applications are being accepted for presenters at the 2017 Princeton Research Day, the second annual campus-wide celebration of research and creative endeavors by the University’s undergraduates, graduate students, postdoctoral researchers and other non-faculty researchers. The May 11, 2017 event offers an opportunity for student and early career researchers and artists to share their work with the community through talks, posters, performances, art exhibitions, demonstrations and digital presentations. Topics will represent the range of research across the University, including the natural sciences, social sciences, engineering, the arts and humanities. More information about the event and the application for presenters is available on the Princeton Research Day website. The application deadline is Feb. 20.

[The link to the Research Day website is available here.](#)
[The link to the application is available here.](#)

Demolition on LSB Annex & C-Site MG building

Demolition will begin later this week on the Lyman Spitzer Building (LSB) Annex and the C-Site Motor Generator (MG) Building as part of PPPL's Infrastructure and Operational Improvements (IOI) project.

Workers from contractor Whiting-Turner will begin on the top floor of the LSB Annex and work their way down to the first floor. There will also be a limited amount of work in the basement, which will be carefully coordinated with the ongoing use of this space. When the demolition is complete, contractors will construct new office spaces and install a new HVAC system. The demolition is "an important step in revealing unknowns on the project," said Les Hill, the head of the IOI project. "If there are any unknowns, they're hidden behind walls and above the ceiling tiles."

Work will also proceed on demolition on the C-Site MG Building, where the concrete floors in the basement will be removed. This will allow contractors to do the necessary excavation work to install columns and steel work for a new first floor where most of the tech shops will be located.

This first phase will probably take four to six weeks and will conclude in late January, Hill said. Contractors will work through most of the week between Christmas and New Year's.

Hill emphasized that both the LSB Annex and C-Site MG Building are construction zones and will be cordoned off with red hazard tape. Unauthorized staff must stay out of those areas for their own safety, Hill said. 📍

Get merry at PPPL's Holiday Luncheon

Come have some holiday fun with your fellow PPPL'ers at PPPL's annual Holiday Luncheon Dec. 22 at noon in the LSB lobby.



Holiday Food Drive

Nov. 28 to Dec. 14

Supporting Mercer Street Friends Food Bank

Please bring your donations of canned food and home beauty products to donation bins in the LSB Lobby.

It's time to get your flu vaccine!

Influenza is a contagious disease caused by a virus. It can be spread by coughing, sneezing or nasal secretions. By getting the flu vaccine, you can protect yourself from influenza and may also avoid spreading this illness to others.

Please call the OMO at extension 3200 to make an appointment.

COLLOQUIUM

Princeton University's District Energy Approach and Implications for Improving Energy Efficiency



Edward T. Borer
Princeton University

Wednesday, Dec. 14
4:15 p.m., M.B.G Auditorium, Lyman Spitzer Building

BROCK

NICK PETTI
Chef Manager



BREAKFAST 7 a.m. • 10 a.m.
CONTINENTAL BREAKFAST 10 a.m. • 11:30 a.m.
LUNCH 11:30 a.m. • 1:30 p.m.
SNACK SERVICE until 2:30 p.m.

	Monday December 12	Tuesday December 13	Wednesday December 14	Thursday December 15	Friday December 16
COMMAND PERFORMANCE Chef's Feature	Eggplant Parmigiana with Pasta	Taco Bar Tuesday served with Rice and Beans	Teriyaki Roast Pork Loin served with Vegetable- Fried Rice and an Egg Roll	Sloppy Joe with Tater Tots	Catfish Po' Boy with Fried Okra
Early Riser	Blueberry Pancakes	Roast Vegetable Egg White Omelet with Home Fries	Tater Tot Breakfast Bake	Ham, Egg & Cheese French Toast	Bacon, Spinach & Mozzarella Quesadilla with Cilantro Cream
Country Kettle	Cream of Broccoli	Minestrone	Potato, Cheddar & Bacon	Tuscan White Bean	Beef and Rice
Deli Special	Egg Salad Club Sandwich Wrap	Hawaiian Ham with Pineapple Slaw	Lemon Rosemary Turkey Sandwich	American Hoagie with Ham, Bologna, and American Cheese	Capicola, Pepperoni, Salami, and Fresh Mozzarella Flatbread with Spicy Pepper Pesto Mayo
Grill Special	My Big Fat Greek Turkey Burger	Made-to-Order Grill	Sweet and Sour Salmon Burger on a Whole Wheat Roll with Lettuce, Tomato and Grilled Scallion	Grilled Margherita Sandwich	Philly-Style Cheesesteak Calzone
Panini	Spicy Crab Salad Wrap	Chicken Breast, Fontina Cheese, Pesto Mayonnaise & Tomato on Ciabatta Bread	Buffalo Chicken Sliders served with Fries	Meatball Parmigiana Sandwich	NY Street Dog— 2 Sabrett Hot Dogs with Sauerkraut, Red Onions & Mustard served with Fries

MENU SUBJECT TO CHANGE WITHOUT NOTICE

HEART HEALTHY

VEGETARIAN OPTION

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The PPPL WEEKLY is published by the [PPPL Office of Communications](#) on Mondays throughout most of the year and biweekly during the summer, except for holidays.

DEADLINE for calendar item submissions is noon on WEDNESDAY. Other stories should be submitted no later than noon on TUESDAY.

Comments: commteam@pppl.gov ♦ PPPL WEEKLY is archived on the web at: <http://w3.pppl.gov/communications/weekly/>.

**The Dec. 19 issue of the Weekly will be the last issue of the year.
The next issue will be on Jan. 9.**