PPPL PRINCETON PLASMA PHYSICS LABORATORY
A Collaborative National Center for Fusion & Plasma Research
U.S. DEPARTMENT OF ENERGY
WEEKLY
March 20, 2017

THIS WEEK

WEDNESDAY, MARCH 22

PPPL Colloquium
4:30 p.m. ◆ MBG Auditorium
Let's Go to Mars!
Aprille Ericsson, NASA

THURSDAY, MARCH 23

Young Women's Conference in STEM
9 a.m.–2 p.m.
See page 4 for information on how to volunteer.

UPCOMING

WEDNESDAY, MARCH 29

PPPL Colloquium
4:15 p.m. ◆ MBG Auditorium
The long and the short of collisions in strong magnetic fields
Daniel Dubin, University of California - San Diego

THURSDAY, MARCH 30

PPPL Colloquium
4:15 p.m. ◆ MBG Auditorium
The U.S. D.O.E. Exascale Computing Project – Goals and Challenges
Paul Messina, Argonne National Laboratory

WEDNESDAY, APRIL 6

PPPL Colloquium
4:15 p.m. ◆ MBG Auditorium
Pilot-wave hydrodynamics
John W. M. Bush, MIT

INSIDE

Plasma Instability 2
DVVR 3
YWC Volunteers 4
Colloquium 4
Society of Women Engineers 5
"Revealing War" Discussion 6
Menu 6

PPPL resumes collaboration with Large Helical Device in Japan

PPPL has restarted its collaboration with the Large Helical Device (LHD) in Japan and David Gates, head of the Laboratory stellarator division, this month attended the first plasma shot fueled by deuterium on the Japanese machine on March 7. The LHD, known as a "heliotron" in Japan, is similar to a stellarator and had operated with hydrogen rather than deuterium since it began running in 1998. "Deuterium has produced better confinement than hydrogen in some fusion machines and the Japanese want to test if that will also hold true for the LHD," said Gates.

Japanese dignitaries, including government officials and plasma physicists, gathered for the first deuterium-fueled plasma shot on the Large Helical Device. David Gates, head of PPPL's stellarator division, is seated third from right.

continued on page 3

New facilities head has extensive experience and a zest for challenges

By Jeanne Jackson DeVoe

David Carle, PPPL's new head of facilities, is no stranger to the task of leading facilities groups, having headed facilities at hospitals and a national pharmaceutical company during his 36 years in the field. Carle began work at PPPL in mid-February.

David Carle

As head of facilities and site services, Carle heads a staff of 45 people and oversees maintenance for 34 buildings and the 88-acre campus. With all of the changes at the Lab recently, Carle hopes to bring the resources and experience that his staff need to support their efforts and provide them a vision to do great things in support of the Lab." "I have been extremely impressed by the talents and attitude of staff here," Carle said. "We're all in this together to make a difference."

Carle was most recently director of plant operations and maintenance at Cooper University Health Care Systems in Camden, New Jersey, a 500-bed facility. He said he wanted to come to PPPL the moment he discovered the opportunity. "When I heard of the opening in Facilities at PPPL, my interest piqued," he said. "The Lab has a great reputation and is known as a world-wide leader in science. I wanted to be here."

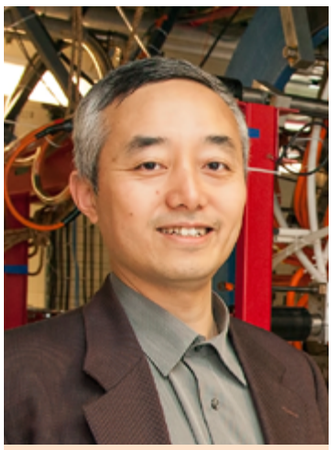
continued on page 5

Physicists upgrade experiment to study cosmic plasma instabilities

By Raphael Rosen

Scientists have found a way to upgrade an experiment to study a plasma instability that may affect the movement of matter swirling around and falling onto stars and black holes, the process that also formed the sun and planets in our solar system. According to a paper by former Princeton University post-doc Xing Wei published in the December 2016 issue of *Physical Review*, the team found that by installing a pair of copper endcaps on the machine, known as the Magnetorotational Instability (MRI) experiment at PPPL, they would be able to detect, and therefore study and understand, the instability much more easily.

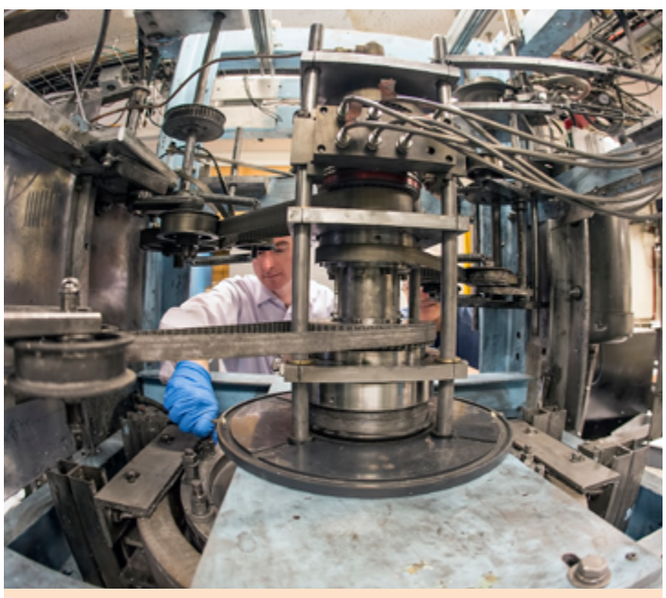
According to coauthor Hantao Ji, a professor in Princeton's Department of Astrophysical Sciences and a Distinguished Research Fellow at PPPL, past theoretical research has hinted that the instability is the mechanism most likely to create the turbulence needed to transfer angular momentum from one clump of matter to another, causing changes in rotational speed and movement of the matter within the accretion disk. But until now scientists have not confirmed the MRI's existence, either in a laboratory or in nature. Part of the MRI experiment's purpose is to definitively observe the instability for the first time, but the signals produced by the machine have so far been too weak to detect conclusively. "In order to detect MRI with confidence, we need to find a way to significantly increase the MRI signal," Ji said.



Hantao Ji

In addition to Ji, coauthors from PPPL include physicists Fatima Ebrahimi and Erik Gilson. Other coauthors are from Princeton University and the Max Planck Institute for Plasma Physics.

The team ran computer simulations testing what would happen if the plastic endcaps on the top and bottom of the device were replaced with a conducting material like copper. The simulations suggested that the new endcaps could boost the MRI signal by as much as an order of magnitude, making it detectable by special sensors.



PPPL physicist Erik Gilson and PPPL technician Peter Sloboda make final adjustments to the lid that holds the liquid metal before spinning up the Magnetorotational Instability experiment. *(Photo by Elle Starkman)*

"We found that the MRI signals can be increased significantly by switching axial boundaries from electrically insulating materials to electrically conducting materials," Ji said.

The MRI experiment was built to test the hypothesis that magnetorotational instabilities could help cause the movement of material within accretion disks, large accumulations of gas, dust, and plasma (gas consisting of electrically charged particles) captured by the gravitational pull of all kinds of stars, including white dwarfs and neutron stars. As the disk grows, the matter around it can fall inward toward the central object. Physicists have long wondered exactly how that process occurs, since it would require the loss of the angular momentum that originally kept the gas and plasma swirling in a circle. By creating enough turbulence, magnetorotational instabilities could be a fundamental plasma mechanism causing loss of that momentum.

The device consists of two cylinders, one nested inside the other, each one rotating independently and at different speeds. Between them is a liquid metal that interacts with magnetic fields in ways similar to how plasma behaves. Finally, a magnetic field is sometimes applied to the liquid metal.

Ji and other researchers hypothesize that as the cylinders turn, magnetorotational instabilities will occur in the liquid. The instabilities transfer angular momentum from the inner part of the liquid to the outer part. This transfer mimics the transfer of momentum in rotating plasma. In the past, the MRI experiment has successfully demonstrated that without the presence of a magnetic field, the rotating flows

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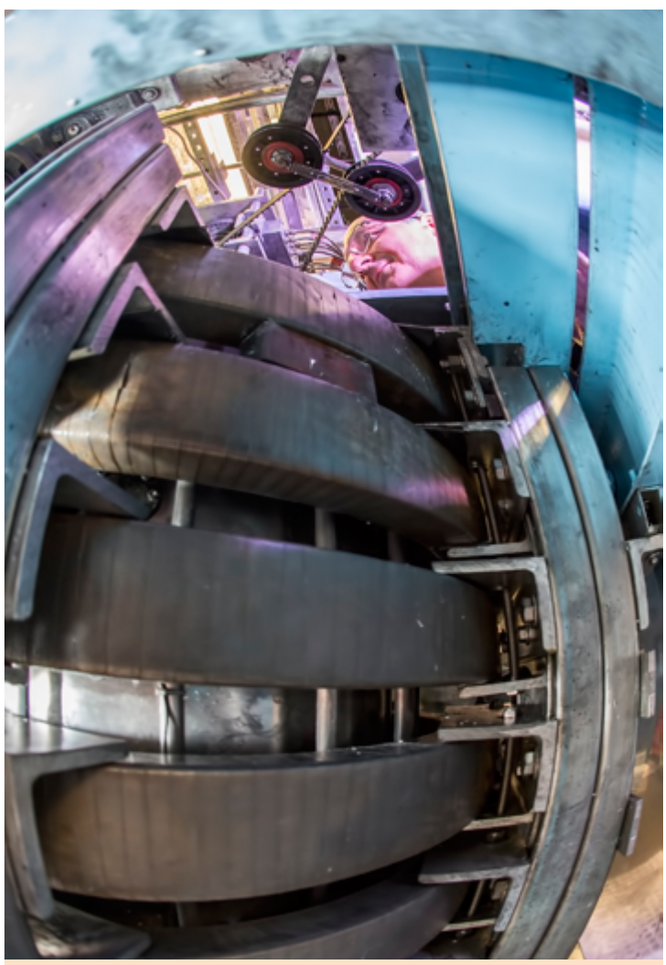


PPPL technician Peter Sloboda overlooks thick magnet coils that can carry over 1,000 amperes of electric current, producing a magnetic field that changes the flow of the liquid metal inside the Magnetorotational Instability experiment and helps produce the instability. *(Photo by Elle Starkman)*

Eighth DVVR focuses on the NSTX-U test cell

By Jeanne Jackson DeVoe

The test cell that surrounds the National Spherical Torus Experiment-Upgrade (NSTX-U) is aging and in need of some upgrades but it does not have any major problems that could halt operations of the experiment, engineers said during a review of the test cell's design and construction last week.

The design verification and validation review (DVVR) was the eighth of 12 reviews of the systems on the NSTX-U aimed at identifying any possibly gaps in the design and construction of the components of the machine. The issues that could potentially halt operation of the machine will be addressed in a corrective action plan to be delivered to the U.S. Department of Energy (DOE). An interim report is due at the end of this month.

The one-day DVVR on the test cell on Thursday, March 16, was effective, said Rich Hawryluk, head of the NSTX-U Recovery Project.

"The DVVRs are going smoothly," Hawryluk said. "We've done enough of these reviews that people know what to do and how to prepare and they get very useful feedback from their colleagues."

The NSTX-U test cell was built between 1978 and 1981 for the Tokamak Fusion Test Reactor (TFTR) and was called the hot cell back then. It was used for a neural beam test stand and later as a decontamination laundry during deuterium-tritium operations on TFTR, said Erik Perry, the responsible engineer for the test cell. The test cell has housed NSTX-U since it was constructed in 1999.

Erik Perry, the responsible engineer for the NSTX-U test cell DVVR, speaks to the review committee. *(Photo by Elle Starkman)*

Erik Perry, center, talks to Nick Balshaw, an external reviewer from the Culham Centre for Fusion Energy. From left are: Jessica Cuttenfelder, Stefan Gerhardt, Mark Cropper, Balshaw, and Pete Titus. *(Photo by Elle Starkman)*

The test cell is surrounded by four-foot thick walls on all but the east walls, which is three-feet thick, and concrete labyrinths on the south and north walls that act as barriers to absorb energetic neutrons from the fusion reactions.

The review committee found one issue in the test cell is the need to provide shielding in areas of the wall called "penetrations" where holes have been drilled through and diagnostic wires are coming through. Without additional shielding, it may be necessary to restrict access to parts of D-site or limit the number of high power experiments that are performed. While this would address the PPPL administrative requirements, it would impact operations and the scientific program, which is why this is being evaluated.

Other areas needing improvement are maintenance that will likely need to be addressed in the next few years. For example, the HVAC system and controls for the test cell and the rest of D Site are old and may need to be replaced and the roof may likewise need replacement.

Nick Balshaw, of the Culham Centre for Fusion Energy, took part in the review at PPPL, and Jim Irby, of MIT's Plasma Science and Fusion Center, took part remotely. Valeria Riccardo, the head of engineering, chaired the review.

This week's DVVR will be a one-and-a-half day session on vacuum and fueling on Thursday, March 23, to Friday, March 24. Stefan Gerhardt, deputy head of engineering for the NSTX-U Recovery Team, will chair that session.

LHD

continued from page 1

While in Japan, Gates discussed future collaboration activities with LHD physicists and told dignitaries gathered for the first deuterium shot "how much we value this renewed cooperation." Among other benefits, the collaboration will enable PPPL to compare LHD plasma physics results with those on the Wendelstein 7-X (W7-X) stellarator in Germany, which uses deuterium and began making plasma in late 2015. The findings could aid PPPL in proposing its own future stellarator plans. Gates also met in Japan with PPPL physicist Novimir Pablant, who is collaborating with LHD during a month-long visit.

Photos courtesy of the National Institute for Fusion Science.

David Gates tells Japanese dignitaries how much PPPL values its renewed collaboration on the Large Helical Device. Gates spoke shortly after the LHD conducted its first deuterium-fueled plasma shot. The vertical banner behind him reads, "Deuterium first plasma."

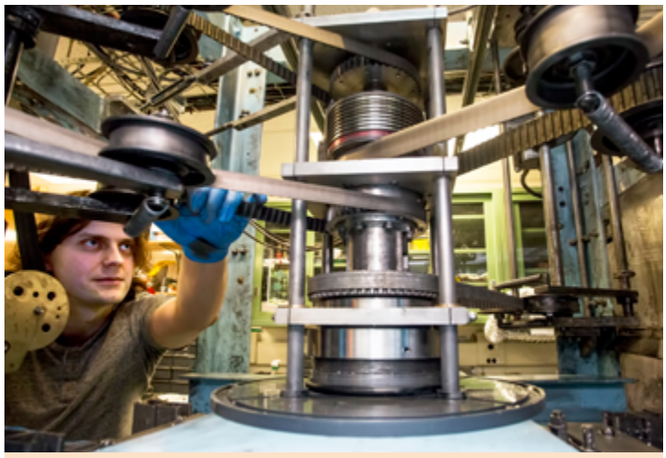
Plasma instabilities

continued from page 2

within accretion disks cannot account for the accretion of matter onto stars. So the more the MRI experiment records the outward transfer of angular momentum, the more evidence there is that magnetorotational instabilities can cause the loss of angular momentum in astrophysical systems.

Erik Gilson, principal research physicist at PPPL, noted the dual roles of both simulation and experimentation in this research. "It's important that the simulations and the experiments are being conducted together in order to try and create the right conditions to see in the lab, for the first time, hard evidence of the existence of the magnetorotational instability," he said.

This research was funded by NASA and the National Science Foundation; the DOE's Office of Science (Fusion Energy Sciences) will begin providing funding this year.



Kyle Caspary, now an associate research physicist, checks the belt tension to make sure the Magneto-rotational Instability experiment will operate reliably at the speeds required to excite the instability in the laboratory. *(Photo by Elle Starkman)*

Volunteer for PPPL's Young Women's Conference

Thursday, March 23
9 a.m.–2 p.m.

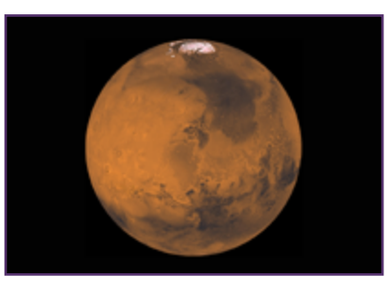
at Princeton University's Frick Chemistry Laboratory

Go to https://goo.gl/forms/uNn3TVQwstzk3Xa72 to fill out a registration form and pick your preferred job or jobs. Transportation and lunch will be provided. Thank you!

Please contact organizer Deedee Ortiz, dortiz@pppl.gov, ext. 2785 with any questions.

COLLOQUIUM

Let's Go to Mars!



Aprille Ericsson
NASA

Wednesday, March 22
4:30 p.m., M.B.G Auditorium, Lyman Spitzer Building

Society of Women Engineers members tour PPPL

Members of the Society of Women Engineers (SWE) New Jersey Section toured PPPL during the evening of March 9. Led by engineers Carmela Ciummo and Atiba Brereton, the group visited the NSTX-U Control Room, the NSTX-U test cell, and the Science Education Laboratory. *(Photo by Elle Starkman)*

David Carle

continued from page 1

The new facilities head serves on the leadership council and reports directly to Stacia Zelick, the interim deputy director for operations and chief operating officer (COO). "Unlike many other organizations, I was happy to see that Facilities at PPPL reported directly to the COO. That is important," Carle said. "Often, people don't understand that what Facilities does is both tactical and strategic. The fact is that something as simple as flipping a switch to light up the room relies on us doing our job correctly. It's an often overlooked and sometimes misunderstood area."

Carle has started meeting with department heads and researchers to find out what they need from Facilities. He's also meeting with staff members to find out their view of Facilities' past challenges and how they view the future. "They are a highly skilled and very dedicated staff with a lot of pride in what we do here at PPPL," Carle said.

Working in highly-regulated healthcare field

Working in life sciences-healthcare gave him valuable experience working in a highly-regulated field that translates well to a national laboratory, Carle said. Although there are many differences, both workplaces emphasize safety and compliance. Carle brings the same safety philosophy to each job. "All of my career I've been a firm believer in putting systems and practices in place to increase reliability, decrease business interruptions, and maximize value to the organization," Carle said.

Carle began his career as a cabinetmaker at what was then Princeton Hospital. He went to college part-time at night and earned a bachelor's degree in industrial engineering from the College of New Jersey. When he left the hospital 11 years later he was the assistant director of facilities.

He spent the next 18 years at the pharmaceutical company Bristol-Myers Squib (BMS) in various campuses in New Jersey where he worked his way up from section head of maintenance to director of strategic planning for global engineering. He and his family lived in England for three years when Carle was director of European facilities operations for BMS. He oversaw facilities operations in the United Kingdom, Belgium, and France. The job included managing existing facilities as well as site selection and construction of two new facilities in Brussels and Paris. He also oversaw the space redesign of a UK facility that significantly increased its capacity, thereby avoiding a costly expansion.

Carle returned to the United States to become site director of facilities operations of the BMS campus in Princeton. He then moved to Global Engineering to become director of strategic planning for the Pharmaceutical Research Institute, leading planning and project concept of new research facilities including a collaborative project in Bangalore, India, and a project portfolio in New Jersey and Europe.

A focus on changing culture

Carle worked at four other organizations previous to PPPL and has overseen organizational transformations in most of those positions. As managing director for facilities operations at Thomas Jefferson University and Hospital in Philadelphia, for example, Carle took on a newly-created position with the aim of changing the culture of facilities. One way he did that was by linking customer satisfaction scores and maintenance issues to change attitudes about the importance of maintenance. "It was a very dated environment," Carle recalled. "There were very few processes in place, no planning or scheduling of work, and no predictive maintenance program, so it was quite a challenge!"

Aside from his three years in Europe, Carle is a lifelong resident of Hamilton, New Jersey. His new position at PPPL allowed him to trade an hour-and-a-half commute each way for a 20-minute drive. Carle and his wife, Claudia, a middle school science teacher at Saint Gregory the Great at Hamilton Square, have been married for 34 years. The couple has two grown children, David, 30, in Philadelphia, and Caitlin, 27, in Media, Pennsylvania.

Carle enjoys photography and playing guitar. He shares a passion for music with his wife and children. But mostly Carle is busy at work, where he usually arrives early and stays late "I've got so much to learn," he said. "I feel like I have to take a deep dive to get up to speed but I'll get there."

"I think there's a lot of opportunity in Facilities with where the Lab is going," Carle said. "With the quality and dedication of the staff here, I am sure we can achieve much to enhance the scientific mission."

Princeton University Art Museum discussion on “Revealing War”

The Princeton University Art Museum will host a discussion on “Revealing War: A Conversation About Art and Journalism in the 21st Century,” on **April 27 at 5 p.m. at 101 McCormick Hall**. The discussion will feature Nicholas Schmidle, investigative journalist, staff writer at the New Yorker and visiting lecturer in the Humanities Council and Ferris Professor of Journalism; Daniel Heyman, artist and lecturer at the Lewis Center for the Arts; Katherine Bussard, the Peter C. Bunnell curator of photography; and T. Barton Thurber, associate director for collections and exhibits who will serve as moderator.

The discussion is in conjunction with the exhibit “Revealing Pictures: Photographs from the Christopher E. Olofson Collection,” which includes photos by Edmund Clark of the American naval base at Guantanamo Bay and Tim Hetherington’s coverage of civil wars in Africa.

BROCK

NICK PETTI
Chef Manager

Café at PPPL

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 March 20	Tuesday March 21	Wednesday March 22	Thursday March 23	Friday March 24
COMMAND PERFORMANCE Chef’s Feature	**Chicken-Fried Steak** with Mashed Potatoes and Fried Green Tomatoes	**Whole Wheat Pasta Primavera**	**Pepper Steak** with Rice	GUEST CHEF GORDON RAMSEY HELL’S KITCHEN COOKBOOK RECIPES Lemon and Thyme-Roasted Chicken, Sweet Corn Polenta and Sautéed Spinach and Ginger-Caramelized Carrots	**Pesto-Crusted Tilapia** with Wild Rice
Early Riser	**Peanut Butter and Jelly Pancakes**	**Steak, Egg & Cheese Quesadilla**	**Corned Beef Hash** with 2 Eggs	**French Toast Sticks**	**2 Eggs,** Choice of Breakfast Meat & Tater Tots
Country Kettle	**Spring Vegetable**	**Turkey Noodle**	**Tuscan Bean**	**Split Pea**	**New England Clam Chowder**
Deli Special	**Jerk Chicken** with Pepper Jack and Roasted Peppers on Brioche Roll	**Italian Chopped Antipasti Wrap**	**Shrimp Salad Wrap**	**Asparagus, Sundried Tomatoes, Roasted Peppers & Mozzarella Cheese Wrap**	**Chicken Parmesan Sub**
Grill Special	**Buffalo Black Bean Burger**	**Falafel Wrap**	**Hawaiian Teriyaki Burger**	**BBQ Chicken Grilled Cheese**	**Crab, Asparagus & Roasted Pepper Quesadilla**
Panini	**3 Cheese Panini** with Cheddar, Swiss & Blue Cheese with Bacon & Tomatoes on Sourdough	**Sausage, Peppers & Onions Torpedo**	**Teriyaki Chicken** with Asian Slaw, & Swiss Cheese on a Kaiser Roll	**Open-Faced BBQ Turkey Sandwich**	**Grilled Peanut Butter and Jelly**

MENU SUBJECT TO CHANGE WITHOUT NOTICE

HEART HEALTHY VEGETARIAN OPTION

WEEKLY

Editor: **Jeanne Jackson DeVoe** ◆ Layout and graphic design: **Kyle Palmer** ◆ Photography: **Elle Starkman** ◆ Science Editor: **John Greenwald** ◆ Science Writer: **Raphael Rosen** ◆ Webmaster: **Chris Cane** ◆ Communications Director: **Larry Bernard**

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