

## THIS WEEK

WEDNESDAY, DEC. 13

### Council Café Lunch

12 p.m. ♦ PPPL Cafeteria

#### Scott Weidner

Princeton University assistant vice president for engineering

### Tour Training

12 p.m. ♦ MBG Auditorium

[See page 6 for details.](#)

### Carebridge Presents: How to Have a Stress-Free Holiday

12:30-1:30 p.m. ♦ B318

#### Presented by Mary Holt Paolone

[See page 7 for details.](#)

### Colloquium

4:15 p.m. ♦ MBG Auditorium

#### Predicting Thermal Transport in Nanostructured Materials

Jennifer Lukes,  
University of Pennsylvania

## UPCOMING

WEDNESDAY, DEC. 20

### Council Café Lunch

12 p.m. ♦ PPPL Cafeteria

#### Chelle Reno

Princeton University assistant vice president for operations

THURSDAY, DEC. 21

### PPPL Holiday Party

Details to come.

## INSIDE

Research Open Forum **2**

Plasma 101 Lunch & Learn **3**

United Way Bake Off **5**

Council Café Lunch **6**

Colloquium **6**

Tour Guide Meeting & Training **6**

Holiday Party **6**

Carebridge Presentation **7**

Menu **7**

# Innovative design using loops of liquid metal could improve future fusion power plants

By John Greenwald

Researchers led by PPPL have proposed an innovative design to improve the ability of future fusion power plants to generate safe, clean and abundant energy in a steady state, or constant, manner. The design uses loops of liquid lithium to clean and recycle the tritium, the radioactive hydrogen isotope that fuels fusion reactions, and to protect the divertor plates from intense exhaust heat from the tokamak that houses the reactions.

“There are many challenges to developing fusion energy and the handling of heat on divertor plates is among them,” said PPPL physicist Masa Ono, lead author of a paper about the design published in the journal *Nuclear Fusion*. “We wanted to see how we can protect the divertor plates and keep the fusion chamber clean.”

[continued on page 3](#)

# DOE Under Secretary for Science and Deputy Director for Science Programs visit PPPL



Stefan Gerhardt, right, deputy head of the NSTX-U Recovery Project, shows visitors the NSTX-U Control Room. From left: Kristen Ellis, chief of staff to Under Secretary Paul Dabbar; Dabbar; Steve Binkley, deputy director for science programs, and David McComas, Princeton University vice president for PPPL. (Photo by Elle Starkman)

[see page 4](#)

# An open forum on the future of PPPL research

By Jeanne Jackson DeVoe

What do machine learning for fusion, superconducting research, new diagnostics, space plasmas, atomic Legos, and nanomaterials have in common? They were all among the topics discussed as more than two dozen of the Laboratory's scientists and engineers presented their vision of research areas that PPPL should explore in the coming years in a two-day meeting Nov. 21 and Nov. 28.

The 30 15-minute presentations ranged from plasma material interfaces to space exploration. They were part of an open forum that was intended to encourage a dialogue within the Laboratory on the future of research as part of PPPL's strategic planning.

"We succeeded in creating a forum for people to provide their vision and to share their ideas with each other," said Raffi Nazikian, one of three chairs of the Strategic Planning Task Force for research, along with Hutch Neilson, deputy head of ITER and Tokamaks, and Michael Zarnstorff, deputy director for research. "There was a lot of enthusiasm for sharing and discussing ideas at the meetings, and this bodes well for engaging a broad cross section of the Lab in our future planning."

"This is an open field encouragement of new ideas," Zarnstorff said. "It's an attempt to have a grassroots component to our normal strategic planning and we are off to a very good start."

The Strategic Planning Committee began in October and represents a broad group of staff members. The committee will review the presentations and develop working groups that will identify opportunities for the Lab to support some of the most promising ideas, Nazikian said.



Yuhu Zhai was one of several presenters.  
(Photo by Elle Starkman)



Listening to presentations are, right to left: David Gates, head of Stellarators; physicist Steve Sabbagh; and Michael Zarnstorff, PPPL's deputy director for research.  
(Photo by Elle Starkman)



Physicist Steve Sabbagh at the Nov. 28 meeting.  
(Photo by Elle Starkman)

Nazikian said some of the major questions the task force will consider in evaluating future research programs are:

- What expertise does the Laboratory need that it currently does not have that could potentially make it more competitive or effective in realizing new opportunities?
- What facility infrastructure does the Laboratory need that would help make the Laboratory more competitive in promising research areas?
- What can the Laboratory do now within existing programs to explore new ideas that can enhance mission accomplishment?

"While these meetings are a first step, the enthusiasm and novelty of ideas presented by the staff is a very good sign for the future of the Lab and for our planning efforts," Nazikian said.

"PPPL can lead the world in driving the advances needed to realize fusion energy," Neilson added. "Our staff has shown that we have the ideas that can freshen our vision and program and propel us forward."

"There was a general sentiment that we need to communicate more effectively across the silos of expertise within the Lab in order to drive scientific innovation," Nazikian said. "We have seen a groundswell of enthusiasm from people in all parts of the Lab in the last year, from operations, engineering and research. People are more engaged than ever before and they see that they are making a difference. The leadership team is committed to harnessing this enthusiasm to develop the best possible plan for the future of our Lab." 📌



Roger Raman, of the University of Washington, a long-time collaborator with PPPL, gives a presentation.  
(Photo by Elle Starkman)

# Liquid lithium

continued from page 1

Fusion, the merger of light elements to release energy, is the process that powers the sun and stars. Here on Earth, fusion power plants will combine tritium with its sister isotope deuterium to create the energy for generating electricity. Producing this power in a fusion device is sometimes called “putting a star in a jar.”

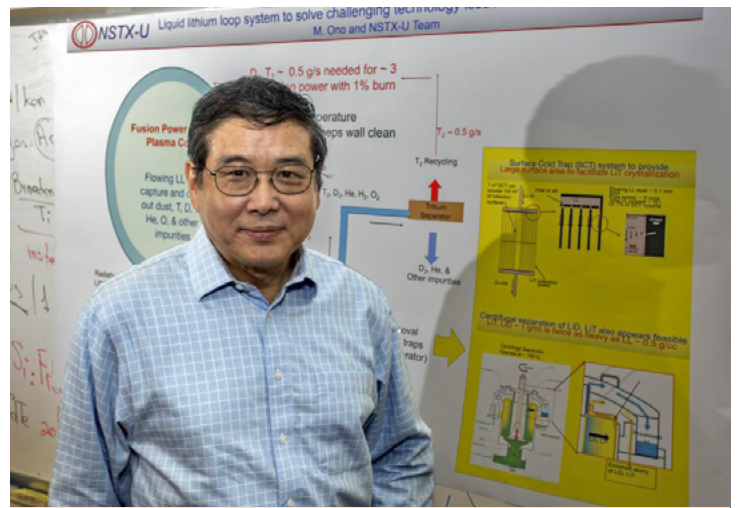
The system that Ono and colleagues designed calls for pumping liquid lithium in and out of a tokamak, a type of fusion device, to maintain steady state operation while cleaning out dust and other impurities from the plasma and safeguarding the divertor. The lithium, a silvery metal that readily combines with other elements, would serve a number of functions:

**Covering divertor plates.** Injection of liquid lithium into the tokamak divertor chamber would coat the plates with the liquid substance, protecting them from heat and particles that rise up from the core of the plasma. The liquid lithium coating would also act as a sponge, capturing the particles before they struck the plate and preventing them from rebounding back into the plasma to cool it down and reduce fusion performance.

“Even a thin layer of liquid lithium can protect the plates,” said Ono. “It also has a promise of improving plasma performance as observed in the National Spherical Torus Experiment and Lithium Torus Experiment at PPPL and in other fusion experiments, and reduces the heat flux. And since liquid lithium evaporates, we must continually provide more to keep the plates moist.”

**Recycling tritium, a key fuel that will fuse with deuterium to produce fusion reactions in future power plants.** Only approximately 1 percent of the tritium that is injected into the plasma is expected to be consumed in this process. The remaining unconsumed tritium must be removed and recycled back to maintain fueling.

To accomplish this task, the liquid lithium would combine with tritium in the tokamak and carry it with dust and other impurities to a filter outside the tokamak where the dust would be removed. The next stop would be a cold trap operating at 200 degrees Celsius that would allow the tritium to crystallize out. After draining lithium from the trap, the system would reheat and regenerate the tritium and bring it to a separator that would discard the impurities and pump




Masa Ono (Photo by Elle Starkman)

the tritium back into the tokamak. Alternatively, the loop could feed into a centrifuge that separated the tritium from the lithium and returned the isotope to the tokamak.

**Removing dust.** If left unchecked, many tons of dust could accumulate in a year from interactions between the plasma and the fusion chamber walls. The same loop that recycles tritium would deliver the dust to a filter as described above. “After the dust filter is filled, it must be replaced,” Ono said. “Since the filter would be relatively close to the fusion chamber, it must be replaced remotely.”

**Eliminating unwanted elements.** Contact between the plasma and tokamak walls would also give rise to impurities such as nitrogen and oxygen that could cool the plasma. The flowing liquid lithium would carry these impurities to the tritium separator, as noted above, which would remove them. “Since these impurities are expected to be relatively low level,” Ono said, “they could be handled after separation through specialized smaller cleaning loops attached to the main one.”

Addressing such ideas are PPPL and groups around the world testing flowing liquid lithium concepts. “We are looking to the future to come up with solutions,” said Ono. “These issues must be dealt with if we are to realize practical and attractive fusion power plants.”

Collaborating with Ono on this work were physicists at PPPL, Oak Ridge National Laboratory, the University of Illinois at Urbana-Champaign and the National Institute of Fusion Science in Japan. Support for the U.S. research comes from the DOE Office of Science. 

## Submit your questions for Plasma 101 Lunch & Learn

Please submit your questions about fusion energy, plasma, or any of the science we do here in the box in the LSB lobby.

### Sample questions:


What is plasma?

How is what we do different from “nuclear power?”

Why don't we have fusion energy on the grid yet?

## DOE Under Secretary for Science and Deputy Director for Science Programs visit PPPL

The U.S. Department of Energy's Under Secretary for Science Paul Dabbar, along with Steve Binkley, deputy director for science programs, and Kristen Ellis, chief of staff to Dabbar, visited PPPL on Dec. 6.

The officials met officials from the Princeton Site Office. They then met with Rich Hawryluk, PPPL interim director, and other members of the leadership team. They had a working lunch with winners of Early Career awards and next-generation leaders. After taking a tour of PPPL that included the National Spherical Torus Experiment-Upgrade, the Lithium Tokamak Experiment and the Magnetic Reconnection Experiment, they continued discussions with the leadership team about the NSTX-U and PPPL advanced computation. 



Physicist Robert Kaita, left, gives a tour to, from left: Scott Weidner, Princeton University assistant vice president for engineering; Kristen Ellis, chief of staff to Under Secretary Paul Dabbar; Dabbar; and Steve Binkley, deputy director for science programs. At the rear are Pete Johnson, head of the Princeton Site Office, left, and Jon Menard, head of the NSTX-U Recovery Project. (Photo by Elle Starkman)



Paul Dabbar, under secretary for science, and Kristen Ellis, his chief of staff, view the NSTX-U center stack casing on a tour led by Jon Menard, head of the NSTX-U Recovery Project, left, and Russ Feder, project manager for the Recovery Project. (Photo by Elle Starkman)



Among those attending the meeting were: Front row, from left: Steve Binkley, deputy director for science programs; Paul Dabbar, under secretary for science; and Kristen Ellis, chief of staff to Dabbar. Back row, from left: Terry Brog, PPPL deputy director for operations; Scott Weidner, Princeton University assistant vice-president for engineering; Stacia Zelick, PPPL chief planning officer; Rich Hawryluk, PPPL interim director; Chelle Reno, Princeton University assistant vice president for operations; David McComas, Princeton University vice president for PPPL; Pete Johnson, Princeton Site Office manager; Sandy Rogan, deputy Princeton Site Office manager; and Michael Zarnstorff, PPPL deputy director for research. (Photo by Elle Starkman)

# United Way bake-off is a sweet success

**P** PPL's second annual bake-off for United Way raised \$1,068 — a \$268 increase over last year's bake off. The IT Department won the bake-off trophy, raising \$58 per person, and taking the trophy from Business Operations, which was the champion last year. 🍪



Enjoying the treats were from left, Marianne Tyrrell, Theresa Gillars, and Gretchen Zimmer. (Photo by Elle Starkman)



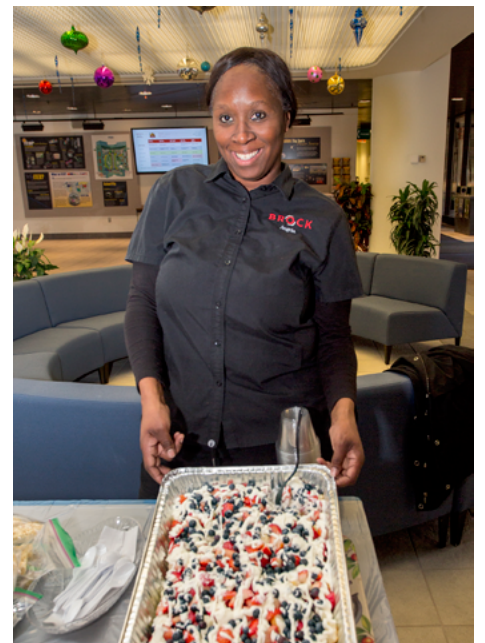
Irene Newman, left, and Alana Coleman at the Business Operations table. (Photo by Elle Starkman)



Andrew DeCaro, left, and Nelson Neal, load up on goodies. (Photo by Elle Starkman)



Chris Smiet provided the first bake-off entry from the Theory Department. (Photo by Elle Starkman)



Angela Roberson from the PPPL Café shows off her delicious shortcake. (Photo by Elle Starkman)



The Environmental Services Division cooked up several treats. From left, Virginia Finley, Ana-Marie Datuin, and Leanna Sullivan. (Photo by Elle Starkman)



Neelima Yeragudipati, left, and Ewa Kontor decorate the Christmas tree. (Photo by Elle Starkman)



Kyle Palmer and Deedee Ortiz at the Communications & Public Outreach table. (Photo by Elle Starkman)

## Council Café Lunch

This Week: **Scott Weidner**,  
Princeton University assistant  
vice president for engineering



**Wednesday, Dec. 13**  
12 p.m., PPPL Café

*Next Week: Chelle Reno*

## Tour Guide Meeting & Training

Are you a physicist, engineer, graduate student, or knowledgeable staff member who would like to tell visitors about PPPL's research? Sign up to be a tour guide! Please contact Jeanne Jackson DeVoe, [jjackson@pppl.gov](mailto:jjackson@pppl.gov), ext. 2757, if you're interested.

There will be a general tour meeting for all tour guides with a pizza lunch followed by tour training for new tour guides on Wednesday, Dec. 13 at noon in the MBG Auditorium.

# COLLOQUIUM

## Predicting Thermal Transport in Nanostructured Materials

**Jennifer Lukes**  
University of Pennsylvania

**Wednesday, Dec. 13**  
4:15 p.m., M.B.G. Auditorium, Lyman Spitzer Building

## Holiday Party

**Save the Date:**  
PPPL's holiday party  
is Dec. 21!

Stay tuned for details.

# Carebridge Presents:

## How to Have a Stress-Free Holiday

Presented by Mary Holt Paolone

With gifts to buy and wrap, visits to make and goods to bake you may find yourself feeling overwhelmed during the holiday season. Learn strategies for managing your time, sticking to your budget and staying healthy through the season so you don't miss out on the festivities.

**Wednesday, Dec. 13**  
**12:30–1:30 p.m., Room B318**

[Click here to sign up!](#)

**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 Dec. 11	Tuesday Dec. 12	Wednesday Dec. 13	Thursday Dec. 14	Friday Dec. 15
<b>COMMAND PERFORMANCE Chef's Feature</b>	<b>Beef Stew</b> over Egg Noodles	<b>Baked Potato Bar</b>	<b>Fried Chicken</b> and a Biscuit	<b>Super Salad</b>	<b>Tortellini Primavera</b> with Garlic Bread
Early Riser	<b>Bacon, Egg &amp; Cheese Croissant</b>	<b>Sausage, Egg and Cheese Biscuit</b>	<b>Chocolate Chip Pancakes</b> served with Choice of Breakfast Meat	<b>Ham, Egg and Cheese Sandwich</b>	<b>2 Eggs, 1 Pancakes,</b> Choice of Breakfast Meat & Potatoes
Country Kettle	<b>Vegetable Noodle</b>	<b>Beef Barley</b>	<b>Cream of Mushroom</b>	<b>Tuscan Chicken and Pasta</b>	<b>Seafood Chowder</b>
Deli Special	<b>California Wrap</b>	<b>Hummus Turkey Wrap</b>	<b>Buffalo Chicken Salad Wrap</b>	<b>Grilled Ham and Cheese</b> on Texas Toast	<b>Chicken, Mozzarella,</b> Red Onion, Basil, Arugula and Balsamic Tomatoes on French Bread
Grill Special	<b>Patty Melt</b>	<b>Shrimp Tacos</b>	<b>Pork Torta</b> on Ciabatta	<b>Portobello Mushroom "Cheesesteak"</b>	<b>Monte Cristo</b>
Panini	<b>Tomato, Fresh Mozzarella, Spinach and Pesto Hoagie</b>	<b>Grilled Eggplant,</b> Spinach and Tomato Parmesan with Caesar Salad	<b>Clam Strip Po' Boy</b>	<b>Sausage and Peppers</b>	<b>Cuban Sandwich</b>

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

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