

At PPPL
THIS WEEK

TUESDAY, JUNE 5



**Princeton University
Commencement 2012**

11 am. ♦ Nassau Hall, Main Campus
[INFO](#)

WEDNESDAY, JUNE 6

GFDL Events and Seminars

12 p.m. - 1:15 p.m. ♦ GFDL
Smagorinsky Seminar Room

Topics in LDEO Decadal Climate Research: Impacts of Ozone Depletion on the Hydrological Cycle; Centennial Tropical Pacific Variability in Coupled GCMs

Dr. Kushnir and Seager (LDEO)

www.gfdl.noaa.gov/events

(Gov't, Univ. or 2 other forms of I.D. needed)

PPPL Colloquium

4:15 p.m. ♦ M.B.G. Auditorium

Ecological Lessons Learned 30 Years After Mount Saint Helens

Virginia Dale

(Oak Ridge National Laboratory)

FRIDAY, JUNE 8

DIII-D Science Meeting

1 p.m. ♦ B-233

**SAFETY
SURVEY
UPDATE**
see page 4

**Koel Applies Science of Surface
Chemistry to Fusion Research at PPPL**

by Catherine Zandonella

In the lab down the hall from Bruce Koel's new office, the temperature is about to go up over 11 million degrees Centigrade in a hot tub-sized chamber that cradles the energy of a burning star.

The chamber is housed at the U. S. Department of Energy's Princeton Plasma Physics Lab (PPPL), where scientists are exploring ways to harness the fusion of atoms, the same process that fuels the sun and other stars, to provide safe, clean and abundant energy for homes and businesses.

Koel, a professor of chemical and biological engineering at Princeton University, is joining with PPPL scientists to tackle the challenge of capturing the energy of the sun on Earth. Appointed to the Princeton faculty last year, Koel's expertise is in surface chemistry. His mission at PPPL is to apply the science of surfaces to solving one of the biggest obstacles facing fusion: how to keep the fusion reaction burning for long periods.

The fusing together of atoms releases vast amounts of energy, but the process can take place only at extremely high temperatures. For fusion to be the basis of the power plant of the future, scientists need to find ways to keep the process from cooling. Amazingly, a thin metal lining, just the width of a human hair, on the inner wall of the reactor could help prevent this cooling. Koel is collaborating with PPPL scientists to study materials for this lining. The most promising lining is lithium, the lightest metal on Earth and the only metal that floats on water.



Bruce Koel

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**Jack
Anderson**

A New COO for Fermilab

This summer Fermilab will welcome former PPPLer Jack (J.W.) Anderson as its next chief operating officer. Anderson is currently the director of the Office of Integrated Performance Management at Oak Ridge National Laboratory. He will replace Bruce Chrisman, who is retiring after more than 40 years at the laboratory.

"It's a true privilege to have the opportunity to work at Fermilab," Anderson said. "The national laboratory system provides a truly unique research environment, and I am especially excited by Fermilab's rich history of scientific accomplishments.

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Maintaining temperatures in the millions of degrees is essential because fusion occurs when certain forms, or isotopes, of hydrogen atoms become so heated that their positively charged nuclei separate from their negatively charged electrons to form a charged cloud called a plasma. These hydrogen nuclei zip around and smash into each other at high speeds, resulting in fusion of the nuclei and the release of energy.

This plasma is so hot that only a magnetic force field, housed inside a cylindrical stainless steel and copper chamber, can contain it. But stray particles constantly escape from the charged cloud and hit the chamber wall, then bounce back into the plasma. The cycling of cold particles back into the scorching gas cools the plasma, and causes it to become turbulent and unstable.

Although heat-resistant carbon tiles line the inside of the chamber, they do not stop particles from cycling in and out of the plasma, which is confined in the middle of the vessel by the magnetic field and does not directly contact the chamber walls. "No matter how hot you make the middle, the walls are cold," said Richard Majeski, a PPPL principal research physicist and lecturer with the rank of professor in astrophysical sciences. "It is sort of like bad insulation in a house."

A lithium lining on the inside of the chamber, however, can act like a sponge, soaking up stray particles that flee the fusion reaction.

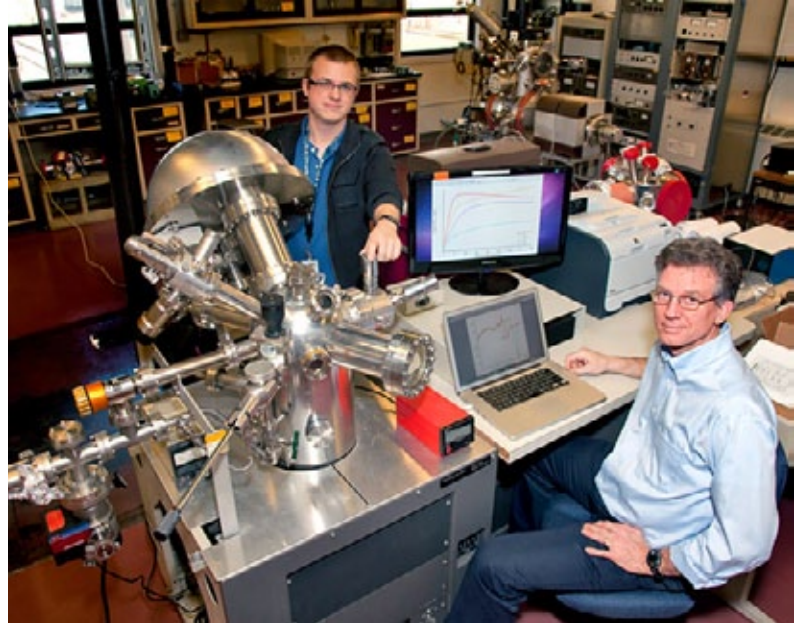
Experimenting with Lithium

Known for its use in batteries and psychiatric drugs, lithium has unique properties that make it ideal for the task of keeping the plasma from cooling down. One of these properties is that it eagerly links up with other atoms. Lithium grabs renegade particles, preventing them from rebounding into the plasma.

Previous studies with lithium have shown that the metal can extend the plasma lifetime significantly, but to really boost the efficiency, researchers need to learn more how it behaves. "We have the basic knowledge but exactly what is happening on the surface is not so clear," said PPPL principal research physicist Charles Skinner. "This is where Koel comes in."

Lithium is a challenge to work with, however, because of its tendency to react with just about any atom that comes along. Lithium quickly links up with oxygen to make lithium oxide, nitrogen to make lithium nitride, water to make lithium hydroxide, and so on.

Adding to this complexity, the particles that barrage the lithium surface include not only the hydrogen nuclei ejected from the plasma, but also neutral particles, called neutrons, formed during the fusion reaction. Further, the extreme heat can blister the inner wall of the chamber, resulting in a surface that is buckled, coarse and littered with lithium compounds.



Koel (right) and mechanical and aerospace engineering graduate student Ryan Sullenberger (left) use X-rays to blast electrons from the surface of a sample and measure their energies in this device, an X-ray photoelectron spectrometer. This information can reveal what happens to the lithium during fusion and help the researchers find ways to improve lithium liners in fusion reactor experiments.

To explore lithium and other inner wall surfaces, Koel established a new materials characterization lab at PPPL dedicated to surface analysis. The lab now spans two rooms and includes a total of five surface analysis instruments. And this summer he will expand his group at PPPL to include a new postdoctoral researcher and an undergraduate researcher.

"Surface chemists have learned a lot over the past 20 years about lithium, but most of the studies were done with pure lithium," Koel said. "We are moving into new territory by studying how plasma particles react with not just pure lithium but with all the other compounds it makes."

With his equipment, Koel and his team will be examining metallic lithium and lithium compounds and then working their way up to lithium liquid alloys. "Even in the vacuum conditions inside a fusion experimental chamber," said Koel, "molecules of water and air are present and collide to form compounds that completely cover the surface of the walls. Every gas molecule that collides with the wall will make a lithium compound."

The researchers will explore lithium's performance as a lining under plasma conditions in the Lithium Tokamak Experiment (LTX), a relatively small reactor nestled among offices on the second floor of one of PPPL's lab buildings. Led by Majeski with co-investigators Robert Kaita and Leonid Zakharov, both principal research physicists, and Thomas Kozub, an engineering and scientific staff member, the LTX is a smaller version of the lab's main experimental device, the National Spherical Torus Experiment, or NSTX.

Koel plans to study samples collected from the inner walls of the LTX and NSTX to see how lithium performs

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when surrounding a high-temperature plasma. In a typical experiment, researchers will place several lithium-coated wafers on the inner wall of the reactor vessel, fire up the LTX to produce plasmas, then shut it down and collect the wafers to be sent to Koel for analysis. Researchers are designing a special cart — complete with its own vacuum pump — that could be used to rush the samples down the hall from the LTX reactor to Koel’s lab. The challenge is to keep the samples isolated from air and under vacuum — the slightest trace of air or water vapor will ruin the experiment.

Using surface analysis equipment, Koel and his team, consisting of Koel and mechanical and aerospace engineering graduate student Ryan Sullenberger and chemistry graduate student Steven Wulfsberg, will study what happened to the top layer of atoms on the wafers. The equipment includes a machine that uses X-rays to blast electrons from the surface of a sample and catches them in a trap that looks like an upside-down soup bowl. By measuring the energies of these electrons, the device, called an X-ray photoelectron spectrometer, can reveal what happened to the lithium during plasma exposure to see whether it combined with hydrogen nuclei, formed lithium hydroxide or made other products.

“Koel’s experiments are a crucial addition to our understanding of how to design the fusion reactor’s inner wall,” Kaita said. “In the past, we just tried different materials as linings in our fusion experiments, and some worked better than others. We want to get to the point where we have an understanding of the complex physics and chemistry at the surface of the inner wall of the reactor.”


If the experiments are successful, the plasma fusion reactor of the future could sport a thin liquid lithium wall.

But because lithium is so light, the molten metal would stick to the surface rather than running down the walls. One concept for a future reactor involves constantly replenishing the liquid lithium wall using nozzles to emit a broad, uniform sheet of liquid, similar to a decorative “wall of water” fountain.

Using lithium, physicists at PPPL hope to increase the efficiency of fusion reactors, unleashing greater amounts of energy from smaller-sized plasmas. With current designs, plasma chambers must be massive if the fusion reaction is to release more energy than it consumes for heating and confining the plasma. A prototype fusion chamber known as ITER, which is being built in France to demonstrate that fusion is a viable energy source for the future, will stand three stories high.

Scientists hope that lithium, or another coating like it, could improve the heat containment enough that a relatively small plasma vessel, similar in design to the one on the second floor at PPPL, could generate energy more efficiently. “The hope is that with lithium or another inner wall coating,” said Majeski, “it will be possible to make a fusion reactor with longer running times and lower cost in a way that would ease the transition to commercial power use.”

Koel’s work at PPPL is funded by a PPPL Laboratory Directed Research and Development grant.

Princeton University has managed PPPL since its origins in 1951, when Professor Lyman Spitzer, a founder of the field of plasma physics, initiated the study of fusion at the University. The facility, which was officially named the Princeton Plasma Physics Laboratory in 1961, is one of 10 national science laboratories funded by DOE’s Office of Science. 

Anderson continued from page 1


I look forward to helping the lab fulfill its important scientific mission.”

As COO, Anderson will plan, direct and oversee Fermilab operations. He will assist the laboratory director with day-to-day laboratory management, help define the overall direction for the lab and its performance expectations and assess resource needs, priorities and allocation. Anderson will also serve a dual role as associate laboratory director for operations support, overseeing the 300 staff members in the Business Services, Facilities Engineering Services and Workforce Development and Resources sections.

“We are very fortunate that Jack Anderson is joining Fermilab,” said Director Pier Oddone. “He is well-known and well-respected by his peers at the laboratories, is

very enthusiastic about our laboratory and its mission and brings a compelling vision for the future of the lab.”

Anderson is very familiar with operations roles at DOE national laboratories. In addition to serving as an operations leader in his current role at Oak Ridge, he held several key management positions at Princeton Plasma Physics Laboratory. Jack currently serves on the PPPL Advisory Board.

“I have known Jack for many years in many different roles and I know that he will fit in extremely well at the laboratory,” said Chrisman, who became Associate Laboratory Director in 1984 and assumed the COO title in 2007. “He brings extraordinary skills and experience to Fermilab, and I am confident that I will leave the lab in excellent hands.” 

— Katie Yurkewicz (Fermi National Laboratory)

ESH&S Analyzes Safety Survey

Close to 75 percent of PPPL employees responded to the Safety Survey distributed electronically prior to the May 16 Safety Stand-down, indicating the staff's high level of interest in safety. The number of respondents was 342, which included 67 supervisors and 275 non-supervisors.

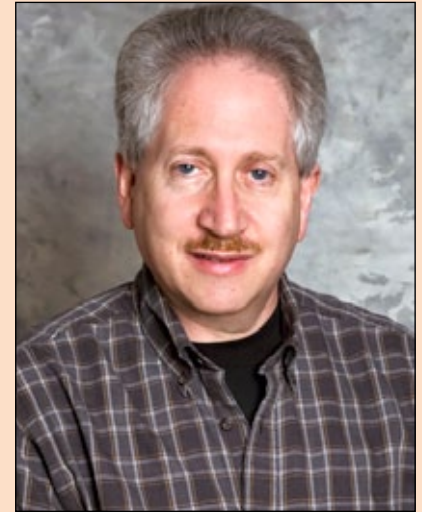
"I thought the response was outstanding," said Jerry Levine, Head of ESH&S at PPPL. "Not every question was applicable to every group, but generally I'm pleased with the survey and the response to it."

The ESH&S Department conducted the survey which was developed by the Indiana University of Pennsylvania to develop the questions. The Department, with help from the survey originator, is presently analyzing the results and plans to release the results to staff sometime this summer.

"We are going through the surveys and analyzing the answers so that we can learn as much as possible and make improvements to the safety culture here," Levine said.

Two surveys — one for supervisors and one for non-supervisors — were distributed electronically through a link in an email from PPPL Director Stewart Prager, who encouraged staff to participate. The survey for supervisors included 62 questions and the survey for non-supervisors included 66 questions.

It was the first time the Lab conducted a safety survey that centers on institutional safety culture. "This was geared more toward people's global view of safety at the Lab and within their Department or Division, and how employees feel about the safety environment, not just about the safety department," Levine said. The answers, he added, will reflect the local environment of the respondent, as well as the overall Lab environment in terms of safety.



Jerry Levine

The Laboratory will also be looking at how it compares to other facilities. A preliminary finding from the survey originator said PPPL performed well from a safety culture point of view in comparison to other facilities.

"We are actively working on analyzing the survey, and will share the results with staff as soon as they are tabulated, evaluated, and summarized," Levine said. ☞

U.S.-Japan Workshop on Magnetic Reconnection held at Princeton

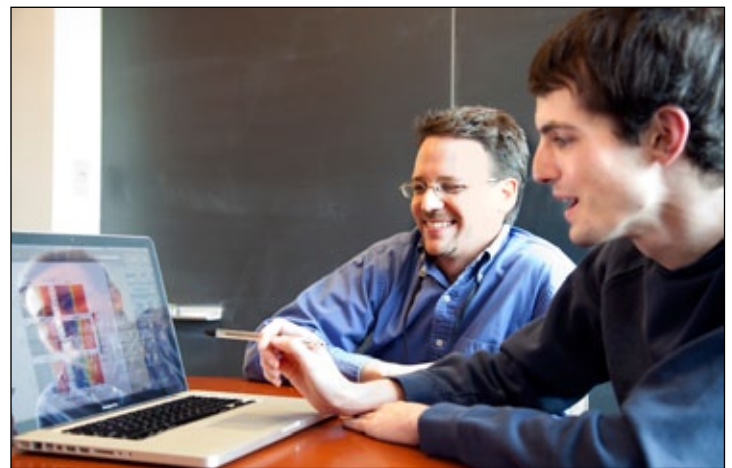
More than 70 researchers from around the world gathered at Princeton University May 23-25 for the 2012 U.S.-Japan Workshop on Magnetic Reconnection. PPPL physicist Hantao Ji chaired the international workshop, which was the twelfth since 1998 and the third to be held at Princeton. The event featured more than 55 papers, includ-

ing two presented by Ji and Masaaki Yamada, who directs PPPL's Magnetic Reconnection Experiment. ☞

— John Greenwald (PPPL)



PPPL physicist Masaaki Yamada (right) discussed the work of Akihiro Kuwahata, a graduate student at the University of Tokyo.



Post-doctoral fellow Seth Dorfman (right), who earned his Ph.D as a graduate student at PPPL last December, used a computer to show his work to Paul Cassak, a professor of plasma physics at the University of West Virginia.

EPA Honors PPPL for Electronics Reduction



PPPPL has received the 2011 WasteWise Gold Achievement Award from the U.S. Environmental Protection Agency (EPA) in the category of electronics reduction. The award recognizes the Laboratory's efforts in 2010, when it recycled 12 tons of electronics, 32 tons of outdated magnetic tapes, and more than 45 tons of non-PCB capacitors. These efforts prevented more than 1,200 metric tons of carbon dioxide equivalent. PPPL's Fran Cargill and Kyron Jones accepted the award during a ceremony held on April 27 in New York. In photo above, from left are Mayor Dana Redd of Camden, N.J., the keynote speaker for the awards ceremony, Cargill, Jones, and U.S. EPA Regional Administrator Judith Enck. A special thanks goes to PPPL's Matt Lawson, Jones, and the PPPL staff for their continual efforts to recycle and reduce waste. **PHOTO BY ROBIN HOLLAND, U.S. EPA.**

COLLOQUIUM

Ecological Lessons Learned 30 Years After Mount Saint Helens

VIRGINIA DALE

Oak Ridge National Laboratory

Wednesday, June 6

4:15 p.m. (Coffee/Tea at 4 p.m.)
M.B.G. Auditorium, Lyman Spitzer Building

Princeton University is Excited to Announce an EXCLUSIVE MEMBERSHIP OFFER.

Staff will receive up to a \$25 Sam's Club® Gift Card when they sign up for or upgrade to a new Sam's Club Plus® Membership or renew an existing Plus Membership by June 30, or, choose an Advantage or Business Membership and receive a \$10 Sam's Club Gift Card.



Go to
<http://www.princeton.edu/hr/benefits/worklife/samsclub.pdf>



PPPL Café Menu

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

MONDAY JUNE 4

TUESDAY JUNE 5

WEDNESDAY JUNE 6

THURSDAY JUNE 7

FRIDAY JUNE 8

COMMAND PERFORMANCE
CHEF'S FEATURE



FISH AND CHIPS WITH VEGETABLE



VEGETABLE LASAGNA



SOUTHERN FRIED CHICKEN



CREATE YOUR OWN... CRUNCHY BEEF TACOS



CHICKEN & SAUSAGE GUMBO OVER RICE

EARLY RISER

The XL Western Omelet with Home Fries

Cinnamon Apple Raisin Pancakes with Bacon

The Belly Buster Hoagie

Pork Roll, Egg, Potato, Pepper Jack, Onion Wrap

Fresh Baked Cinnamon Apple Bread

COUNTRY KETTLE

Hearty Chicken Vegetable

Turkey Chili

Cheese Bacon and Potato

Vegetarian Lentil

Cream of Mushroom

GRILLE SPECIAL

Pepperoni and Provolone Chicken Cheese Steak, Fries

Fat Cat w/Chicken Tender, Steak, Fries, Cheese w/ Rings

Pulled Pork Sandwich with Memphis Mustard Cole Slaw

Blue Cheese and Spinach Stuffed Burger, Onion Rings

Trenton Cheeseburger with Onion Rings

DELI SPECIAL

Classic Italian Hoagie

Toasted Ham and Provolone Cheese Hoagie

Louisiana Crab Salad on a Multi Grain Roll

Open Faced Corned Beef Reuben Melt

Waldorf Chicken Salad on a Multi Grain Roll

PANINI

Eggplant, Squash, Zucchini

Crispy Chicken, Red Pepper, Provolone

Texas Roadhouse Griller

Philly Cheese Steak

Turkey, Bacon, Pepper Jack, Tomato Chipotle Mayo Griller

MENU SUBJECT TO CHANGE WITHOUT NOTICE

[CLICK HERE FOR A PRINTABLE WEEKLY MENU](#)

WEEKLY

Editor: **Patti Wieser** ♦ Copy Editor/Graphic Designer: **Gregory Czechowicz**
Photographer: **Elle Starkman** ♦ Webmaster: **Chris Cane**

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Deadline for calendar item submissions is noon on Thursday. Other stories should be submitted no later than noon on Wednesday.

Send to: pwieser@pppl.gov ♦ Comments: comteam@pppl.gov ♦ PPPL WEEKLY is archived on the web at: <http://www.pppl.gov/ppplweekly.cfm>