

## At PPPL THIS WEEK

MON., DEC. 8

### Andlinger Center for Energy and the Environment Highlight Seminar Series

4:30 p.m. ♦ Computer Science  
Auditorium 104, Main Campus

Computational Identification of Materials  
for Solar Energy Conversion including  
Semiconductors for Water Splitting

David Ginley - National Renewable  
Energy Laboratory

### UPCOMING EVENTS

December 14

Last day to contribute to  
United Way

December 17

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

Industrialization of Nb<sub>3</sub>Sn conductor

Jeffrey Parrell - Oxford Instruments  
Superconductivity Technology

December 23

PPPL Holiday Luncheon

Noon ♦ LSB Lobby and Café



December 24-Jan. 2

Lab Closed - Holidays

January 14, 2015

PPPL's Records/  
Paper Shredding Event

9 a.m. - 4 p.m. ♦ Receiving 3



## Monumental effort

# How a dedicated team completed a massive beam box relocation for the NSTX upgrade

By John Greenwald



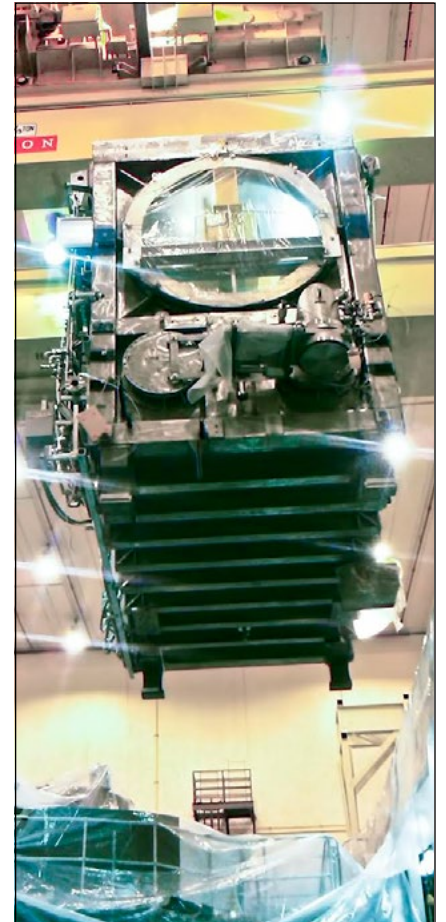
**Y**our task: Take apart, decontaminate, refurbish, relocate, reassemble, realign and reinstall a 75-ton neutral beam box that will add

a second beam box to the National Spherical Torus Experiment-Upgrade (NSTX-U) and double the experiment's heating power. Oh, and while you're at it, hoist the two-story tall box over a 22-foot wall.

Members of the "Beam Team" faced those challenges when moving the huge box from the Tokamak Fusion Test Reactor (TFTR) cell to the NSTX-U cell. The task required all the savvy of the PPPL engineers and technicians who make up the veteran team. "They're a tight-knit group that really knows what they're doing," said Mike Williams, director of engineering and infrastructure and associate director of PPPL and a former member of the team himself.

The second box is one of the two major components of the upgrade that will make NSTX-U the most powerful spherical tokamak fusion facility in the world when construction is completed early next year. The new center stack that serves as the other component will double the strength and duration of the magnetic field that controls the plasma that fuels fusion reactions.

*continued on page 2*



An overhead crane lifts the massive beam box into the NSTX-U test cell.

Photo by Mike Viola

# Physicist Ilya Dodin honored with new APS award

By Jeanne Jackson DeVoe

**I**t's fitting that Theory Department physicist Ilya Dodin was the first to receive the American Physical Society's Thomas H. Stix Award for Outstanding Early Career Contributions to Plasma Physics Research.

Dodin, honored at the annual APS-Division of Plasma Physics meeting in New Orleans in October, was recognized for his research on waves in plasmas. The award is named for the late Princeton University Physics Professor Thomas H. Stix, a pioneering plasma physicist at PPPL and first director of the Princeton Program in Plasma Physics. Stix, who died in 2001, wrote one of the most influential books about waves in plasmas.

There are numerous different types of waves in plasma, an electrically charged gas. Dodin's work devising mathematical formulas that can accurately describe how they operate may provide the key to learning how to control them.

*continued on page 4*



Ilya Dodin

## Inside...



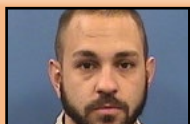
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# Beam Box

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The two new components will work together hand-in-glove. The stronger magnetic field will increase the confinement time for the plasma while the second beam box performs double-duty. Its beams will raise the temperature of the plasma and will help to maintain a current in the plasma to demonstrate that future tokamaks can operate in a continuous condition known as a “steady state.” The second box is “an absolutely crucial part of the upgrade,” said Masayuki Ono, project director for the NSTX-U.

## Work began in 2009

Work on the second beam box began in 2009 when technicians clad in protective clothing dismantled and decontaminated the box as it sat in the TFTR test cell. While the box had used radioactive tritium to heat the plasma in TFTR, no tritium will be used in NSTX-U experiments.

The decontamination took a huge effort, said Tim Stevenson, who led the beam box project. Workers wearing protective garb used cloths, Windex and sprayers with deionized water to clean every part of the box by hand, and went over each part as many as 50 separate times. The cloths were then packaged and shipped to a Utah radiation-waste disposal site.

Next came the task of moving the beam box and its cleaned and refurbished components out of the TFTR area and into the NSTX-U test cell next door. But how do you get something so massive to budge?

The Beam Team solved the problem with air casters, said Ron Strykowski, who heads the NSTX-U upgrade program. Using a ceiling crane, workers lifted the box onto the casters, which floated the load on a cushion of air just above the floor, enabling forklifts to tow it. Technicians then removed some hardware from the large doorway between the two test cells so the beam box could get through.

The doorway led to a section of the NSTX-U area that is separated from the vacuum vessel by a 22-foot-high shield wall — a barrier too high for the box and its lid to clear when suspended by sling from a crane. Workers surmounted the problem by first lifting the box and then the lid, which had been removed during the decontamination process. The parts cleared the wall and sailed over the vacuum vessel before coming to rest on the test cell floor. The vessel itself was

wrapped in plastic to prevent contamination from any tritium that might still be in the box and the lid as they swung by overhead.

## “Like rebuilding a ship in a bottle”

The beam box was now ready to be reassembled and reinstalled. But carving out room for all the parts and equipment, including power supplies, cables, and cooling water pipes, proved difficult too. “There were so many conflicting demands for space that it was like rebuilding a ship in a bottle,” Stevenson said, citing a remark originally made by engineer Larry Dudek, who heads the center stack upgrade project. “There was no existing footprint,” Stevenson added. “We had to make our own footprint.”

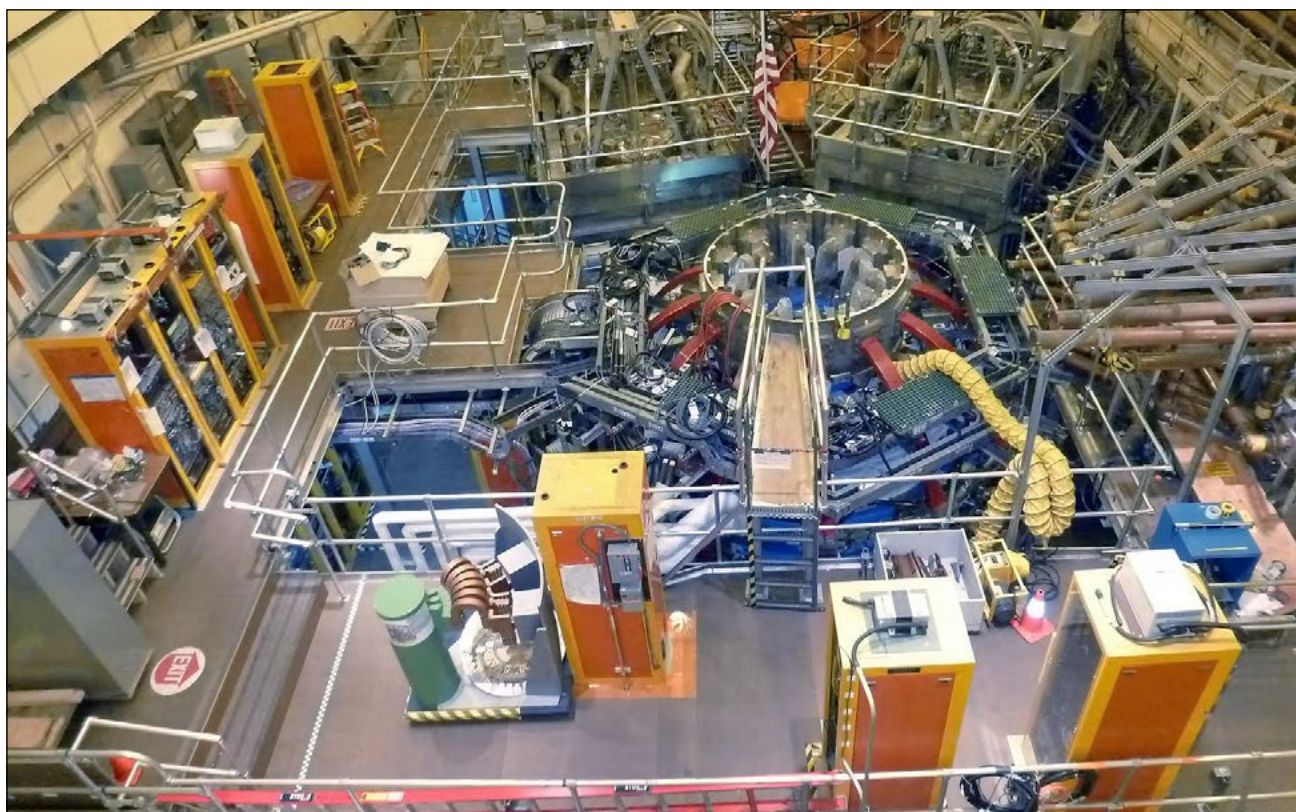
Technicians needed to cut a port into the vacuum vessel for the beam to pass through. But the supplier-built unit that connected the box to the vessel left too much space between the unit and this new port, requiring the Welding Shop to fill in the gap. “The Welding Shop saved the port,” Stevenson said.

Still another challenge called for ensuring that the beam would enter the plasma at precisely the angle that NSTX-U specifications required. Complicating this task was the test cell’s uneven floor, which meant that the position of the box also had to be adjusted. To align the beam, engineers used measurements to derive a bull’s-eye on the inside of the vessel; technicians then used laser technology to zero in on the target. The joint effort aligned the beam to within 80 thousandths of an inch of the target.

## Installing power supplies

Left to complete was installation of power supplies, a task accomplished earlier this year. The job called for bringing three orange high-voltage enclosures — the source of the power — up from a basement area and into the test cell through a hatch in the floor. Taken together, the two NSTX-U beam boxes will have the capacity to put up to 18 megawatts of power into the plasma, enough to briefly light some 20,000 homes.

When asked to name the greatest challenge the project encountered, Stevenson replied, “The whole thing was fraught with challenges and difficulties. It was a monumental team effort that took a great deal of preparation. And when it was showtime, everyone showed up.”



Overview of the NSTX-U test cell with the second neutral beam box installed at upper left.

Photo by Scott Gifford

## PPPL Provides Mutual Aid Support to Plainsboro



By Fran White - Head, PPPL Site Protection, ESH&S

Virtually every day, PPPL Emergency Services Unit (ESU) personnel provide mutual aid support to our community. Last year, we had some 250 such calls for assistance. Most of the calls involve medical emergencies but on occasion our team provides support at structure fires.

Sept. 24 was such an occasion. Mercer County Central contacted ESU at 5:27 p.m. and requested the ESU respond to a structure fire on Hampshire Drive in Plainsboro.

The four-person team was led by Capt. Howard Caruso, assisted by Site Protection Division Emergency Planning and Training Coordinator Jamie Dunnigan, and included Acting Driver/Operator Chris Pietsch and Officer Jeff Chaplin. Upon arrival, they found a large fire in a second-floor apartment that was quickly spreading to adjacent apartments. Over the next four hours, they teamed with other Plainsboro Fire crews to battle this two-alarm fire. ESU personnel made several building entries in order to search the building and to assess the tactical requirements necessary for fighting the fire. The ESU platoon, along with Plainsboro crews, conducted both offensive and defensive fire-fighting operations as the situation progressed.

Both Caruso and Dunnigan also monitored the activities and safety of the PPPL personnel, with Dunnigan sending frequent updates and pictures to Site Protection Division (SPD) on the status of the team and the progress of their efforts.

### Back at PPPL

Meanwhile, back at PPPL, Officer Robert Walker, the ESU Communications Officer, kept track of the on-

scene crew while monitoring alarms and other activities at PPPL. Capt. Kevin Rhoades, who was off duty at the time, returned to PPPL to ensure that the campus was patrolled until the platoon returned to the site.

Four hours later, at 9:45 p.m., the fire was safely extinguished and the ESU team returned to PPPL. But there was no rest for the weary — several additional hours of cleanup and servicing by the platoon was necessary to prep the fire engine and equipment for the next emergency assignment.

### Rendering assistance

Day in and day out, the actions of our officers help to protect life and property in our community by rendering assistance to our local emergency responders. Those efforts have not gone unnoticed. "Over the past few decades we have enjoyed a solid working relationship with PPPL ESU," said James Pedley, Chief of the Plainsboro Fire Department. "You have assisted us on numerous community events and incidents, many of which were major in scope, and most recently with the two-alarm fire in a multi-family housing development. You also respond to calls at the local skilled nursing and assisted-living facility, the hospital, and provide backup when we are committed to other calls or events. The relationship also extends beyond incidents as we frequently work together on response plans to enhance safety for major projects and events."

Our support of Plainsboro has the added benefit of helping the SPD team build and maintain response skills so the officers are fully prepared to respond professionally and effectively to any emergencies at PPPL.

Great job! 🍷



PPPL's Emergency Services Unit members help to put out a house fire in Plainsboro after responding to a mutual aid call.

Photo by Jamie Dunnigan

# Ilya Dodin

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Dodin, who splits his time between the University and PPPL, uses Stix's textbook "The Theory of Plasma Waves" as a resource in a graduate course he teaches. The course, "Plasma Waves and Instabilities," was also taught by Stix for many years. The course is compulsory for all graduate students in plasma physics, including Dodin, who took the course himself in 2000.

"I appreciate Ilya being the first recipient of the Thomas Stix award," said Amitava Bhattacharjee, head of the Theory Department at PPPL. "It's especially appropriate that he has won the prize in an area of work for which Professor Stix was celebrated."

"I was really surprised and honored and I was very happy," Dodin said after receiving the award during the conference. "I have recently been working with students a lot and this is very inspiring."

## From graduate student to "valued colleague"

A native of the city Nizhny Novgorod in Central Russia, Dodin graduated from the Advanced School of General and Applied Physics at Nizhny Novgorod State University, where he received bachelor's and master's degrees. He arrived as a graduate student at PPPL and Princeton University's Department of Astrophysical Sciences in 2000 and has never left. Dodin and his wife Eugenia Dodin, a pharmacist at University Hospital in Newark, live in Cranford, N.J.

Nat Fisch, director of the Program in Plasma Physics, was Dodin's thesis advisor. Fisch said his former student is now a "valued colleague." "He now teaches me more than I teach him" Fisch said. "Besides teaching me, Ilya Dodin has gotten glowing reviews from students taking his class precisely because he brings his own research into the classroom. He teaches students the mathematical formulas he has developed that describe plasma waves. I think students appreciate when you're teaching a class and you bring a subject to life and point out not just what people know but how people use these tools in figuring out what they don't know."

Fisch said Dodin is not only "invaluable" to PPPL's physics program and a brilliant researcher. "He also has a nice way about him in approaching problems in physics together with colleagues. He has a gentle way in dealing with people."

A large variety of waves occur in plasma. The magnetic fields that confine the plasma in donut-shaped tokamaks, which are designed for controlled nuclear fusion experiments, allow the plasma to support an even greater variety of waves. Waves at radio frequency (RF waves) are injected into the plasma, heating it to 100 million degrees centigrade or more to create temperatures conducive to nuclear fusion. Still other waves can disrupt plasmas.

## Formulas describe the behavior of waves

Dodin's formulas describe the behavior of waves even as the parameters governing them change. "By putting equations in a simplified but robust form, you can see dynamics that are much harder to see from all-inclusive equations," Dodin said.

"Some of the questions that drive Ilya Dodin are the subtle ones we've been asking ourselves," Fisch said. "What is the momentum in a wave? 'What happens to waves when a plasma is compressed?'; 'Can you construct a wall out of a wave in which some particles bounce off and some go through?' and 'Can you control waves with other waves?'"

Fisch has collaborated with Dodin over many years. "We had posed together a number of questions," he said, "but the sophisticated methods to solve them are really Ilya Dodin's own invention. It was Ilya's own general approach that enabled us to reach solutions rigorously, and now Ilya has himself taken this approach much, much further than that."

"The formulas he derived allow Ilya to look at waves kind of like mathematical objects and that unique perspective allows him insights into the behavior of waves in general," Fisch said.

Dodin's formulas could apply to essentially all types of waves from light waves to sound waves. "The work that I've been doing is about learning how to make the approximations right for the general theory of these waves," Dodin said. "We also apply it to specific waves too, but the main point at this stage is to get the fundamental theory right."

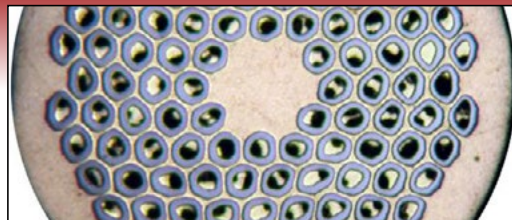
Dodin's research could provide a more efficient way of analyzing waves found in fusion energy experiments like PPPL's National Spherical Torus Experiment and ITER, the international fusion experiment in Cadarache, France. The formulas could eventually lead to codes that could be used in simulations aimed at controlling plasmas in fusion experiments. "If the code is more efficient you can experiment with it more and eventually you can predict the behavior of waves better. That can also lead to better ways of launching waves in a tokamak," Dodin said.

## Applications to other physics fields

The possibility of applying Dodin's research to all kinds of waves has attracted the attention of researchers in other physics fields. For example, Dodin has been invited to talk to a group of atomic physicists. Because of his work on the very basic mathematical aspects of classical waves, he was also asked recently to write a chapter on waves in a book on the foundations of quantum mechanics. "I realized there are important connections with quantum mechanics," Dodin said. "Quantum waves behave in a very similar manner to waves we have in plasma and there may be a lot of potential in bridging the quantum and plasma theories."

Fisch predicts that Dodin's formulas will have an even greater impact in the future as more physicists become aware of them. "The greatest part of the impact is yet to come when people will begin to adopt these methods," he said. 📍

## COLLOQUIUM



### Industrialization of Nb<sub>3</sub>Sn conductor

Jeffrey Parrell

Oxford Instruments Superconductivity Technology

Wednesday, December 17

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

# STEM Talk at Stuart Country Day School

Atiba Brereton, a diagnostic engineer at PPPL, gave a presentation on engineering as part of a STEM (science, technology, engineering, and mathematics) event at Stuart Country Day School of the Sacred Heart in Princeton. Brereton also gave hands-on plasma demonstrations when he spoke to third graders on Nov. 17 and to second graders on Nov.

19. The second graders included Mykaela Sanders, 7, at left in photo below, the daughter of PPPL's Chandra Sanders. She is posing with Brereton who is leaning on a plasma demonstration that shows how a metal ring reacts with a central magnet. At left, one of many thank-you notes from the second graders to Brereton.

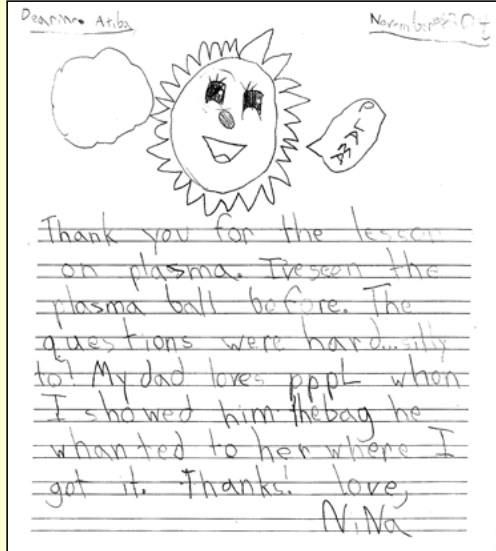


Photo by Chandra Sanders.

## SPD • TIP • OF • THE • WEEK

### COOKING SAFETY: Part III of III

**FACT:** Over 500,000 scald burns occur annually in the United States. The two highest risk populations are children under the age of 5 and adults over 65.

Have a kid-free zone while you are cooking. Maintain a 3-foot zone around your cooking area to keep children safe from hot spills and burns.

- Maintain a 3-foot zone around areas where hot foods are prepared, stored and carried.
- Never hold a child while cooking, drinking or carrying hot food or hot liquids.
- Use the back burners on your stove to avoid a child reaching the hot food or liquid.
- Continuous and adequate supervision of children in the kitchen is imperative to their safety as well as yours. Distractions can cause injury.

PPPL TRAVEL TIPS

### Change in United Airlines Through-check baggage policy

United Airlines is changing its policy for through-checking baggage when a customer has two separate tickets. Starting March 1, United will through-check bags only when the secondary ticket is on the following airlines: United and United Express and Star Alliance partner airlines.

Passengers who do not have tickets on one of those airlines must retrieve their bags at their first destination and check them into the baggage check for the second airline. Please contact the travel office [travel@pppl.gov](mailto:travel@pppl.gov) with any questions.

## Registration Open for Young Women's STEM Conference

You can help inspire the next generation of female scientists, engineers, and mathematicians by encouraging young women you know to attend the Young Women's Conference in Science, Technology, Engineering and Mathematics, hosted by PPPL on March 19.

The conference for seventh-to-tenth grade girls at Princeton University's Frick Chemistry Building includes hands-on science activities by women in the STEM fields, tours of Princeton's science laboratories, and lectures by prominent women in the field.

PPPL employees can register at least three young women by filling out the form [here](#). Members of the public can also register at [https://pppl.princeton.edu/ywc\\_information](https://pppl.princeton.edu/ywc_information). The deadline is Feb. 13. Please contact Deedee Ortiz, [dortiz@pppl.gov](mailto:dortiz@pppl.gov)

## Please contribute to United Way by Dec. 14

Please help numerous charitable organizations in the Mercer County area by contributing to United Way Mercer County. Employees can make contributions by cash or check or through payroll deductions through Dec. 14. Princeton University will contribute an additional 15 percent for all gifts through payroll deductions or 10 percent for all gifts by cash or check.



## Donate food to feed the hungry

PPPL will collect food and personal hygiene items for The Mercer Street Friends Food Bank in the LSB Lobby through Dec. 17 as part of a University-wide effort. The food bank distributes food to hungry people in the greater Mercer County area through nearly 50 pantries, shelters, and soup kitchens. The most needed items are:

- Canned salmon, tuna or chicken
- Low sodium soups
- Fruit cocktail in 100 percent juice
- Shelf-stable fat free milk such as Parmalat
- Whole grains
- Beans, nuts, crackers
- Peanut butter
- Gravy, herbs, and spices
- Vinegar & mustard
- Canned vegetables
- Salad dressing
- Dish and laundry soap
- Soaps, body wash, shampoo and conditioner
- Deodorants & feminine products



No open packages or glass containers please!

More information about the Princeton University Holiday Outreach programs is available [here](#).



Donation box is located in the LSB lobby.

## PPPL Welcomes New Employees!



**ELLIOTT BAER**  
Electrical Technician  
Engineering



**DAVID PRYOR**  
Project Engineer  
Engineering



**GEORGE ROTH**  
Procurement Specialist  
Business Operations



**ROMAN ROZENBLAT**  
Software Developer  
Information Technology

## BROCK Café Menu 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.

— MARK GAZO, *Chef Manager*

	MON. 8 DEC.	TUE. 9 DEC.	WED. 10 DEC.	THU. 11 DEC.	FRI. 12 DEC.
<b>COMMAND PERFORMANCE CHEF'S FEATURE</b>	 <b>Spaghetti &amp; Meatballs served with Garlic Bread</b>	 <b>Create Your Own Burrito Bar</b>	 <b>Create Your Own Omelet Bar with Home Fries</b>	 <b>Chicken Fried Rice served with an Egg Roll</b>	 <b>Tilapia Francaise served with Rice and Vegetables</b>
<b>EARLY RISER</b>	Grilled Cheese with Ham, Fried Egg & Cheese	Spanish Omelet	Egg White Omelet with Broccoli, Spinach & Potatoes	Pumpkin Cranberry Pancakes	Denver Scramble-Scrambled Eggs
<b>COUNTRY KETTLE</b>	Turkey Corn Chowder	Broccoli & Cheddar	Chicken Rice	Loaded Potato Soup	Beef Barley
<b>GRILLE SPECIAL</b>	Jersey Burger with Bacon, Onions, Mushrooms & Cheese	Kielbasa & Sauerkraut Torpedo	Chicken Finger Parmesan Hoagie	Oven-Fried Chicken BLT Melt with Smoked Bacon	Classic Tofu Reuben on Rye
<b>DELI SPECIAL</b>	Veggie Burger with Cottage Cheese & Fruit Salad	Turkey & Cranberry Flatbread	Ham & Salami Hoagie	Tuna Avocado Club	Apple Cranberry Chicken Salad on a Kaiser Roll
<b>PANINI</b>	Grilled Chicken Breast with Ham, Swiss, Tomato & Honey Mustard	Tuna Salad with Artichokes & Garbanzo Spread	Turkey on French Bread with Jalapenos & Cheddar Cheese	Fried Zucchini Parmesan Torpedo	Roast Beef & Swiss Cheese with Tomato on a Kaiser Roll

MENU SUBJECT TO CHANGE WITHOUT NOTICE

 VEGETARIAN OPTION

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

## WEEKLY

Editor: **Jeanne Jackson DeVoe** ♦ Layout and graphic design: **Gregory J. Czechowicz**  
Photography: **Elle Starkman** ♦ Science Editor: **John Greenwald** ♦ Webmaster: **Chris Cane**

The PPPL WEEKLY is published by the [PPPL Office of Communications](#) on Mondays throughout the year 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](mailto:commteam@pppl.gov) ♦ PPPL WEEKLY is archived on the web at: <http://w3.pppl.gov/communications/weekly/>.