

## Calendar of Events

### THIS WEEK

**MONDAY, SEPT. 5**

**Labor Day**  
Laboratory closed

### UPCOMING

**WEDNESDAY, SEPT. 14**

**Princeton University classes begin**

**PPPL Colloquium**  
4:15 p.m. ♦ MBG Auditorium  
[Spacetraveler's Manifesto:  
The Other-Worldly Career  
of Freeman Dyson](#)  
Dr. Phil Schewe, University of Maryland

**SATURDAY, SEPT. 17**

**Community and Staff Day**  
3:30 p.m. ♦ Princeton University  
[See page 7 for details.](#)

**TUESDAY, SEPT. 27**

**Tour Guide Meeting**  
10-11 a.m. ♦ MBG Auditorium  
[See page 6 for details.](#)

**FRIDAY, OCT. 7**

**American Red Cross Blood Drive**  
8 a.m.-1 p.m. ♦ American Red Cross  
Bloodmobile, Lower End Parking Lot

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## High-performance software project is in development

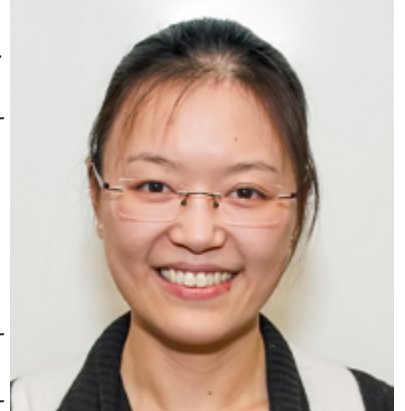
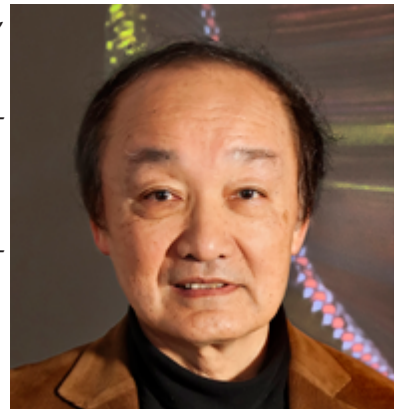
By John Greenwald

**P**rincenton University and the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) are participating in the accelerated development of a modern high-performance computing code, or software package. Supporting this development is the Intel Parallel Computing Center (IPCC) Program, which provides funding to universities and laboratories to improve high-performance software capabilities for a wide range of disciplines.

The project updates the GTC-Princeton (GTC-P) code, which was originally developed for fusion research applications at PPPL and has evolved into highly portable software that is deployed on supercomputers worldwide. The National Science Foundation (NSF) strongly supported advances in the code from 2011 through 2014 through the "G8" international extreme scale computing program, which represented the United States and seven other highly industrialized countries during that period.

Heading the new IPCC activity for the University's Princeton Institute for Computational Science & Engineering (PICSciE) is William Tang, a PPPL physicist and PICSciE principal investigator (PI). Working with Tang is co-PI Bei Wang, Associate Research Scholar at PICSciE, who leads this accelerated modernization effort. Joining them in the project are co-PIs Carlos Rosales of the NSF's Texas Advanced Computing Center at the University of Texas at Austin and Khaled Ibrahim of the Lawrence Berkeley National Laboratory.

The current GTC-P code has advanced understanding of turbulence and confinement of the superhot plasma that fuels fusion reactions in doughnut-shaped facilities called tokamaks. Understanding and controlling fusion fuel turbulence is a grand challenge of fusion science, and great progress has been made in recent years. It can determine how effectively a fusion reactor will contain energy generated by fusion reactions, and thus can



Co-principal investigators  
William Tang and Bei Wang.  
(Elle Starkman)

[continued on page 2](#)

## New runaway electrons center is led by PPPL and Princeton University

By John Greenwald

**R**unaway electrons, a searing, laser-like beam of electric current released by plasma disruptions, could damage the interior walls of future tokamaks the size of ITER, the international fusion experiment under construction in France. To help overcome this challenge, leading experts in the field have launched a multi-institutional center to find ways to prevent or mitigate such events.

"This is like a strike force to solve the problem and we need to get it right," said physicist Dylan Brennan of PPPL and Princeton University. "It's very clear that runaways will be a problem," said Brennan, who with Xianzhu Tang of Los Alamos National Laboratory is co-lead principal investigator. "The goal is to take different scenarios for runaway electrons and come up with a recipe for solving them."

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# PPPL, DOE and Princeton University officials sign declaration of cooperation

By Jeanne Jackson DeVoe



Signing the declaration of cooperation on Aug. 8 were, left to right, Stewart Prager, PPPL's director; Pete Johnson, the Princeton Site Office manager; and Dave McComas, the Princeton University vice president for PPPL.

Representatives from the Princeton Plasma Physics Laboratory (PPPL), Princeton University and the U.S. Department of Energy's Princeton Site Office (PSO) signed a declaration on Aug. 8 committing them to working together to "serve the public interest in delivery of world-class science, supported by excellence in engineering, management, operations, and community service."


This type of agreement, an industry best practice, declares each institution's commitment to carrying out PPPL's mission "in alignment with the Department's management principles," and specifies the role of each in carrying out the mission. The declaration affirms that each partner has a distinctive role that is respected by others. These roles include contractor assurance system principles to improve Laboratory mission delivery.

"The success of the Lab depends crucially upon the DOE site office, Princeton University and PPPL working in concert and in collegial partnership toward our common goals," said

Stewart Prager, PPPL's director. "Working together will ensure the Lab functions smoothly to produce pioneering science."

The declaration is an additional commitment that supplements the contract, which was signed in 2013 and extends through 2018. It demonstrates that the commitment goes beyond the contract and serves as a value-based framework for the relationship between the organizations, in order to achieve mutually beneficial results. The last such declaration was signed in 2012.

"It's a one-page document that says we're all going to work together," Pete Johnson, the Princeton Site Office manager, said of the new declaration.

"This is a vision document," said Dave McComas, the Princeton University vice president for PPPL. "It's a joint declaration with the intention that we step out of all those details and we talk about what really matters to all of us, and working together is the only way to really get it right." 

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## High-performance software

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strongly influence the eventual economic attractiveness of a fusion energy system. Further progress on the code will enable researchers to study conditions that arise as tokamaks increase in size to the enlarged dimensions of ITER — the flagship international fusion experiment under construction in France.

Through the IPCC, Intel will provide access to systems for exploring the modernization of the code. Included will be clusters equipped with the most recent Intel "Knights Landing" (KNL) central processing chips.

The upgrade will become part of the parent GTC code, which is led by Prof. Zhihong Lin of the University of California, Irvine, with Tang as co-PI. That code is also being modernized and will be proposed, together with GTC-P, to be included in the early science portfolio for the Aurora supercomputer. Aurora will begin operations at the Argonne Leadership Computing Facility, a DOE Office of Science User Facility at Argonne National Laboratory, in 2019. Powering Aurora will be Intel "Knights Hill" processing chips.

Last year, the GTC and GTC-P codes were selected to be developed as an early science project designed for the Summit supercomputer that will be deployed at Oak Ridge Leadership Computing Facility, also a DOE Office of Science User Facility, at Oak Ridge National Laboratory in 2018. That modernization project differs from the one to be proposed for Aurora because Summit is being built around architecture powered by NVIDIA Volta graphical processing units and IBM Power 9 central processing chips.

Moreover, the code planned for Summit will be designed to run on the Aurora platform as well.

The two new machines will boost U.S. computing power far beyond Titan, the current leading U.S. supercomputer at Oak Ridge that can perform 27 quadrillion — or million billion — calculations per second. Summit and Aurora plan to perform some 200 quadrillion and 180 quadrillion calculations per second, respectively. Said Tang: "These new machines hold tremendous promise for helping to accelerate scientific discovery in many application domains, including fusion, that are of vital importance to the country." 



# PPPL'ers credited for an outstanding TOFE conference

By Jeanne Jackson DeVoe

PPPL organizers and attendees of the 2016 Technology of Fusion Energy (TOFE) conference in Philadelphia said the event was a huge success due in large part to the work of more than a dozen PPPL'ers.

The American Nuclear Society's four-day conference at the Sheraton at Society Hill brought together some 180 engineers, scientists, and students from national laboratories and institutions across the United States and around the world, including China, Japan, South Korea, France, Germany, the United Kingdom, Canada, and Russia.

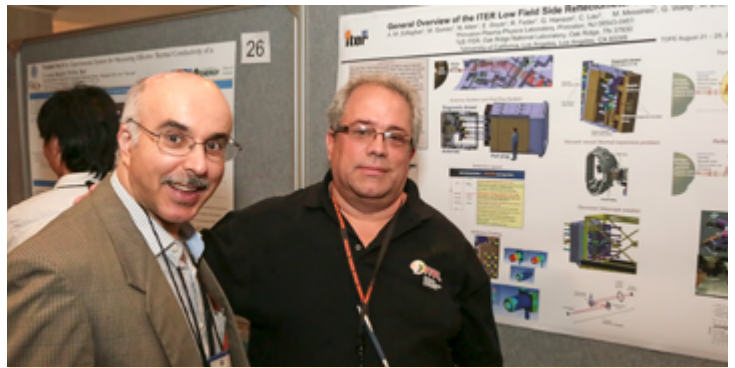
The event was chaired by Adam Cohen, deputy under secretary for science and energy at the U.S. Department of Energy and PPPL's former deputy director of operations, along with Susana Reyes, of Los Alamos National Laboratory and Arnie Kellman, of General Atomics. Keith Rule, an environmental project engineer at PPPL, was the organizing and finance chair and planned the event for the past two years with key support by Environmental Scientist Leanna Meyer and Environmental Engineering Assistant Mark Hughes, both of PPPL.

"The conference came together seamlessly due to all the back office stuff going on," said Charles Gentile, the technical program chair, who reviewed presentations and will review papers accompanying the presentations. "You wouldn't know there was a staff of people coming together on every talk."

The conference featured more than 200 presentations, including 12 plenary sessions and nearly 100 poster sessions. Several PPPL'ers gave talks including a talk on "Fusion Nuclear Science Facility Overview, Physics Assumptions and Operating Space," by engineer Charles Kessel. Physicist Devon Battaglia gave an overview of the National Spherical Torus Experiment-Upgraded and Jonathan Menard, program director for NSTX-U, discussed spherical tokamaks as the model for the next fusion



Madeline Vorenkamp, a mechanical engineering student at the University of San Diego; Lauren Garrison, a researcher at Oak Ridge National Laboratory, and Karla Hall, a graduate student at the University of Wisconsin-Madison, tour NSTX-U.



Ali Zolfaghari and Mike Gomez at the poster session.

experiment. Hutch Neilson, head of advanced projects, led the final plenary session on, "Toward Improved Stellarators: Future Directions for U.S. Research." In addition to the talks, Gentile chaired a fusion technology session, Rule chaired a "Safety Accident Analysis" session, and physicist Yhu Zhai chaired a session on "In-Vessel Components."

Rule noted that the sessions were well attended through the very last day. "A number of people said they were impressed by the breadth and quality of the presentations," Rule said.

Some 30 students attended the conference and several presented posters in a session chaired by PPPL's Deedee Ortiz. Physicist Alex Nagy, PPPL's deputy head of DIII-D off-site research, chaired the Sponsors and Exhibits Committee.

Organizers chose Philadelphia as a venue in part because of its proximity to PPPL, Rule said. Al von Halle, head of PPPL's Electrical Engineering Division, organized a tour by several PPPL engineers for some 70 people attending the conference. The scientists and engineers took buses to PPPL for a tour that included a visit to the National Spherical Torus Experiment-Upgraded (NSTX-U) and the NSTX-U Control Room. The tour also visited sites of interest to engineers: the field power conversion building, which provides electrical power to the NSTX-U magnets, and the neutral beam conversion building, which provides high-voltage pulses to the NSTX-U neutral beams.

Karla Hall, a graduate student at the University of Wisconsin-Madison studying materials science and engineering physics, said she enjoyed seeing the high bay where TFTR was once located and seeing NSTX-U in person. "I've never been up close to something this large," she said. "This is a large facility."

"I'm really glad I came," said another tourgoer, Hamid Ouroua, from the University of Texas. "I'm a plasma physicist so I've known about this facility for a very long time, so when I got the chance I said, 'I'm going to do it!'"

[continued on next page](#)



Stewart Prager, PPPL's director, speaks at the podium. Left to right: the three general chairs of the TOFE conference: Arnie Kellman, of General Atomics; Susana Reyes, of Lawrence Livermore National Laboratory; and Adam Cohen, deputy under secretary for science and energy at the U.S. Department of Energy and PPPL's former deputy director for operations; Keith Rule, an environmental project engineer at PPPL, who was the organizing and finance chair, and Arnie Lumsdaine, of Oak Ridge National Laboratory, the Fusion Energy Division chair.



# TOFE

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The visitors had dinner in PPPL's cafeteria and received a custom-made coaster before leaving PPPL. Lena Scimeca and Drina Duryea coordinated the dinner and refreshments.

PPPL's Keith Erikson, who chaired the Local Organizing Committee, organized social events, and helped out with the tour and a banquet on Thursday evening. Patricia Devine, an architectural engineer at Princeton University donated an entire week of her time to planning and performing companion tours of Philadelphia. PPPL photographer Elle Starkman took photos throughout the conference, assisted by graduate student Jacob Schwartz. Starkman put together a slide show of candid photos of presenters for the banquet.

Other PPPLers working on the conference included Leanna Meyers, Kathleen Lukazik, Ana Marie Datuin, and Mark Hughes. Jeanne Jackson DeVoe and Raphael Rosen helped with tours. Tour guides were Al von Halle, Larry Dudek, Tim Stevenson, Ray Camp, Steven DePasquale, and Atiba Brereton. 📷

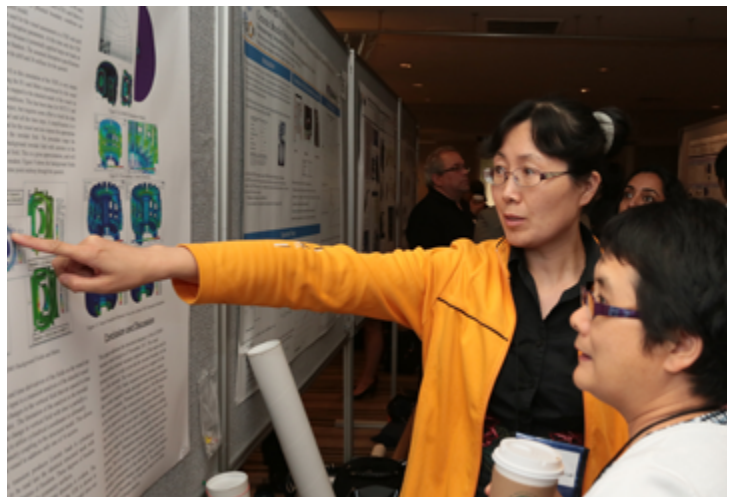
Photos by Elle Starkman.



Neway Atnafu, a project engineer at PPPL, with Leanna Meyer, an environmental engineer at PPPL who helped organize the conference.



PPPL's Ana Marie Datuin and organizer Keith Rule at the conference.

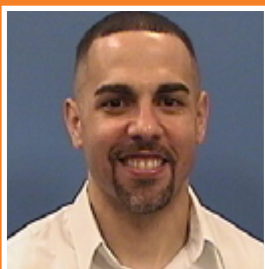


PPPL engineers Wenping Wang, left, and Han Zhang at the poster session.



PPPL engineer Tim Stevenson, left, leads a tour of NSTX-U.

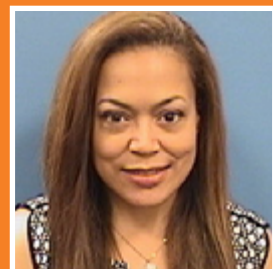
## PPPL Welcomes New Employees!



**RICARDO MARQUEZ**  
Human resources assistant  
Human Resources



**FARRA ROSKO**  
Executive assistant  
Office of the Director



**PAMELA SERAI**  
Senior administrative assistant  
Office of the Director

# Tour Guides and Tour Hosts Wanted!

We are looking for engineers and physicists who are willing to donate a couple of hours of their time each month to show off the Laboratory to students, clubs, and local people who are interested in science. Our growing tour program is a great way to educate the community about fusion energy and the Lab's mission and to let them know about the cutting-edge research taking place at PPPL.

Please plan to come to our tour meeting. See page 6 for details.

Please email Jeanne Jackson DeVoe, [jjackson@pppl.gov](mailto:jjackson@pppl.gov), to volunteer.

## Runaway electrons

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### Causes and solutions for runaway electrons

The project, called "Simulation Center for Runaway Electron Avoidance and Mitigation," will combine simulations and data from worldwide experiments to explore the causes and solutions for runaway electrons. Members are from nine U.S. universities and national laboratories. Participants include the Oak Ridge, Lawrence Berkeley and Los Alamos national laboratories, the universities of Texas, California-San Diego and Columbia University and General Atomics in San Diego. Support totals \$3.9 million over two years from the DOE's Office of Science.



Dylan Brennan

Runaway electrons are relativistic—they travel at nearly the speed of light. To control these particles, researchers must utilize equations derived from Einstein's special theory of relativity, which describes the effect of relativistic speeds on moving bodies.

These equations apply to the huge ITER tokamak. "ITER will be operating in a regime of plasma parameters well beyond the reach of any existing tokamak experiment," said Amitava Bhattacharjee, head of the Theory Department at PPPL. "Therefore, one must rely on the predictive power of theory and simulation, which must be validated by comparison with present-day experiments and extrapolated to ITER conditions."

### Disruption mitigation system for ITER

Research of the center will contribute to a disruption mitigation system to be incorporated in ITER. The US ITER Project Office, based at Oak Ridge National Laboratory (ORNL), will be responsible for the system.

Tasks of the center will include:

- Establishing the physical basis for the generation and evolution of runaway electrons.
- Exploring the path for avoiding runaway electrons.
- Investigating the leading candidates for mitigating the problem.

A key center tool will be input from scientists supported by DOE's Advanced Scientific Computing Research (ASCR) program. It will handle the complex mathematics needed to simulate how runaways traveling at relativistic speed interact with the background plasma—a major issue in comprehending the problem. "There is still much that we don't understand," said Brennan.

### Cutting-edge simulations

ASCR scientists will facilitate cutting-edge simulations with advanced codes on the Titan supercomputer at the Oak Ridge Leadership Computing Facility (OLCF) at ORNL, and on supercomputers at the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory. The center will cross-check the results to verify their accuracy. OLCF and NERSC are DOE Office of Science User Facilities.

Another critical step will be to close the gap between theoretical explanations of runaway electrons and experimental observations, for which wide discrepancies have been found. The center will determine how well its simulations fit the experimental data—a key factor needed to create confidence in the group's predictions for ITER.

Also under study will be the primary methods for mitigating runaway electrons. These methods inject impurities in the form of massive gas or shattered pellets to cool the plasma and shut it down before disruptions can occur. But such techniques could also cause the electrons to accelerate; the center therefore aims to define the best mix of impurities and their injection rates for avoiding the problem.



## 14 trailers equal 2 new temporary office buildings

Two temporary office building complexes are taking shape outside the Theory Wing off the lower parking lot where two groups of seven trailers are being transformed into workspaces.

The last of the trailers arrived by mid-August and workers have been assembling them to create the two complexes, said John Lacenere, interim head of Facilities. "I'm happy with the way the project has progressed," Lacenere said. "It should be a good temporary home for people. I think they'll be comfortable there."

The complex closer to the lower parking lot entrance, which has been dubbed C33, will house employees from Procurement and Accounting. It will also include a meeting room. The complex closer to the upper parking lot, dubbed, C34, will house engineering staff. Up to 80 employees from the LSB annex will likely move into their new quarters in October.

Both buildings have been assembled and the roof, floors, and side walls have been sealed from the outside and inside. Contractors will install electric power, data/telecommunications systems, a fire detection system and the EVES evacuation system.



Two sets of trailers in the lower park lot will be converted into office building complexes. (Elle Starkman)

Once employees move out of the LSB annex, construction can begin in late October to renovate the building as part of PPPL's \$26 million facility renovation project, the Infrastructure and Operational Improvements (IOI) project. Plans call for all three floors of the annex to be gutted and replaced with modern office spaces to utilize the space more efficiently. 📍

## PPPL bids a fond farewell to a retiring employee!



**TONY MORGADO**

**Janitor**

Engineering

**37 YEARS**

## Tour Guide Meeting

Please come to a tour meeting on **Sept. 27 from 10 a.m. to 11 a.m. in the MBG Auditorium**. Both experienced and new tour guides are welcome.

After a general meeting, experienced tour guides will be free to leave at 11 a.m. New tour guides will stay for a tour training session from 11 a.m. to noon.

# Community and Staff Day

## Community and Staff Day Sept. 17 features a day of free activities at Princeton University

PPPL proudly participates in this event each year! Community and Staff Day will be held on Sept. 17. Volunteers are needed for the Family Fun Fest from 3:30 to 6:30 p.m. with a table featuring our plasma, light, vacuum and electricity/magnetism demonstrations. If you've never engaged the public with these cool devices, this is a great introduction to the demos and to the rewarding experience of communicating our work to people outside the Lab.

To volunteer, please contact Shannon Greco ([sgreco@pppl.gov](mailto:sgreco@pppl.gov)). For more info on the event, please see <https://community.princeton.edu/events/community-staff-day>.

## The Community and Staff Day schedule includes:

- Princeton Tigers football game versus Lafayette University. Kickoff is at 5 p.m. Get your free tickets online at [www.GoPrincetonTigers.com/tickets](http://www.GoPrincetonTigers.com/tickets) or pick them up from Marianne Tyrell, in Engineering 106, Ana Datuin, in Mod 6, room 132, or in the Director's Office or Human Resources, from 10 a.m.-4 p.m.
- Youth Sports Clinic for children ages 5 to 12, 3:30 to 4:30 p.m., Weaver Track
- Family Fun Fest: 3:30 p.m. through halftime - Games and activities from local non-profits and University departments.
- Fireworks after the game.

Call 609-258-5144 for more information.

**BROCK**

**MARK GAZO**  
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 September 5	Tuesday September 6	Wednesday September 7	Thursday September 8	Friday September 9
COMMAND PERFORMANCE <b>Chef's Feature</b>	<p><b>Labor Day</b></p>	<b>Ravioli</b> with Spinach & Peas in Vodka Pink Sauce	<b>Maple-Glazed Ham</b> served with Au Gratin Potatoes & Roasted Squash & Zucchini	<b>Knockwurst &amp; Sauerkraut</b> with Braised Cabbage & German Potato Salad	<b>Grilled Salmon</b> with White Beans, Arugula & Red Onion
Early Riser		<b>Italian Meat &amp; Cheese Omelet</b> topped with Wilted Spinach with Home Fries	<b>Potato, Roasted Pepper &amp; Sundried Tomato Casserole</b> with 2 Eggs Any Style	<b>Cinnamon-Raisin Pancakes</b> with Homemade Apple Compote	<b>Brunch Panini</b> with Prosciutto, Provolone, & Strawberry Preserve
Country Kettle		<b>Potato Corn Chowder</b>	<b>Chicken Noodle</b>	<b>Creamy Spinach and Artichoke</b>	<b>Turkey Chili</b>
Grille Special		<b>Grilled Ham &amp; 3 Cheese</b> on Texas Toast	<b>Cheese Calzone</b> with Marinara Sauce	<b>Turkey Burger</b> with Bacon, Cheddar & Provolone Cheese on a Kaiser Roll	<b>BBQ Tempeh Wrap</b> with Cheddar Cheese, Peppers & Onions
Deli Special		<b>Asiago Roast Beef Toasted Ciabatta</b> with Grilled Onion, Tomato & Horseradish	<b>BBQ Pulled Chicken</b> on a Kaiser Roll	<b>Fried Flounder Po' Boy</b>	<b>Curry Chicken Salad</b> with Grapes on a Kaiser Roll
Panini		<b>Fried Fish</b> with Cheddar, Tomato & Tartar Sauce Torpedo	<b>Breaded Chicken Cutlet</b> with Ham, Swiss Cheese, Lettuce & Honey-Mustard Ciabatta	<b>Curried Lentil &amp; Brown Rice Wrap</b>	<b>Texas BBQ Beef</b> topped with Southwest Slaw on a Kaiser Roll

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** ♦ Webmaster: **Chris Cane** ♦ Communications Director: **Larry Bernard**

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