

Calendar of Events

WEDNESDAY, FEB. 24

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

[New Horizons at Pluto](#)

Dr. Andy Cheng, Johns Hopkins University Applied Physics Laboratory

SATURDAY, FEB. 27

Ronald E. Hatcher Science on Saturday Lecture Series

9:30 a.m. ♦ MBG Auditorium

[Brutal Efficiency: How Mating and Reproduction Influence C. Elegans Longevity](#)

Coleen Murphy, Princeton University

UPCOMING

WEDNESDAY, MAR. 2

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

[History, Applications, Numerical Values and Problems with the Calculation of EROI - Energy Return on \(Energy\) Investment](#)

Professor Charles Hall, State University of NY College of Environmental Science and Forestry

SATURDAY, MAR. 5

Ronald E. Hatcher Science on Saturday Lecture Series

9:30 a.m. ♦ MBG Auditorium

[Reimagining the Possible: Scientific Transformations Shaping the Path Towards Fusion Energy](#)

Ed Synakowski, DOE

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Developing the digital safeguard that protects the National Spherical Torus Experiment-Upgrade at PPPL

By John Greenwald



Keith Erickson designed the real time computer and software system for the DCPS.

As the most powerful spherical tokamak in the world, the National Spherical Torus Experiment-Upgrade (NSTX-U) at PPPL produces magnetic forces that are far greater than what its predecessor could generate. Moreover, the power supply system that drives current in the fusion facility's electromagnetic coils can potentially produce even higher forces unless properly constrained. To access the impressive operating capability planned for NSTX-U, while protecting the coils from accidental overload, a new Digital Coil Protection System (DCPS) was a key requirement.

At PPPL, engineers have successfully designed, built, tested and installed a state-of-the-art system that is up to the task. It replaces the analog system on the old NSTX that was too limited for the new operating levels. The new approach provides real-time computation of forces and stresses that result from the combined influence of current flowing in all the coils and in the plasma that fuels fusion reactions. This system is the first digital safeguard for a fusion device, said Charles Neumeyer, the engineer who defined its requirements, and could serve as a model for other labs, including ITER, the

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PPPL joins a workshop on stellarators at MIT

By John Greenwald

The recent startup of the Wendelstein 7-X (W7-X) stellarator in Germany has awakened worldwide interest in stellarators, fusion devices that confine plasma in twisty magnetic fields rather than the symmetrical fields that tokamaks use. Last week, more than 30 individuals, representing 10 U.S. research institutions and the U.S. Department of Energy, met at MIT to discuss stellarator issues.

The two-day workshop, inspired in part by the W7-X startup, considered research needs for the development of a revitalized U.S. stellarator program. "The sessions went very well," said David Gates, stellarator physics leader at PPPL who organized the workshop with physicist David Anderson of the University of Wisconsin-Madison. Also attending were PPPL physicists and Laboratory leaders including Director Stewart Prager, Deputy Director for Research Michael Zarnstorff, and Head of Advanced Projects Hutch Neilson.



David Gates

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By John DeLooper,
Acting Deputy Director
for Operations

We are often too busy or comfortable with our surroundings to recognize when it's time to do some housekeeping. We put hardware or paperwork in a pile and then we get busy and we never return to it. Then we become too busy to clean up.

Those piles of paper and hardware can not only create a mess but also can become a potential hazard. These areas are sometimes cited in management safety walkthroughs because of the hazardous conditions they create.

After touring the Laboratory and receiving feedback from our customer, visitors and employees, it's clear that we need to do a better job with housekeeping. The photos here (one of which was taken in my office) show some examples of our collections. Often we have items that we'll never use again. In addition, many of us have file cabinets filled with old memos, presentations and even publications that are readily available on the Internet. All of these file cabinets take up valuable space.

We are planning to tackle this housekeeping problem through a Laboratory-wide cleanup like those we've done in the past. In addition, we plan to make it easier to discard old papers by hiring a company to digitize the necessary files we need to keep.

But we are asking you to take action now in your individual work areas. Please:

- Excess equipment we don't need or won't use in the future. To excess property, fill out a [Transfer and Excess Form](#) located on the [Material Services Home Page](#). Instructions can be found on the back of the form.
- File design and operational information in the operations center rather than in your work areas.
- Clean up your work areas by removing items that are no longer necessary. (Please recycle whenever possible.)

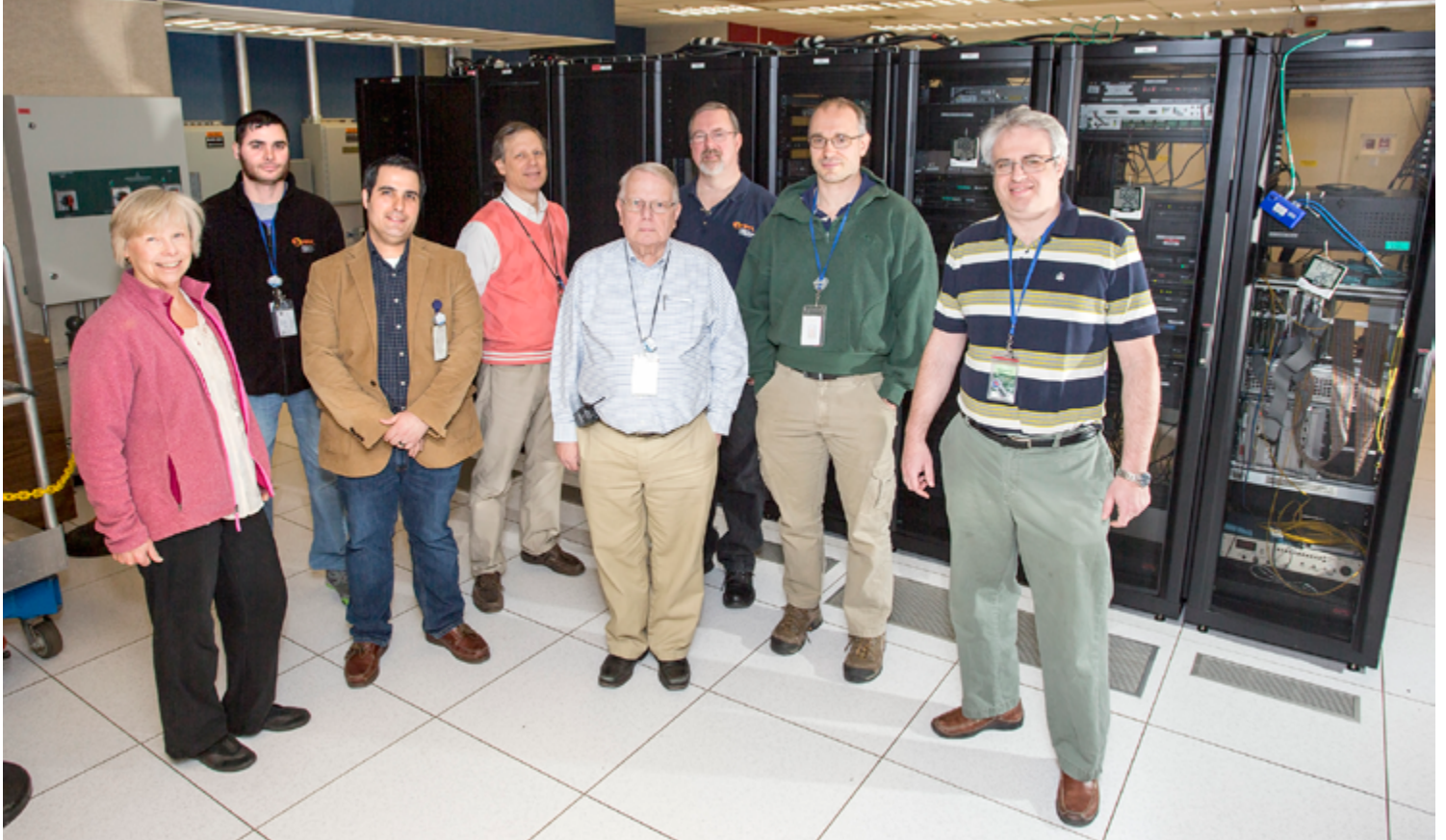
Our records program dictates that we can recycle our files. In fact, most items don't have to be saved more than five years, so check with your records coordinator and dispose of the unnecessary files too!

Having a clean, clutter-free workplace is not only safer, but it creates a more professional atmosphere. Thank you for your cooperation. 📧



Digital Coil Protection System

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Members of the team that developed the DCPS, from left: Gretchen Zimmer, Kevin Lamb, Greg Tchilinguirian, Paul Sichta, John Lawson, Tim Stevenson, Stefan Gerhardt and Roman Rozenblat. Not shown: Vince Mastrocola, John Dong, Gary Gibilisco.

international experiment under construction in France. This work was supported by the DOE Office of Science.

The safeguard consists of hardware, software and a network of fiber-optic cables that all work together at lightening speed. The system checks critical variables during each NSTX-U shot at a rate of 1,200 times every 200 microseconds and forces a shutdown if pre-set limits are approached.



Hans Schneider, who built the DCPS hardware that ties the system together, holds key cards that select for run mode or test mode.

The team that developed the DCPS devoted four years of long hours to a project disrupted by tragedy when Ron Hatcher, a beloved engineer who led the work, suddenly died. “At our first meeting afterward I said to the team, ‘Ronnie’s gotten us this far, let’s finish it.’ And we did,” recalled engineer Tim Stevenson, who became leader of the project in 2014.

The advanced system’s software consists of two identical codes that look at the same data and back each other up. The first code, located in the NSTX-U control room computer, is set more restrictively to trip first. The second code, which runs on a dedicated computer at the site of the NSTX-U, would respond and trip second. The two are independent and redundant and each is set to operate if the other one fails.

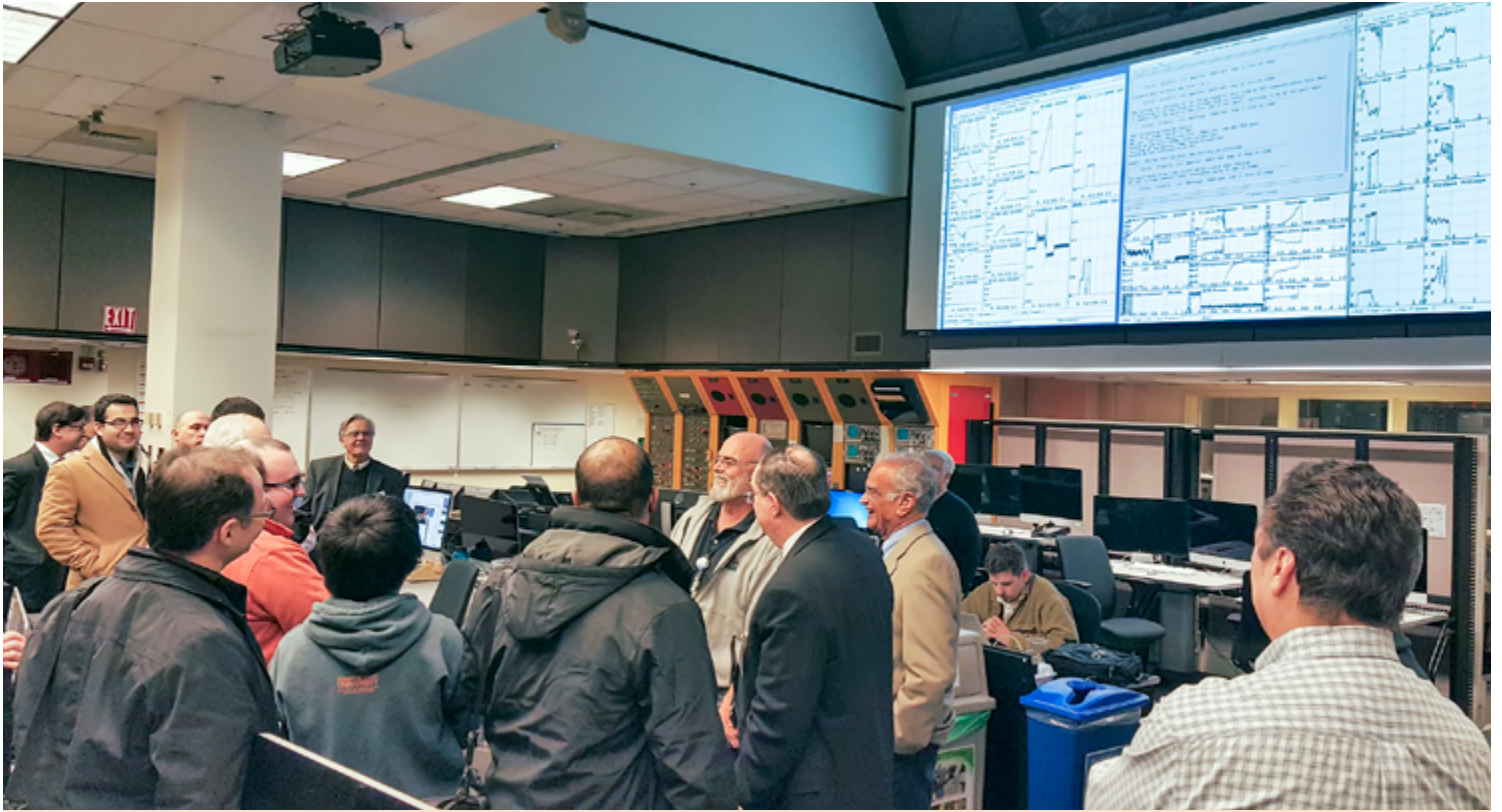
This system is highly flexible. Engineers have already adjusted it to ensure that the ohmic heating coil that puts current in the plasma stays hotter than the coils that produce the magnetic field that encircles the plasma. This proved necessary when an intended air gap between the ohmic heating coil and the inner coils was not provided during the construction process.

Development of the DCPS “was a project within a project,” Stevenson noted, because it paralleled development of the NSTX-U “and was a real team effort.” Major contributors included engineers Keith Erickson, who designed the real-time computer and software system, and Hans Schneider, who built the hardware that ties the DCPS together with substantial assistance from Vince Mastrocola, Kevin Lamb, Gary Gibilisco and John Dong.

Key contributions came also from engineers Gretchen Zimmer, who developed an auto-testing system for the

[continued on next page](#)

New Jersey Technology Council members tour PPPL



Some 100 people attended the New Jersey Technology Council's Innovation Forecast 2016 on Feb. 11 at PPPL, where entrepreneurs and corporate representatives discussed innovations. Following the tour, Al von Halle and Charlie Gentile led some of the participants on a brief tour of the Laboratory. Here, Al von Halle shows visitors the NSTX-U Control Room.

Stellarator conference

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The workshop reached consensus on a number of issues. Quasi-symmetric stellarator configurations, which share important properties with tokamaks, are of broad interest among the participants and have the potential to dramatically improve the vision and development path for stellarators. Participants agreed that the multiple options available within this family of designs need to be evaluated in terms of their physics and engineering benefits and risks.

While the QUASAR design developed at PPPL around 2000 exemplifies one of those options, new tools are becoming available that may enable even better designs — designs that include better power handling solutions, reduced levels of turbulence-driven particle transport, simpler coils, and relaxation of certain constraints on plasma stability. There was broad agreement that these new tools need to be rapidly

brought to a level of readiness for use in developing new stellarator designs that could become the basis for a world-leading U.S. stellarator initiative.

Looking ahead, the group agreed to study and compare three different types of stellarators, two of which are now in use. These include the W7-X; a smaller machine at the University of Wisconsin called the Helically Symmetric Experiment (HSX); and the uncompleted QUASAR stellarator at PPPL, on which construction was halted in 2008. The comparisons will include experiments conducted on the W7-X and the older HSX, which has compiled data over the past 15 years, and theoretical research based on the QUASAR design. Results could indicate the type of stellarator that physicists would be interested in developing in the United States. [▶](#)

Digital Coil Protection System

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software; Greg Tchilinguirian, who designed data management systems; Roman Rozenblat, who tested the software; John Lawson, who developed fiber-optic connections; and Paul Sichta, who provided input to the overall design. Engineer Peter Titus and members of the engineering analysis division derived protection algorithms for NSTX-U throughout the entire upgrade design process. Physicist Stefan Gerhardt, who heads experimental research operations for the NSTX-U, compiled these results into a format

appropriate for the real-time protection system and verified the final results.

The DCPS has proven vital to the NSTX-U. “The system has worked effectively,” Stevenson said. “It caught things it was supposed to catch and plays a critical role in protecting the upgraded facility.” [▶](#)

Girl Scouts plunge into plasma and other science topics on PPPL tour

PPPL hosted a group of Girl Scouts from several troops in Doylestown, Pennsylvania, on Feb. 15. The girls were taking part in an all-day program organized by the Philadelphia Society of Women Engineers and Princeton University's Graduate Molecular Outreach Program. Science Education Program Leader Shannon Greco gave the girls a tour and then showed them plasma demonstrations in the Science Education Laboratory. After touring PPPL, the group visited the Molecular Biology Laboratory at Princeton. 📷

(Photos by Jeanne Jackson DeVoe)



Natalie Douglass, 16, tries out a Van De Graaff generator.



Greco, at left, speaks to the Girl Scouts in the Science Education Laboratory.



Girl Scouts use a spectrometer to look at various gases.

Cub Scouts join the pack at PPPL

A group of Cub Scouts from Pack 992 in Hamilton Township, along with a few of their siblings and parents, toured the Laboratory during the early evening of Feb. 16. Rob Sheneman was the tour guide and Atiba Brereton showed the group plasma demonstrations in the Science Education Laboratory.

(Photos by Elle Starkman)



Sheneman gives the Scouts an overview of the Laboratory in the Vis Wall room.



Brereton shows the Scouts an electromagnet demonstration.



Some of the Cub Scouts try out a plasma ball.



Brereton demonstrates how a Tesla coil affects a lightbulb.

Students learn about electricity and magnetism in workshop led by PPPL'ers

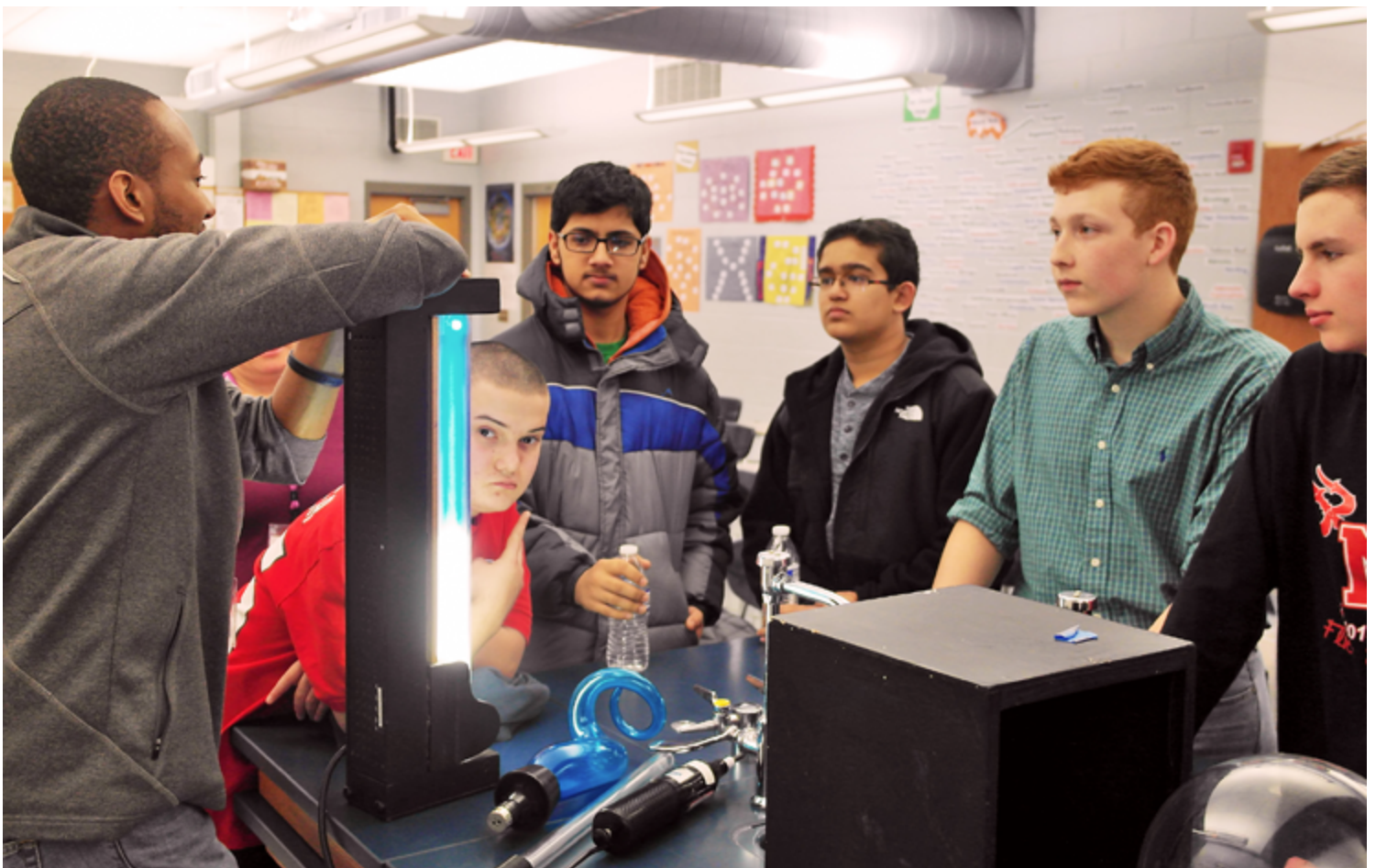
Science Education Senior Program Leader Arturo Dominguez and Program Leader Shannon Greco organized a workshop on electricity and magnetism for 80 high school students taking part in an IEEE/Neptune Jump Start Engineering Mini Academy at Neptune High School on Feb. 17. The weekly science program is sponsored by the Institute of Electrical and Electronics Engineers.

Dominguez gave an overview of PPPL's research during the workshop. Greco, along with Mike Kalish and Ethan Schartman, had teams of students create circuits, electromagnets and motors. Eric Gilson, Atiba Brereton and Charles Swanson showed students plasma demos. 📷

(Photos courtesy of IEEE)



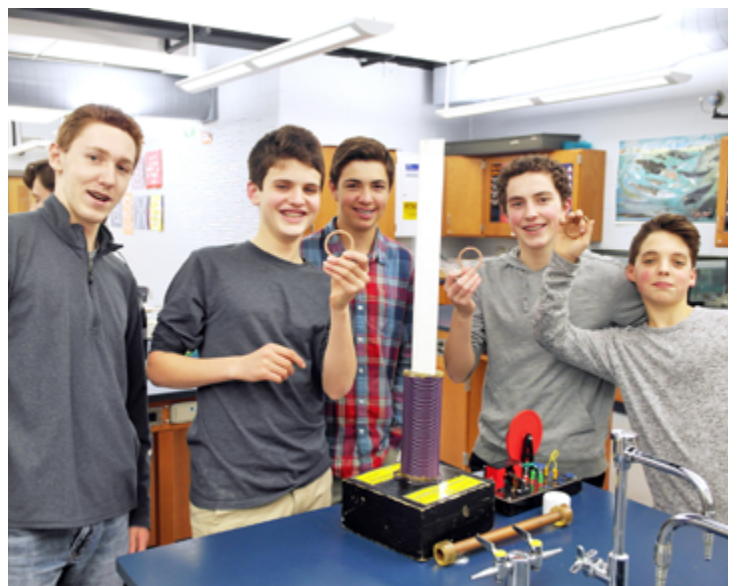
Charles Swanson shows students an electromagnet demonstration.



Atiba Brereton shows students a half-coated fluorescent bulb.



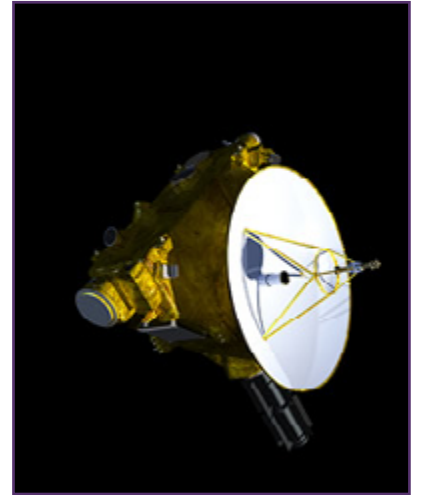
A student tries out a Van De Graaff generator.



Students show off rings in the electromagnet demonstration.

COLLOQUIUM

New Horizons at Pluto



Dr. Andy Cheng

Johns Hopkins University Applied Physics Laboratory

Wednesday, Feb. 24

4:15 p.m., M.B.G Auditorium, Lyman Spitzer Building

Ronald E. Hatcher

Science on Saturday LECTURE SERIES

Feb. 27

**Brutal Efficiency: How Mating and Reproduction Influence
C. Elegans Longevity**

Coleen Murphy, Princeton University

Mar. 5

**Reimagining the Possible: Scientific Transformations Shaping
the Path Towards Fusion Energy**

Ed Synakowski, DOE

Mar. 12

Taking the Universe's Baby Picture

David Spergel, Princeton University

Mar. 19

Using Physics and Chemistry to Understand the Genome

Mary Jo Ondrechen, Northeastern University

Saturdays at 9:30 a.m., MBG Auditorium

Volunteers wanted for Mercer Science and Engineering Fair

Organizers of the Mercer Science and Engineering Fair are looking for scientists and engineers to volunteer as judges of fourth to twelfth-grade science projects during the fair next month at Rider University.

Students from Mercer County schools show off their original science projects at the fair from March 12 to March 15. Judging for the elementary division (grades 4 to 5) and the junior division (grades 6 to 8) takes place Sunday, March 12. Judging for the senior division takes place March 12 and March 13. Additional information about the fair is available at <https://mercersec.org/about/msef>.

To volunteer, create an account online and check off judge to volunteer at <https://mercersec.org/help/BecomeAJudge>.

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 February 22	Tuesday February 23	Wednesday February 24	Thursday February 25	Friday February 26
COMMAND PERFORMANCE Chef's Feature	Chicken Parmesan served with a Side of Pasta & Garlic Bread	Assorted Quiche served with Caesar Salad	Carved Grilled Eye Round Steak with Chimichurri Sauce, Roasted Potatoes & Collard Greens	NATIONAL CHILI DAY Beef Chili served in a Bread Bowl with Assorted Toppings	DINNER & A MOVIE—NO RESERVATIONS Spaghetti Oreganata with Shrimp Skewer
Early Riser	Italian Omelet with Mushrooms, Onions, Mozzarella, Marinara & Hash Browns	Scrambled Eggs with Cheddar Ham Biscuits	Breakfast Tortilla with Ham, Green Onions & Cheddar Cheese Sauce	Corned Beef Hash with 2 Eggs any style	Banana Chocolate Chip Pancakes
Country Kettle	Pasta Fagioli	Turkey Corn Chowder	Creamy Potato with Cabbage & Cheddar	White Turkey Chili	Black Bean Cilantro
Grille Special	BURGERLICIOUS The Simple Man Grilled Beef Burger with American Cheese, Tomatoes, Onions, Dill Pickle Chips, Shredded Lettuce & Secret Sauce on a Grilled Brioche Roll Served with Sweet Potato Fries (Available All Week)	Hot Pastrami & Cheddar Cheese on French Bread	Fish & Chips Wrap with Tartar Sauce, Malt Vinegar and a Side of Slaw	Chicken Breast on a Pretzel Roll with Caramelized Onions & Mushrooms with Pepper Jack Cheese	Potato Pancakes served with Sour Cream & Apple Sauce
Deli Special	Hummus, Avocado, Roasted Peppers, Feta Cheese & Fresh Basil in a Wheat Wrap served with Maple Glazed Pears	Roast Beef & Swiss Club Sandwich with Bacon on Choice of Bread	Southwest Pulled Pork on a Brioche Bun served with Pickled Slaw	Fish Cake Po' Boy	Smoked Turkey & Swiss Cheese on French Bread with Lettuce & Tomato
Panini	Meatball Torpedo with Peppers, Onions, Pepperoni & Provolone	Crispy Tilapia on a Grilled Brioche Roll with Tartar Sauce, Lettuce & Tomato	Turkey & Stuffing Wrap served with Gravy & Cranberry Sauce and a side of Fries	Veggie Burger with Guacamole, Tomato, Cilantro, Red Onion & Salsa on a Kaiser Roll served with Corn Chips	Cheddar French Dip on Ciabatta served with Fries

MENU SUBJECT TO CHANGE WITHOUT NOTICE

VEGETARIAN OPTION

WEEKLY

Editor: **Jeanne Jackson DeVoe** ♦ Layout and graphic design: **Kyle Palmer**
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 ♦ PPPL WEEKLY is archived on the web at: <http://w3.pppl.gov/communications/weekly/>.