PPPL PRINCETON PLASMA PHYSICS LABORATORY
A Collaborative National Center for Fusion & Plasma Research
U.S. DEPARTMENT OF ENERGY
WEEKLY
July 25, 2016

## Calendar of Events

### THIS WEEK

**THURSDAY, JULY 28**

**Liberty Science Center Camp**
10:30 a.m.–1 p.m. ◆ Science Education Laboratory

### UPCOMING

**WEDNESDAY, AUGUST 10**

**Summer intern poster session**

**THURSDAY, AUGUST 18**

**Liberty Science Center Camp**
10:30 a.m.–1 p.m. ◆ Science Education Laboratory

**AUGUST 22–25**

**Technology of Fusion Energy (TOFE) Conference**
Philadelphia

### SUMMER SCHEDULE FOR PPPL WEEKLY

**The PPPL Weekly will be published every other week during the summer. The next issue will be on August 8.**

## INSIDE



# PPPL launches expanded new nanolaboratory

By John Greenwald

Plasma – the hot ionized gas that fuels fusion reactions – can also create super-small particles used in everything from pharmaceuticals to tennis racquets. These nanoparticles, which measure billionths of a meter in size, can revolutionize fields from electronics to energy supply, but scientists must first determine how best to produce them.

After more than two years of planning and construction, PPPL has commissioned a major new facility to explore ways to optimize plasma for the production of such particles. The collaborative facility, called the "Laboratory for Plasma Nanosynthesis," is nearly three times the size of the original nanolab, which remains in operation, and launches a new era in PPPL research on plasma nanosynthesis. Experiments and simulations that could lead to new methods for creating high-quality nanomaterials at relatively low cost can now proceed at an accelerated pace.

The facility will host a number of different experiments using advanced diagnostics to observe nanosynthesis in situ, or as the experiments take place. "We should be able to simultaneously characterize and correlate the plasma and nanosynthesis processes," said physicist Yevgeny Raitses, who heads the new laboratory. "This will help take our research to the very top level needed for fundamental studies in this interdisciplinary field." All research will be conducted under the aegis of the Plasma Science and Technology Department, headed by physicist Philip Efthimion.

continued on page 3

# Deputy Site Office manager was accomplished leader at two federal agencies

By Jeanne Jackson DeVoe

Sandy Rogan, the deputy site office manager for the U.S. Department of Energy's Princeton Site Office, brings more than two decades of experience in contract management at federal agencies and a management style that is built on working together on any potential challenges.


Sandy Rogan

Rogan began work in April as the deputy to Site Office Manager Pete Johnson, who started in December 2015. "I'm delighted Sandy took the position here," Johnson said. "We're fortunate to have her expertise here in the site office."

Rogan said she has been introducing herself to various departments at PPPL and has been warmly welcomed by both the Laboratory and the Department of Energy (DOE). She encourages people to come talk to her in B292 if they have any issues. "My style is I like to solve problems face-to-face rather than by email, so people should come talk to me rather than call or email me," she said. "That's my management style: Let's just all get together and solve it."

continued on page 5

# Workshop gives physics professors hands-on plasma experiments for their classrooms

By Jeanne Jackson DeVoe

A group of college professors recently learned about incorporating plasma physics into their curricula by spending a few days in PPPL's Science Education Department Laboratory. They will bring the lessons they learned about hands-on plasma experiments into their classrooms to teach the next generation of scientists.

Four professors and a lab lecturer were part of a Laboratory Immersion workshop from July 12 to 14. The event was one of 11 summer workshops at institutions around the country organized by the Advanced Laboratory Physics Association (ALPhA) and sponsored by the organization and the National Science Foundation.

"Plasma physics is generally not taught in depth in undergraduate classes and laboratories at undergraduate institutions across the country," said Arturo Dominguez, a Science Education senior program leader and one of the instructors in the course. "This is a way of getting it into the curriculum and preparing professors to get students involved early on in their undergraduate careers."

After getting a brief introduction to plasma physics, the professors spent most of the workshop in the Laboratory constructing one of two experiments. In one, they created a DC discharge experiment in which they produced a plasma in a vacuum tube attached to electrodes at each end. They then plotted the transition from a gas to a plasma and correlated the voltage, the length of the tub and the gas pressure, empirically reproducing Paschen's Law.

In the second experiment, the professors attached a simple spectrometer to the same DC glow discharge experiment to analyze the temperature of the plasma and the spectra of argon and helium plasmas.

PPPL has taken part in the workshops for three years. "The idea is to give faculty members an opportunity to become familiar with experiments that they can bring back to their institutions at the intermediate to advanced level," said Jeremiah Williams, one of the instructors in the course and a faculty member at Wittenberg University in Springfield, Ohio.

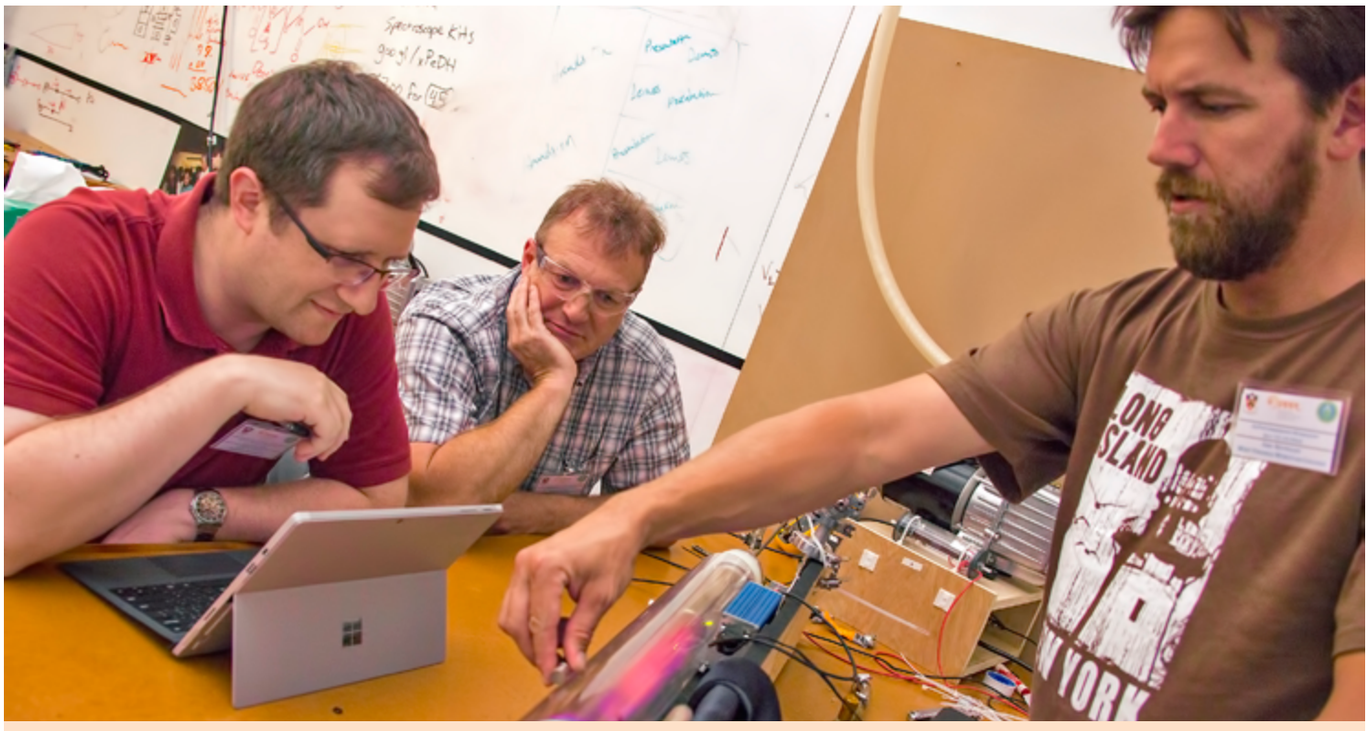
Tim Tharp, left, an assistant professor at Marquette University in Milwaukee and Matthew ArchMiller, a professor at Saint John's University in Collegeville, Minnesota, work on a spectroscopy experiment.

Getting plasma physics into the undergraduate curriculum may help inspire more students to pursue graduate degrees in the subject, Williams said. "Plasma physics doesn't show up in the undergraduate curriculum, which leads to all sorts of issues with workforce pipelines," he said.

Both experiments are relatively inexpensive and easy ways to teach students some basic concepts. The DC discharge experiment teaches students principles of classical mechanics, electricity and magnetism and even calculus, Williams said. Students plot their findings to create a Paschen curve, which shows all the parameters. "It's nice when you can see how these things thread together," he said.

Daniel Rosenberg, a lecturer/demonstrator at Harvard University who is part of a group that develops experiments for physics professors, said he was happy to learn some new experiments. "The physics laboratories have three weeks to work on a project, so this is a very strong contender," he said.

Tim Tharp, an assistant professor at Marquette University in Milwaukee who did his postgraduate research at PPPL, said he was also drawing inspiration from the workshop. "It's awesome," he said. "I think it's going to be really useful."



Working on the DC discharge experiment are from left to right: Derek Thuecks, an assistant professor at Washington College in Chestertown, Maryland; Daniel Rosenberg, a lecturer/demonstrator at Harvard University; and Eric Reynolds, an assistant professor at West Virginia Wesleyan College in Buckhannon.

# Laboratory for Plasma Nanosynthesis

continued from page 1

Nanomaterials exhibit remarkable strength, flexibility and electrical conductivity. Carbon nanotubes, found in sporting goods, body armor, transistors and countless other products, are tens of thousands of times thinner than a human hair and stronger than steel on an ounce-for-ounce basis.

Plasma could serve as an ideal substance for synthesizing — or producing — nanomaterial. The new 1,500-foot laboratory will study so-called low-temperature plasmas that are tens of thousands degrees hot, compared with fusion plasmas that are hotter than the 15-million degree core of the sun. These low-temperature plasmas contain atoms and free-floating electrons and atomic nuclei — or ions — that can be shaped by magnetic fields to provide reliable, predictable and low-cost synthesis of tailored nanoparticles.

However, achieving these goals requires a fuller understanding of plasma nanosynthesis than is currently available. One method of synthesis first turns a rod of iron or other material into plasma by vaporizing it with an electric arc. The plasma then condenses into solid nanomaterial. New understanding is needed to explain the chemical, kinetic and electrical interactions that accompany these changes and must be controlled to ensure the quality and purity of the nanomaterial.

The new laboratory will use a collection of diagnostic systems to measure these processes as the synthesis takes place. A number of advanced laser systems developed specifically for this research are among the instruments employed. "The hope is that these measurements will give us physical insight into the whole chain of the synthesis process," said Raitses. The chain extends from the generation of plasma to the formation — or "nucleation" —of nanoparticles and their growth.

Overseeing the diagnostics is physicist Brent Stratton, who directs all diagnostic systems at PPPL. Mikhail Shneider, a senior research scientist at Princeton University, developed the diagnostic concepts and proposed a key laser system for measuring nanoparticles in a gas.

Once the synthesis is complete, researchers will evaluate the material with electron microscopes and other devices in facilities outside the laboratory. Participants will include the Princeton Institute for the Science and Technology of Materials (PRISM) at Princeton University, and Bruce Koel, a Princeton chemical and biological engineer with offices at PPPL and the University.

Researchers will also produce theoretical models of plasma nanosynthesis and compare the results to actual measurements. Models that correctly predict the data could deliver a precise understanding of the processes involved. Leading these simulations is Igor Kaganovich, deputy head of the PPPL Theory and Computation Department.

The diagnostic developments and synthesis experiments are conducted in close collaboration with Princeton theorists Roberto Car, a professor of chemistry, and Biswajit Santra, a postdoctoral fellow in the chemistry department. Also actively engaged in theoretical research is Predrag Krstic of the Institute for Advanced Computational Science at Stony Brook University.

PPPL engineer Andrei Khodak and postdoctoral fellow Alexander Khrabry are modeling use of an arc plasma reactor for synthesis of nanoparticles. They work in collaboration with an arc expert, Valerian Nemchinsky.

Major new topics for the overall project include plasma synthesis of nanotubes made from boron nitride, a compound that could become an efficient vehicle for drug delivery. Successfully designed boron nitride nanotubes could be loaded with drugs and directed to carefully targeted points in the body.

continued on next page

Inside the laboratory. Front and center: Philip Efthimion, Charles Gentile, and Yevgeny Raitses with nanolab team members.

# Laboratory for Plasma Nanosynthesis

continued from page 3

Exploration of plasma as a synthesizing agent is a natural development for PPPL, the only national laboratory dedicated to research in fusion energy and plasma science. Findings of the existing PPPL nanolab, a two-room 600-square-foot facility that opened in 2013, give strong indications of improved methods for producing carbon nanomaterial.

The new facility can build on such findings. "The inclusion of this increased capability positions PPPL for expanded future opportunities in nanotechnology," said Charles Gentile, lead engineer for operations and a designer of the facility. Contributing to the design was electrical engineer John Lacenere. Also helping to plan the facility were PPPL engineers Craig Shaw and Alex Merzhevskiy.

Both new and old laboratories provide attractive research opportunities for students and for postdoctoral fellows who are starting their careers. Postdocs Alexandros Gerakis, Vlad Vekselman, and Shurik Yatom at PPPL are developing advanced laser diagnostics and conducting plasma nanosynthesis experiments, together with James Mitrani, a graduate student in the Princeton Program in Plasma Physics. Yao Wen Yeh, a graduate student in the Princeton University School of Engineering and Applied Science, is working with Koel on evaluating materials.

The postdocs participate in many collaborations. They work on diagnostic developments with Stratton and Shneider and conduct experiments with Raitses and collaborators from George Washington University, led by Michael Keidar, and Case Western Reserve University led by Mohan Sankaran. Also engaged in experiments is Sophia Gershman, a research scientist at PPPL.

A number of other scientists are consulting or working on diagnostic development. They include PPPL physicists Benoit LeBlanc, Ahmed Diallo and postdoctoral fellow Jorge Munoz Burgos, and research scholar Arthur Dogariu of the Princeton Department of Mechanical and Aerospace Engineering.

The new facility occupies a former storage area that had to be thoroughly remodeled and carefully engineered to ensure health and safety, like its smaller cousin. Features include a ventilation system that takes in outdoor air and pipes it back through ultra-low particulate filters instead of recycling it. The system also generates negative air pressure that is a few degrees below atmospheric pressure to keep laboratory air from circulating into hallways.

# Design and review team for ITER port plug camera system


Designers and reviewers of an upper port plug camera system that PPPL is developing for ITER with General Atomics and Dutch company TNO held a day-long Zoom meeting last week with experts from outside the Laboratory to evaluate a preliminary design. Five identical systems, which researchers will use to view plasma during experiments, will be mounted in ITER upper port plugs after the final design is approved in 2019. Rear row from left: Matt Smiley, General Atomics engineer; Roger Reichle, ITER physicist; Irving Zatz, PPPL engineer and review chairman; George Labik, PPPL engineer; Frank Hoffman, PPPL engineer. Middle row: Mark Smith, PPPL project engineer; Travis Gray, PPPL physicist. Front row: Ray O'Neill, General Atomics managing engineer; Ankita Jariwala, PPPL port integrator; Dave Johnson, PPPL physicist; and Ad Verlaan, TNO optical expert.

# PPPL bids a fond farewell to retiring employees!

**BUDDY KEARNS**
**Vacuum technician, Engineering**
**36 YEARS**

**SID MEDLEY**
**Plasma Science & Technology**
**NEARLY 39 YEARS**

## Sandy Rogan

continued from page 1

The position is not a new one but had been vacant for several years due to various changes in the Site Office. Rogan helps manage the 11-member department and is the first-line supervisor for office staff. She works to resolve many of the daily issues that arise between the Site Office and the Laboratory.

### An "alter ego" to site manager

Rogan fills the role of deputy, which the DOE describes as the "alter ego" to the site office manager. Johnson said Rogan brings a set of skills and experience to the position that complement his own. "Sandy's background is in procurement and contracting, my background is technical, so it's a good pairing of senior capabilities," Johnson said.

Rogan previously had leadership positions in procurement with the Department of Veterans Affairs (VA) and the U.S. Army at Fort Monmouth. In her most recent position, she was director of the VA's Acquisition Rapid Response Service (ARRS) in Eatontown, New Jersey, which develops requirements for IT procurement for the VA's Office of Information and Technology. In that position, Rogan oversaw five teams of computer and electronics engineers and procurement coordinators who helped create 300 IT packages valued at over $1 billion annually.

Rogan was born in Panama, the daughter of John and Marian Sinnicki, both of whom worked for the Foreign Service. She and her family lived all over the world, including Washington, D.C., Poland, the former Yugoslavia, Pakistan and Nigeria. Rogan went to the American School in Warsaw and the International School of Belgrade. "It gives you a great perspective," she said. "It makes you unable to understand how we cannot all get along in the world."

She attended high school in Virginia and then Rutgers Business School in New Brunswick, New Jersey, as an undergraduate majoring in marketing. She graduated with high honors and was named a Mabel Smith Douglass/Stanton-Anthony Scholar.

Rogan went on to earn a master's degree in public administration from Rutgers University and won the Outstanding Graduate Award from Pi Alpha Alpha, the National Honor Society for Public Affairs and Administration. She also has numerous certifications in purchasing and contracts.

Rogan commutes an hour each way from her home in Holmdel, New Jersey. She and her husband, Tom, a contractor who owns his own company, have two children, Tom, 19, a sophomore at Boston College, and Kelly, 18, who will be a freshman at Syracuse University. She and her husband enjoy going to the beach and to theater and dance performances. They spend much of their free time rooting for their son in lacrosse and soccer and their daughter in lacrosse and the dance team.

### Helped establish VA's Technology Acquisition Center

Rogan was one of 10 employees chosen by the VA to establish the agency's billion-dollar Technology Acquisition Center in 2009. She also helped manage the development of the ARRS division staff from three to 30 people and managed that staff, which included engineers and program coordinators.

Prior to her work at the VA, Rogan spent 17 years at the U.S. Army's Fort Monmouth. Her most recent position there was directing the Logistics Readiness Center's Rapid Response Project Office, which had a budget of $25 million and a staff that grew from 25 to 75 employees. Her office managed procurement for more than 1,000 programs valued at over $3 billion.

The Army recognized Rogan's work with several awards. These included a Defense Acquisition Executive Award in 2002, an Army Achievement Medal for Civilian Service in 1992 and a Commander's Medallion in 1994.

The new deputy site office manager said she came to the DOE looking for a new challenge. She likes the fact that the job is so varied. "I think it's a great job in that every day there are different issues and different areas and you get to use a variety of skill sets," she said. "Sometimes there are fires that have to be put out and sometimes there are long-term projects, so it's a nice balance."

She said she hopes that more people at PPPL will get to know her and will come to her to discuss any issues that come up. "I think I'm pretty approachable and I am looking forward to working with everyone in the DOE and the Lab," she said.

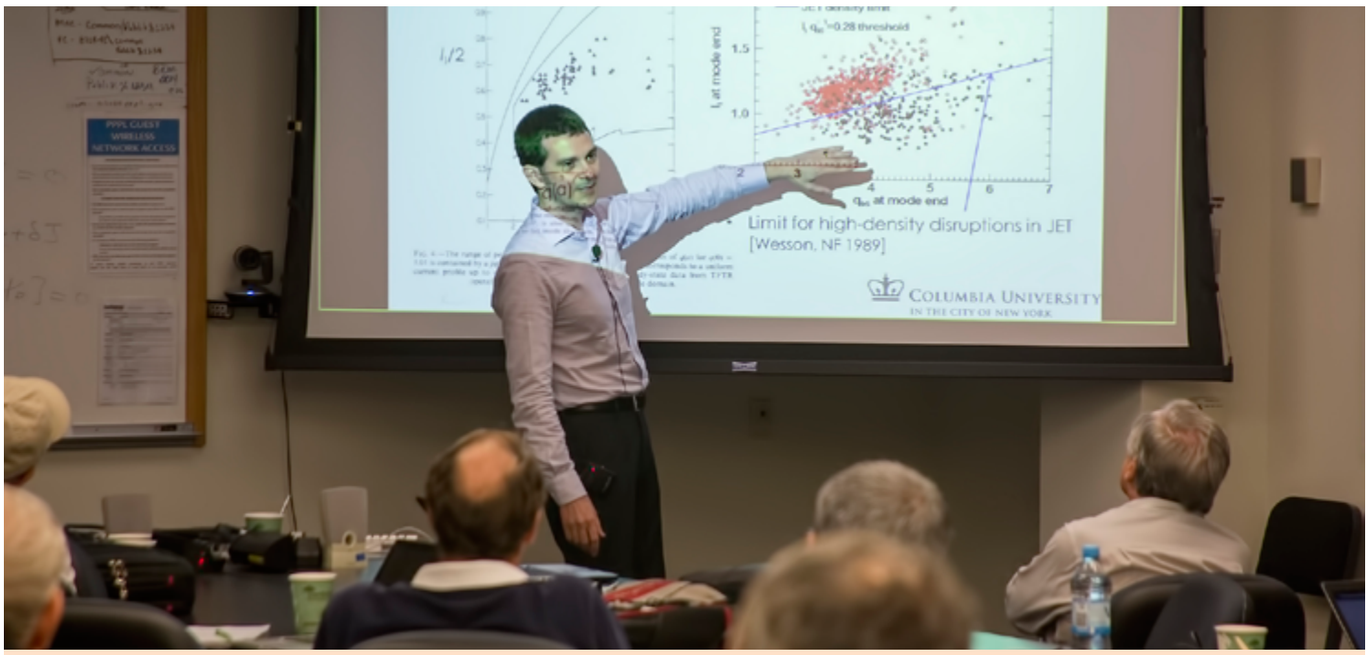
# PPPL-led workshop addresses key ITER issues

More than 40 leading scientists from PPPL, other U.S. research institutions and Europe gathered here last week for the fourth annual Laboratory-led workshop on the Theory and Simulation of Disruptions. The July 20-22 event focused on ways to predict and mitigate disruptions that could pose a challenge for ITER, the international tokamak under construction in France to demonstrate the feasibility of fusion power.

"What is becoming clear are certain issues pertinent to ITER progress," said Amitava Bhattacharjee, head of the Theory Department at PPPL and organizer of the workshops. The sessions discussed relevant findings and proposed experiments and simulations to address these issues.

Among the European participants were Michael Lehnen, who leads research on the physics of disruptions for ITER, and Yves Peysson, principal investigator for runaway electrons — a major source of disruptions — for Eurofusion. Also attending was John Mandrekas, a program manager for the U.S. Department of Energy's Office of Fusion Energy Sciences.

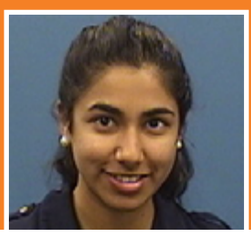
Workshop participants included, from left: John Mandrekas, Office of Fusion Energy Sciences; Michael Lehnen, ITER; Amitava Bhattacharjee, head of the Theory Department at PPPL, and Yves Peysson, Eurofusion.




Francesco Volpe of Columbia University describes prediction and control of locked plasma disruptions.

MIT physicist Robert Granetz describes a powerful type of current produced by disruptions on Alcator C-Mod.

# PPPL Welcomes New Employees!



**SOHA ASLAM**
Project manager facilitator
Engineering

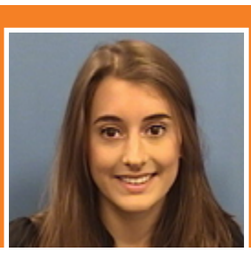
**RICHARD BURKE**
Mechanical engineer
Engineering

**FENG CAI**
Mechanical engineer
Engineering

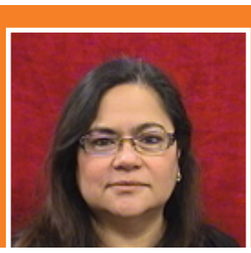
**JINPING CHEN**
Diagnostics engineer
Engineering

**JUGAL CHOWDHURY**
Associate research physicist
Theory

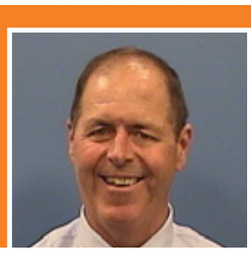
**WILLIAM CHYZIK**
Security, emergency planning & training coordinator
Site Protection



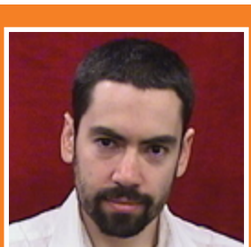
**CARMELA CIUMMO**
Mechanical design engineer
Engineering



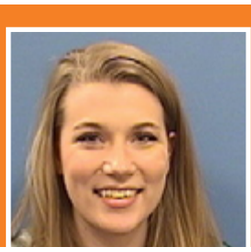
**ANA MARIE DATUIN**
Administrative assistant
ES&H



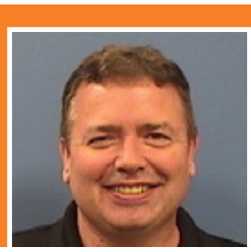
**LESLIE HILL**
IOI project manager
Office of the Director



**ALEXANDER KHRABRY**
Associate research physicist
Theory

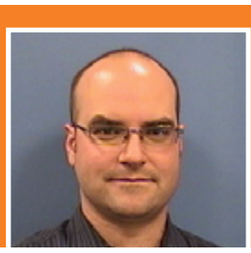


**OLIVIA MERRILL**
Media support technician
Information Technology

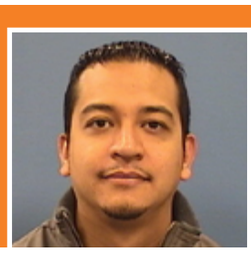


**DAVID NOVAK**
Electrician
Engineering/Facilities

**MARY PAYNE**
Office support/secretary
Information Technology

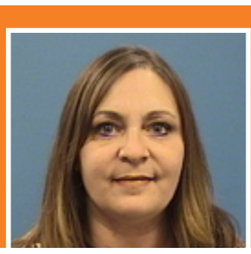


**JOSEPH PETRELLA**
Electrical engineer
Engineering

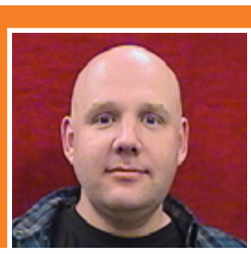


**FREDY RABANALES**
Experimental technician
Engineering

**JOSE RODRIGUEZ**
Mail & package/receiving clerk
ES&H



**JENNIFER WILEY**
Administrative associate
Site Protection



**SHURIK YATOM**
Associate research physicist
Plasma Science & Technology

BROCK

**MARK GAZO**
**Chef Manager**

Café 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.

| | Monday July 25 | Tuesday July 26 | Wednesday July 27 | Thursday July 28 | Friday July 29 |
|---|---|---|---|---|---|
| COMMAND PERFORMANCE **Chef's Feature** | **Baked Rosemary & Garlic Chicken** served with Cajun-Spiced Roasted Potatoes | **Vegetarian Lasagna** | **Carla's Ravioli — Create your own pasta bar!** | **Baked Moussaka** served with a Greek Salad | **Fried Flounder** with Tartar Sauce served with Corn on the Cob & Macaroni Salad |
| Early Riser | **Blueberry Pancakes** | **Roast Vegetable Egg White Omelet** with Home Fries | **Tater Tot Breakfast Bake** | **Ham, Egg & Cheese French Toast** | **Bacon, Spinach & Mozzarella Quesadilla** with Cilantro Cream |
| Country Kettle | **Black Bean & Ham** | **Minestrone** | **Potato, Cheddar & Bacon** | **Tuscan Bean** with Escarole | **White Bean Chicken Chili** |
| Grille Special | **Gyro Turkey Burger** with Feta Cheese, Lettuce, Tomato, Red Onion & Tzaziki Sauce on an Onion Roll | **Sausage & Peppers Torpedo** | **Salmon Burger** on a Whole Wheat Roll with Lettuce, Tomato & Tzaziki Sauce | **Blackened Chicken** with Sautéed Onion & Peppers, Pepperjack Cheese, Tomato & Chipotle Mayonnaise on a Kaiser Roll | **Philly-Style Cheesesteak Calzone** |
| Deli Special | **Egg Salad Club Sandwich Wrap** | **Caesar Salad** with Grilled Tuna, Hearts of Palm, Artichoke, Roasted Peppers & Kalamata Olives | **Pizza Steak Sub** with Pepperoni, Provolone & Marinara | **Italian Tuna Salad** with Capers, Olives, Sundried Tomatoes and Basil on Choice of Bread | **Cobb Salad Wrap** with Turkey, Spinach. Tomato, Blue Cheese, Bacon & Hard-Cooked Egg |
| Panini | **Chicken Breast,** Tomato, Pesto Mayonnaise and Arugula on a Fresh-Baked Asiago Cheese Roll | **Chicken Breast,** Fontina Cheese, Pesto Mayonnaise & Tomato on Ciabatta Bread | **Buffalo Chicken Sliders** served with Fries | **Vegan BLT** with Tempeh, Tomato, Romaine & Veganaise on a Whole Wheat Roll | **NY Street Dog** 2 Sabrett Hot Dogs with Sauerkraut, Red Onions & Mustard served with Fries |

| | Monday August 1 | Tuesday August 2 | Wednesday August 3 | Thursday August 4 | Friday August 5 |
|---|---|---|---|---|---|
| COMMAND PERFORMANCE **Chef's Feature** | **BBQ Pulled Chicken** with Mashed Potatoes & Vegetable | **Ravioli** with Spinach, Sundried Tomatoes, Roasted Peppers, Olives and Artichokes | **Maple-Glazed Ham** served with Au Gratin Potatoes & Roasted Squash & Zucchini | **Knockwurst & Sauerkraut** with Braised Cabbage & German Potato Salad | **Grilled Salmon** with White Beans, Arugula & Red Onion |
| Early Riser | **Bacon Egg & Cheese Croissant** | **Italian Meat & Cheese Omelet** topped with Wilted Spinach with Home Fries | **Potato, Roasted Pepper & Sundried Tomato Casserole** with 2 Eggs any style | **Cinnamon-Raisin Pancakes** with Homemade Apple Compote | **Brunch Panini** with Prosciutto, Provolone, & Strawberry Preserve |
| Country Kettle | **Turkey Soup** with Dumplings | **Potato Corn Chowder** | **Tortilla Soup** | **Creamy Spinach and Artichoke** | **Turkey Chili** |
| Grille Special | **Broccoli Rabe & Beef Flatbread** | **Grilled Ham & 3 Cheeses** on Texas Toast | **Cheese Calzone** with Marinara Sauce | **Turkey Burger** with Turkey Bacon, Cheddar & Provolone Cheese on a Kaiser Roll | **BBQ Tempeh Wrap** with Cheddar Cheese, Peppers & Onions |
| Deli Special | **Pepper & Mushroom Quesadilla** with Cilantro & Cheddar | **Asiago Roast Beef Toasted Ciabatta** with Grilled Onion, Tomato & Horseradish | **Chili Cheese Dog** served with Fries | **Fried Flounder Po' Boy** | **Curry Chicken Salad** with Grapes on a Kaiser Roll |
| Panini | **Ham, Pickle, Jack Cheese,** Brown Mustard & Tomato on a Pretzel Roll | **Fried Fish** with Cheddar, Tomato & Tartar Sauce Torpedo | **Breaded Chicken Cutlet** with Ham, Swiss Cheese, Lettuce & Honey Mustard Ciabatta | **Curried Lentil & Brown Rice Wrap** | **Texas BBQ Beef** topped with Southwest Slaw on a Kaiser Roll |

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** ◆ Communications Director: **Larry Bernard**

The **PPPL WEEKLY** is published by the PPPL Office of 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 ◆ **PPPL WEEKLY** is archived on the web at: http://w3.pppl.gov/communications/weekly/.

The PPPL Weekly will be published every other week during the summer.
The next issue will be on August 8.