

Calendar of Events

NOV. 30-DEC. 16

Holiday Food Drive
LSB Lobby

WEDNESDAY, DEC. 9

PPPL Colloquium
4:15 p.m. ♦ MBG Auditorium
[Introduction to Quantum Algorithms](#)
Dr. Nadya Shirokova, University of Santa Clara

UPCOMING

WEDNESDAY, DEC. 16

PPPL Colloquium
4:15 p.m. ♦ MBG Auditorium
[Binary Black Hole and Neutron Star Collisions](#)
Dr. Frans Pretorius, Princeton University

WEDNESDAY, DEC. 23

PPPL Holiday Party

DEC. 24-JAN. 3

Laboratory Closed

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PPPL physicists propose new plasma-based method to treat radioactive waste

By Raphael Rosen

Physicists at PPPL are proposing a new way to process nuclear waste that uses a plasma-based centrifuge. Known as plasma mass filtering, the new mass separation techniques would supplement chemical techniques. It is hoped that this combined approach would reduce both the cost of nuclear waste disposal and the amount of by-products produced during the process. This work was supported by PPPL's Laboratory Directed Research and Development Program.

"The safe disposal of nuclear waste is a colossal problem," said Renaud Gueroult, staff physicist at PPPL and lead author of the paper that appeared in the Journal of Hazardous Materials in October. "One solution might be to supplement existing chemical separation techniques with plasma separation techniques, which could be economically attractive, ideally leading to a reevaluation of how nuclear waste is processed."

The immediate motivation for safe disposal is the radioactive waste stored currently at the Hanford Site, a facility in Washington State that produced plutonium for nuclear weapons during the Cold War. The volume of this waste originally totaled 54 million gallons and was stored in 177 underground tanks.

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PPPL volunteers promote girl power on Lego® robotics teams

By Jeanne Jackson DeVoe

The "Orange Power" and "Orange Alert" all-girl robotics teams organized by PPPL had fun building and programming Lego robots before their final contest last month.

The two teams of 11 girls from ages 9 to 14 were the first all-girls robotics teams for the FIRST LEGO® League at the Princeton YWCA. They met twice a week for two months at University Medical Center of Princeton at Plainsboro, nearby PPPL, before the regional qualifying event on Nov. 21 at West Windsor-Plainsboro High School-South. They gave a practice presentation at a colloquium at PPPL on Nov. 13, and got some pointers from invited scientists and engineers as well as from the Green Machine, a Girl Scouts team invited to the colloquium.



Members of the Orange Power team give their presentation during a colloquium at PPPL.

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Plasma mass filtering

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In 2000, Hanford engineers began building machinery that would encase the radioactive waste in glass. The method, known as “vitrification,” had been used at another Cold War-era nuclear production facility since 1996. A multibillion-dollar vitrification plant is currently under construction at the Hanford site.

Since vitrification and disposal in a federal repository of highly radioactive waste is expensive, there is an advantage to first reducing the amount of the highly radioactive waste to be vitrified, with the goal of having to process less volume. The high-level radioactive waste would then be incorporated into the glass matrix.

This vitrified waste is deposited into canisters that measure approximately 10 feet long and two feet in diameter. These canisters would be sent away to a federal repository where the radioactivity dissipates over thousands of years. The low-level waste by-product would be similarly, but less expensively, immobilized in a glass wasteform. This immobilized low-level waste would be disposed of at the Hanford Site.

To reduce the cost of high-level waste vitrification and disposal, it may be advantageous to reduce the number of high-level glass canisters by packing more waste into each glass canister. To reduce the volume to be vitrified, it would be advantageous to separate the nonradioactive waste, like aluminum and iron, out of the waste, leaving less waste to be vitrified. However, in its 2014 report, the DOE Task Force on Technology Development for Environmental Management argued that, “without the development of new technology, it is not clear that the cleanup can be completed satisfactorily or at any reasonable cost.”

The high-throughput, plasma-based, mass separation techniques advanced at PPPL offer the possibility of reducing the volume of waste that needs to be immobilized in glass. “The interesting thing about our ideas on mass separation is that it is a form of magnetic confinement, so it fits well within the Laboratory’s culture,” said physicist Nat Fisch, co-author of the paper and director of the Princeton University Program in Plasma Physics. “To be more precise, it is ‘differential magnetic confinement’ in that some species are confined while others are lost quickly, which is what makes it a high-throughput mass filter.”

How would a plasma-based mass filter system work? The method begins by atomizing and ionizing the hazardous waste and injecting it into the rotating filter so the individual elements can be influenced by electric and magnetic fields. The filter then separates the lighter elements from the heavier ones by using centrifugal and magnetic forces. The lighter elements are typically less radioactive than the heavier ones and often do not need to be vitrified. Processing of the high-level waste therefore would need fewer high-level glass canisters overall, while the less radioactive material could be immobilized in less costly wasteform (e.g., concrete, bitumen).

The new technique would also be more widely applicable than traditional chemical-based methods since it would depend less on the nuclear waste’s chemical composition. While “the waste’s composition would influence the performance of the plasma mass filter in some ways, the effect would most likely be less than that associated with chemical techniques,” said Gueroult.



Securing a shipment of mixed, low-level waste from Hanford for treatment and disposal. (Photo courtesy U.S. Department of Energy)

Gueroult points out why savings by plasma techniques can be important. “For only about \$10 a kilogram in energy cost, solid waste can be ionized. In its ionized form, the waste can then be separated into heavy and light components. Because the waste is atomized, the separation proceeds only on the basis of atomic mass, without regard to the chemistry. Since the total cost of chemical-based techniques can be \$2,000 per kilogram of the vitrified waste, as explained in the *Journal of Hazardous Materials* paper, it stands to reason that even if several plasma-based steps are needed to achieve pure enough separation, there is in principle plenty of room to cut the overall costs. That is the point of our recent paper. It is also why we are excited about our plasma-based methods.”

Fisch notes that “our original ideas grew out of the thesis of Abe Fetterman, who began by considering centrifugal mirror confinement for nuclear fusion, but then realized the potential for mass separation. Now the key role on this project is being played by Renaud, who has developed the concept substantially further.”

According to Fisch, the current developments are a variation and refinement of a plasma-based mass separation system first advanced by a private company called Archimedes Technology Group. That company, started by the late Dr. Tihiro Ohkawa, a fusion pioneer, raised private capital to advance a plasma-based centrifuge concept to clean up the legacy waste at Hanford, but ceased operation in 2006 after failing to receive federal funding.

Now an updated understanding of the complexity of the Hanford problem, combined with an increased appreciation of new ideas, has led to renewed federal interest in waste-treatment solutions. Completion of the main waste processing operations, which was in 2002 projected for 2028, has slipped by 20 years over the last 13 years, and the total cleanup cost is now estimated by the Department of Energy to be greater than 250 billion dollars, according to the DOE Office of Inspector General, Office of Audits and Inspections. DOE, which has the responsibility of cleaning up the legacy nuclear waste at Hanford and other sites, conducted a Basic Research Needs Workshop on nuclear waste cleanup in July that both Fisch and Gueroult attended. The report of that workshop, which is expected to highlight new approaches to the cleanup problem, is due out this fall. 📄

LEGO® robotics teams

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Shannon Greco, the Science Education program leader who helped organize the teams and coached Orange Power, said the important thing was how much the girls learned along the way.

“The program gives students real programming experience, public speaking experience, robotics and engineering experience, said Greco, who organized the groups and helped coach Orange Power. “They also learned collaboration and the spirit of teamwork and finding a place for everyone. Those are all essential to the program.”

The theme of the program was “Trash Trek,” and the girls had to invent LEGO® Mindstorms® robots that could lift and transport trash and recyclables. They also did research on the problem of trash disposal and came up with their own invention to solve the problem. Orange Power invented a way to turn tee shirts into shopping bags while Orange Alert invented a method of detecting aluminum cans in the trash to sort them out before they are put in the landfill.

Volunteers from PPPL and Princeton University worked with the two teams. In addition to Greco, Atiba Brereton helped coach the Orange Power team, along with Willow Dressel, the former librarian at PPPL who is now a librarian at the University’s School of Engineering and Applied Science; and Songtian Zhang, a graduate student in the Physics Department. Laurie Bagley and Hannah La Fleur, a contractor at PPPL, coached the Orange Alert team, along with Jacob Maddox, a SULI student, and Yancey Sechrest, another contractor. Graphics designer Kyle Palmer worked with the girls on Orange Power to design their tee shirts. Virginia Finley, head of environmental compliance, spoke to the Orange Power girls about recycling as part of their research. 🗑️



The Orange Alert team presents during the PPPL colloquium.



Simone Spence, left, and Lea-Jade Richards play with the LEGO creations.



Members of the Orange Alert team show off their invention: a device that detects aluminum cans in the trash.



Members of the Orange Power team exchange high fives as Coach Atiba Brereton looks on as they prepare for the contest. From left to right: Coach Songtian Zhang, Sia Anand, Janvi Jadhav, Arya Kinikar, and Aliza Manekia.



Bytes and bats: Silber's computer career at PPPL is linked to his baseball avocation

For more than 30 years Ken Silber has pursued his career in IT and his passion for baseball with equal gusto. He has taken on many roles at PPPL – helping to maintain the Lab's computer systems, developing web-sites for many departments and individuals, and finding time to do some inventing on the side. He was one of the inventors of the MINDS device, which can detect nuclear materials used in nuclear weapons or "dirty bombs." "During the early days of MINDS development Kenny was instrumental in the system design which differentiated MINDS from other radionuclide identifiers," said Charlie Gentile, who headed the MINDS team, which also included Bill Davis. "Kenny is a talented software engineer who provided excellent insights for advancing MINDS capabilities."

Through the years, Silber has also kept a hand in the world of baseball, first as a long-time assistant coach at Princeton University and currently as an associate scout for the Chicago Cubs. A native of Brooklyn, Silber grew up in an avid baseball family. One of his brothers played minor league player for the Detroit Tigers and another was a baseball All American at Oklahoma City University. Silber played baseball for Brandeis University and when head baseball coach Tom O'Connell became the head baseball coach at Princeton University after Silber graduated in 1982, he asked Silber to be his assistant. Silber took the job for \$3,000 and a room at the top of Dillon gym with other assistant coaches. When the team honored O'Connell, who was inducted in the College Baseball Hall of Fame in 1999, it named new dugouts in his honor. Silber was one of the names engraved on a plaque in the dugouts.

Silber also arrived at PPPL in 1982, starting out as an applications programmer for the DAS group at PPPL, supporting the Princeton Large Torus (PLT), the Princeton Beta Experiment (PDX) and the S-1 experiment.

Working at the Laboratory has been a tradition for Silber's family. Linda, his "partner in crime" of 27 years, also worked in the IT department in the 1980s and was known for her role in "meticulous and well-documented coding" that helped bring TFTR online. She was also the lead singer and drummer in PPPL's unofficial band, "Changing Faces," which also included Carl Scimeca and Paul Funk. Silber's daughter, Emily, was an intern in the Office of Communications for two summers and is currently finishing a fellowship with the Audubon Society. His older daughter Lisa also worked for two summers in the radiation group and is now coordinator of a cancer research laboratory at Mount Sinai Hospital.

Ken and Linda Silber own a home in Hopewell, New Jersey. Silber is an avid golfer who plays in the Princeton University Golf League and he and his partner, Barry Jedic, won the League Championship in 2014. He also enjoys going to concerts and Broadway shows and



Ken Silber, left, with former Coach Tom O'Connell and members of Princeton University's 1985 team at a November ceremony commemorating dugouts in O'Connell's honor at the University. Names of the 1985 team members, including Silber's as assistant coach, were inscribed on a plaque in the dugouts. (Photo by Chris Cane).

vacationing with his family, and especially gets a kick out of "tormenting my daughters' boyfriends."

What does your job entail?

I wear many hats, but as part of a team I primarily help maintain Unix servers and the HPC clusters that the lab employees use for accessing data from many different sources. I also do a bit of Web development for different departments.

What do you like best about your work?

One of my passions is analyzing and solving things, whether as the pitching coach for Princeton University, a scout for the Chicago Cubs or as an IT person at the Lab. My job allows me to help people solve IT problems and to come up with solutions to make using the labs resources a bit easier.

Can you tell us about your baseball coaching at Princeton?

It was a priceless experience to part of such a rich tradition in academia and athletics. From 1982 until 1997, I was the number one assistant coach, participating in all aspects of running a college baseball program. Besides the day-to-day coaching of two teams, Varsity and JV, I helped in recruiting, fundraising, scouting, tutoring, mentoring, and running a very successful summer baseball camp sponsored by Babe Ruth baseball. We appeared in three NCAA tournaments over those years and had many players drafted into the minor leagues. Some of

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I Am the Lab: Ken Silber

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the notable former Princeton baseball players include Chris Young, Will Venable and Jason Garrett (Head Coach of the Dallas Cowboys). The 1985 team is one of the most celebrated teams in Princeton baseball history and holds the record for most wins in a season.

What were your proudest moments at PPPL?

This is very hard to say. Two projects that stand out were EMCS (Energy Management and Control System) and MINDS. The EMCS system was a way to track demand usage during the TFTR run cycles. The program I wrote interacted with Demand Energy meters around the lab to calculate demand usage every two seconds. The program saved the laboratory a lot of money in electric bills.

In addition to the obvious benefits of MINDS, it also generated some money for the Lab, and the vendor that commercialized the system received the American Security Challenge 2009 Finalist award of \$600,000 for innovative technology. And of course my proudest moments were when I had a chance to show off my kids when they interned here during the summers.

Are you working on other inventions?

Yes, I am currently working on another invention, which I cannot discuss at this time. It is another device that will be good for the environment.

What is it like working with the IT staff and staff in other departments?

I enjoy being part of the IT division and especially the group I am in, Systems and Networking. There is a lot of chemistry in our group. Being on the IT support staff, I am fortunate to have the opportunity to work with almost all departments in the Lab. In the four corners of the Lab there are always people who will greet you with a hello, a smile and maybe a little anecdote of something that has happened in their lives.

How has PPPL changed over the years?

Back in the day, there were a lot more programmers working for the experiments writing code and the researchers focused mainly on hardware and theory. Now, the researchers are much more advanced in software development and there are more tools available to them to do a lot of their own programming.

What do you tell people about the research taking place at PPPL?

I like the fact that the people I work with are all committed to a common goal and are serious about their work. I tell people we are working on an experiment that contributes to a larger effort that can someday change the world as we know it and thereby present a bright future for our kids. 🍌

Thank you for your clothing donations and your recycling efforts!

PPPL collected 360 pounds of clothing to contribute to Princeton University's drive to help the Rescue Mission of Trenton break Guinness World Records. The Rescue Mission won the Guinness title for the largest clothing for recycle/donation with a total of 179,550 items of clothing, which adds up to nearly 90,000 pounds of clothes.

PPPL also collected 1,328 pounds of home electronics for Unicorn Recycling and gave out more than 15 gifts to employees who were caught recycling or using reusable containers, lunch bags or cups in the cafeteria.

Please continue to bring discarded office supplies to the Terracycle box in the lobby and discarded protective goggles to the stock room for recycling.

Thousands of students learn about plasma at APS-DPS Expo

The Science Education staff, along with about 20 graduate students and scientists, volunteered to help out with plasma demonstrations at a PPPL booth at the Plasma Science Expo during the APS Division of Plasma Science Conference in Savannah, Georgia. Some 1,200 middle and high school students attended the event on Nov. 19 and some 2,000 high school students came on Nov. 20. Arturo Dominguez presented the Plasma 101 course to about 75 middle and high school teachers taking part in the APS-DPP Teacher's Day workshop on Nov. 17. (Photos by Deedee Ortiz). 📷



Some students use a plasma ball to light a fluorescent rod.



Students discover how a Tesla coil lights up a fluorescent bulb.



Students try out diffraction glasses, which break lights into different colored wavelengths, as volunteer Dick Majeski looks on.



Science Education Program Leader Shannon Greco shares a laugh with a student at the Expo.



Senior Program Leader Arturo Dominguez shows off one of the experiments.



Graduate student Brian Kraus, one of the volunteers, makes a balloon expand in a vacuum chamber.

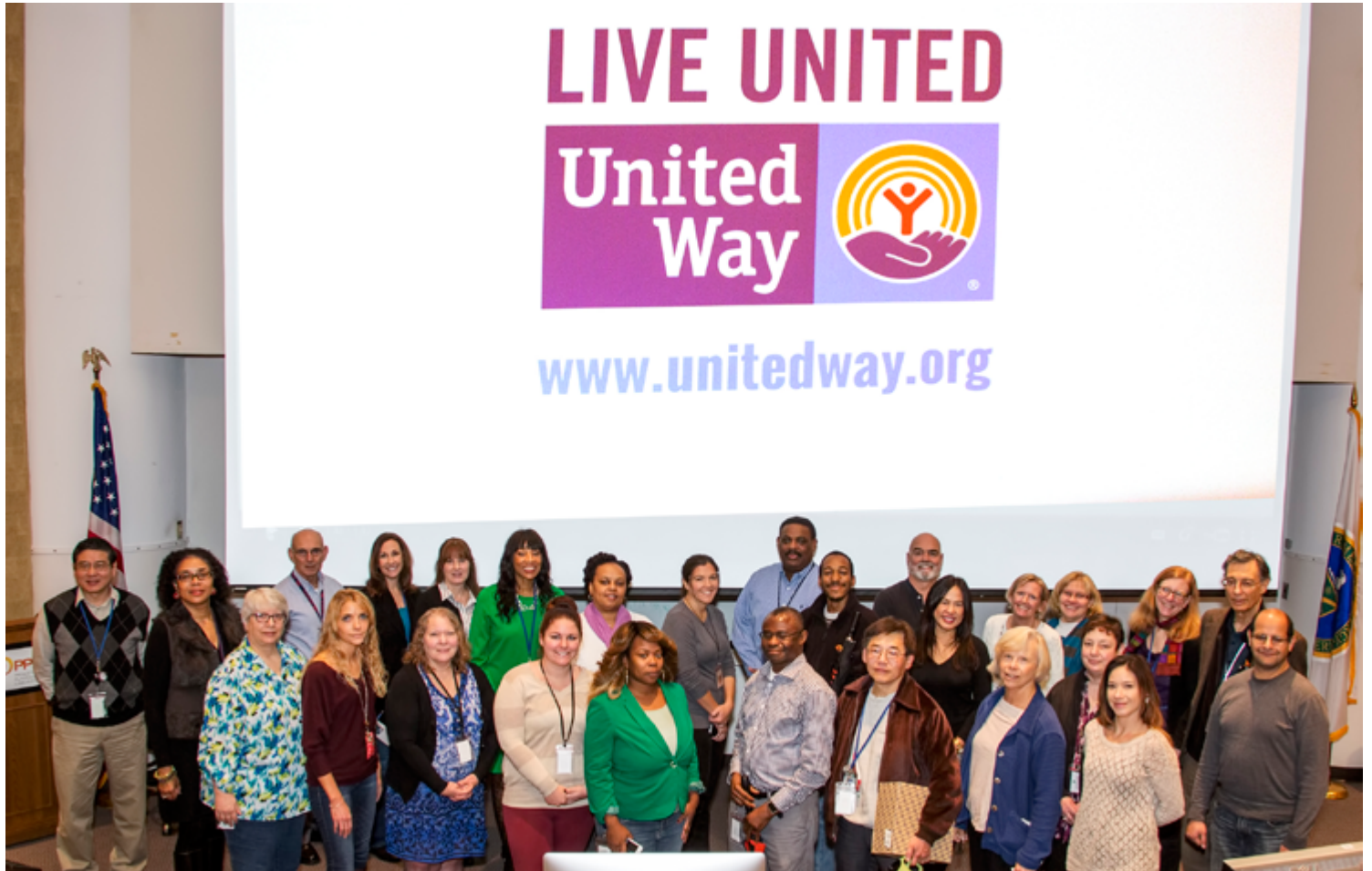
PPPL's annual United Way drive kicks off

PPPL kicked off its annual event kicking off the Princeton University United Way Campaign on Dec. 2 with a bacon and eggs breakfast, a presentation by United Way officials, and prizes for some of the attendees.

United Way of Mercer County has a major focus on education through programs like Reading Oasis, which purchases books for children to encourage a love of reading and gets parents involved to offer encouragement. It offers a variety

of programs that range from tax assistance for low-income people to health programs that help people manage and prevent chronic diseases.

More information about the drive is available at <http://www.princeton.edu/pr/uw/home/>. PPPLers can drop off United Way forms with Kate Harkness in Human Resources through Jan. 1 or mail forms to main campus. 📄



PPPLers attending the kick-off of PPPL's United Way campaign won numerous prizes including coveted parking spaces, wine glasses, umbrellas, a clock, and other items.



The United Way Committee with Denise Daniels, the director of Outreach and Volunteer Services for United Way of Greater Mercer County, front row, second from right, and from left to right: Marianne Tyrrell, Lena Scimeca, Dana Eckstein, Kate Harkness, Rich Kovac, Himanchi Sachdeva, also from the United Way, and Carol Ann Austin.

MHD Stability Control Workshop at PPPL



More than 60 researchers from around the world gathered at PPPL two weeks ago for the 20th Workshop on MHD Stability Control. Conference-goers heard more than 45 talks on non-linear processes that are frontiers in the control of toroidal confinement systems. Invited speakers included physicists Raffi Nazikian, Roscoe White and Michael Bell. Co-chairing the program were Jong-Kyu Park and Michio Okabayashi of PPPL and Egemen Koleman of PPPL and Princeton University. The event was jointly organized by PPPL, Los Alamos National Laboratory, Columbia University, General Atomics, the University of Wisconsin-Madison and Auburn University.

Announcing a new opportunity for undergraduates, graduate students and postdocs: Princeton Research Day

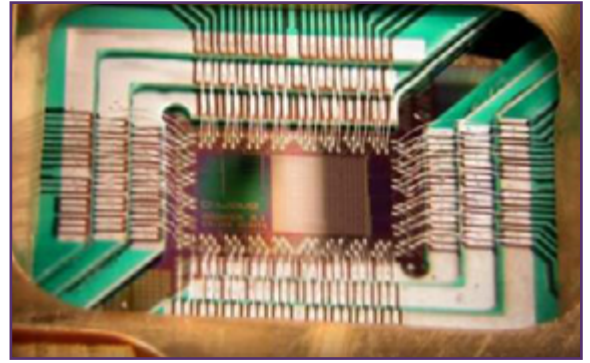
Juniors, seniors, graduate students and postdoctoral researchers are encouraged to present at the inaugural Princeton Research Day, a celebration of research and creative works to be held **May 5, 2016** at Frist Campus Center. Presenters will gain valuable experience in communicating across disciplines to a nonspecialist audience. Resources — including workshops, practice sessions and technical help — will be available to help presenters prepare for the event. Types of presentations include posters, talks, performances, exhibitions and videos. See researchday.princeton.edu for more information and to apply.

Applications will be accepted Dec. 1 through Feb. 5, 2016

COLLOQUIUM

Introduction to Quantum Algorithms

Dr. Nadya Shirokova
University of Santa Clara



Wednesday, Dec. 9

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

Holiday outreach programs at Princeton University and in the community

Princeton University has several programs that collect food, toys, and other items to help make the season bright for those in need:

- Take part in the holiday food drive at PPPL by bringing non-perishable food items to the lobby. (See page 9)
- Bring two non-perishable food items to the Princeton University's men's basketball game versus Liberty University on Dec. 17 at 7 p.m. and receive free admission.
- Donate items to the Crisis Ministry of Princeton and Trenton for needy families. Donate home products for a Welcome Home package (new cleaning supplies, dish detergent, laundry detergent, bed supplies, baby supplies, etc.) or personal care products such as toothbrushes, toothpaste, feminine products, soaps, etc. Collection will be Monday through Thursday at the Crisis Ministry office at 161 Nassau St. in the basement of the Nassau Presbyterian Church.
- Donate personal care items, kitchen supplies, bedroom or bathroom items to Homefront, 1880 Princeton Ave., Lawrenceville, Mondays, Wednesdays, Thursdays and Fridays 9 a.m. to 5 p.m. and Tuesdays 11 to 6 p.m.

For a complete list of programs, go to <http://www.princeton.edu/community/happenings/service/outreach/>.

New training modules for PPPL travelers on the PPPL Travel Website

Attention PPPL travelers and administrators: Check out two new travel modules under the new training link on the PPPL Travel Website at <http://travel.pppl.gov>.

A voucher training module is designed to help you get reimbursed for your trips! The travel module leads you through all the steps you'll need to take to properly fill out the travel voucher.

[Click here for the Voucher Training module.](#)

A Foreign Travel Management System training module will assist you in filling out the documentation for any foreign travel.

[Click here for the Foreign Travel module.](#)

Holiday Food Drive

PPPL will take part in the University's holiday food drive from **Nov. 30 through Dec. 16**. The food will go to the Mercer Street Friends Food Bank, which has been a leader in fighting hunger in the Mercer County area, supplying food to nearly 50 pantries, shelters and soup kitchens for nearly 20 years.

Flu Vaccines Are Here!

Influenza is a contagious disease caused by a virus. It can be spread by coughing, sneezing or nasal secretions.

By getting the flu vaccine, you can protect yourself from influenza and may also avoid spreading this illness to others.

Please call the OMO at extension 3200 to make an appointment.

Thank you.

—The OMO Staff

Get LinkedIn with PPPL!

Help promote PPPL to job seekers by following the Lab's LinkedIn page at <https://www.linkedin.com/company/princeton-plasma-physics-lab>

That's the message from PPPL's Office of Human Resources, which has given the Lab's LinkedIn page a new look with information about research, job openings, current events, and inspirational memes. The hope is to have more PPPL'ers join (or "follow") the LinkedIn page, and for all Lab employees to help spread the word about what makes the Lab a great place to work and learn.

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 December 7	Tuesday December 8	Wednesday December 9	Thursday December 10	Friday December 11
COMMAND PERFORMANCE Chef's Feature	Turkey & Mushroom Bolognese served over Spaghetti	Chicken Tetrazzini	Salisbury Steak served with Egg Noodles & Gravy & Vegetable	Glazed Ham with Apple Cider Raisin Sauce served with Stuffing & Vegetable	Stuffed Shells
Early Riser	Breakfast Taco with Homemade Turkey Sausage Hash	Grilled Cheese with Sausage, Ham, Egg & Cheese	French Toast English Muffin Sandwich with Sausage & Egg	Grilled Cheese with Veggies, Egg & Cheese	Blueberry Pancakes
Country Kettle	Sweet Potato Soup	Jambalaya Soup	Tomato Tortellini	Cheeseburger Soup	Lentil
Grille Special	Handmade 8 oz. Burger with Onion Straws, American Cheese & BBQ Sauce	Bologna Burger with Peppers, Onions & American Cheese	Fried Shrimp Po' Boy	Roast Turkey on a Torpedo Roll with Stuffing, Cranberry Sauce and Gravy served with Sweet Potato Fries	Bacon Cheddar Burger
Deli Special	Portobello & Grilled Onion on Ciabatta with Provolone & Chipotle BBQ Sauce	Slow-Cooked Italian Beef Torpedo	American Hoagie with Cooked Salami, Bologna & American Cheese	Apple Tuna Salad with Walnut, Relish & Grapes served on Multigrain Bread	Chicken-Fried Steak Sandwich
Panini	Muffaletta Panini on Sourdough Bread	Turkey, Ham & Smoked Gouda with Roasted Peppers	Vietnamese Chicken Sandwich	Veggie Burger Parmesan with Mushrooms and Mozzarella	Italian Hot Dog

MENU SUBJECT TO CHANGE WITHOUT NOTICE

VEGETARIAN OPTION

WEEKLY

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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/>.