PPPL PRINCETON PLASMA PHYSICS LABORATORY
A Collaborative National Center for Fusion & Plasma Research
U.S. DEPARTMENT OF ENERGY
WEEKLY
November 21, 2016

THIS WEEK

NOV. 24–25

Happy Thanksgiving!
Laboratory closed.

UPCOMING

WEDNESDAY, NOV. 30

Last day to donate to United Way
See page 7.

PPPL Colloquium
4:15 p.m. ◆ MBG Auditorium
Overview of Domestic Electric and Gas Markets
Ralph Izzo, Public Service Enterprise Group (PSEG)

FRIDAY, DEC. 2

Public Tour
10 a.m.

Princeton Envision Conference Tour
4:45–6:45 p.m.

DEC. 5–8

Max Planck Princeton Center Workshop 2016
Princeton Center for Theoretical Science, Jadwin Hall

TUESDAY, DEC. 6

Chemistry Council of N.J. Plant Operations Management Workshop

WEDNESDAY, DEC. 14

Princeton University's District Energy Approach & Implications for Improving Energy Efficiency
Edward T. Borer, Princeton University

The PPPL Weekly will not be published on Nov. 28 due to the Thanksgiving holiday. The next issue will be on Dec. 5.

INSIDE

PPPL senior physicist Wei-li Lee honored at week-long symposium

By Raphael Rosen

Physicists from around the world gathered at the University of California, Irvine this past summer for a symposium in honor of Wei-li Lee, a senior physicist at PPPL. The week-long event, held from July 18-22, focused on gyrokinetic simulation — a technique Lee invented in the 1980s to model the behavior of particles within plasma, the ultrahot gas composed of electrons and atomic nuclei that fuels fusion reactions. Approximately 15 papers related to Wei-li Lee and the symposium are planned to appear in a special issue of *Physics of Plasmas* in mid-2017.

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Recycling Day celebrates sustainability efforts

By Jeanne Jackson DeVoe

Kyron Jones, left, with an old television donated by Howard Yuh during the UNICOR recycling drive on Nov. 15. *(Photo by Elle Starkman)*

A recycled art contest, lunchtime videos, and numerous opportunities to recycle everything from electronics to gently-used clothing highlighted PPPL's America Recycles Day on Nov. 15.

The recycled art contest featured imaginative uses of recycled materials such as a purple disco ball made of plastic cups, a pocketbook made of cardboard, and a radio made from recycled parts.

"It's important that we give our trash a second chance," said Margaret Kevin-King, Building and Grounds supervisor and a member of the Green Team, which organized the events. "Our recycling rate shows that PPPL'ers are making a difference."

The America Recycles Day celebration included collections of office supplies and personal protective equipment for Terra Cycle, gently-used clothing for the Trenton Rescue Mission, and home electronics for the UNICOR home electronics recycling drive. The UNICOR drive collected 2,095 pounds of home electronics.

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Wei-li Lee honored

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"Dr. Lee has enormous scientific vision and persistence," said Scott Parker, a physics professor at the University of Colorado, Boulder and one of the symposium's organizers. "He has been a role model and mentor to many leaders in the field today."

The simulations rely on a branch of plasma physics called gyrokinetics that helps scientists understand how charged particles spiral around and move along and between magnetic field lines within fusion plasmas. Gyrokinetics averages out fast oscillations in the motion of the particles spiraling around the field lines, simplifying the calculations needed for computers to simulate the plasma's behavior.

The more that physicists understand the mechanisms underlying the motion of particles, or "transport," between field lines, the better they can design doughnut-shaped facilities called tokamaks so that transport can be reduced. Such motion cools down fusion reactions, making them less efficient.

Lee's development of gyrokinetic simulations birthed a new subfield within the plasma physics world. "But I didn't do it alone," Lee said. "I was influenced by two PPPL scientists: Ed Freeman, who created gyrokinetics, and John Dawson, who pioneered simulation. And over the years, various people, including myself, have modified and improved the equations I devised." Lee's equations reformulate gyrokinetics so it can be fitted into particle simulations.

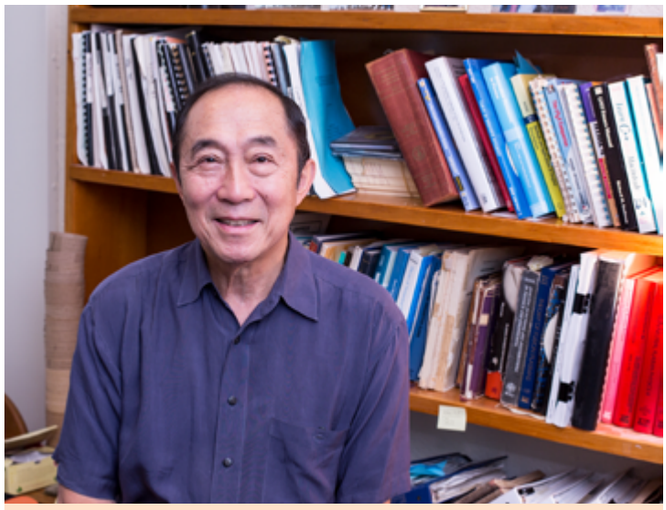
Simulations used around the world

The resulting simulations are in use throughout the world. "The gyrokinetic simulation that Wei-li pioneered is undoubtedly the most important breakthrough in fusion simulations, with hundreds of active researchers around the world currently developing and applying this powerful tool," said Zhihong Lin, a physics professor at the University of California, Irvine, co-sponsor of the symposium, and one of Lee's former students. Scientists plan to use the simulations to analyze the plasmas within ITER, the multinational fusion facility being built in the south of France to demonstrate the feasibility of fusion power. "But there is still some physics we have to put into the codes," Lee notes.

Physicists still debate how best to solve gyrokinetic simulation equations. One method, called particle simulation, is the most efficient in present-day supercomputers. It models the particle interactions within plasmas by using a much smaller number of particles than exist in real plasmas and giving each particle three degrees of freedom to move.

Because there is less communication between the particles in these simulations, computers can solve the equations more easily. But the small number of particles means that the simulations are relatively "noisy:" there is not enough information for the computer program to model the plasma as precisely as it could otherwise.

A separate technique called "continuum simulation" solves the same equations in five dimensions, not three, and reduces the amount of noise through a process called "coarse graining." But the greater amount of information in continuum simulations means that computers have to take more time and processing power to run them. "In continuum simulations, there are simply too many neighbors talking to one another, which can become a serious problem for modern parallel computers," Lee said.



Wei-li Lee *(Photo by Elle Starkman)*

The debate over the best method to solve the equations now includes a new idea: combining particle and continuum simulations. It's clear that modeling an entire plasma using just a continuum simulation would strain the capabilities of current supercomputers.

Just too much

"It would just be too much," Lee noted. "The volume of the simulated plasma using a five-dimensional grid would be too big. Fortunately, the two simulation methods complement each other at this stage of fusion research."

Lee earned a bachelor's degree from National Taiwan University, a master's from Duke University, and a Ph.D. from Northwestern University, where he studied mechanical engineering and aeronautical science. His advisor was Jacque Denavit, a plasma physicist who pioneered the continuum simulation code and told Lee that plasma physics would be a worthy subject for him to pursue.

So Lee applied for a position at PPPL, where he could work with simulation pioneer Dawson. His application was rejected, however, because of a lack of funding. So, he took a position at Fermilab, the DOE national laboratory outside Chicago, where he studied particle codes and beam physics.

Several years at Fermilab

Lee spent several years at Fermilab before learning that PPPL was building the Tokamak Fusion Test Reactor (TFTR), a machine that operated from 1982 to 1997 and produced the highest temperatures ever created in a laboratory. He reapplied for a position and was hired by Paul Rutherford, the head of PPPL's theory department. Unfortunately, Dawson, the scientist Lee had greatly wanted to work with, had already left the Lab for UCLA.

Lee spent 41 years at PPPL and retired in 2015. During his career he focused on gyrokinetic equations and finding ways to integrate them into simulation codes, as well as using those codes to investigate microturbulence in tokamaks. Recently, he has been trying to derive magnetohydrodynamic equations by taking a "gyrokinetic point of view" and calculating the radial electric field at the tokamak's edge. His research continues in his capacity as a senior physicist, a recently created position for retired researchers at PPPL. "I'm grateful that the Lab let me keep my office, and I'm happy that I can still come into my office and interact with my colleagues," said Lee. "I feel like my job isn't finished yet, but I also need some time for myself and my family, especially my grandchildren."

America Recycles Day

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PPPL recycled 98 percent of all construction and demolition and waste material, primarily from the removal of concrete and metal in the C Site-MG Building. This included more than 3,400 tons of concrete, 201 tons of metal, 28 tons of wood from tree removal, and 8 tons of wood.

The Laboratory also recycled or composted 69 percent of all its solid waste, including 41 tons of single stream recycling, 19 tons of food waste and 10 tons of yard waste. In addition to recycling paper, cans and bottles, PPPL recycles or reuses binders, batteries, and office supplies such as transparencies, pens, and pencils. PPPL also reuses furniture, electronics, cafeteria silverware and trays.

PPPL's sustainability efforts in fiscal year 2016 had the following effects, according to PPPL's Environmental Services Division:

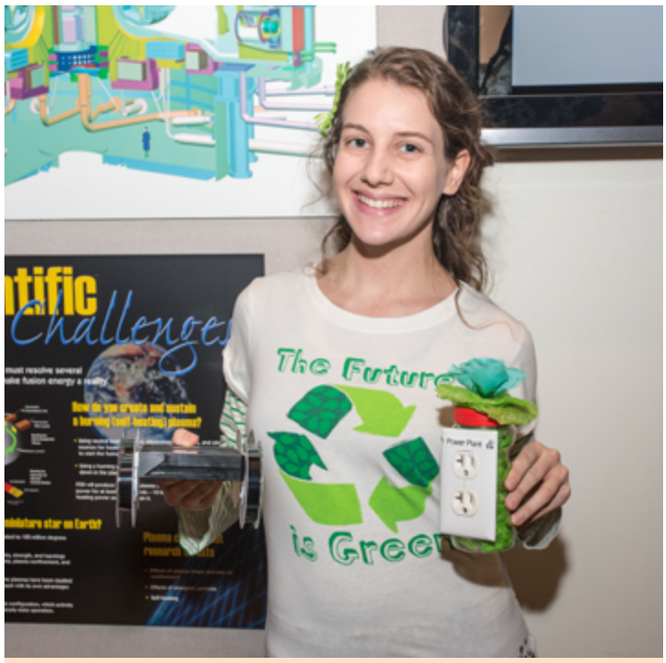
- More than 4,000 barrels of oil conserved
- More than 200,000 gallons of gas conserved
- Energy savings equivalent to 150 homes
- Gasoline savings equivalent to 500 passenger vehicles removed from the road

Winners of the Recycling Art Contest:

- 1st Prize to Irene Newman for "Staying Alive" Disco Sphere Art
- 2nd Prize to Nevell Greenough for Recycling Radio
- 3rd Prize to Dana Eckstein for Power Plant

Virginia Finley behind a disco ball made out of clear plastic cups and holiday lights at the recycled art display. *(Photo by Elle Starkman)*

Ewa Kontor, left, and Helen Wotjenko examine a pocketbook made of recycled materials by Margaret Kevin-King.*(Photo by Elle Starkman)*



Dana Eckstein with her recycled vase and a car made of VHS tapes. *(Photo by Elle Starkman)*

Some members of the Green Team, which organized the America Recycles Day event. From left to right: Ana Marie Datuin, Leanna Meyer, Margaret Kevin-King, Virginia Finley and Mark Hughes.*(Photo by Elle Starkman)*

Engineers move into temporary offices

Engineering staff moved into a new modular office complex last week in preparation for the complete renovation of the Lyman Spitzer Building Annex. Construction is expected to begin in mid-December as part of the $26 million Infrastructure and Operational Improvements (IOI) project. Movers moved boxes for 27 engineers into the modular complex, Module 2 (C34) The complex has 34 offices and is located next to the Accounting and Procurement office complex, which is next to the Theory Wing. Some offices in C34 will also be used as temporary offices by visiting collaborators.

Mike Kalish gets to work. *(Photo by Elle Starkman)*

Marc Sibilia in his new office. *(Photo by Elle Starkman)*

Soha Aslam settles into her office. *(Photo by Elle Starkman)*

Princeton Ririxin School students and teachers toured PPPL

Sixteen students from the Princeton Ririxin School and five teachers toured PPPL on Nov. 17 with tour guide Brian Kraus, who speaks Mandarin. The group viewed videos in the MBG Auditorium and visited the model stellarator, the NSTX-U Control Room, the Hall thruster, and the Science Education Laboratory. *(Photo by Han Zhang)*

PPPL's bake-off contest and sale nets $800 for United Way

PPPL's Business Operations Department won a trophy in the Laboratory's first bake-off contest and sale on Nov. 14, in which PPPL departments competed to see which could raise the most money for the United Way.

The Business Operations Department raised $227 of the $800 raised by the bake sale.

"Everybody's donations really help make an impact in Mercer County or the county where they live or designate," said John Santana, director of financial empowerment and community engagement at the United Way of Greater Mercer County, who attended the event. "Even the smallest donation helps the community in areas such as economic mobility, access to health care, and early childhood education."

Following brief remarks by Santana, the annual raffle for parking spaces was held with about a dozen people winning three-month designated parking spaces.

Princeton University's United Way campaign kicked off Nov. 1 and ends Nov. 30. (See story p. xxx)

Photos by Elle Starkman.

Alana Coleman and Irene Newman with the trophy won by Business Operations for earning the most money for United Way.

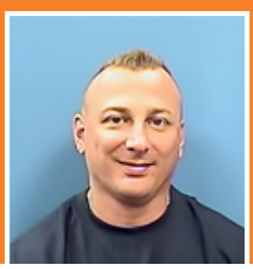
Deedee Ortiz holds her winning raffle ticket for a parking spot.

Mike Zarnstorff with some treats.

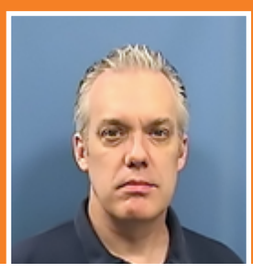
Al Mark with a tray full of goodies.

Some of the bakers who contributed to the sale: From left: Carol Ann Austin, Virginia Finley, Jeanne Jackson DeVoe, Janice Huang, Farra Rosko, Alana Coleman, Irene Newman, Mary Payne, Sue Hill, Ana Marie Datuin, Andrea Moten and Ricardo Marquez. Not shown are: Kristen Fischer, Tori Sikkema, Jaclyn Pursell, Helen Wojtenko, Marie Iseicz, Deedee Ortiz, John DeLooper and Olivia Merrill.

PPPL Welcomes New Employees!

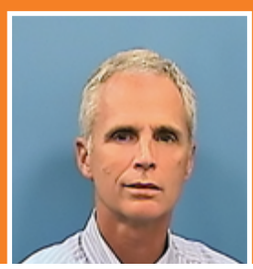


MICHAEL CONSULMAGNO
Janitor
Engineering/facilities



ANTHONY DALESIO
Heating systems technician
Engineering

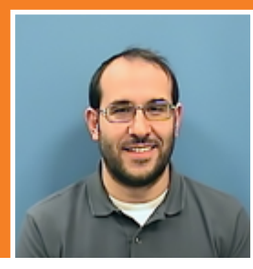
ANGELA POWELL
Senior administrative assistant
Plasma Science & Technology



RICHARD RAINEY
Head of Material Services Division
ES&H

RICHARD SHIM CHIM
Senior service desk administrator
Information Technology

JORGE GONZALEZ TEODORO
Optical mechanical engineer
Engineering



HARRY TSAMUTALIS JR.
Senior media support specialist
Information Technology

It's time to get your flu vaccine!

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.

Book Drive for Children in Grades 1–5

Please contribute to the United Way of Greater Mercer County Book Drive by donating gently-used or new books to be used in classroom libraries for children in first through fifth grade. Please bring your donations to a collection bin in the LSB Lobby through Nov. 30. Please do not bring textbooks, encyclopedias, or books for teens or adults.

Contact Ricardo Marquez, rmarquez@pppl.gov, ext. 2221 for a list of suggested books.

Donate to the United Way

The Princeton University United Way Campaign takes place **Nov. 1 to Nov. 30**. Employees can give a one-time contribution or donate a certain dollar amount from their paychecks. They can opt for donations to specific causes or initiatives or a non-profit agency of their choice.

$25 can buy 100 meals to local food banks. $60 can provide three literacy kits $150 can provide help for 10 students to go to college

The donation form is available here.

COLLOQUIUM

Overview of Domestic Electric and Gas Markets

Ralph Izzo
Public Service Enterprise Group (PSEG)

Wednesday, Nov. 30
4:15 p.m., M.B.G Auditorium, Lyman Spitzer Building

Terra Cycle is collecting office items to recycle in the LSB lobby and personal protective equipment in the stockroom.

Allowable office items:

- Staples
- Scissors
- Pens, markers & highlighters
- Tape, clips, rubber bands
- Mouse pads
- Transparencies

Personal Protective Equipment & other items:

- Eyewear
- Cloth/fabric
- Work gloves
- Wrappers & miscellaneous plastic

Please do not discard electronics, organic items or hazardous waste.

BROCK

NICK PETTI
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 November 21	Tuesday November 22	Wednesday November 23	Thursday November 24	Friday November 25
COMMAND PERFORMANCE **Chef's Feature**	**Chicken Parmesan** served with Pasta	**Roast Turkey** with Cornbread Stuffing and Gravy	**Vegetable Baked Ziti** with Garlic Bread	**Happy Thanksgiving!**	
Early Riser	**Bacon, Egg & Cheese Croissant**	**Banana-Walnut French Toast** with Caramel Sauce	**Mango & Blueberry Pancakes** served with Choice of Breakfast Meat		
Country Kettle	**Creamy Chicken**	**Tomato Bisque**	**Beef Barley**		
Grille Special	**Chili Burger** with Crisp Onions & Cheddar Cheese on an Onion Roll with Chipotle Mayo	**Hot Pastrami** & Cheddar Cheese on French Bread	**Fish Taco** with Cabbage, & Pico de Gallo served with Corn Relish & Chipotle Lime Sour Cream		
Deli Special	**Middle Eastern Stacked Veggie Sandwich** with Hummus, Eggplant, Red Onion, Red Pepper Tomato, Mozzarella & Balsamic on Wheat Roll	**Turkey, Avocado,** Pepperjack Cheese & Tomato on Ciabatta Bread	**Egg Salad Croissant**		
Panini	**Tomato, Fresh Mozzarella, Spinach and Pesto Flatbread**	**Spicy Italian Grinder**	**Turkey Meatball Parmesan Torpedo**		

	Monday November 28	Tuesday November 29	Wednesday November 30	Thursday December 1	Friday December 2
COMMAND PERFORMANCE **Chef's Feature**	**Sushi made to order**	**Carla's Pasta Prosciutto Sacchettini Puttanesca** with Olives, Capers, Red Onion, Garlic & Basil	**Vegetable Lo Mein** with Egg Roll	**Chicken Pot Pie** with Cheddar Biscuit Crust and Buttered Noodles	**Pub-Style Fish & Chips**
Early Riser	**Potato Skins** with Egg, Bacon & Swiss Cheese	**Steak, Egg & Cheese Quesadilla**	**Ham & Bacon Breakfast Strata**	**Ham Steak** with White Country Gravy, 2 Eggs & Biscuit	**2 Eggs,** Choice of Breakfast Meat & Tater Tots
Country Kettle	**Egg Drop**	**Spinach Tortellini Tomato**	**Italian Wedding Soup**	**Split Pea**	**Manhattan Clam Chowder**
Grille Special	**Corned Beef Reuben** on Rye	**Bugerlicious Simple Man Burger**	**Chicken Cacciatore Sub**	**BBQ Chicken,** Cheddar Cheese, Onion Straws, Lettuce & Tomato on Kaiser Roll	**Crab, Asparagus & Roasted Pepper Quesadilla**
Deli Special	**Buffalo Tofu Wrap**	**Italian Chopped Antipasto Wrap**	**Shrimp Salad** on Multigrain Bread	**Asparagus, Sundried Tomatoes, Roasted Peppers & Mozzarella Cheese Wrap**	**Chicken Parmesan Sub**
Panini	**3-Cheese Panini** with Cheddar, Swiss & Blue Cheese & Bacon & Tomatoes on Sourdough Bread	**Andouille Sausage Torpedo** with Peppers & Onion	**Teriyaki Chicken** with Grilled Pineapple, & Swiss Cheese on a Kaiser Roll	**Turkey Gobbler**	**Jerk Chicken,** Peppers & Onions on Flatbread

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** ◆ Science Writer: **Raphael Rosen** ◆ 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/.