PPPL PRINCETON PLASMA PHYSICS LABORATORY
A Collaborative National Center for Fusion & Plasma Research
U.S. DEPARTMENT OF ENERGY
WEEKLY
November 23, 2015

Calendar of Events

NOV. 22–24

20th Workshop on MHD Stability Control
"Non-linear phenomena and MHD control for ITER and beyond"

TUESDAY, NOV. 24

PPPL Colloquium
2:30 p.m. ◆ MBG Auditorium
DIII-D Recent Results and Future Direction
Dr. Richard Buttery, General Atomics

PPPL Colloquium
4:15 p.m. ◆ MBG Auditorium
Sustainability Economics
James Morris, Rutgers University

NOV. 26–27

Laboratory Closed
Happy Thanksgiving!

NOV. 30–DEC. 16

Holiday Food Drive
LSB Lobby

WEDNESDAY, DEC. 2

PPPL Colloquium
4:15 p.m. ◆ MBG Auditorium
Chance, Necessity, and the Origins of Life
Professor Robert Hazen, Carnegie Institute of Washington & George Mason University

The PPPL Weekly will not be published on Nov. 30 due to the Thanksgiving holiday. The next publication date will be Dec. 7.

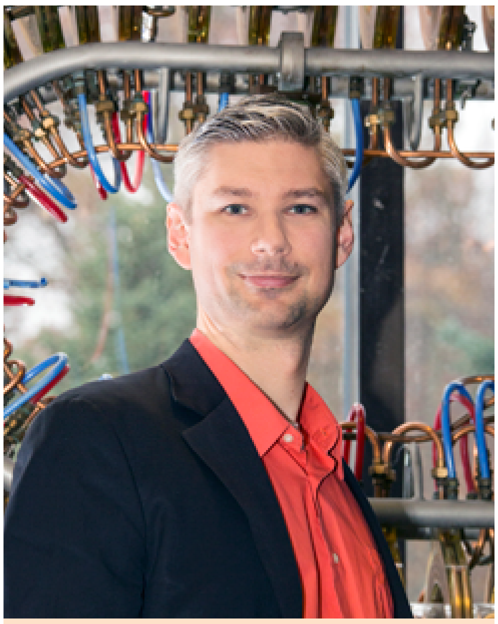
INSIDE

PPPL researcher maps magnetic fields in first physics experiment on W7-X

By Jeanne Jackson DeVoe

As excitement builds around the first plasma, scheduled for December, on the Wendelstein 7-X (W7-X) experiment in Greifswald, Germany, PPPL physicist Sam Lazerson can boast that he has already achieved results.

Lazerson, who has been working at the site since March, mapped the structure of the magnetic field, proving that the main magnet system is working as intended. This was achieved using the trim coils that PPPL designed and had built in the United States. He presented his research at the APS Division of Plasma Physics Conference in Savannah, Georgia, on Nov. 18.


Sam Lazerson

PPPL leads U.S. laboratories that are collaborating with the Max Planck Institute for Plasma Physics in experiments on the W7-X, the largest and most advanced stellarator in the world. It will be the first optimized stellarator fusion facility to confine a hot plasma in a steady state for up to 30 minutes. In doing so, it will demonstrate that an optimized stellarator could be a model for future fusion reactors.

Stellarators are fusion devices that use twisting, potato chip-shaped magnetic coils to confine the plasma that fuels fusion reactions in a three-dimensional and steady-state magnetic field. Stellarators are not subject to disruption of the current that completes the magnetic confinement as are traditional donut-shaped tokamaks. Such disruptions can halt fusion reactions.

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PPPL researchers unveil latest cutting-edge results at 57th Annual APS Meeting

More than 165 physicists, engineers, staffers and graduate students from PPPL attended the week-long American Physical Society Division of Plasma Physics annual meeting that drew some 1,700 participants from around the world to Savannah, Georgia, last week. PPPL speakers presented results of their cutting-edge research on topics ranging from solar and astrophysical plasmas to the challenges of producing magnetic confinement fusion.

Featured speakers included Masaaki Yamada, a Distinguished Laboratory Research Fellow at PPPL, who won this year's James Clerk Maxwell Prize in Plasma Physics. He gave a plenary talk titled, "Study of Magnetic Reconnection in Plasma: How It Works and Energizes Plasma Particles."

The articles that follow are shortened versions of PPPL news releases that were included in the meeting's virtual pressroom. The full text of the releases is available in the Virtual Pressroom 2015.

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W7-X

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"W7-X is a fantastic experiment," said PPPL Director Stewart Prager. "It's going to be critical to the future of stellarator research in the world. We're anxious to be a part of it since stellarators are a part of the future of fusion. We're delighted that Sam is spending time there and we're excited that the first experimental results are from Sam's work."

Hutch Neilson, head of advanced projects at PPPL, is equally enthusiastic. "Once W7-X comes on line it will be the most advanced fusion experiment in the world," said Neilson, who is technical coordinator for the U.S. partnership with the Max Planck Institute. "It will allow us to study 3-D plasma physics and test a concept that can be steady state and have the potential to make a simpler fusion reactor. It could be a step on a path to a new more attractive fusion reactor concept."

In the past, tokamaks were better than stellarators at confining plasma at the high temperature and density needed to create fusion energy. But the W7-X could potentially overcome this problem. "W7-X will meet or exceed the performance of modern tokamaks," Lazerson predicted. "That's why W7-X is important — because it's ground-breaking."

PPPL played key role

PPPL has played a key role in the development of W7-X and leads the U.S. collaboration on the experiment under a 2014 agreement between the U.S. Department of Energy and the Max Planck Institute for Plasma Physics. PPPL physicists and engineers designed and delivered the five 2,400-pound trim coils that fine-tune the shape of the plasma in fusion experiments.

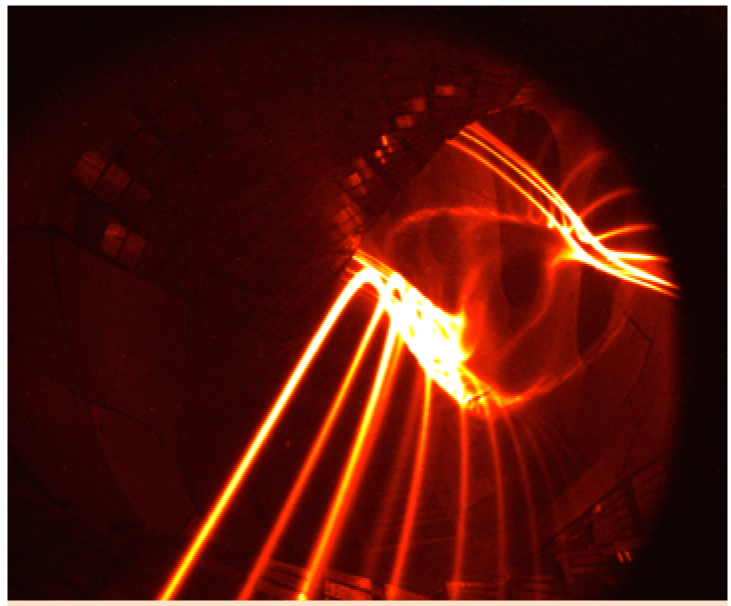
In addition, PPPL physicists Novimir Pablant and engineer Michael Mardenfeld designed and built an X-ray crystal spectrometer for the experiment that was one of several diagnostics created by U.S. researchers from PPPL, Los Alamos National Laboratory, and Oak Ridge National Laboratory. PPPL engineers led by Doug Loesser are building two divertor scraper units, a device designed in collaboration with Oak Ridge to intercept heat coming from the plasma to protect against damage to the W7-X divertor targets.

Neilson was at the Max Planck Institute from July of 2014 to April and helped pave the way for American researchers as coordinator of the U.S. collaboration on W7-X. Gates, who is the stellarator physics leader at PPPL, has traveled to Germany several times to manage the U.S. research program. "Dave's leadership is critical to ensuring that Sam and other PPPL physicists are strongly engaged in important W7-X research tasks," Neilson said.

Mapping the magnetic field

Lazerson arrived last March and has been working with a team that has been designing and analyzing experiments that map the stellarator's magnetic field. Lazerson used a diagnostic designed by physicist Matthias Otte of the Max Planck Institute. It consists of two fluorescent rods inserted into the W7-X vacuum vessel, one of which emits an electron beam. This beam causes the other fluorescent rod to glow and trace the pattern of electrons moving around the magnetic field. Cameras in W7-X capture the glowing rod as it tracing the field.

The recorded image allows researchers to determine whether the stellarator's massive magnets are have the required accuracy and whether the trim coils designed by PPPL are producing the intended results. The coils are designed to control "error fields" that can be used to create and manipulate a chain of magnetic islands that are located at the edge of the plasma and serve to distribute heat evenly among the 10 divertors that exhaust heat from the plasma. The trim coils can shrink or grow the magnetic islands, depending on how strong a magnetic field is applied.



A camera inside the W7-X catches an image of a fluorescent rod as it traces the pattern of the magnetic field. (Photo courtesy of the Max Planck Institute for Plasma Physics)

The photographs allow researchers to calculate the size of these small islands. By varying the trim coil current, researchers can check that the size of the islands is changing as expected, enabling researchers to determine if there are error fields in the main magnet system.

"Once we make a plasma, we can perform experiments using the trim coils," Lazerson said. "The measurements we've made in the absence of a plasma, with just the magnetic field, give us a basis for what the system looks like without a plasma, and an understanding of what the trim coils do to the basic magnetic structure. That's interesting in its own right, but it's also a stepping stone to the plasma experiments."

A "great opportunity"

Lazerson said he has enjoyed working at the Max Planck Institute, which at 500 people is about the same size as PPPL. "It's a great group of people," he said. "This is a really unique experience. It's a great opportunity."

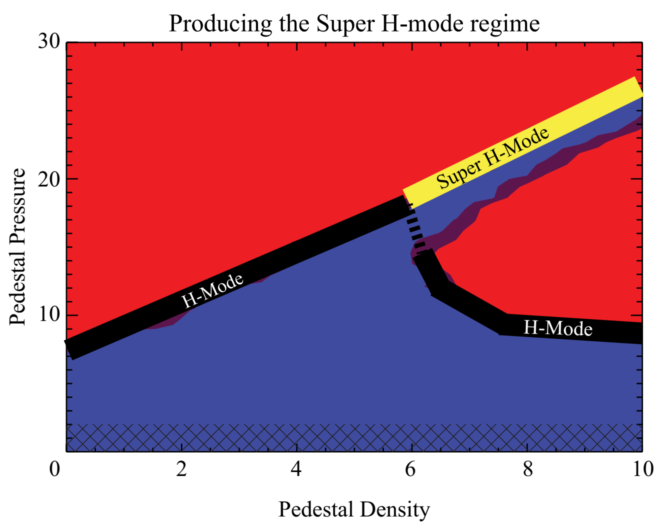
The Lazerson family, which includes Lazerson's wife Meghan and the couple's five-year-old daughter Samantha, live in Greifswald, where Lazerson can bike to work and take Samantha to the local kindergarten by bicycle. Greifswald is a university town in northeastern Germany that began in the 15th century, when it was part of Sweden. It is not far from a beach on the Baltic Sea and is about two-and-a-half hours from Berlin.

Lazerson said he has often had visits from Neilson and Gates, as well as DOE officials who have stopped in to see the project's progress.

Lazerson is looking forward to doing research after the first plasma. "We haven't even touched on the interesting science that we're going to be able to do with this device," he said. "I think the success of W7-X will perhaps chart a new course on how we do fusion energy or what we want to do as our next experiment."

Discovery of a new Super H-mode regime could greatly increase fusion power

Meet "Super H mode," a newly discovered state of tokamak plasma that could sharply boost the performance of future fusion reactors. This new state raises the pressure at the edge of the plasma beyond what previously had been thought possible, creating the potential to increase the power production of the superhot core of the plasma.



In this figure, the red signifies instability while blue is the quiescent region. Plasma density needs to increase along the narrow blue channel to reach the Super H-mode state. Image adapted from General Atomics.

Discovery of this mode has led to a new line of research within plasma physics that aims to define a path to higher power. The route could prove particularly promising for ITER, the international experiment under construction in France to demonstrate the feasibility of fusion energy.

Researchers led by Wayne Solomon of the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) accessed the new state on the DIII-D National Fusion Facility that General Atomics operates for DOE in San Diego. Motivating their findings were theoretical predictions of a plasma state beyond H-mode, the current regime for high-level plasma performance.

Developing the predictions was Philip Snyder, director of Theory and Computational Science for GA's Energy and Advanced Concepts Group. His surprising discovery was that a model called EPED predicted more than one type of edge region in tokamak plasmas, with the previously unknown super H-mode among them.

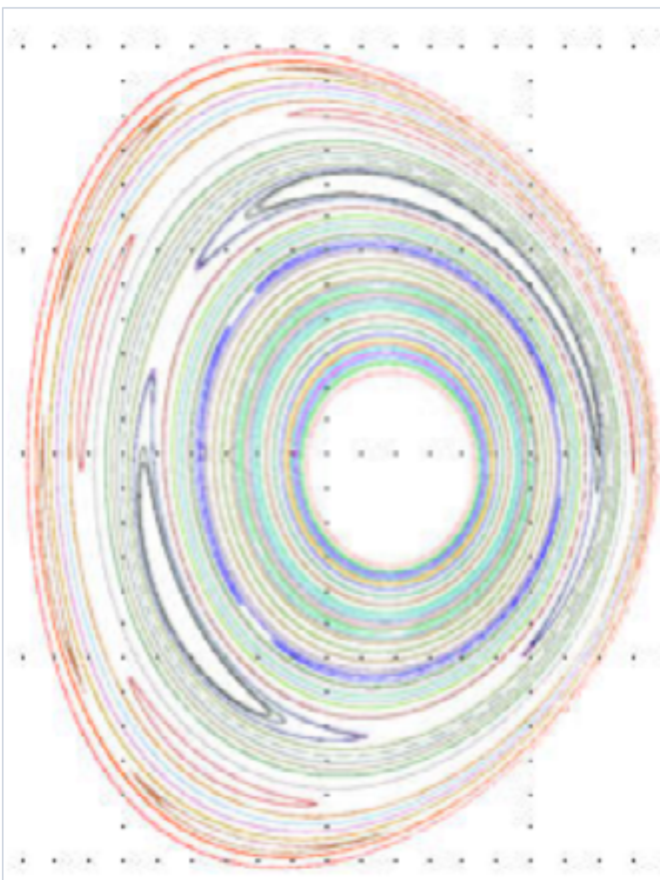
Verification of this prediction is what the researchers found. Their experiments reached the higher Super H-mode regime by steadily increasing density in a quiescent state that naturally avoids pedestal collapses. The results caused the plasma to follow a narrow path to the Super H-mode, the physics equivalent of steering a boat through rocky shores.

Using powerful computers, physicists uncover mechanism that stabilizes plasma within tokamaks

A team of physicists led by Stephen Jardin of the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) has discovered a mechanism that prevents the electrical current flowing through fusion plasma from repeatedly peaking and crashing. The results have been published online in Physical Review Letters.

The team, which included scientists from General Atomics and the Max Planck Institute for Plasma Physics, produced a three-dimensional simulation that showed that under certain conditions a helix-shaped whirlpool of plasma forms around the center of the tokamak. The swirling plasma acts like a dynamo — a moving fluid that creates electric and magnetic fields. Together these fields prevent the current flowing through plasma from peaking and crashing.

The researchers found two specific conditions under which the plasma behaves like a dynamo. First, the magnetic lines that circle the plasma must rotate exactly once, both the long way and the short way around the doughnut-shaped configuration, so an electron or ion following a magnetic field line would end up exactly where it began. Second, the pressure in the center of the plasma must be significantly greater than at the edge, creating a gradient between the two sections. This gradient combines with the rotating magnetic field lines to create spinning rolls of plasma that swirl around the tokamak and gives rise to the dynamo that maintains equilibrium and produces stability.



A cross-section of the virtual plasma showing where the magnetic field lines intersect the plane. The central section has field lines that rotate exactly once.

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This dynamo behavior arises only under certain conditions. Both the electrical current running through the plasma and the pressure that the plasma's electrons and ions exert on their neighbors must be in a range that is "not too large and not too small," said Jardin. In addition, the speed at which the conditions for the fusion reaction are established must be "not too fast and not too slow."

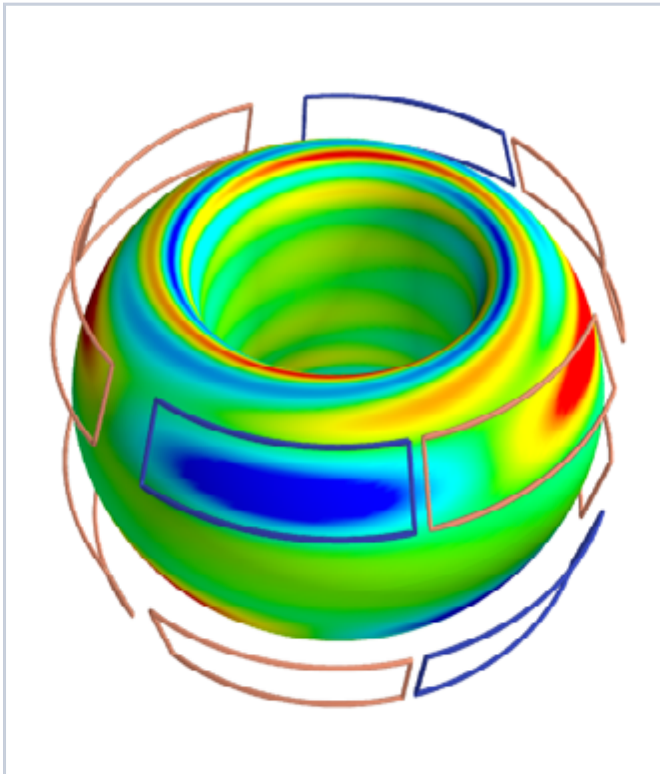
Striking the right note on a magnetic violin

The swirling plasma in donut-shaped facilities called tokamaks is subject to intense heat bursts that can damage the vessel's walls. Halting or mitigating these bursts, called Edge Localized Modes (ELMs), is a key goal of fusion research

While physicists have long known that they could suppress ELMs by pushing and pulling on the plasma with magnetic fields, they frequently found that doing so destabilized the core of the plasma and halted fusion reactions.

Now scientists at General Atomics and the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) have found an effective way to mitigate ELMs without shutting down the reactions. They were able to do this because the magnetic fields that enclose the plasma are like the strings on a violin that produce notes when struck with the fields from external magnetic coils. And one of these notes, the researchers found, is particularly useful for preventing ELMs.

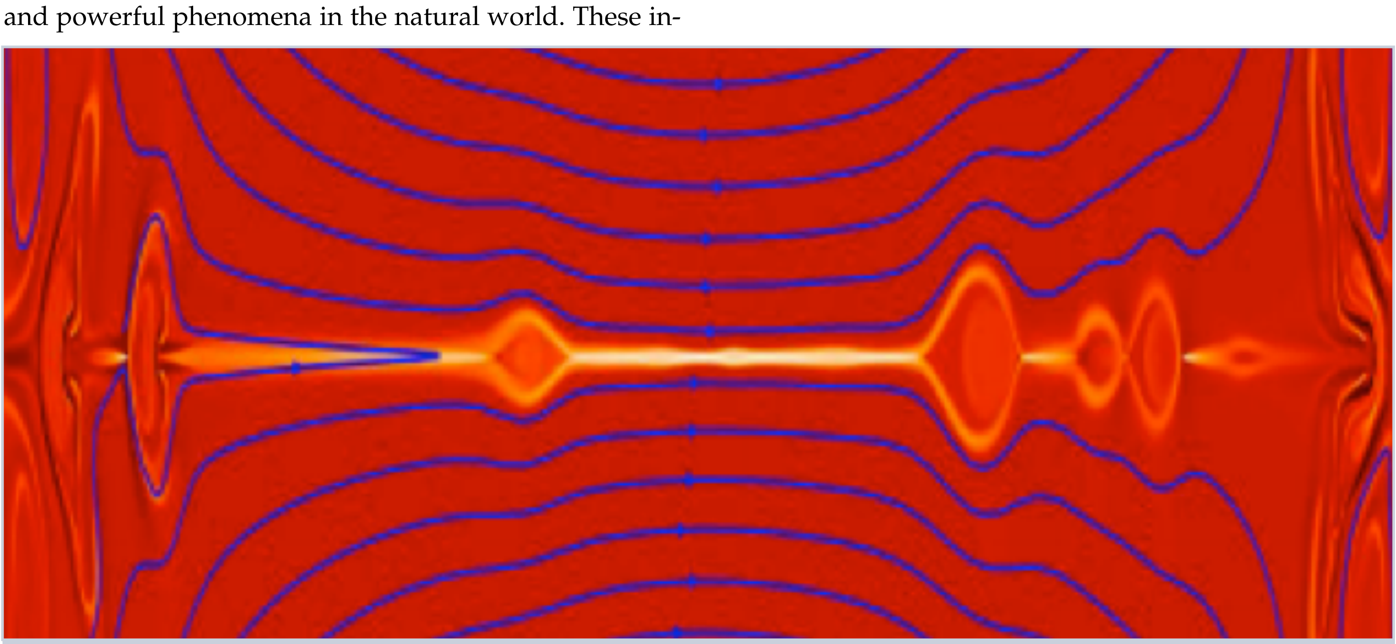
The researchers verified these findings with diagnostics from the DIII-D National Fusion Facility that General Atomics operates for the DOE. "We now understand how to pluck just the notes that sound the best, giving us the power to fine-tune our plasmas" says Nikolas Logan, who led the research team with Carlos Paz-Soldan of General Atomics.



Researchers used the rectangular coils shown here to strike the magnetic fields that enclose the donut-shaped plasma. The colors of the plasma denote the different vibrations produced by striking the fields with external magnetic coils. Figure courtesy of Princeton Plasma Physics Laboratory and General Atomics.

A new explanation for the explosive nature of magnetic reconnection

Magnetic reconnection, which occurs when magnetic lines of force break apart and reconnect with a violent burst of energy, gives rise to many beautiful and powerful phenomena in the natural world. These include solar flares, the Northern Lights, and geomagnetic storms that can disrupt cell-phone service or knock out power grids.



Model of a current sheet of plasma with magnetic field lines that are ready to reconnect showing plasmoid instabilities in the center of the sheet. Courtesy of Yi-Min Huang.

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Scientists have long known that the Sweet-Parker model typically used to describe magnetic reconnection was unable to explain the speed at which it operates. Now, researchers have gone beyond the framework of that model to include new mechanisms that speed up reconnection, providing new insights into the process.

At the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL), researchers found that the Sweet-Parker model itself is flawed. To solve the problem, the researchers turned their attention to plasmoids—instabilities that occur in plasma containing the reconnecting lines of force—as the possible cause of fast reconnection. These instabilities take place very rapidly and change the predictions described by the Sweet-Parker model.

The new model predicts a novel regime in which the fast reconnection rate appears to be independent of the resistivity—or resistance to electrical current—of the system. "This fundamental discovery has attracted a great deal of interest from theorists as well as experimentalists in laboratory and space plasma physics," said Amitava Bhattacharjee, head of the Theory Department at PPPL. Bhattcharjee presented the findings in a talk to the 57th annual meeting of the American Physical Society-Department of Plasma Physics in Savannah, Georgia.

This new nonlinear model was developed by Bhattacharjee and Yi-Min Huang, a research scholar in Princeton University's Department of Astrophysical Sciences. The model is based on an earlier model of the linear instability by Nuno Loureiro, a former post-doctoral fellow at PPPL. Loureiro now heads the Theory and Modeling Group at the Institute for Plasmas and Nuclear Fusion in Lisbon and received the Thomas H. Stix Award for Outstanding Early Career Contributions to Plasma Physics Research at the APS meeting.

Explaining a mysterious barrier to fusion known as the "density limit"

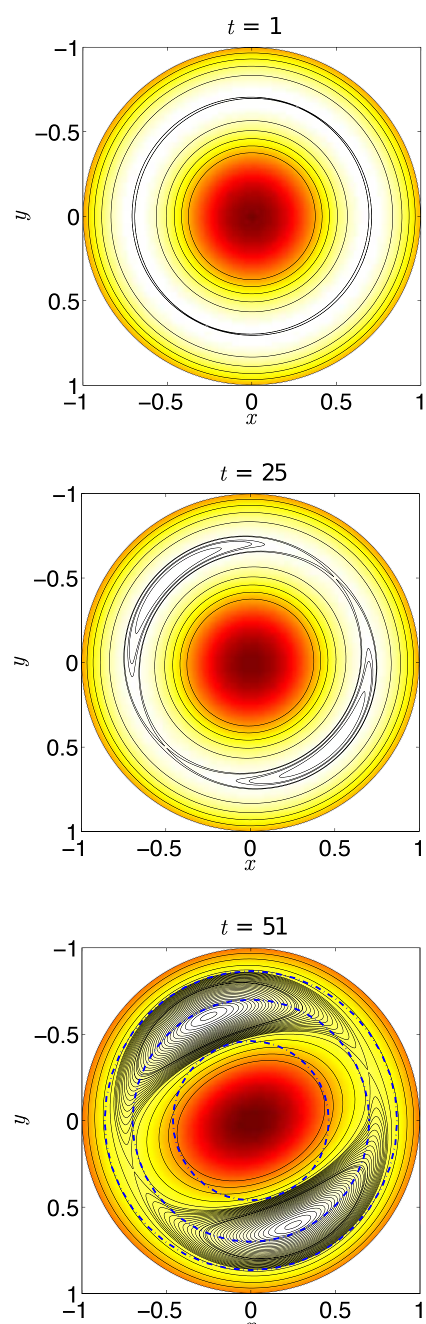
For more than 50 years physicists have puzzled over a daunting mystery: Why do tokamak plasmas spiral apart when reaching a certain maximum density and halt fusion reactions? This "density limit" serves as a barrier that prevents tokamaks from operating at peak efficiency, and understanding what sets this maximum density would speed the development of fusion as a safe, clean and abundant energy source.

Recently, researchers at the U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) have revisited an old idea: bubbles called magnetic islands that form in the confining magnetic field produce the observed density limit. The PPPL team, led by David Gates with Roscoe White, Luis Delgado-Aparicio and Dylan Brennan, found new physics overturning decades of thought on the growth of these bubbles.

The new PPPL research locates this physics in the process by which the islands are cooled by impurities that stray plasma particles kick up from the walls of the tokamak. Countering this cooling is heating that researchers pump into the plasma. But the scientists found that even a tiny bit of net cooling in the interior of the islands can cause them to grow exponentially, leading to disruption of the crucial current that runs through the plasma and completes the magnetic field that holds the hot gas together.

If confirmed by experiment the findings could lead to steps to overcome the barrier, also known as the "Greenwald limit" after Massachusetts Institute of Technology physicist Martin Greenwald, who derived an empirical rule for it. The PPPL model quantitatively reproduces the empirical Greenwald density limit.

Still to come are explorations of effects such as turbulent transport of particles, heat and the impurities that lead to plasma cooling. Examining these conditions should provide further evidence that the local power balance inside an island can serve as a very accurate prediction of the density limit.



Visualization of a magnetic island growing in a tokamak plasma. Courtesy of Qian Teng.

Recycling electronics

Eliot Feibush and Kyron Jones show off some of the items Feibush recycled as part of the Unicor electronics collection on Nov. 17, during which Jones collected 1,325 pounds of electronics. The event was one of several recycling activities at PPPL during a month-long celebration of America Recycles Day.

A renewed contract for ESU

Acting Deputy Director for Operations John DeLooper, left, and Robert Walker, president of the PPPL chapter of the International Association of Firefighters Local #74, sign an updated two-year contract with the union representing members of PPPL's Emergency Services Unit on Nov. 9. Behind them are Paulette Gangemi, director of Human Resources, left; Fran White, head of Site Protection, and Ani Malool, vice-president of the union.

PPPL celebrates recycling by rewarding PPPL'ers caught "green-handed"

More than two dozen PPPL'ers received lunch vouchers and prizes last week when they were "caught green-handed" using the proper bins for recycling, or using recyclable cups or lunch bags. Members of PPPL's Green Team awarded the prizes during lunch and breakfast on Nov. 17 and 19 as part of PPPL's month-long celebration of America Recycles Day. Green Team members awarding prizes were: Dana Eckstein, Jeanne Jackson DeVoe, Kate Morrison, Virginia Finley, Ed Jenkins Margaret Kevin-King and Joanne Bianco.

Richard Owusu shows off his prize for recycling and composting. (Photo by Margaret Kevin-King)

Julia Weiss shows off the cafeteria voucher she won for recycling.

Elliott Baer received a prize for using a reusable lunch container.

Nelson Neal thumbs through a calendar he won for checking and sorting out recyclables from the waste stream. (Photo by Margaret Kevin-King)

Irene Newman, left, and Wendy Worringer received prizes for bringing reusable lunch bags.

Larry Dudek, left, and Steve Raftopoulos right, sitting with John Lawson at center, won lunch vouchers for bringing reusable lunch bags.

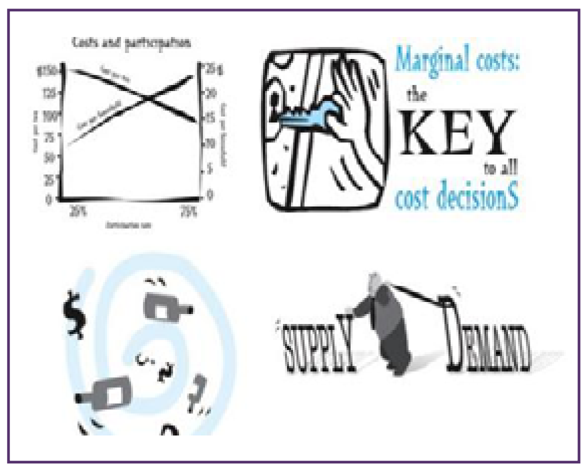
COLLOQUIUM

DIII-D Recent Results and Future Direction

Dr. Richard Buttery
General Atomics

Tuesday, Nov. 24
2:30 p.m., M.B.G Auditorium, Lyman Spitzer Building

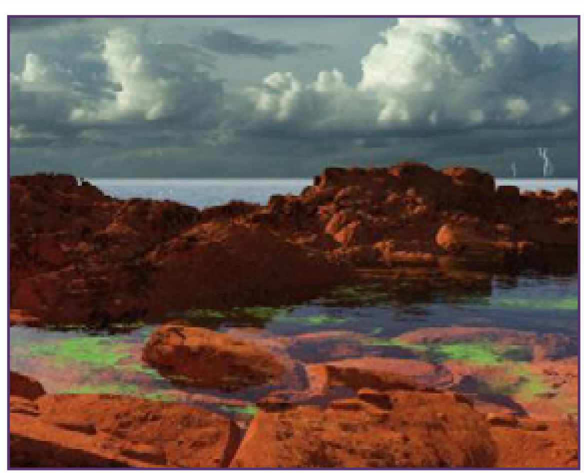
Sustainability Economics



James Morris
Rutgers University

Tuesday, Nov. 24
4:15 p.m., M.B.G Auditorium, Lyman Spitzer Building

Chance, Necessity, and the Origins of Life



Professor Robert Hazen
Carnegie Institute of Washington
& George Mason University

Wednesday, Dec. 2
4:15 p.m., M.B.G Auditorium, Lyman Spitzer Building

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://pppltravel.princeton.edu/.

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.

Numerous opportunities to go green as PPPL celebrates recycling

PPPL is celebrating America Recycles Day throughout November with the following events:

Nov. 24 at 4:15 p.m.

James Morris, of Rutgers University, the author of "Practical Recycling Economics," will discuss the economics of sustainability in a colloquium in honor of America Recycles Day

There will also be special recycling collections throughout November:

Personal protection equipment recycling by Terracycle:

Bring old safety glasses and hard hats, as well as earplugs and gloves to the collection box next to the stockroom.

Office supply recycling by Terracycle:

Bring old office supplies to the collection box in the lobby. Allowable items include tape desk organizers, card and document filers, binders, calendars, labels, hole punchers, dividers, paper cutters and correction supplies, as well as fasteners including paper clips, staples, and binder clips. Please bring metal products such as staplers and scissors, as well as electronic media to the warehouse for recycling and discard paper, plastics or cans in regular recycling. Please do not discard electronics or hazardous waste such as batteries or aerosol sprays or organic items.

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 November 23	Tuesday November 24	Wednesday November 25	Thursday November 26	Friday November 27
COMMAND PERFORMANCE **Chef's Feature**	**Fish & Chips**	**Baked Mac & Cheese** served with Stewed Tomatoes	COMMAND PERFORMANCE **Create Your Own Carla's Ravioli Bar**	**Happy Thanksgiving!**	
Early Riser	**Pumpkin Pancakes** with Turkey Sausage	**Corned Beef Hash & 2 Eggs Any Style**	**Cream Chipped Beef over Biscuits** served with 2 Eggs any Style		
Country Kettle	**Chicken Rice**	**French Onion**	**Tomato Bisque with Rice**		
Grille Special	**Grilled 3 Cheese** with Tomato	**BLT on French Bread**	**Crispy Tilapia Sandwich** with Pineapple Slaw		
Deli Special	**Rosemary Chicken Breast** on a Kaiser Roll with Sundried Tomatoes & Smoked Gouda Cheese	**Pastrami, Turkey, Swiss Cheese,** Coleslaw & Russian Dressing on Rye	**Ham Salad** on a Croissant with Lettuce & Tomato		
Panini	**Popcorn Chicken & Mashed Potato Bowl** topped with Seasoned Corn & Country Gravy	**Fish Cake Po' Boy**	**Chicken Salad** with Walnuts, Apples & Raisins on a Wheat Roll		

	Monday November 30	Tuesday December 1	Wednesday December 2	Thursday December 3	Friday December 4
COMMAND PERFORMANCE **Chef's Feature**	**Spaghetti & Meatballs**	**Baked Rosemary Garlic Chicken** with Cajun-Spiced Roasted Potatoes	COMMAND PERFORMANCE **Create Your Own Omelet Bar**	**Roast Pork** with Apple Cider Sauce, Mashed Sweet Potato & Vegetable	**Seafood Stuffed Tilapia** with Rice Pilaf
Early Riser	**Grilled Cheese** with Steak, Egg & Cheese	**Raisin Bread French Toast** with choice of Breakfast Meat	**Breakfast Enchilada** with Home Fries	**Grilled Cheese** with Pork Roll, Egg & Cheese	**Fried Spaghetti** with Scrambled Eggs & Parmesan
Country Kettle	**Mushroom Crab Bisque**	**Minestrone**	**Turkey Corn Chowder**	**Cream of Asparagus**	**Curry Chicken & Rice**
Grille Special	**Hot Pastrami & Cheddar** on Rye	**French Toast Monte Cristo** with Grilled Pineapple, Ham, Turkey & Swiss Cheese	**Flounder Parmesan Torpedo**	**BBQ Pulled Chicken** on a Soft Roll with Slaw	**Grilled Cheddar Cheese & Apple** on Raisin Bread
Deli Special	**Hummus Veggie Sandwich** with Tapenade, Cucumber & Carrot on Multigrain	**Turkey,** Caramelized Onions, Cheddar Cheese & Russian Dressing on Rye	**Roast Beef & Cheddar** with BBQ Sauce & Slaw on French Bread	**Pesto Tuna Salad** with Jack Cheese on French Bread	**Chicken Breast Gyro**
Panini	**Salami, Pesto, Roasted Pepper & Arugula Ciabatta**	**Tuna Burger** on Whole Grain Roll	**Blackened Chicken,** Muenster Cheese & Bruschetta on Ciabatta Bread	**Grilled Jerk Vegetables** served with Provolone Cheese Wrap served with Seasoned Corn	**French Dip Sandwich** with Caramelized Onions, Horseradish Cream Sauce and Potato Wedges

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/.

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