

At PPPL THIS WEEK

WEDNESDAY, MAY 21

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

N.J. as U.S. Electronics Center

Benjamin Gross, The Sarnoff Collection

UPCOMING EVENTS

May 26

Lab closed
Memorial Day

The PPPL Weekly will not be published due to the holiday. Look for next issue on June 2.

May 28

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

Future Projections of Climate Change:
An Update from IPCC AR5/IPCC AR5
WG1 Report

Claudia Tebaldi, NCAR

June 11

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

Magnetic Reconnection

Vassilis Angelopoulos, UCLA

June 18

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

Nuclear Winter

Alan Robock, Rutgers University

June 25

PPPL Colloquium

4:15 p.m. ♦ MBG Auditorium

Cosmic Microwave Background (CMB)

Dr. Renee Hlozek, Princeton University

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PPPL physicist Brian Grierson wins DOE Early Career Research Program grant

By John Greenwald

PPPL Physicist Brian Grierson has won a highly competitive Early Career Research Program award sponsored by the DOE's Office of Science. The five-year grant will total some \$2.5 million and fund exploration of the mechanisms that govern the formation and maintenance of the hot edge of fusion plasmas — the electrically charged gas that results in fusion reactions in facilities called tokamaks. The work will be carried out on the DIII-D National Fusion Facility in San Diego.

Understanding and controlling the edge of hot fusion plasma is crucial for achieving high performance in devices like the ITER tokamak, the world's largest fusion experiment currently under construction in France.



Brian Grierson at the DIII-D tokamak
Photo: Lisa Petrillo, General Atomics

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PPPL panel predicts fantastic future in space

By Jeanne Jackson DeVoe

A panel of PPPL researchers explored space with a group of middle and high school students recently in a voyage of the mind. They delved into questions such as how to power space vehicles, how colonists could survive on Mars, and whether those colonists would be able to come back to earth.

"I'm optimistic about space exploration," said Arturo Dominguez, a postdoctoral fellow in the Science Education Department, who organized the panel with Debra Cohen, a gifted and talented resource specialist with sixth to eighth graders in the West Windsor-Plainsboro Regional School District's PRISM program. "I think the best is yet to come and you all are going to be part of it."

The panel was aimed at helping students think about space research as part of their preparation for the [Future Problem Solving International Conference](#) in Ames, Iowa, in June. They will represent New Jersey and compete against other students from the U.S. and the world. The idea is to come up with creative solutions to situations under the broad topic of "space" in the world of 30 years from now.

A finalist to colonize Mars

The panel included Charles Swanson, a second-year graduate student at PPPL, who is one of 706 finalists chosen out of 200,000 applicants in a competition to join a privately funded mission to Mars through a group called Mars One. A former electrical engineer on the Space X Dragon capsule, a privately developed spacecraft developed by Space Exploration Technologies Corp. (Space X) in Hawthorne, Calif., Swanson had a lot of insights about what a Mars colony might look like.

Swanson told students that Mars is well suited for colonization because there is water on the planet underneath the north polar ice cap. That means that the planet could sustain human life and vegetables could even grow there, he said. In fact, NASA is doing experiments to see if it can grow vegetables in a simulated Mars soil made out of volcanic rock. However, the vegetables would have to be grown under ultraviolet light because Martian light is only a third as strong as the light on Earth, Swanson said.

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The award for Grierson, who is on long-term assignment to the DIII-D National Fusion Facility operated by General Atomics for the DOE, marks the second Early Career grant to PPPL physicists in as many years. Ahmed Diallo, who serves as deputy boundary-group leader for PPPL's National Spherical Torus Experiment (NSTX), won a five-year award for research on the plasma edge last year.

The Early Career grants fund scientists who have demonstrated exceptional ability. This year's awards went to 35 researchers who were chosen from among some 750 applicants from across the country. "By supporting our most creative and productive researchers early in their careers, this program is helping to build and sustain America's scientific workforce," said Patricia M. Dehmer, Acting Director of DOE's Office of Science.

Grierson's research focuses on a thin, roughly thumb-wide slice of the plasma edge called the "pedestal" in which conditions change very rapidly, becoming far hotter and denser toward the plasma core. "It's like going from the surface atmosphere to the bottom of the sea," Grierson said of the transition, "only this change happens in a very small distance."

Conditions within the little-understood pedestal can strongly affect the core of the plasma where fusion reactions take place. Comprehending what happens in the pedestal can thus lead to better confinement, greater stability and more fusion power in tokamak plasmas.

Funds from the Early Career award will enable Grierson to install new diagnostic equipment on the DIII-D tokamak and bring in two postdoctoral fellows to assist with the research. Included in the new equipment will be 16 fiber-optic lines to relay light from the edge of the plasma to new spectrometers — devices that measure and record shifts in the spectrum of light — and to high-speed scientific cameras. Grierson will work closely with researchers from General Atomics, Oak Ridge National Laboratory, Lawrence Livermore National Laboratory and several U.S. universities to leverage this new mea-

surement capability towards an improved understanding of the pedestal region.

Results of Grierson's experiments will test computer models that seek to predict conditions such as the temperature and pressure of the deuterium atomic nuclei, or ions, the main fusion fuel. The behavior of these fueling ions has proven far more difficult to measure than the behavior of impurities that enter the edge of the plasma from the walls of a tokamak and have been studied in detail. "Our research combines diagnostic development with model validation," Grierson said.

Current methods infer the behavior of the main fueling ions from the properties of impurity ions. However, there is significant uncertainty in these inferences because of the complexity of the physics at the plasma edge. So direct measurement of the fueling ions is essential to advance understanding of edge-plasma physics and to test emerging plasma models.

Those building edge models include theorists from PPPL and General Atomics who are developing complex, large-scale simulation codes to run on supercomputers. "There's a lot of theoretical work out there and the question is how to tie it all together with state-of-the-art measurements," noted PPPL physicist Richard Hawryluk, who oversees the Laboratory's collaboration with General Atomics on DIII-D.

Grierson's new research will employ techniques that he previously developed to measure the properties of main ions in the plasma core. "The challenges at the core were overcome by comprehensive modeling and detailed spectral analysis," he said. "As we get to the edge there will be new challenges as well."

While such challenges could be great, the scientific results could be greater. Combining measurement of the main ions with validation of models of the plasma edge could help pave the way for high-performance operation of ITER and future tokamaks, Grierson said. ☐

ExxonMobil executives visit PPPL



A dozen ExxonMobil executives, including T.J. Wojnar, the company's president, visited PPPL on May 14. Adam Cohen, PPPL's deputy director for operations, gave the group a presentation, and a tour of NSTX-U with the help of John DeLooper, Head of Best Practices and Outreach.

From left to right, front row: Grant Karsner, vice president, Products Technology; Kenneth Warren, vice president of engineering; Charles Martinez, manager, planning; Bob Scrib, controller; second row, left to right: Audrey Gagie, human resources manager; Patricia Sparrell, manager, process engineering and optimization; Emil Jacobs, vice president of research and development; Loan Tran, planning advisor, T.J. Wojnar, president, all from ExxonMobil Research & Engineering Co.; Adam Cohen, PPPL deputy director for operations; back row, left to right: Carol Hutnek, manager, human resources; John Noel, vice president of projects, both from ExxonMobil Research & Engineering Co.; Doug Collins, chief attorney, ExxonMobil Corp., and PPPL's John DeLooper, Head of Best Practices and Outreach.

Space Panel

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The first colonies on Mars would have to convert waste products to drinking water, Swanson said. The colonies, as a result, would need to transport large machines capable of filtering water and extracting water from ice.

Powering space rockets

Another panelist was Yevgeny Raitses, a PPPL physicist who is the principal investigator of the PPPL Hall Thruster Experiment, which could be used to power rockets and other space vehicles. Raitses said plasma rockets and spacecraft could be very effective for exploring and colonizing Mars. A major challenge is finding a way to provide enough power for manned plasma rockets and spacecraft to travel 33.9 million miles from Earth. Nuclear energy could be used but poses some environmental challenges, he said. Fusion energy also might be the answer for deep space exploration, Raitses said, but would have to first be developed on Earth before it is used in space exploration. The future of space exploration "will depend on our ability to solve this challenge," he said.

One student asked whether Earth-based solar panels could be used to power spacecraft. The challenge there, scientists replied, would be how a solar panel on earth could be tethered to a space station or spacecraft. A wire extending 22,000 miles to a space station would cost some \$180 million, the scientists said, after doing a quick calculation. Raitses said it could theoretically be done using carbon nanotubes, one-atom thick tubes that are 10,000 times smaller than a human hair, are extremely strong and can conduct electricity but scientists do not yet know how to assemble them for a tether, Raitses said.

Swanson said nanotechnology will be key to space exploration for items like solar panels and is already being used in satellites. He predicted that material science "will experience a boom of breakthrough ideas for space exploration."

Cohen asked whether countries could work together on space travel in much the same way six different countries including the U.S., along with the European Union, are working together on the massive fusion energy experiment called ITER in Cadarache, France. "Is it possible we could translate that to space travel for the betterment of mankind?" she asked. "Because we're exhausting our resources on this planet."

Some private organizations like Mars One, which is organizing the Mars Mission, are investing in space exploration. However, both space exploration and fusion energy are long-term commitments that companies are generally reluctant to invest in, Dominguez replied. "ITER is still a science experiment," Dominguez said. "The reason why it's hard to get private funding is the short-term pay-off isn't there. It's hard for private individuals to see a profit in this."

Raitses asked students why people here on Earth might want to begin a colony on another planet. One student said that humankind might need to colonize because of population problems on Earth. Another student said global warming and climate change could cause numerous problems that would force people to find another planet on which to live.

Debating whether Mars colonist can return

The panel also discussed whether space explorers, particularly Mars colonists, would be able to return to Earth to tell about their adventures. Swanson said the Mars One plan is to send just four colonists a year and they would likely have to commit to staying on Mars because it would cost too much money to transport them back to Earth.

His comments led to a discussion of whether the first space colonists would be comparable to early immigrants to the U.S. who often permanently left their home countries to voyage to new lands. But Swanson said there is a distinction between those immigrants and early explorers, like Christopher Columbus, who returned to their home countries to spread the word about what they had found.

Cohen told the students they could draw on what they knew about early explorers on Earth to think about some of the challenges facing space explorers. She told the students their homework was to watch "Star Trek," to get an idea of how space exploration is portrayed in popular culture. She pointed out that many inventions were based on the fictional items portrayed in "Star Trek" including the cell phone, the hypospray, a needleless hypodermic similar to today's EpiPen, and video communications programs like Skype and Facetime.

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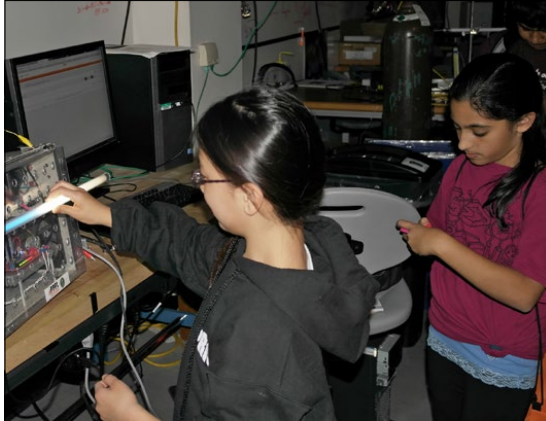
A panel of scientists at PPPL discusses space exploration with middle and high school students from the West Windsor-Plainsboro School District who are finalists in the Future Problem Solving International Competition. They are from left to right: Yevgeny Raitses, a physicist who is the principal investigator of the PPPL Hall Thruster Experiment and whose work has direct applications for space exploration; graduate student Eugene Evans; postdoctoral fellow John Schmitt; graduate student Charles Swanson, a finalist for a possible mission to Mars; physicist Erik Gilson; and Arturo Dominguez, a postdoctoral fellow in PPPL's Science Education Department.

Space Panel

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But “Star Trek’s” idea of teleporting in which people or items can move instantly from one place to another on “Star Trek,” is still the stuff of science fiction, panel member Eugene Evans told students. “We have the ability to take the properties of a single atom and copy that to another atom,” Evans said. “The problem is it doesn’t work on a large scale.” (To put that in perspective, Dominguez said, the size of an atom is to a grape what the size of a grape is to the size of the Earth.)

Evans said there are many exciting developments happening in space exploration, including the recent discovery of the Kepler-186f, an earth-sized planet that could be habitable.



Rayna Wuh tries out a plasma speaker in PPPL's Science Education Laboratory during students' visit to the Laboratory on April 29, as Rhea Kak gets ready to take a photo.



Arturo Dominguez, right, who organized the space panel, leads students on a tour of PPPL.




Students listen to the panel. From left to right: Emily Huang, Rayna Wuh, and Rhea Kak, with Raghav Ramesh in the background, all sixth graders from Thomas R. Grover Middle School in West Windsor.



Debra Cohen, holding a microphone, a gifted and talented resource specialist with sixth to eighth graders in the West Windsor-Plainsboro Regional School District's PRISM program, moderated the space panel.

Golden age of space exploration ahead

When a student asked how scientists would know whether we're currently in the “golden age of space exploration,” Evans said some people believe that the golden age ended with manned missions to the moon in the 20th century. But most of the panelists said they believe the golden age is ahead of us. “The golden age is yet to come,” Raiteses said.

In addition to Raiteses, Swanson, Dominguez and Evans, the panel also included PPPL physicist Erik Gilson, post-doctoral fellow John Schmitt, and graduate students Leland Ellison. 

Hospital offers web health talks

University Medical Center of Princeton at Plainsboro is offering a series of live web-chats in which physicians will discuss various health topics and answer your questions. To participate, go to the hospital's UStream Channel www.ustream.tv/princetonhealth on your computer, smartphone or tablet. You can also send questions in advance to PrincetonHealth@gmail.com

If you RSVP in advance for the talks, you will be eligible to win one of several \$25 gift cards. Call 1-888-897-8979 or go to <http://www.princetonhcs.org/phcs-home/who-we-serve/community/community-education-amp-outreach/whats-happening.aspx?d=29293> to RSVP or submit questions.

For a complete list of community events go to <http://www.princetonhcs.org/phcs-home/who-we-serve/community/community-education-amp-outreach/whats-happening.aspx>.

The upcoming web seminars are:

May 22: “Robotic Surgery: Is It Right for Me?”

June 2: “Acute Rehab vs. Sub-Acute Rehab: What does it all mean?”

June 16: “Take Back Control from Urinary Incontinence”

June 19: “Secrets to Healthy Skin”

COLLOQUIUM



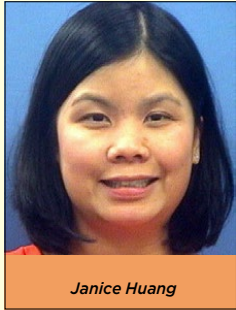
N.J. AS U.S. ELECTRONICS CENTER
BENJAMIN GROSS
THE SARNOFF COLLECTION

Wednesday, May 21

4:15 p.m. (Coffee/Tea at 4 p.m.) • MBG Auditorium

Welcome Janice Huang

Please welcome Janice Huang, a program assistant to A.J. Stewart Smith, Princeton University's V.P. for PPPL.



Janice Huang

Site Protection Division • TIP • OF • THE • WEEK •

HOSTING FOREIGN NATIONAL VISITORS


When inviting foreign nationals to visit the Laboratory, please remember that the visitor must complete the **Foreign National Registration Form** <http://fnvisit.pppl.gov/fnregister.aspx> in advance of the visit.

In addition, all hosts of foreign nationals must complete the Host Training, which may be found on the Human Resources Training E-Learning [website](#).

It is important to begin the Visitor Notification and Approval process as early as possible. The level of documentation and approvals required for a visit to PPPL can vary depending on a number of factors. Requests should therefore be submitted in a timely manner in order to avoid delays in receiving approvals for the proposed visit.

For additional information on the coordination of visits, assignments and collaborations at PPPL, please contact the Site Protection Division (ext. 3208) or see PPPL Procedure GEN-008: <http://bp.pppl.gov/procedures/gen008.pdf>.

This procedure applies to all individuals referred to as "visitors" (visits, assignments, collaborations), as well as new hires, temporary employees, subcontractor employees, and visiting students, both domestic and foreign, that require physical and/or cyber access to PPPL.



BROCK Café Menu 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.

— MARK GAZO, Chef Manager

	MON. MAY 19	TUE. MAY 20	WED. MAY 21	THU. MAY 22	FRI. MAY 23
COMMAND PERFORMANCE CHEF'S FEATURE	 Rotini Pasta With Turkey Bolognese Sauce served with Garlic Bread	 Cheese Ravioli Marinara with Arugula, Mushrooms & Sun-Dried Tomatoes	 Albanian-Style Stuffed Pepper	 Chicken Paprikash with Wide Egg Noodles	 English-Style Fish & Chips
EARLY RISER	Cheesy Grits with Country Sausage Gravy	Hungry Man Breakfast - 2 Eggs, Meat, Pancakes & Potatoes	Herbed Egg White Omelet with Tomatoes served with Baby Greens	Challah French Toast	Eggs in Purgatory
COUNTRY KETTLE	Cream of Mushroom Soup	Chicken Rice	Tomato Soup	Split Pea with Ham	Turkey Chili
GRILLE SPECIAL	Grilled California BLT Burger with Caramelized Onions & Avocado	Bratwurst & Sauerkraut Torpedo served with German Potato Salad	Grilled Tuna Melt with Swiss Cheese, Grilled Onions and Tomato on Rye	Mediterranean Chicken Breast with Spring Grilled Vegetables	Veggie Burger with Mushrooms, Cheese, Arugula on an English Muffin
DELI SPECIAL	Mediterranean Veggie Wrap	Roast Beef with Onion, Arugula, Cheddar & Horseradish Sauce	Ham, Muenster Cheese, Bacon, Tomato & Spicy Mayo Torpedo	Seafood Salad Croissant	Chicken Cordon Bleu Panini
PANINI	Smoked Ham, Swiss Cheese & Sliced Pear on Ciabatta	Popcorn Shrimp Parmesan Torpedo	Grilled Chicken, Roasted Eggplant, Red Peppers, Provolone on Ciabatta	Vegetable Stromboli	Italian Meatball Sub with Provolone Cheese

MENU SUBJECT TO CHANGE WITHOUT NOTICE

VEGETARIAN OPTION

[CLICK HERE FOR A PRINTABLE WEEKLY MENU](#)

WEEKLY Editor: **Jeanne Jackson DeVoe** ♦ Layout and graphic design: **Gregory J. Czechowicz**
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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 Thursday. Other stories should be submitted no later than noon on Wednesday. Comments: commteam@pppl.gov ♦ PPPL WEEKLY is archived on the web at: <http://w3.pppl.gov/communications/weekly/>.

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