

Calendar of Events

THE MONTH OF MAY

[National Inventors Month](#)

TUESDAY, MAY 24

Blood Pressure Screening
11:00 a.m.-1 p.m. ♦ LSB Lobby

WEDNESDAY, MAY 25

PPPL Colloquium
1:30-2:45 p.m. ♦ MBG Auditorium
[Proton Therapy for Cancer:
Current Status, Promise and
Challenges](#)
Dr. Dennis Mah, ProCure Proton
Therapy Center

FRIDAY, MAY 27

**Princeton University
Reunions Tours**
10-11:30 a.m., 1:30-3 p.m.

BBQ Blues Jam
11:30 a.m.-1 p.m.
[See page 7 for details.](#)

UPCOMING

JUNE 6-10

**SULI program begins with
one-week course for students**

WEDNESDAY, JUNE 8

Inventors Recognition Dinner
6 p.m. ♦ Prospect House

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Lithium Tokamak Experiment gets \$2 million upgrade

By John Greenwald

A promising experiment that encloses hot, magnetically confined plasma in a full wall of liquid lithium is undergoing a \$2 million upgrade at PPPL. Engineers are installing a powerful neutral beam injector in the laboratory's Lithium Tokamak Experiment (LTX), an innovative device used to test the liquid metal as a first wall that enhances plasma performance. The first wall material faces the plasma.

"This will bring us one step closer to demonstrating this particular approach to fusion," said Dick Majeski, principal investigator of the LTX. The experiment is a collaborative effort that includes researchers from Oak Ridge National Laboratory, UCLA, the University of Tennessee, Knoxville, and Princeton University, as well as PPPL. Funding comes from the DOE Office of Science.

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MINDS used to screen for possible nuclear materials at military base air show

By Jeanne Jackson DeVoe



Charles Gentile, one of the inventors of the MINDS device, shows Master Sergeant Amanda Leal, left, and Senior Airman Brittany DiLeo, right, how to scan for nuclear materials in an impromptu training session at PPPL May 6.

When thousands of people streamed into the 2016 "Power in the Pines" Open House and Air Show May 14 to 15, one of the security measures was the Miniature Integrated Nuclear Detection System, or MINDS, a lightweight portable device designed by PPPL inventors to detect radioactive materials that could be used in a so-called "dirty bomb."

The device was set up on a truck at one of the entrances to the air show at the Joint Base McGuire-Dix-Lakehurst. Laurie Bagley, head of PPPL Technology Transfer, said the device was used for 10 hours over the weekend and estimates that more than 22,000 vehicles and 66,000 people were scanned.

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Synthetic muscle experiment back on Earth after 13 months in space

By Jeanne Jackson DeVoe

The safe return to Earth on May 11 of a SpaceX Dragon capsule carrying the synthetic muscle experiment that was on board the International Space Station (ISS) for more than a year is welcome news for scientist Lenore Rasmussen and the PPPL researchers and engineers who helped test the material.

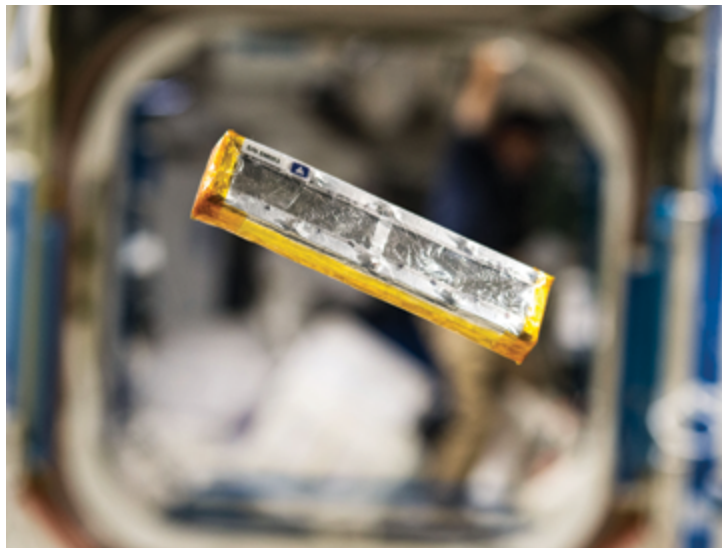
The capsule landed in the Pacific Ocean off Long Beach, California at 11:31 a.m. PDT. It will be shipped by boat to Los Angeles where the cargo, including the experiment, will be processed. The material will then return to Rasmussen's Ras Labs in Quincy, Massachusetts, in early June.

"I am so relieved," said Rasmussen, a synthetic polymer chemist and RasLabs founder, (www.raslabs.com). "They kept me apprised all day but it's nice to know that it landed, there were no incidents and it should be on its merry way soon. It's nice to know my baby is coming home."

Rasmussen worked closely with PPPL researchers and engineers to characterize her Synthetic Muscle™, a robust gel-like electroactive polymer. The material could be used to make better artificial limbs or more responsive robots. It may also have applications for robotics in deep space such as travel to Mars because of its resistance to high doses of radiation found in space.



The Dragon capsule carrying the synthetic muscle experiment and other payloads prepares to land in the Pacific Ocean on May 11. (Photo courtesy of SpaceX)



Astronaut Scott Kelly took this photo of a sample of the synthetic muscle material floating in space. (Photo courtesy of NASA)

Rasmussen has a long relationship with PPPL. She worked with PPPL scientists several years ago under a RasLabs-funded Cooperative Research and Development Agreement to develop the material's ability to adhere to metal by treating metal electrodes with plasma. At the time, as part of its broader studies in plasma science, PPPL was interested in exploring the ability of treatment with plasmas to increase the adherence properties of certain materials. She also tested the material for radiation resistance at PPPL laboratories in 2014 through work funded by RasLabs through a "Work for Others" agreement with the Laboratory. Charles Gentile, head of the Tritium Systems Group at PPPL, and other scientists exposed the material to more than 300,000 RADs of gamma radiation. (The equivalent of a trip to Mars and back). For selected formulations of Synthetic Muscle™, the tests showed there was no change in the material integrity or electroactivity of the material when exposed to high doses of radiation.

The material was among 4,300 pounds of supplies and payloads, including several research experiments, on the SpaceX Falcon 9's Dragon capsule, which was propelled into space after being carried by the SpaceX-10 rocket. The experiment was originally scheduled to remain in space for 90 days but was delayed after an unmanned SpaceX-7 Falcon 9 rocket headed for the ISS exploded a few minutes after liftoff in June 2015.

Rasmussen has been busy during that time. She has been working to develop the next generation of the material for prosthetic limbs and other applications. She recently worked on a prototype for an adjustable prosthetic liner made from the material through a grant from the Pediatric Device Consortium at the Children's Hospital of Philadelphia. As the vestigial limbs of amputees shrink or swell during the day, the electroactive polymer in the prosthetic liner would adjust to maintain an extremely comfortable snug fit. With the material's intrinsic ability to sense pressure, these electroactive polymers can provide for self-adjusting prosthetic liners, and impact attenuating devices/protective gear, or robotic grippers or hands.

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Synthetic Muscle Experiment

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The additional 10 months in space should make for better results when she compares the space samples to identical samples that remained in her laboratory on Earth, Rasmussen said. “It should be a better experiment,” she said. “If there’s any difference between the on-Earth and the ISS samples and then between the additives and coatings, we should see more of that effect. If there are any trends, we should be able to see that more.”

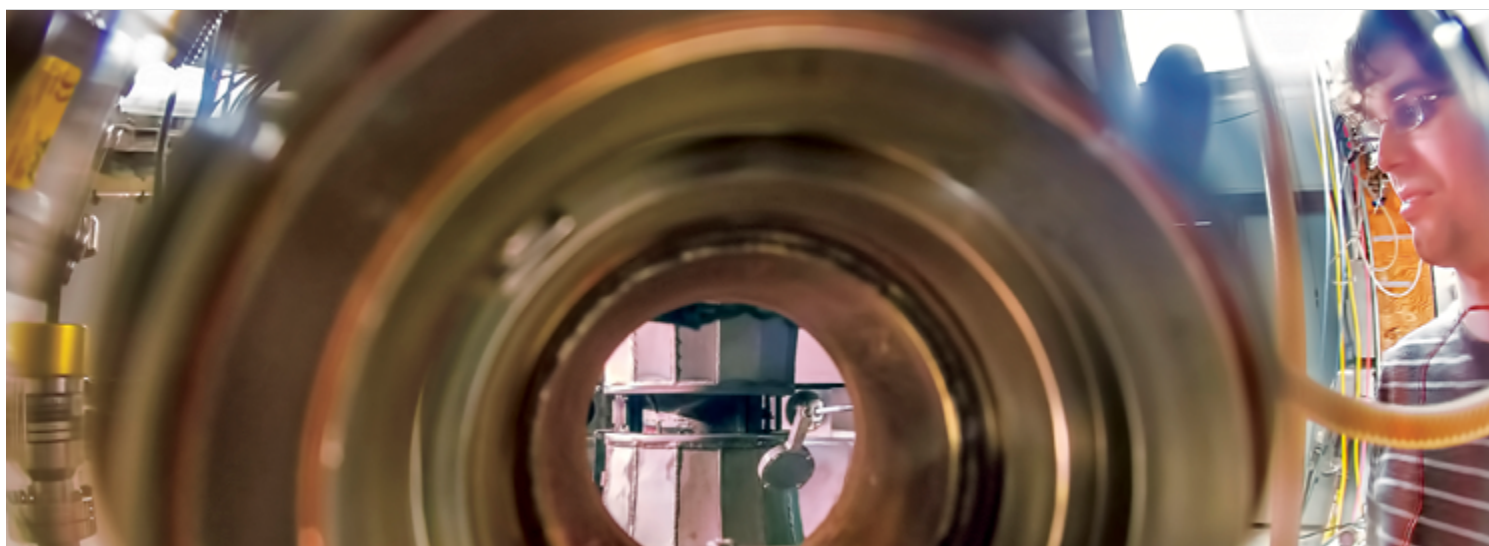
Gentile said he and other researchers will also help test the material over the summer. “It’s excellent,” Gentile said. “We are very excited. We’ll be able to evaluate the effectiveness of the material to see if there was any degradation due to the space flight and to see how well it performed.”



PPPL engineer Charles Gentile, in white, talking with Rasmussen, in black, was involved in testing at PPPL and in planning for the space mission.

LTX Upgrade

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A view of the interior of the LTX prior to the upgrade.

The neutral beam injector, a Russian-built device on loan from the Tri Alpha fusion firm in California, will shoot energetic beams into the small spherical tokamak to fuel the core of the plasma and increase its temperature and density — key factors in fusion reactions. “The beams will maintain the density and raise the temperature to a more fusion-relevant level,” said Philip Efthimion, PPPL head of the Plasma Science and Technology Department that includes the LTX.

The experiment recently became the first device in the world to produce flat temperatures in a magnetically confined plasma. Such flatness reduces the loss of heat from the plasma that can halt fusion reactions. The LTX also has provided the first experimental evidence that coating a large area of walls with liquid lithium can produce high-performance plasmas.

However, without fueling from the neutral beam the density of an LTX plasma tends to drop off fast. The beam upgrade will keep the density from dropping, and test whether the liquid lithium coating can continue to maintain flat temperatures in much hotter plasmas.

PPPL has long been a leader in the use of liquid lithium to coat and protect the plasma-facing components inside tokamaks. The predecessor to LTX, the Current Drive Experiment-Upgrade (CDX-U), ran with a circular pool of liquid lithium at the bottom of the plasma. The CDX-U operated from 1999 to 2007 before it was disassembled for installation of heatable shells composed of thin stainless steel and thick sheets of copper that form the tokamak’s inner walls. LTX made its first plasma in 2008 and first used liquid coatings in 2010.

Researchers have also explored the use of liquid lithium in the National Spherical Torus Experiment-Upgrade (NSTX-U), the laboratory’s flagship fusion experiment, prior to its recent upgrade. PPPL will continue to investigate use of the liquid metal in the revamped machine.

The value of lithium as a first-wall material comes from its ability to sponge up particles that stray from the core of the plasma and keep them from recycling back and cooling down the edge and then the core. Lithium is a highly reactive material that combines with other elements and doesn’t let go.

In LTX experiments, researchers use an electron beam to evaporate a pool of liquid lithium at the base of the tokamak. The evaporated metal then coats the shells. Keeping the temperature of the shells above the melting point of lithium sustains its liquid state.

This approach differs sharply from the use of a heavy metal such as tungsten for a tokamak’s first wall. While tungsten resists erosion, has a high melting temperature and conducts heat well, heavy impurities kicked up by contact with the plasma can rapidly cool down the hot core. The Joint European Torus (JET) in the United Kingdom experiments with tungsten. ITER, the international tokamak under construction in France, also plans to use it.

The LTX upgrade, scheduled for completion later this year, marks the latest PPPL format for studying the liquid metal. Experiments could resume next spring and plasma operations with the neutral beam by fall. The performance of the LTX upgrade could then provide new evidence of the ability of liquid lithium to serve as a first wall.

MINDS goes to Air Force

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Senior Airman Brittany DiLeo keeps her eye on the computer screen inside the truck, which is connected to the MINDS device as it scans incoming cars at the air show. (Photo by Laurie Bagley)

Bagley, who observed the device at the air show on May 15, said the system didn't indicate any dangerous radioactive materials. "It was good to see it in action," she said. "The alarm never went off, which means they never saw anything dangerous. They did see the spectra changing, which means we had hits with medical isotopes."

Nearly a dozen officers and civilians assigned to the Chemical, Biology, Radiation and Nuclear and Explosive (CBRNE) team came to PPPL on May 6 to pick up the device, get some hands-on training from inventors Charles Gentile and Ken Silber, and take a tour of PPPL. They will use the device to detect nuclear materials at one of the gates to the base.

This is the fourth time MINDS was used at the air show, which is held at the base every two years. The Air Force estimated 375,000 people attended the air show over the weekend. "It's just one additional layer of protection, that's what it is," said Tim Larkin, a retired colonel on the Training Division. The device was returned to PPPL on May 17.

The free air show featured The U.S. Air Force Thunderbirds, the Golden Knights, an Army parachute team that was grounded on Sunday due to high winds, and flybys of military planes. The 42,000-acre base is 18 miles southeast of Trenton. It is home to the U.S. Air Force, Army, Navy, Marine Corps, and Coast Guard and is the only joint base to include five military branches.

Steve Robertson, the emergency management chief at the base, began using MINDS after meeting former head of Technology Transfer Lew Meixler when both were serving on a state weapons of mass destruction committee. "I thought it might be a good tool in the box," Robertson said.

A precursor of MINDS was invented in 1999 to help decommission the Tokamak Fusion Test Reactor at PPPL. MINDS was invented after the 9-11 attacks in 2001 when concerns rose over a possible nuclear attack. The U.S. Department of Energy and the U.S. Army funded further research into the device.

Gentile showed the group how to operate the device, which instantly detects gamma ray spectra emitted by nuclear material in real time and identifies the type of radiation. "If people were trying to sneak something past you, they wouldn't be able to do that," said Gentile. "If it was material that could be used in a weapon it would trigger an alarm and make the screen turn red."

The software in MINDS can readily identify materials used in weapons even when the source is hidden to escape detection,

Silber told the group. "It's capable of saying if something is trying to shield the material through a lead box," he said.

The device can be programmed for any amount of time and calibrated against background radiation. In this case, Gentile set the machine to take readings every five seconds. He noted that MINDS has been used in numerous locations, including Newark Penn Station, tollbooths on the New Jersey Turnpike, and Picatinny Arsenal, and to scan cargo containers at the Port of Oakland. But it has never detected weapons. MINDS avoids false alarms by filtering out radiation from materials used to treat cancer.


Gentile demonstrated how the software shows spikes when it detects a nuclear material by showing the group how MINDS detects a minuscule amount of radiation from an old camping lantern mantle and a smoke detector. MINDS can detect materials from 25 to 50 feet away and can go back to previous readings if someone misses a reading.



The MINDS device was attached to the back of a truck at one of the entrances to the air show. (Photo by Laurie Bagley)

What does Gentile get from lending out said device? "I get the data!" he said. Bagley said Gentile and his partners will use data from the weekend at the base to look at how many hits there were and analyze how well the device works.

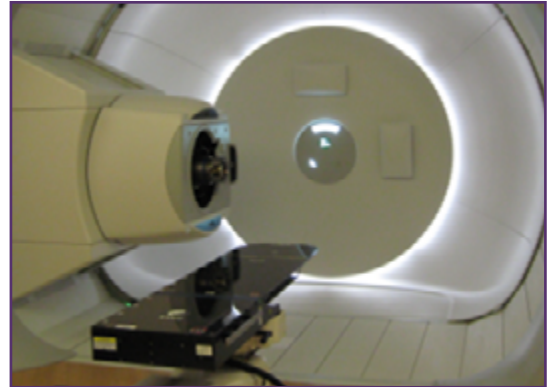
MINDS was featured in the television show, "NCIS: Los Angeles," in which the heroes recover the stolen device from villains. It won the 2008 Thomas Alva Edison Patent Award from the Research Development Council of New Jersey and the 2009 Award for Excellence in Technology Transfer from the Federal Laboratory Consortium for Technology Transfer.

Other members of the team that invented MINDS were: Dana Mastrovito, Bill Davis, Steve Langish, Andrew Carpe, and Jason Perry. 

COLLOQUIUM

Proton Therapy for Cancer: Current Status, Promise and Challenges

Dr. Dennis Mah
ProCure Proton Therapy Center



Wednesday, May 25

1:30–2:45 p.m., MBG Auditorium, Lyman Spitzer Building

It's not too late to join the Federal Bike Challenge

May is National Bike Month and it's not too late to register for one of six PPPL bike teams [here](#). One of four team captains will contact you with registration information. Then all you have to do is log your cycling miles during May for all your bike rides at home and to work.



As of May 5, 46 people on six teams have registered for the Bike Challenge. The team captains are: Mike Zarnstorff, Dave Johnson, Daren Stotler, Larry Dudek, Theresa Gillars and Rob Sheneman.



Some members of PPPL's National Bike Challenge Team set off on a 10-mile lunchtime ride on May 12. From left to right: Rob Sheneman, Mark Karlik, Tony Bleach, Carol Ann Austin, Kenan Qu, Jake Maddox, and Andrei Khodak.

PPPL celebrates our inventors during National Inventors Month



PPPL congratulates Manfred Bitter, Ken Hill and Phil Efthimion for their invention of a new imaging system that uses a pair of spherical reflectors with a concave and convex arrangement that can be used in various types of spectrometers. The inventors received a patent for their device this month.

**Do you have an idea that is novel, useful, and non-obvious?
You should file an Invention Disclosure Form!**

Contact Laurie Bagley, lbagley@pppl.gov ext. 2425.

The OMO will be conducting a blood pressure screening

Tuesday, May 24

11 a.m. to 1 p.m.

In the LSB Lobby



ATTENTION ALL PPPL MUSICIANS

Sign up to Participate in PPPL's

SUMMER KICK OFF BBQ BUFFET BLUES JAM AND OPEN MIC LUNCH

Friday May 27, 2016

11:30 a.m.-1 p.m. in the Courtyard

PA system, Amps, Microphone & Backing Blues Tracks
Provided. Just Sign Up....Show Up...Plug In...Play

**See Chef Mark in the Cafeteria to sign up or for more details
or call extension 3350.**

Robotics coaches needed for all-girls robotics teams

PPPL's Science Education team is looking for volunteer coaches for a new all-girls FIRST Lego League Robotics team (ages 9 to 13) and the new FIRST Tech Challenge Team (ages 13 to 18) being organized in collaboration with the YWCA-Princeton.

The teams will meet throughout the fall semester and there are lots of events throughout the spring and summer to engage everyone. The program welcomes volunteers with all kinds of skills.

**Please call Shannon Greco ASAP to volunteer:
sgreco@pppl.gov, 609-243-2208.**

Save the date!

PPPL's Inventor Recognition Dinner will be held on Wednesday, June 8th, from 6-9 p.m. at Princeton University's Prospect House.

More information to follow!

If you have questions, please contact Laurie Bagley, x2425, lbagley@pppl.gov.

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 May 23	Tuesday May 24	Wednesday May 25	Thursday May 26	Friday May 27
COMMAND PERFORMANCE Chef's Feature	Chicken Parmesan served with Pasta and Garlic Bread	Cheese Ravioli in a Pink Vodka Sauce with Peas & Mushrooms served with Garlic Bread	COMMAND PERFORMANCE Oriental Stir Fry	Meatloaf with Mashed Potatoes, Roasted Carrots & Gravy	OUTDOOR BBQ BLUES JAM Hamburgers, Hot Dogs, Pulled Pork, Chicken, Beans, Coleslaw, Corn, Cornbread, Iced Tea & Water
Early Riser	Chicken & Cheddar Omelet served with Hash Browns	Grilled Cheese French Toast with Bacon	Sausage Hash Brown Bake	Egg McMuffin with Ham served with Hash Browns	Sausage Gravy & Biscuits served with 2 Eggs any style
Country Kettle	Sausage Bean Soup	Vegetable Chili	Chicken Rice	Minestrone	Beef Noodle
Grille Special	BURGERLICIOUS-BBQ Beef in a Blanket Grilled Beef Burger with Cheddar Cheese, Bacon Blanket, Crispy Onion Straws, Dill Pickle Chips and Chipotle BBQ Sauce on a Brioche Roll	Cheddar & Bacon on Raisin Bread	Fish Taco with Pickled Slaw, Cilantro, Chipotle Sour Cream	Grilled Texas Toast with Prosciutto, Chicken, Swiss Cheese & Dijonnaise	BBQ
Deli Special	Egg Salad & Provolone with Arugula & Tomato on French Bread	Corned Beef with Swiss Cheese, Cole Slaw, Russian Dressing on Rye	Italian Hoagie with Prosciutto, Capicola, Fresh Mozzarella, Lettuce, Tomato & Marinated Red Peppers	Tuna Club Sandwich with Hard-Cooked Egg	Chicken Salad Croissant with Bacon
Panini	Pork Roll & American Cheese on a Soft Roll served with Fries	Caprese Grilled Cheese Panini with Pesto Mayo, Fresh Mozzarella, Roasted Peppers, Fresh Basil & Tomato on Italian Bread	Turkey, Smoked Gouda, Avocado & Chipotle Mayo on Focaccia Bread	Portobello Parmesan Sandwich	Turkey with Blue Cheese, Onion, & Tomato on Ciabatta Bread

MENU SUBJECT TO CHANGE WITHOUT NOTICE

VEGETARIAN OPTION

WEEKLY

Editor: **Jeanne Jackson DeVoe** ♦ Layout and graphic design: **Kyle Palmer** ♦ Photography: **Elle Starkman**
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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 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/>.