



**November 26–December 2, 2018**

# COLLOQUIUM

## SPARC and the High-field Strategy for Accelerating Fusion Development

**Dennis Whyte**

MIT

**Monday, Nov. 26**

**2 p.m., M.B.G. Auditorium, Lyman Spitzer Building**

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# **The 3rd Annual PPPL United Way Bake-Off**

**Wednesday, Nov. 28  
11:30 a.m.**

**LSB Lobby**

**Sign up by Monday, Nov. 26.  
Check your email for the link!**

Each department will have a table in the lobby presenting their baked goods. Cast your vote by purchasing their tasty creations to determine who gets the coveted PPPL Bake-Off trophy and earns bragging rights!

**Contact United Way Campaign Coordinator Ricardo Marquez  
at [rmarquez@pppl.gov](mailto:rmarquez@pppl.gov) or x2221**

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**America  
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**Through Nov. 28**

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# **PPPL hosts Innovation Discovery Event**

**Thursday, Nov. 29**

**8:30 a.m.–4 p.m.**

**Room B318**

**For more information, contact Laurie Bagley, [lbagley@pppl.gov](mailto:lbagley@pppl.gov), x2425**

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# **YOU'RE INVITED**

## **Holiday Dinner Dance Party**

**Saturday, Dec. 15**

**6–10 p.m.**

**Clarion Hotel**

**Palmer Inn Ballroom**

**Price: \$40/person.**  
**Payment due by Dec. 5**

**RSVP by Nov. 30**

to Marianne Tyrrell, [mtyrrell@pppl.gov](mailto:mtyrrell@pppl.gov);  
Nicole Allen, [nallen@pppl.gov](mailto:nallen@pppl.gov), x2186;  
Diana Adel, [dadel@pppl.gov](mailto:dadel@pppl.gov), x2416; or  
Deedee Ortiz, [dortiz@pppl.gov](mailto:dortiz@pppl.gov), x2785



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**The United Way  
Campaign ends  
Nov. 30!**

**Please contribute  
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help your local  
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# A tasty way to say thank you on third stop of World of Thanks tour





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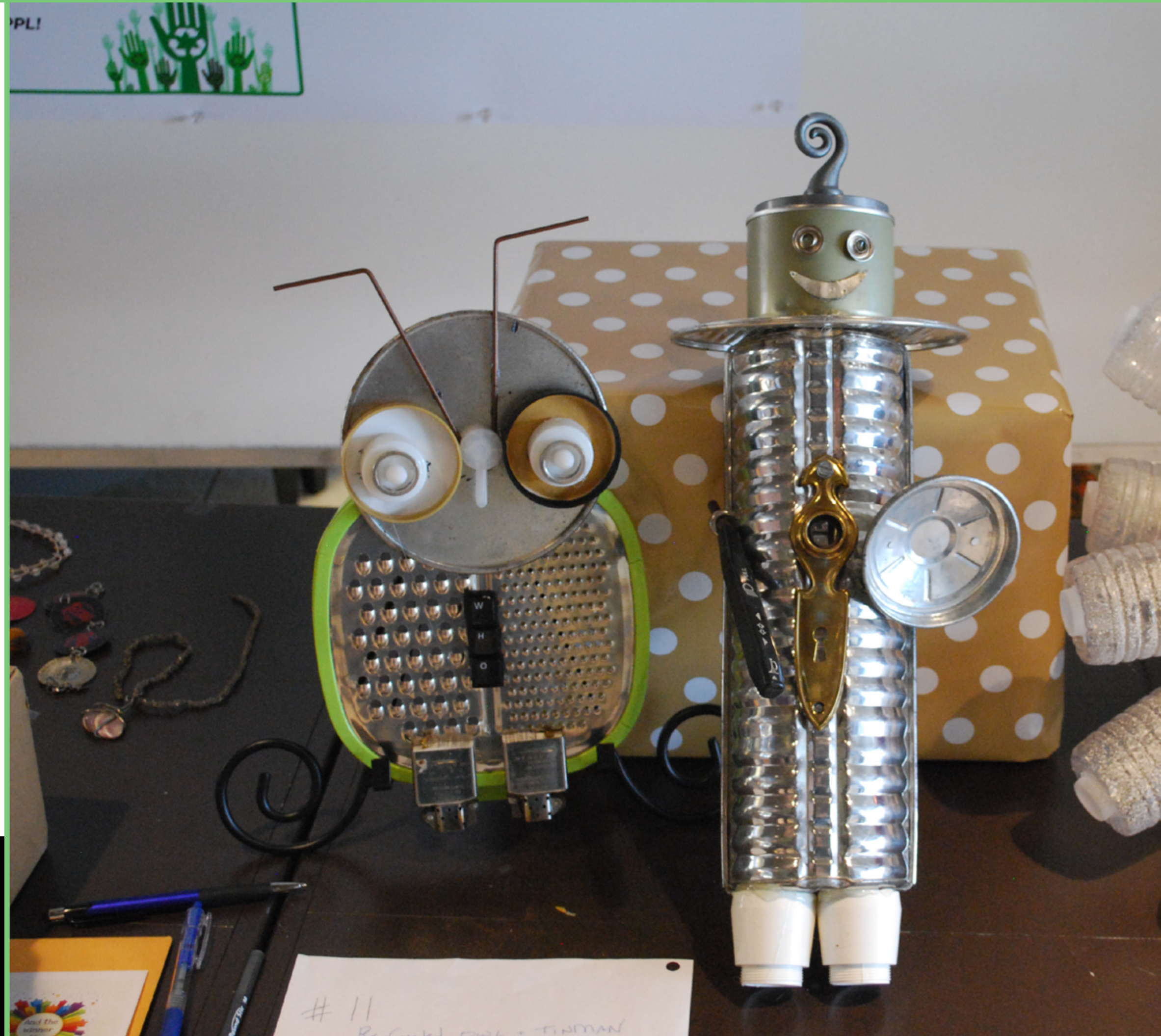


# PPPL celebrates the greening of PPPL during America Recycles Day





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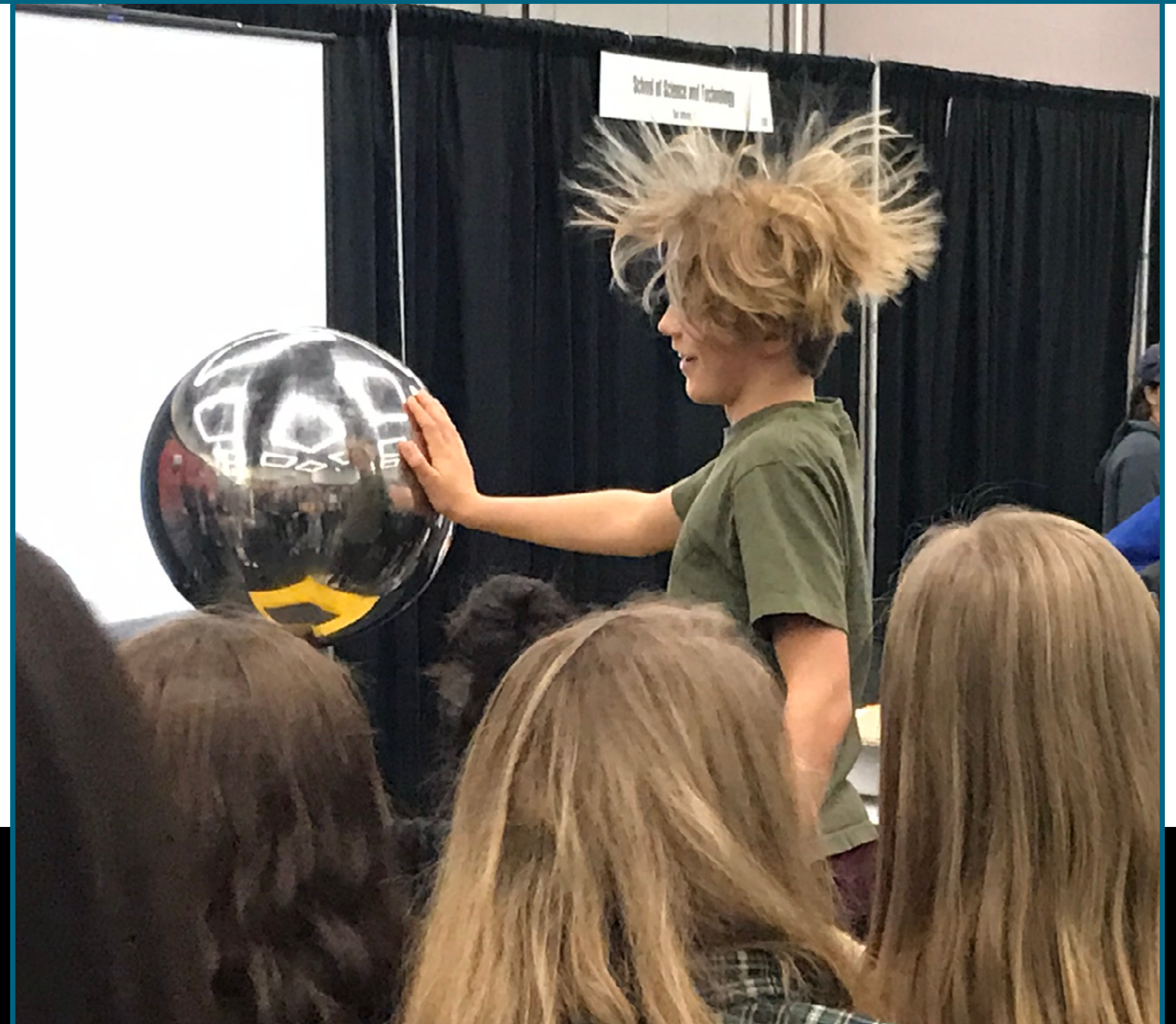
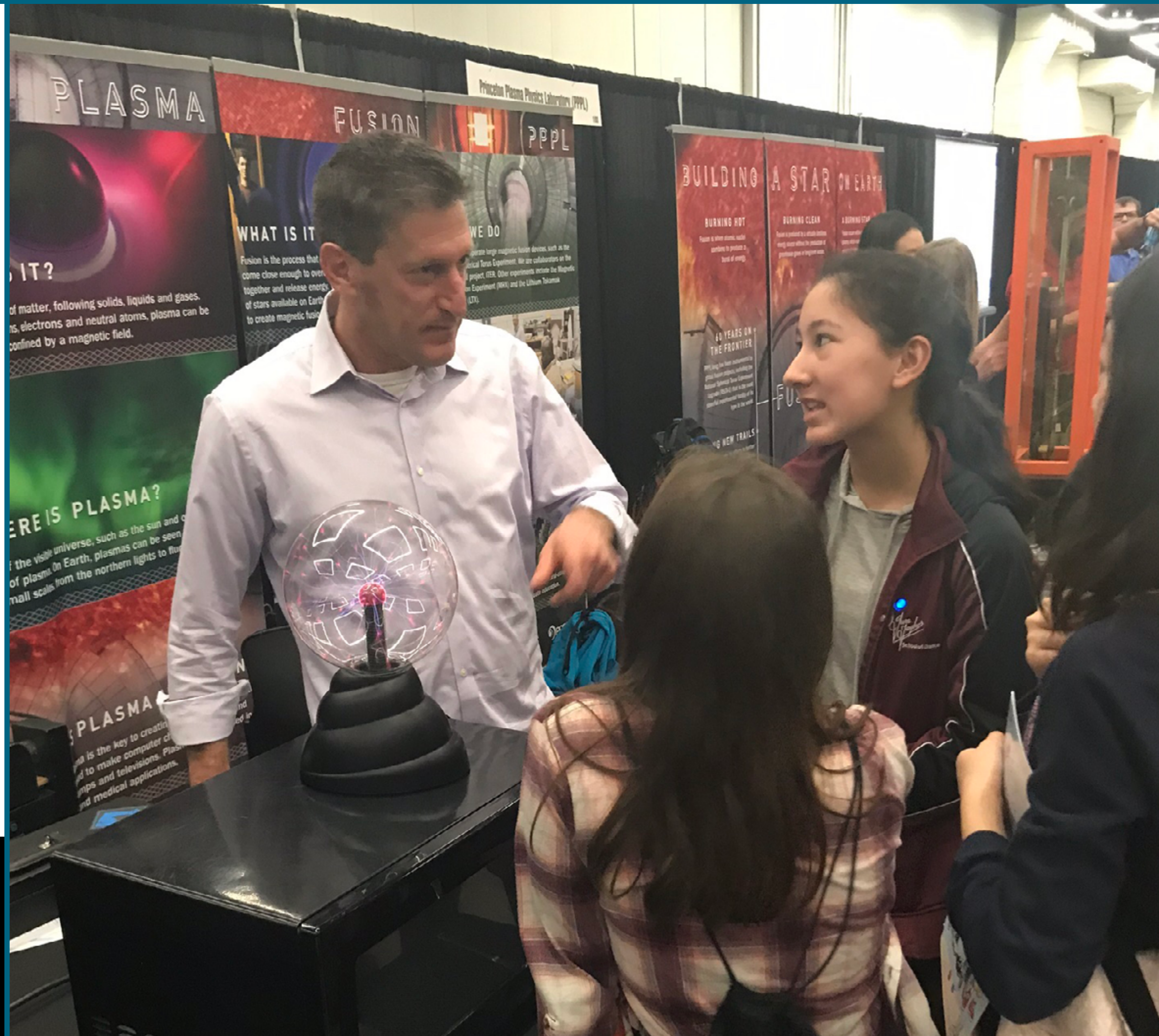


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# Lessons in plasma and fusion energy from Princeton to the APS DPP Science Expo in Portland





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To increase the focus of the laser beam, only one of the lens needs to move. The distance from the laser cavity to the tokamak is 19 meters, so having the lens positioned accurately to the nearest sub-millimeter is imperative. With all of these conditions in mind, the first design iteration had a rod attached to a screw which was connected to the actuator (See Figure 2).

**Figure 3:** A machined part is attached to the lens and held together by a screw. This machined part is mounted to the actuator which moves the lens accordingly. This simple design accomplishes most of the design goals.

To ensure that the motorized system would move accurately and precisely, three actuators (Motorized Screw 8MS00-10-28 from Standa, Piezo Inertia Actuator PIA25 from Thorlabs, Compact Stepper Motor Actuator ZFS25B from Thorlabs) were chosen study in more detail to see which one would be the best for the system. Given the space constraints of the design, the motorized screw from Standa did not meet the requirements because it was very long (167.5 millimeters).

	Multi-directional repeatability	Loading Position	Closed Loop Operation	Step Size	Backlash	Temperature	Nominal Force (N)	Travel (mm)	Total Cost (including motor)
PIA Screw Motor	No	Yes	No that can manually program	0.46 mm	<15 µm	5-40°C	40	25	\$1,517.18*
Compact Screw Motor	5 µm (~10-15µm)	Yes	No that can manually program	20 nm	None	10-40°C	25	25	\$1,817.24*

Table 1: Comparing the characteristics of the two actuators.  
\*Price found on Thorlabs website on 8/8/2018

The maximum travel for both actuators is 25 millimeters, not 30 millimeters. Thus, the design had to be changed to make the machined part give a mechanical advantage.

**Figure 4:** Final design with compression springs to move the lens backward, a bearing attached to the hole where the screw once was, and a rod which gives a 3:2 ratio advantage of the motor to allow it to travel more than 25 millimeters.

When the actuator moves a step size, the machined rod moves in the positive x-direction, sending the other side of the rod move in the negative x-direction causing the spring to compress, and the lens to translate to the position desired.

**Figure 5:** A cross section of the design.

**Motion Study of Design**

**Figure 6:** The figures above show how the design will move when the actuator move a step size.

**Future Work**

- Implement a safety lock on the design to ensure that in non-operation, the position is secured.
- Prototype and test the apparatus to ensure that it works within design guidelines.
- Have the motorized system software controlled so can it can operate through a computerized system.
- Installing the design in the Pulse Burst Laser System in the NSTX-U.
- Implement on a three-lens system.

**References**

- <https://www.thorlabs.com>
- See link below for all references used: <https://docs.google.com/document/d/1h1d14EJUYAI-d7VE9HCyQG6MScWk/edit?usp=sharing>

**Acknowledgements**

This work was funded by the DOE Energy for the Summer University Laboratory Internship (SULI) program.

**Figure 7:** CAD Render of the three-lens system.

**Kinetic simulation of magnetic field generation via the Biermann Battery effect for laser-driven HED experimental conditions**

Jill Peery<sup>1</sup>, Jack Matteucci<sup>2</sup>, Will Fox<sup>2</sup>, Derek Schaeffer<sup>2</sup>, Kirill Lezhnin<sup>2</sup>  
<sup>1</sup>Willamette University <sup>2</sup>Princeton Plasma Physics Laboratory

**Biermann Battery Effect**

The Biermann Battery Effect is the spontaneous generation of a magnetic field in a plasma. It occurs when the temperature and density gradients are non-collinear. It's derived from a term in the curl of Ohm's law as follows:

$$\frac{\partial \mathbf{B}}{\partial t} = \nabla T \times \frac{1}{k_B T} \nabla n$$

**Results**

In PSC, we track density, temperature and magnetic field (Fig. 1), the change in magnetic field caused by each of the terms of Ohm's law as well as the total change in magnetic field (Fig. 2) at each time step. We also track the values shown in Fig. 4 that give additional necessary information about the magnetic field.

**The Effect of Ion Species on Magnetic Field Generation**

We changed atomic number Z in PSC to test ion species for Hydrogen, Helium, Carbon, Aluminum and Gold. We found a general decreasing trend in max magnetic field and Biermann generation as Z was increased.

**The Effect of Collisionality on Magnetic Field Generation**

Collisionality is controlled in PSC using the variable LambdaDad. We found that the BBE term was much higher than it should be and overruled the other terms from the Curl of Ohm's law. The data at these collisionalities, indicated by the shading, is untrustworthy and still under study.

**The Effect of Laser Heating Profile on Magnetic Field Generation**

In PSC, the heating profile of the laser onto the target is a gaussian. We change the power in the experiment, denoted by the variable P, to alter the profile. We found that varying it had negligible effect on both Biermann generation and max magnetic field.

**Future Work**

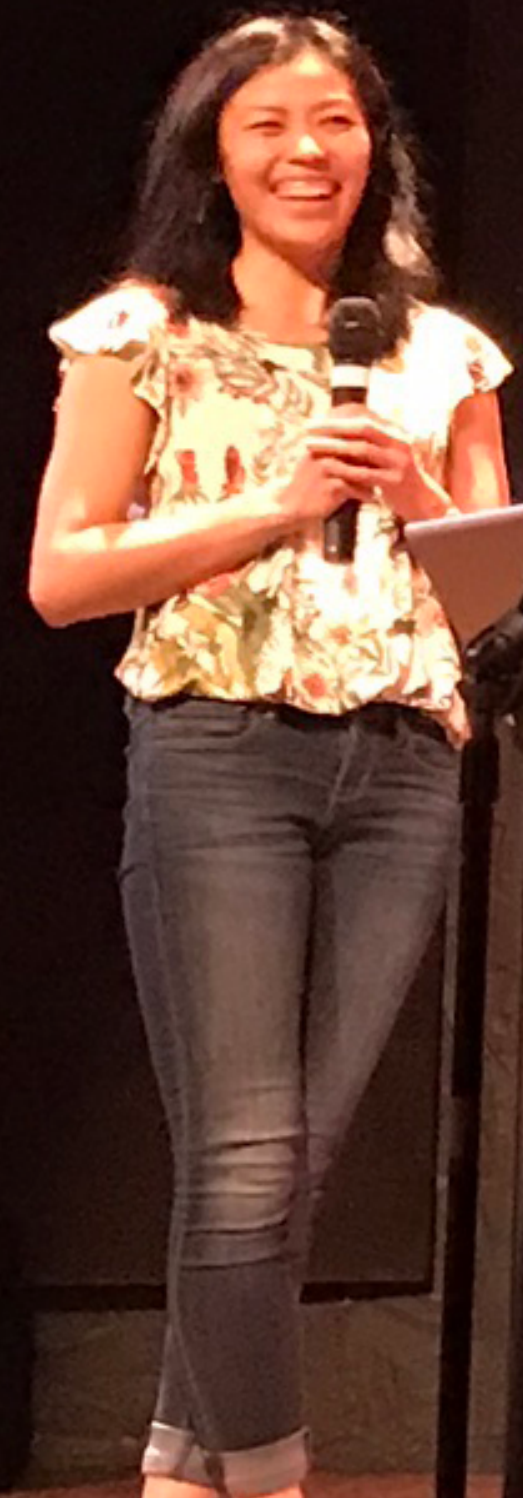
- Further examination of collisionality, laser heating radius and ion species score (collection of more data points)
- Similar examinations of other experimental conditions
- Comparison of this data to results from MHD simulations
- Comparison of this data to results from previous experiments relating to the Biermann Battery Effect.

**Acknowledgments**

PPPL



# Lessons in plasma and fusion energy from Princeton to the APS DPP Science Expo in Portland



## Fusion on Earth: Creating a Star with Magnets or Lasers

Lawrence Livermore National Laboratory

Dr. Tammy Ma  
X-Ray Analysis Group Lead  
ICF Program



Dr. Arturo Dominguez  
Senior Program Leader, Science  
Education Department



SCIENCE  
on  TAP



# **Just Breathe — *Mindfulness Series***

**Monday, Dec. 11**

**12-12:30 p.m.**

**PPPL Furth Plasma Physics Library**

**For PPPL students, faculty, and staff**

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# **2019 Young Women's Conference**

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**March 22, 2019  
at Princeton University**

**Register your  
future scientist!**

**Contact Deedee Ortiz,  
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# Wanted: Tour Guides!

**Show off the Lab  
to the public!**



**Contact Jeanne Jackson Devoe, ext. 2757**



# Make an appointment for your flu shot

Please call the Occupational Medicine Office (OMO) at x3200 to schedule an appointment.



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# What are the key elements of the STOP program?



There are 3 key elements to the STOP program: observe work as it is being performed, talk with the worker(s) about what is seen (safe, unsafe, or both), and fill out a STOP card without identifying whom you observed.

**Safety first:  
Use the STOP program!**

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BROCK

Jerry Vazquez

Chef Manager

Premier

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 26	Tuesday November 27	Wednesday November 28	Thursday November 29	Friday November 30
Sizzle AM	Pork Roll, Egg, and Cheese	Breakfast Pizza	Denver Omelet Diced Peppers, Onions, and Ham	Sausage, Egg, and Cheese Biscuit	French Toast Sticks with Bacon
Stock	Chicken Gumbo and Vegetarian Corn Chowder	Chicken Noodle	Chicken Noodle and Vegetarian Asparagus and Brie	Vegetarian White Bean or Asparagus and Brie	Manhattan Clam Chowder or Vegetarian White Bean
Craft	Roast Beef and Cheddar House-Made Roast Beef and Cheddar Cheese Ciabatta	Egg Salad B.L.T.	Tuna Salad Croissant	Avocado Lime Chicken Chicken Breast with Lime, Cilantro, and Avocado	Asian Vegetable Sandwich Homemade Asian Sauce with Vegetables Served on a Wrap
Sizzle PM	Cheddar Cheese Bacon Burger	Pastrami and Swiss Lean Pastrami and Swiss Cheese Served on Rye	Grilled Eggplant and Fresh Mozzarella Melt	Philly Cheese Steak	Crispy Buffalo Chicken Hand-Breaded Chicken Breast tossed in a Spicy Sauce with Blue Cheese, Lettuce, and Tomato
Discover	General Tso's Chicken Made-in-House Crispy Chicken Tossed with an Asian Sauce	Garlic Herb Flank Steak Flank Steak Seared with Fresh Herbs	Fresh Herb Lemon Flounder—Filet of Flounder Broiled with Lemon and Fresh Herbs	Sushi	Bibimbap Korean-Style Chicken or Beef
Panini	B.B.Q. Shrimp Quesadilla	Garden Vegetable Sandwich—Fresh Vegetables on Pita Bread	Falafel with Spinach and Roasted Peppers	Fresh-Roasted Vegetables with Fresh Mozzarella and Pesto	Chicken Cordon Bleu Chicken Breast, Ham, and Swiss

MENU SUBJECT TO CHANGE WITHOUT NOTICE



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