



November 26–December 2, 2018

COLLOQUIUM

SPARC and the High-field Strategy for Accelerating Fusion Development

Dennis Whyte

MIT

Monday, Nov. 26

3 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 or x2221**

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Clothing Drive**

Through Nov. 28

**Contribute to the clothing drive
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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, 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;
Nicole Allen, nallen@pppl.gov, x2186;
Diana Adel, dadel@pppl.gov, x2416; or
Deedee Ortiz, dortiz@pppl.gov, x2785

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

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



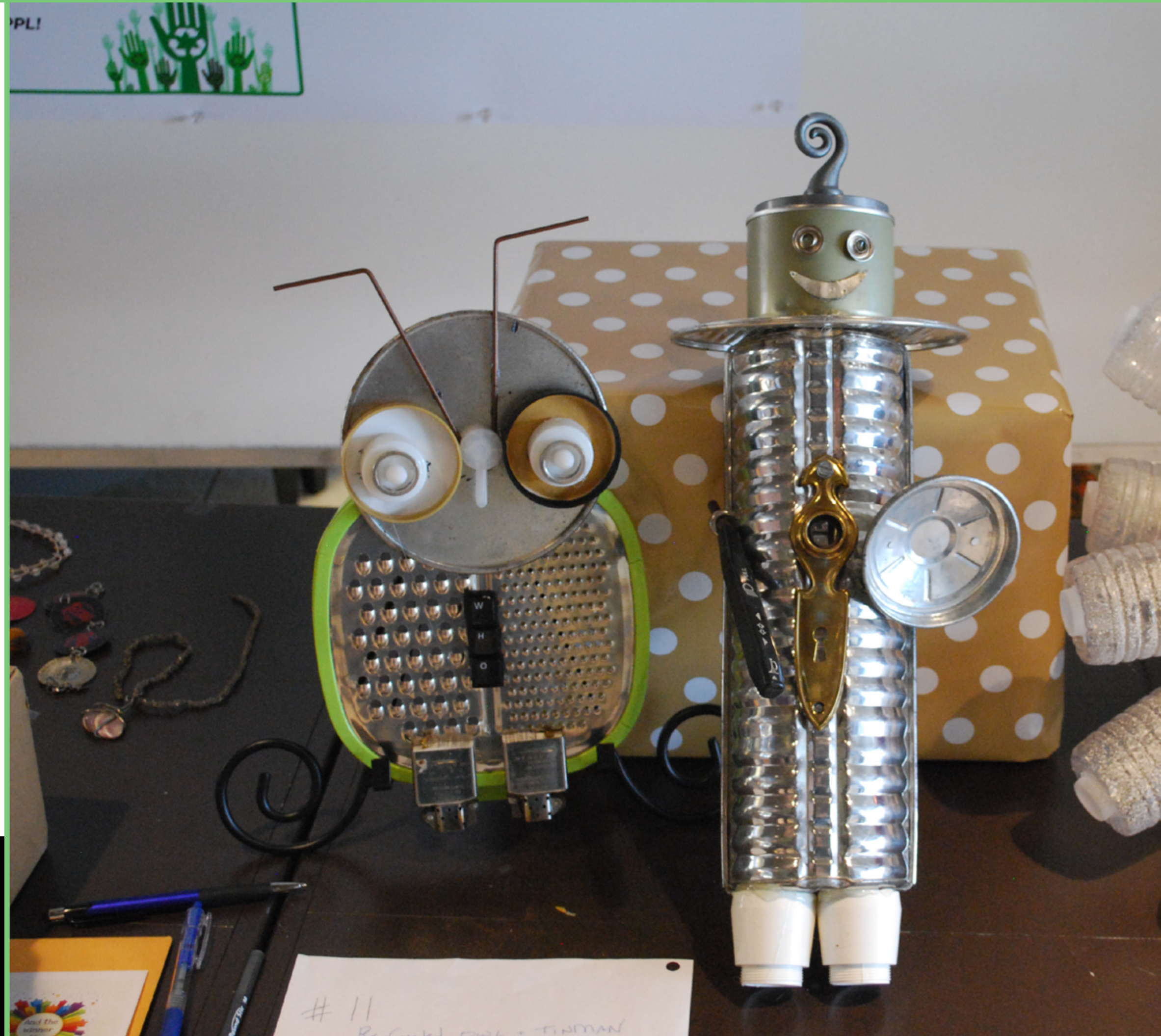
A tasty way to say thank you on third stop of World of Thanks tour



PPPL celebrates the greening of PPPL during America Recycles Day



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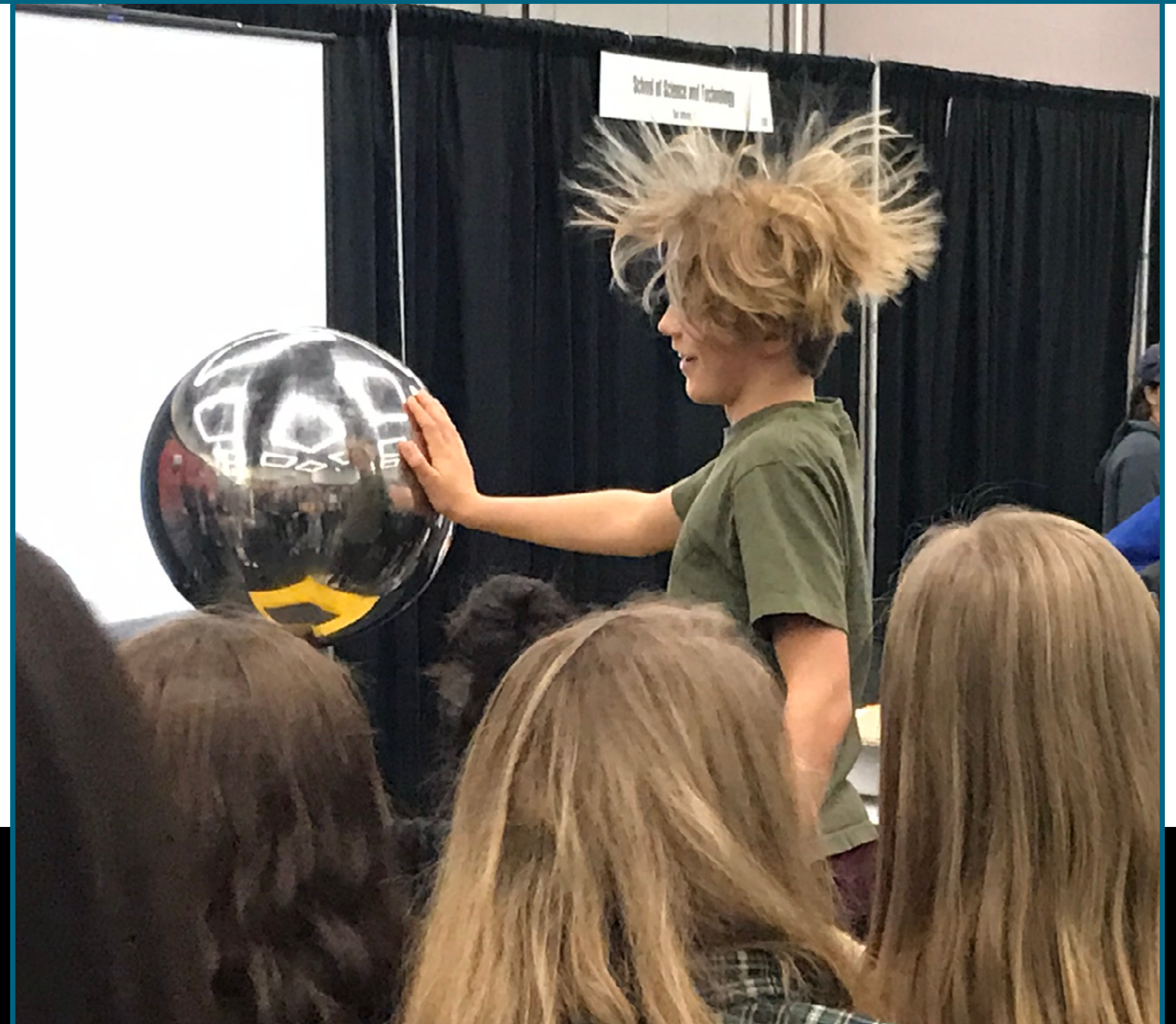
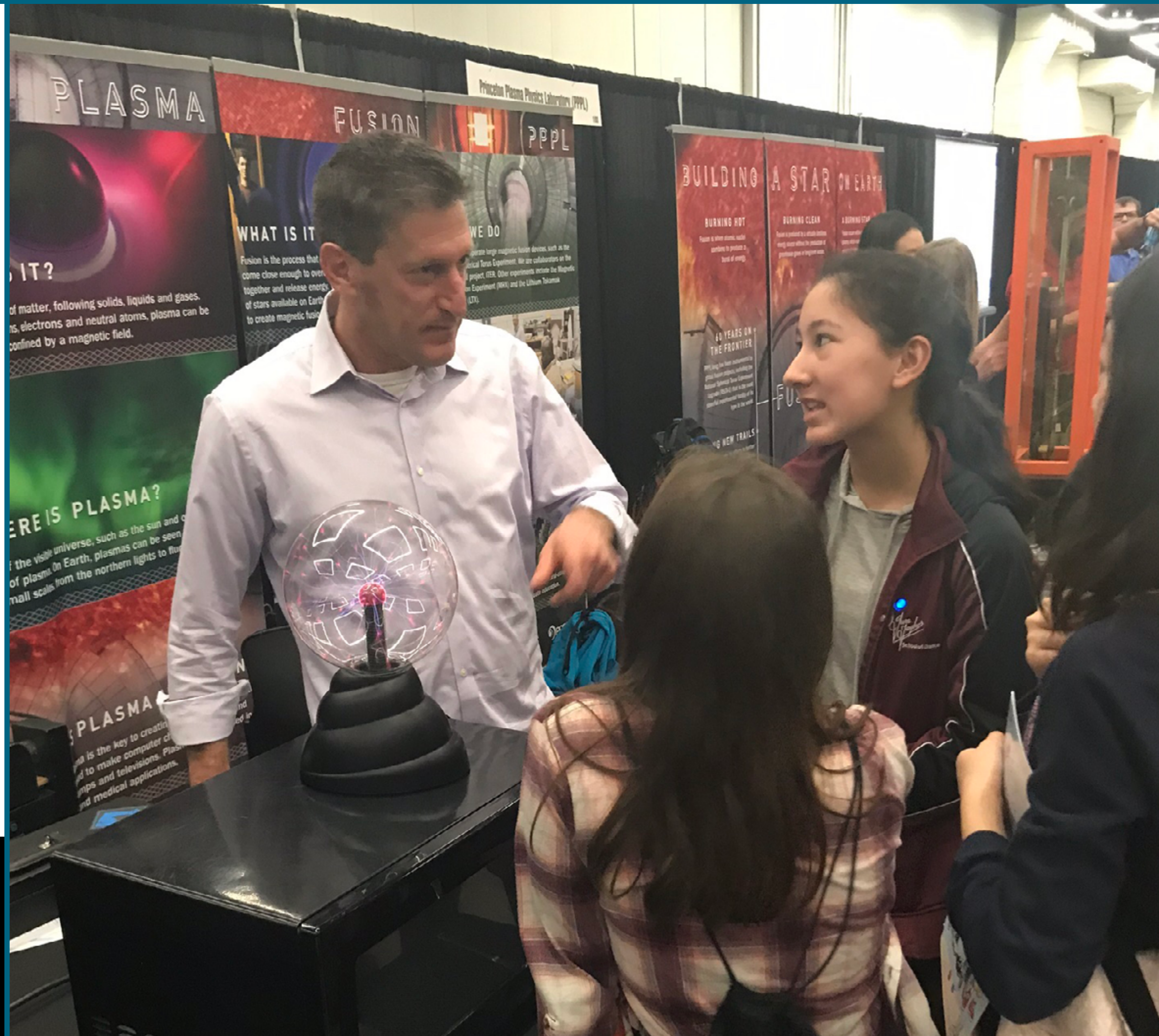
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Lessons in plasma and fusion energy from Princeton to the APS DPP Science Expo in Portland



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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	Closest Lens 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 Peery¹, Jack Matteucci², Will Fox², Derek Schaeffer², Kirill Lezhnin²
¹Willamette University ²Princeton 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:

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

We used PSC, a fully kinetic particle-in-cell (PIC) code (Silicon Case), an HED experiment where a plasma plume is ionized by a laser and expands into a background plasma of low density.

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 Background Plasma Density on Magnetic Field Generation

The background density is represented by the variable n_b and is in relation to the density of the target, which has $n_b=1$. Max magnetic field was found to be not affected meaningfully by variation of background plasma density. Biermann magnetic field generation decreased with increasing background density as the density gradient between the target and the background became smaller.

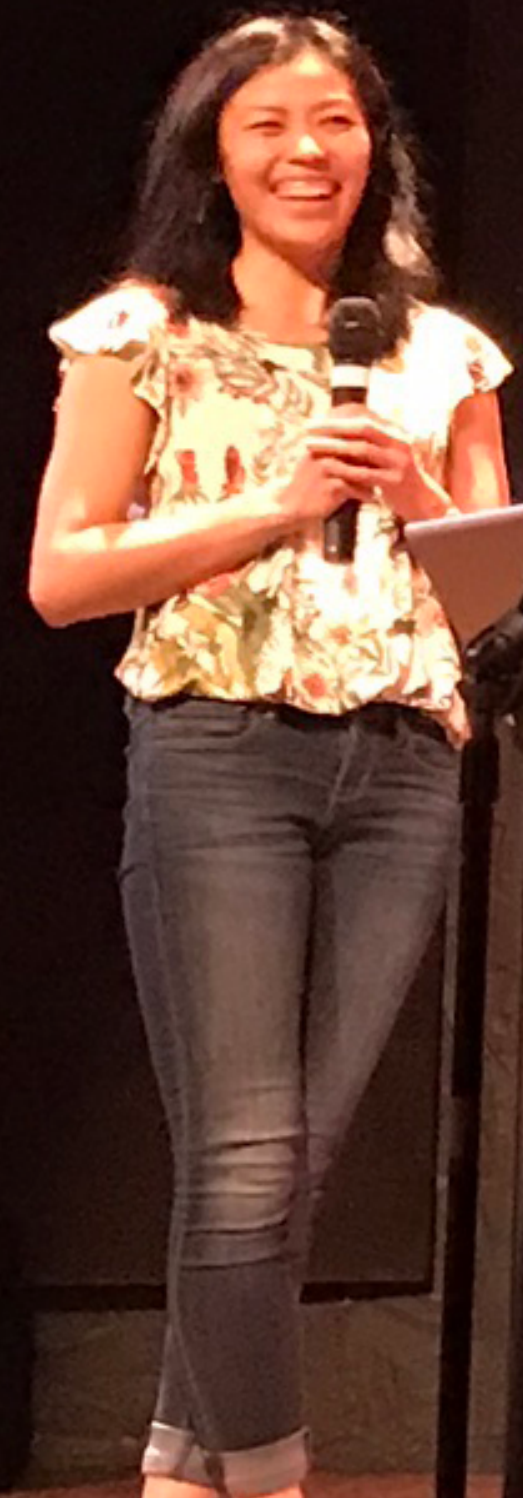
Future Work

- 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.

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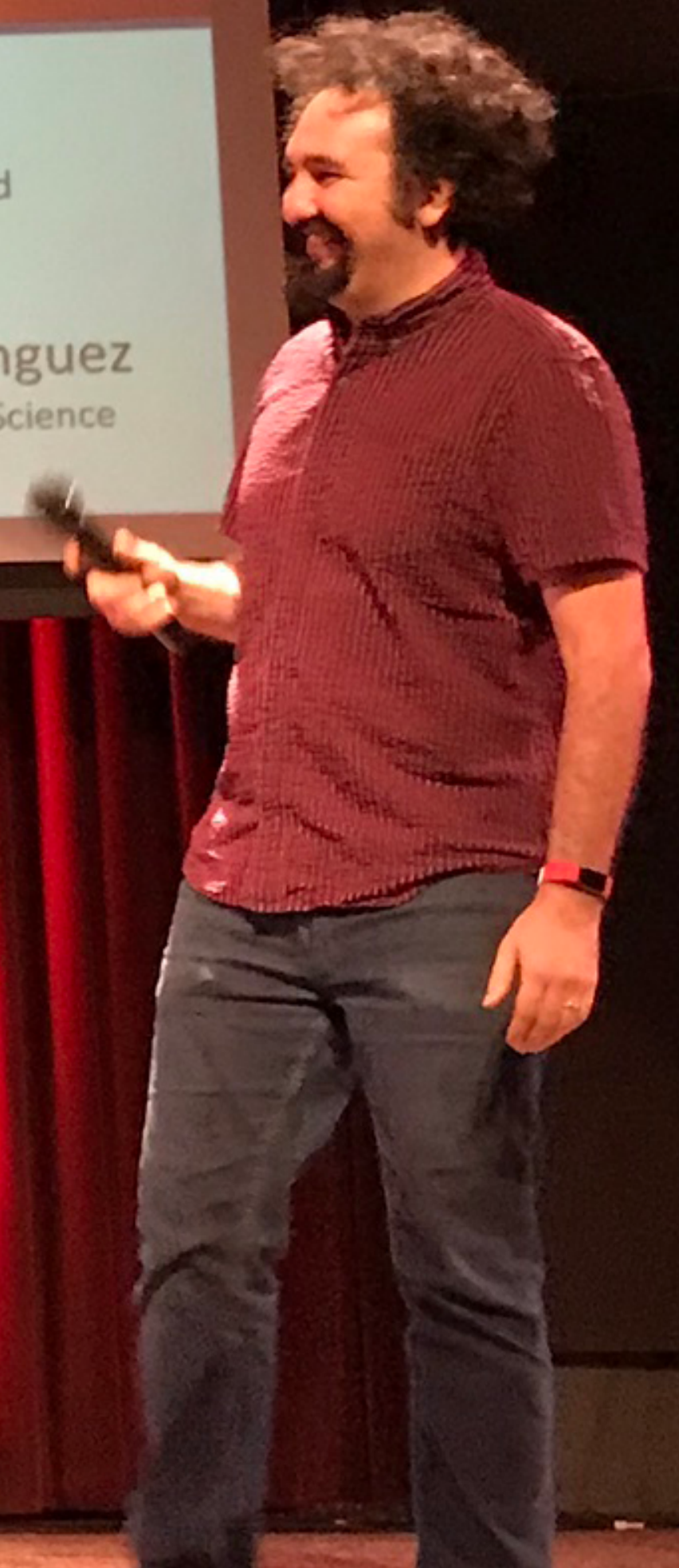
Fusion on Earth: Creating a Star with Magnets or Lasers

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

**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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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	<div>Coming soon</div>				
Stock					
Craft					
Sizzle PM					
Discover					
Panini					



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