

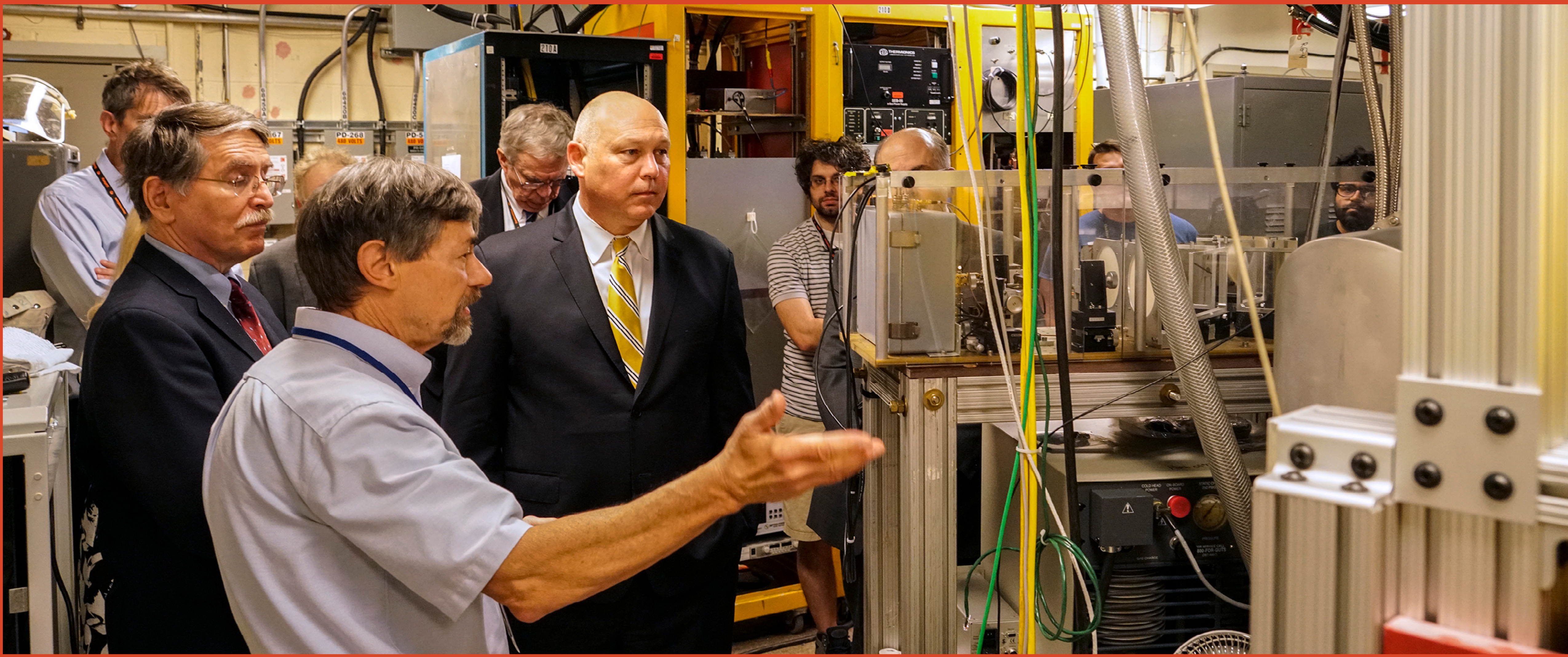


**August 27–September 2, 2018**

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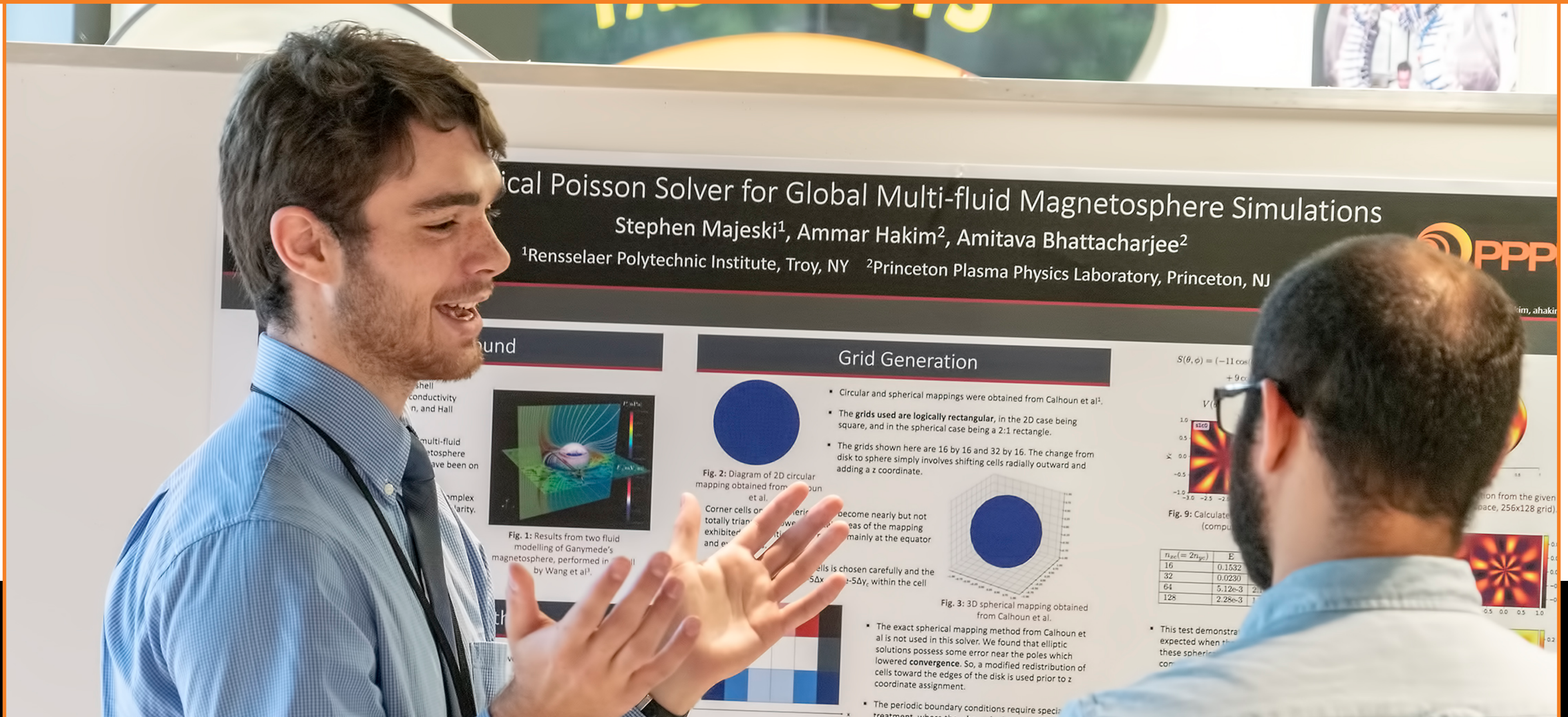
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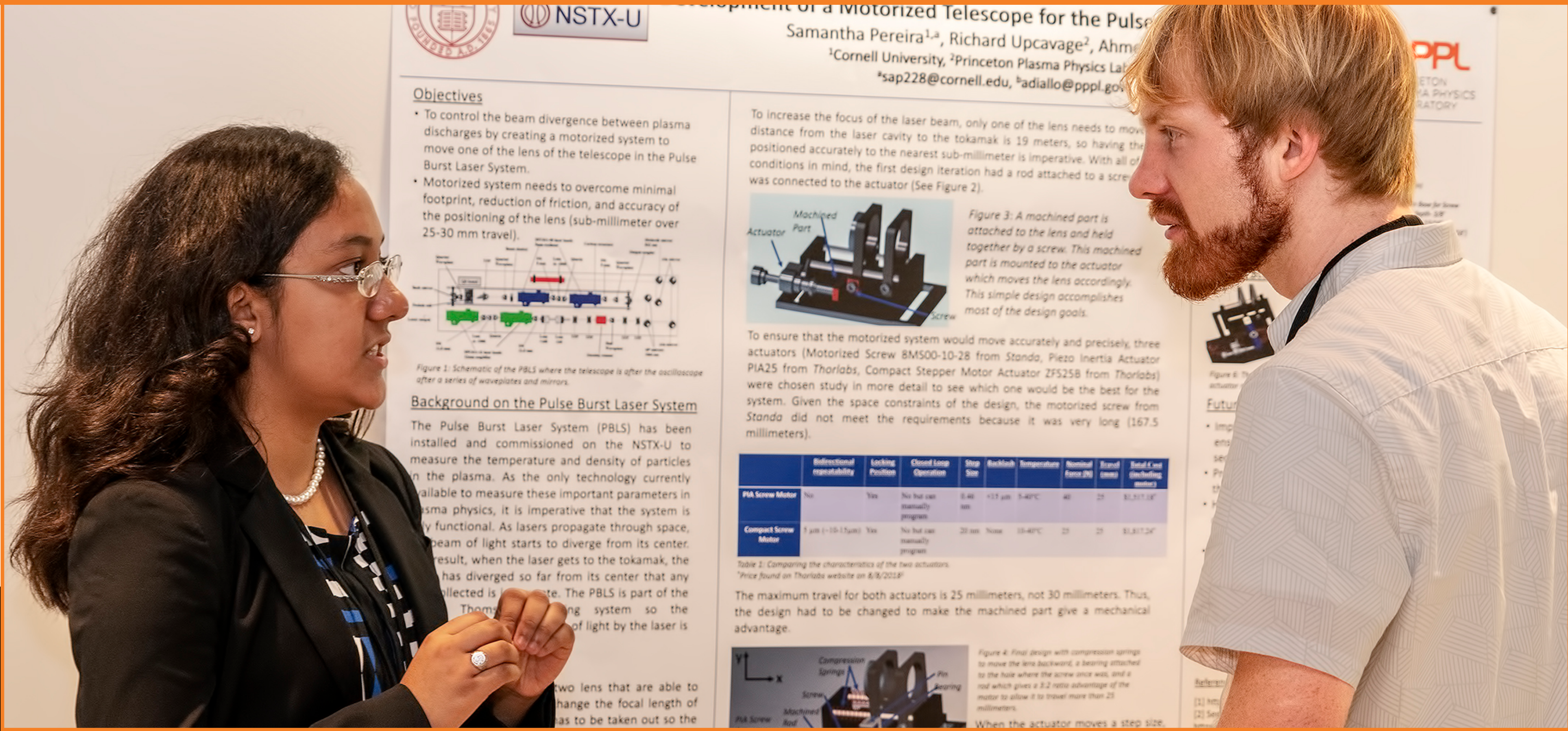
# Summer undergraduate interns present their research



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Development of a Motorized Telescope for the Pulse Burst Laser System  
Samantha Pereira<sup>1,a</sup>, Richard Upcavage<sup>2</sup>, Ahmed  
<sup>1</sup>Cornell University, <sup>2</sup>Princeton Plasma Physics Laboratory  
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## Objectives

- To control the beam divergence between plasma discharges by creating a motorized system to move one of the lens of the telescope in the Pulse Burst Laser System.
- Motorized system needs to overcome minimal footprint, reduction of friction, and accuracy of the positioning of the lens (sub-millimeter over 25-30 mm travel).



Figure 1: Schematic of the PBL system where the telescope is after the oscilloscope after a series of waveplates and mirrors.

## Background on the Pulse Burst Laser System

The Pulse Burst Laser System (PBL) has been installed and commissioned on the NSTX-U to measure the temperature and density of particles in the plasma. As the only technology currently available to measure these important parameters in plasma physics, it is imperative that the system is fully functional. As lasers propagate through space, the beam of light starts to diverge from its center. As a result, when the laser gets to the tokamak, the beam has diverged so far from its center that any collected is lost. The PBL is part of the Thomson Scattering system so the divergence of light by the laser is

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 the conditions in mind, the first design iteration had a rod attached to a screw which was connected to the actuator (See Figure 2).

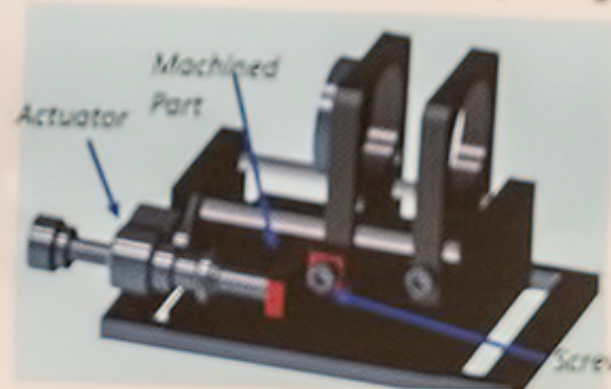


Figure 3: A machined part is attached to the lens and held together by a screw. This machined part is mounted to the actuator which moves the lens accordingly. This simple design accomplishes most of the design goals.

To ensure that the motorized system would move accurately and precisely, three actuators (Motorized Screw BMS00-10-28 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).

	Bidirectional repeatability	Locking Position	Closed Loop Operation	Step Size	Backlash	Temperature	Nominal Force (N)	Brand (mm)	Total Cost (including motor)
PIA Screw Motor	No	Yes	No but can manually program	0.46 mm	+/- 15 µm	5-40°C	40	25	\$1,517.18*
Compact Screw Motor	5 µm (+/- 15 µm)	Yes	No but can manually program	20 µm	None	10-40°C	25	25	\$1,517.24*

Table 1: Comparing the characteristics of the two actuators.  
\*Price found on Thorlabs website on 6/6/2019

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.

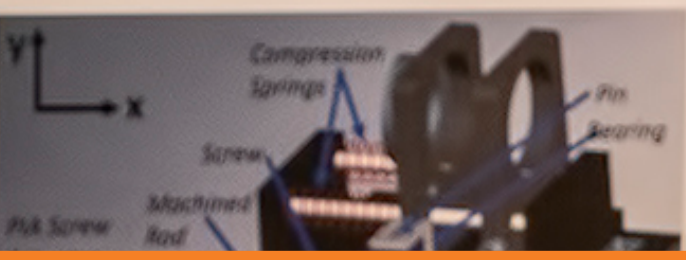


Figure 4: Final design with compression springs to move the lens backward, a bearing attached to the hole where the screw once was, and a rod which gives a 3:2 ratio advantage of the motor to allow it to travel more than 25 millimeters.



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Craig Petty  
collaborate  
on fusion**



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to the public!**



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

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## Single Stream Recycling

Paper, metal, glass, plastic — all in one bin!

- Metal Caps Only.
- Plastic Bags & Plastics Cap are TRASH.
- Keep Clean & No Food residue.

**Think green, keep it clean**



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are trained in the  
STOP Program?**



**119 people are currently trained to  
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Jerry Vazquez  
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 August 27	Tuesday August 28	Wednesday August 29	Thursday August 30	Friday August 31
Sizzle AM	Pepper, Egg, Potato and Cheese Wrap	Ham and Cheese Omelette	Chicken Omelette	Frittata of the Day	Breakfast Pizza
Stock	Chicken Noodle	Vegetable Lentil	Split Pea	Cream of Spinach	Chef’s Choice
Craft	Turkey and Avocado Wrap with Garlic Hummus	Portobello Mushroom and Fresh Mozzarella Stacker	Egg Salad B.L.T.	Ham, Brie Cheese and Spinach	Roast Beef with Asian Slaw and Wasabi Mayo
Sizzle PM	Flank Steak with Mushroom and Onions	Chicken and Spinach and Feta Cheese Pita	Cajun Grilled Cheese with Andouille Sausage	Italian Hot Dog	BBQ Chicken Melt
Discover	Pineapple Bourbon Pork Loin with Brown Rice and Roasted Asparagus	Penne Bolognese	Baked Chicken and Rice with Side of Vegetables	Fresh Carved Turkey with Mashed Potatoes and Herbed Fresh Vegetables	Sloppy Joe with Mac and Cheese
Panini	Grilled Chicken B.L.T. Ciabatta	BBQ Pork Sandwich	Corned Beef and Swiss on Rye	Eggplant Parmigiana Sandwich	Tuna Melt with Tomato and Swiss

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