

# Princeton Plasma Physics Laboratory

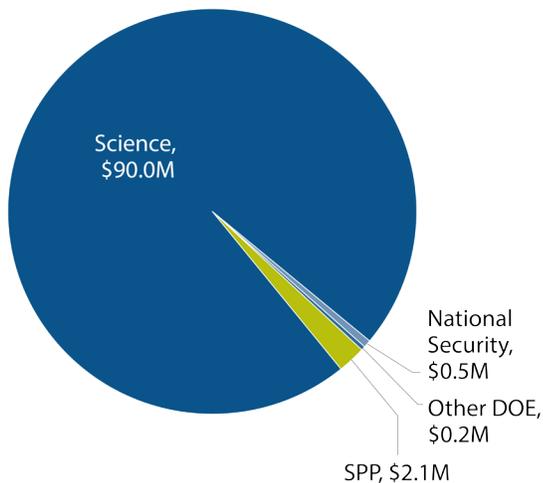
## At a Glance



PPPL is an innovative and discovery leader in plasma and fusion science and engineering. It is the only DOE Laboratory devoted to these areas, and it is the lead U.S. institution investigating the science of magnetic fusion energy. For more than six decades PPPL has been a world leader in magnetic confinement experiments and nationally leading programs in plasma theory and computation, and plasma science and technology. PPPL is a partner in the U.S. contributions to the international ITER Project and hosts multi-institutional collaborative work on the National Spherical Torus Experiment–Upgrade facility. The Laboratory also hosts smaller experimental facilities used by multi-institutional research teams and collaborates strongly by sending scientists, engineers and specialized equipment

to other research facilities in the U.S. and abroad. PPPL has two coupled missions. First, PPPL develops the scientific understanding of plasmas from nano- to astrophysical scale. Second, PPPL develops the scientific knowledge to enable fusion to power the U.S. and the world. Woven throughout PPPL's approach, as a core part of Princeton University's culture, PPPL educates and inspires future generations for the national interest. This includes outreach programs for science education from elementary school to college, a world-leading graduate education program in plasmas and astrophysical sciences in conjunction with Princeton University, and hosting hundreds of external students and thousands of visitors each year.

### FY 2016 Funding by Source



Lab operating costs: **\$92.92M**  
DOE/NNSA costs: **\$90.86M**  
SPP costs (non-DOE/non-DHS): **\$2.06M**

### Facts

**Location:** Princeton, New Jersey  
**Type:** Single-program laboratory  
**Year Founded:** 1951  
**Director:** Terrence Brog (Interim)  
**Contractor:** Princeton University  
**Responsible Site Office:** Princeton Site Office

### Physical Assets

**90.7** acres and **30** buildings  
**765,000** GSF in operating buildings  
Replacement plant value: **\$660M**

### Human Capital

**500** full-time equivalent employees (FTEs)  
**6** joint faculty  
**22** postdoctoral researchers  
**40** graduate students  
**~350** visiting scientists

### Core Capabilities

- Large-Scale User Facilities/Advanced Instrumentation
- Mechanical Design and Engineering
- Plasma and Fusion Energy Sciences
- Power Systems and Electrical Engineering
- Systems Engineering and Integration

### Mission Unique Facilities

- National Spherical Torus Experiment-Upgrade
- Lithium Tokamak Experiment
- Laboratory for Plasma Nanosynthesis
- Magnetic Reconnection Experiment

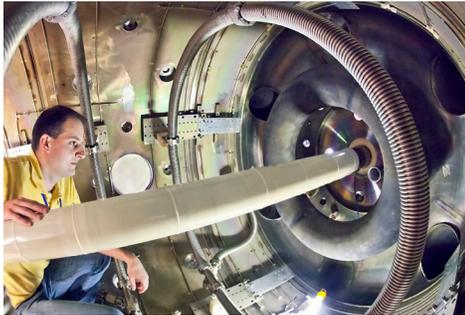


# Princeton Plasma Physics Laboratory Accomplishments



## Research Highlight

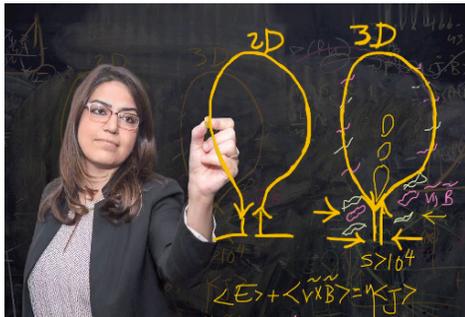
### The Power Behind Solar Storms



Magnetic reconnection, in which the magnetic field lines converge, break apart and violently reconnect, occurs throughout the universe. The process creates massive eruptions of plasma from the sun and triggers brilliant auroras and geomagnetic storms that can disrupt cell phone service and electrical power grids. PPPL research has provided fresh insight into how the stunning transformation of magnetic energy into kinetic energy takes place. Recent findings show that reconnection converts about 50 percent of the magnetic energy in a prototypical conversion layer, with one-third of the conversion heating electrons and two-thirds accelerating the atomic nuclei, or ions, in the plasma. Further findings shed fresh light on why the process occurs much faster than theory says that it should.

## Unique Facility

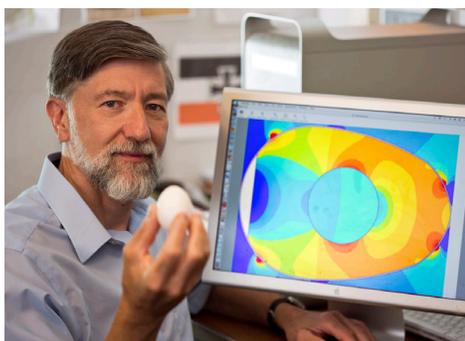
### A Powerful Spherical Tokamak



Using powerful magnetic fields to confine a plasma hotter than the core of the sun, the National Spherical Torus Experiment-Upgrade (NSTX-U) is more compact than a typical tokamak device and studies whether this configuration can lead to a smaller, cheaper, and more efficient nuclear fusion energy power plant. When operational, fusion will be a safe, clean and abundant source of energy to generate electricity for humankind. An extensive upgrade to the original NSTX device doubles the heating power, magnetic field strength and plasma current of its predecessor and will narrow or close critical gaps on the path to fusion energy. When running at full strength, experiments on NSTX-U will provide key information for the next major steps in the U.S. fusion program.

## Technology to Market Highlight

### Pasteurizing eggs in the shell with radio frequency waves



PPPL has long used radio frequency waves to help heat the plasma that fuels fusion reactions. The Laboratory has now applied that knowledge to pasteurizing eggs in the shell in a patented process developed in collaboration with the U.S. Department of Agriculture. The invention uses RF energy to transmit heat into the yolk while the egg rotates. Streams of cool water simultaneously flow over the egg to protect the delicate white. Researchers then bathe the egg in hot water to complete the pasteurization process. The USDA estimates that pasteurizing all U.S.-produced shell eggs could reduce the number of egg-borne salmonella illnesses by up to 85 percent, or more than 110,000 cases a year.