PPPL

PRINCETON
PLASMA PHYSICS
LABORATORY

U.S. DEPARTMENT OF
ENERGY

FUELING THE FUTURE

www.pppl.gov

Welcome to the Future of FUSION ENERGY!

The U.S. Department of Energy's Princeton Plasma Physics Laboratory (PPPL) is a collaborative national center for plasma and fusion science. Its primary mission is to develop the scientific understanding and the key innovations which will lead to an attractive fusion energy source. Associated missions include conducting world-class research along the broad frontier of plasma science and technology, and providing the highest quality of scientific education.

Princeton University manages PPPL under contract with the United States Department of Energy. The Laboratory is sited on 88 acres of Princeton University's James Forrestal Campus, about four miles northeast of the main campus.

Through its efforts to build and operate magnetic fusion devices, PPPL has gained extensive capabilities in a host of disciplines including advanced computational simulations, vacuum technology, mechanics, materials science, electronics, computer technology, and high-voltage power systems. In addition, PPPL scientists and engineers are applying knowledge gained in fusion research to other theoretical and experimental areas including the development of plasma thrusters and the propagation of intense beams of ions. The Laboratory's graduate education and science education programs provide educational opportunities for students and teachers from elementary school through postgraduate studies.

PPPL FACTS

FY2012 FUNDING:
$86 million†

Number of Employees: 454*

Faculty: 4

Physicists: 99

Engineers: 86

Technicians: 160

Administrators: 88

Clerical Support: 17

Graduate Students: 38

* *As of February 1, 2012*

† *Includes $9M of ITER Funds expected from ORNL*

Our History & Achievements

Magnetic fusion research at Princeton began in 1951 under the code name Project Matterhorn. Lyman Spitzer, Jr., professor of astronomy at Princeton University, for many years had been involved in the study of very hot rarefied gases in interstellar space.

Inspired by the fascinating but exaggerated claims of fusion researchers in Argentina, Professor Spitzer conceived of a plasma being confined in a figure-eight-shaped tube by an externally generated magnetic field. He called his concept "the stellarator," and took this design before the Atomic Energy Commission in Washington, D.C. As a result of this meeting and a review of the invention by designated scientists throughout the U.S., the stellarator proposal was funded and Princeton University's controlled fusion effort was born.

In 1958, magnetic fusion research was declassified, allowing all nations to share their results openly. The name of the project was changed to the Princeton Plasma Physics Laboratory in 1961.

PPPL's Research & Development Programs

The National Spherical Torus Experiment

The National Spherical Torus Experiment (NSTX) began operation in 1999. It is a major element in the U.S. Fusion Energy Sciences Program. It is designed to test the physics principles of spherical torus (ST) plasmas. NSTX produces a plasma that is shaped like a sphere with a hole through its center, different from the "donut" shape of the tokamak. The NSTX was designed and built jointly by PPPL, the Oak Ridge National Laboratory, Columbia University, and the University of Washington, Seattle. More information about the NSTX is available at: http://www.pppl.gov/nationalsphericaltorus.cfm.

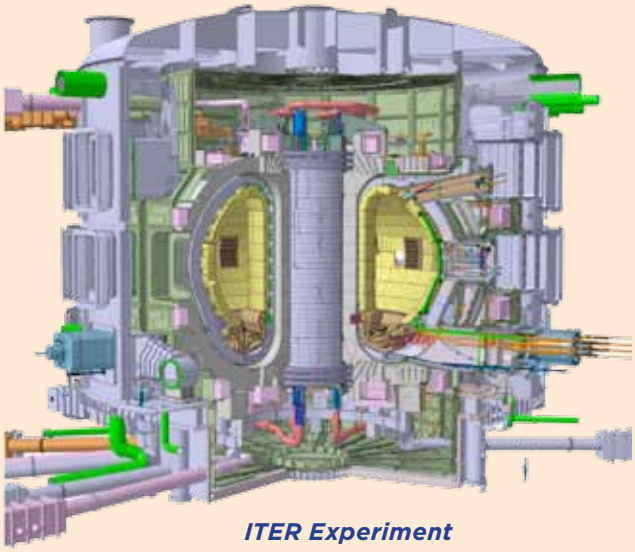
Inside the NSTX Experiment

Lithium Tokamak Experiment

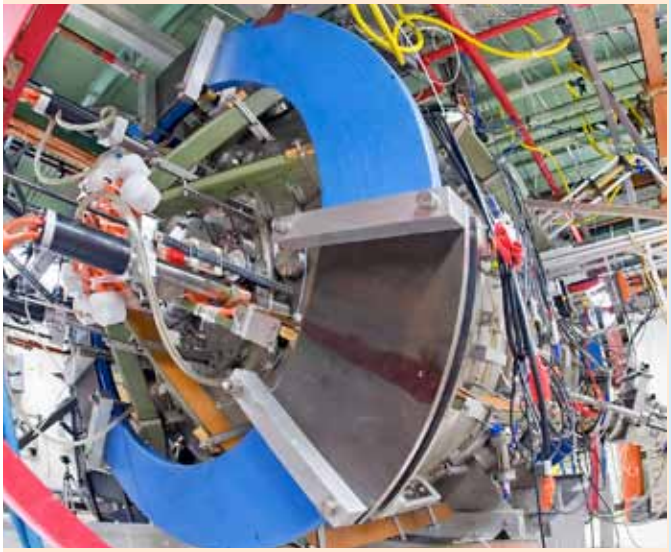
For the past several years, the Current Drive Experiment–Upgrade (CDX-U) has been devoted to investigations of plasma interactions with liquid lithium surfaces. Studies with plasmas in contact with a "pool" of liquid lithium have established that it has very desirable properties as a plasma-facing component in a tokamak. The CDX-U experiment has been rebuilt substantially and renamed the Lithium Tokamak Experiment (LTX). This device has a liquid lithium plasma-facing surface on a solid conducting shell that completely encloses the discharge. LTX produced its first plasma in September 2008. Additional information is available at: http://www.pppl.gov/lithiumtokamak.cfm .

Magnetic Reconnection Experiment (MRX)

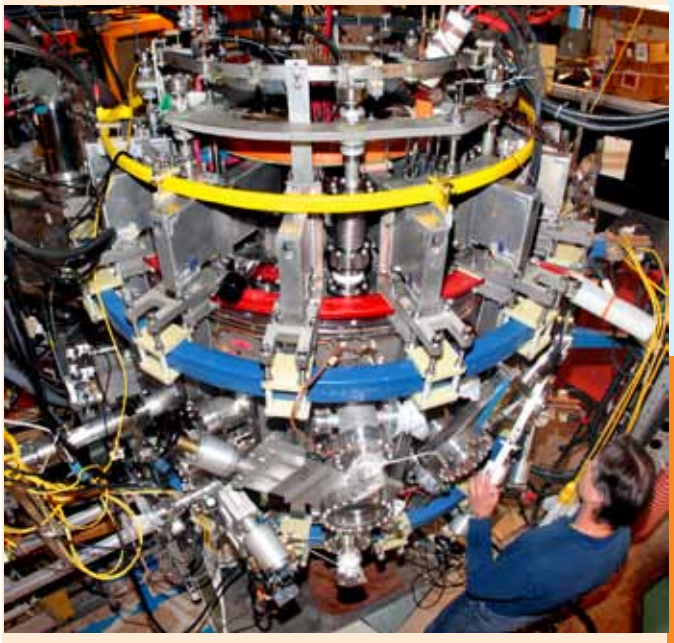
Scientists conducting research on PPPL's Magnetic Reconnection Experiment (MRX), are studying the physics of magnetic reconnection — the topological breaking and reconnection of magnetic field lines in plasmas. Scientists hope to understand the governing principles of this important plasma physics process and gain a basic understanding of how it affects plasma characteristics such as confinement and heating. The results of these experiments have relevance to solar physics, astrophysics, magnetospheric physics, and fusion energy research. The MRX is funded by the U.S. Department of Energy, the National Science Foundation, and the National Aeronautics and Space Administration. Detailed information is available at: http://mrx.pppl.gov .



ITER Experiment



Magnetic Reconnection Experiment (MRX)



Lithium Tokamak Experiment (LTX)

PPPL's Research & Development Programs

ITER

The study of burning plasmas has been identified as the next major step in the world fusion program. The worldwide community of fusion researchers has reached a consensus that the scientific and technological basis is sufficient to proceed to a burning plasma experiment — one in which the plasma is heated predominantly by alpha particles produced in deuterium-tritium fusion reactions. An unprecedented international collaboration of scientists and engineers has performed needed research and development and designed a burning plasma experiment called ITER, which in Latin means "the way." ITER will produce 500 million watts of fusion power, 10 times greater than the external power delivered to heat the plasma. The United States has joined the European Union, Japan, the Russian Federation, China, Korea, and India in the establishment of the ITER Joint Implementation Agreement. ITER will be built in Cadarache, France, with operation expected by 2020. Additional information can be found at http://www.iter.org.

Fusion Theory and Advanced Computing

The primary role of the PPPL Theory Department is to help the Fusion Energy Sciences Program achieve the scientific understanding of the physics of plasmas needed to establish toroidal magnetic confinement as an attractive, technically feasible reactor option. This involves leading the innovative development of improved calculation capabilities and the application of state-of-the-art theoretical and computational tools to the interpretation of experimental results. Realistic physics-based modeling capabilities accelerate breakthroughs in plasma performance by confidently identifying the most attractive designs for new facilities. Additional information on the PPPL Theory Department is located at: http://w3.pppl.gov/theory/ .

Off-site Research and Collaborations

The purpose of the PPPL Off-site Research Program (Collaborations) is to perform fusion science research at the most relevant facilities. PPPL scientists work with teams of colleagues at other laboratories, foreign and domestic, to carry out measurements, to assist in operation of devices, to loan equipment, and to develop databases. Off-site research presently includes efforts at the DIII-D and Alcator C-Mod tokamaks in the U.S., the Joint European Torus in England, the JT-60U and the Large Helical Device in Japan, and the W7X in Germany.

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The Princeton Plasma Physics Laboratory is operated by Princeton University under contract to the U.S. Department of Energy. For additional information, please contact: Office of Communications, Princeton Plasma Physics Laboratory, P.O. Box 451, Princeton, NJ 08543; Tel. (609) 243-2750; e-mail: pppl_info@pppl.gov or visit our web site at: www.pppl.gov.

Cover photo: The Lithium Tokamak Experiment (LTX)