FUSION ENERGY SCIENCES

Excellent Science Attractive Energy

Office of Fusion Energy Sciences

The Fusion Energy Sciences (FES) program is the national research effort to advance plasma science, fusion science, and fusion technology—the knowledge base needed for an economically and environmentally attractive fusion energy source.

RECENT SCIENTIFIC ACHIEVEMENTS

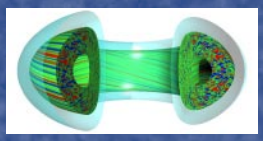
Improved Energy Confinement Demonstrated on DIII-D

Advances in the capability to measure fluctuations in plasma density and temperature have shown agreement between an observed reduction in energy loss and predictive codes.

Microwaves Drive a Million Amperes of Plasma Current in Alcator C-Mod

Nearly all of the plasma current in Alcator C-Mod was driven using electromagnetic waves, replacing the initial current driven by its central transformer – a critical capability for steady-state operation of tokamaks.

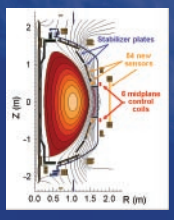
High-Resolution Tokamak Plasma Simulations



State-of-the-art magnetohydrodynamic codes being developed in the U.S. have substantially increased the realism of their simulations by increasing the resolution of their models, allowing the inclusion and study of physical processes previously neglected.

Improved Ion Temperature in the Madison Symmetric Torus (MST)

In MST, an innovative experiment at the University of Wisconsin-Madison, plasmas have recently been produced in which ions, as well as electrons, attain temperatures of about 10 million degrees using its programmable magnetic control system.



Stabilization of Resistive Wall Modes in the National Spherical Torus Experiment (NSTX)

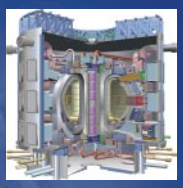
Using the feedback capability of the plasma control coils on NSTX, researchers made significant progress on stabilization of the resistive wall mode instability at plasma rotation speeds relevant to ITER.

Computer Simulations of High Gain for Inertial Fusion Energy (IFE)

Computer simulations at the University of Rochester show that with less expensive lasers for compressing the IFE fuel and a petawatt laser-produced electron beam for heating it, a fusion gain of > 60 can be achieved.

MAJOR USER FACILITIES

ITER (Latin for "the way") will be the first magnetic fusion experiment to produce more energy than it uses. There are seven international collaborators, including the U.S. The site for this project is Cadarache, France.



The **DIII-D** tokamak at General Atomics in San Diego, CA, is the largest magnetic fusion facility in the U.S., with considerable experimental flexibility and extensive diagnostics to measure the properties of high temperature plasmas.

NSTX (National Spherical Torus Experiment) at the Princeton Plasma Physics Laboratory produces a plasma configuration which may have several advantages over conventional tokamaks, including the potential for smaller, more economical fusion reactors.

Alcator C-Mod at MIT is the only tokamak in the world operating at ITER design magnetic field and plasma densities, and produces the highest pressure tokamak plasma in the world, approaching pressures expected in ITER.

NCSX (National Compact Stellarator Experiment), in construction at the Princeton Plasma Physics Laboratory, will be the centerpiece of the U.S. effort to determine the attractiveness of a compact helical magnetic configuration for a fusion reactor.