Think
Plasma

Plasma and Plasma Confinement

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THINK PLASMA, the state of matter that makes up over 99% of the universe.

Research in experimental and theoretical plasma physics at Utah State University (USU) is advancing our ability to confine thermonuclear, fusion plasmas in the laboratory. We are pursuing cutting edge research in the development of a hybrid electrostatic/magnetic scheme for confining dense, high-temperature plasmas for neutron and possibly energy production. At the same time, well-funded work in plasma theory and fluid computation is contributing to ongoing international efforts to make magnetic fusion an abundant, environmentally friendly energy source.

Did you know that . . .

- plasmas are not as exotic as you might think; well-known plasmas include the ionized gases in fluorescent and neon lights, the ionized air in the vicinity of a burning candle and the collection of protons and electrons that make up stars;
- often referred to as the fourth state of matter, plasma is a collection of negatively and positively charged particles that makes up over 99% of the matter in the universe;
- stars like our sun produce energy when protons traveling at high speeds overcome the force of electrostatic repulsion and fuse together to release large amounts of energy;
- fusion using the earth's supply of deuterium, present as 1 atom to 6700 hydrogen atoms in sea water, could fuel our energy needs for centuries to come;
- the screening of luggage in airports and the detection of landmines in war-torn countries may be made more effective through the use of small, fusion devices that produce large fluxes of neutrons,
- USU's hybrid electrostatic/magnetic confinement device may provide just such a neutron source for these and other important applications;
- the world's tokamak fusion community is constructing the International Thermonuclear Experimental Reactor (ITER) which will use deuterium and tritium to produce 300 MW of net fusion power; and
- research at USU is providing theoretical support for ITER through the development and use of the cutting-edge, plasma fluid code NIMROD?

Interested? If graduate research in experimental and theoretical plasma fusion physics sounds interesting, please take time to read the research descriptions that follow and then e-mail us (see last page). We look forward to hearing from you.

Ajay Singh: Following graduate study in experimental plasma physics at the Institute for Plasma Research, Dr. Singh became a professor at the University of Pune, India. While there, Ajay taught a variety of physics courses and advised many masters students working in laboratory plasma physics. In 2000, Dr. Singh began work as the principle experimentalist on the STOR-M tokamak at the University of Saskatchewan where his work focused on the measurement and diagnosis of edge turbulence in tokamak plasmas including the stabilizing influence of sheared plasma flow. In addition, Dr. Singh excelled as a teacher and research adviser at the University of Saskatchewan while also finding time to institute a program involving the synthesis of novel materials using plasmas. In 2006, Dr. Singh joined USU's physics research faculty as principle experimentalist involved in the construction of a novel hybrid electrostatic/magnetic plasma confinement device.

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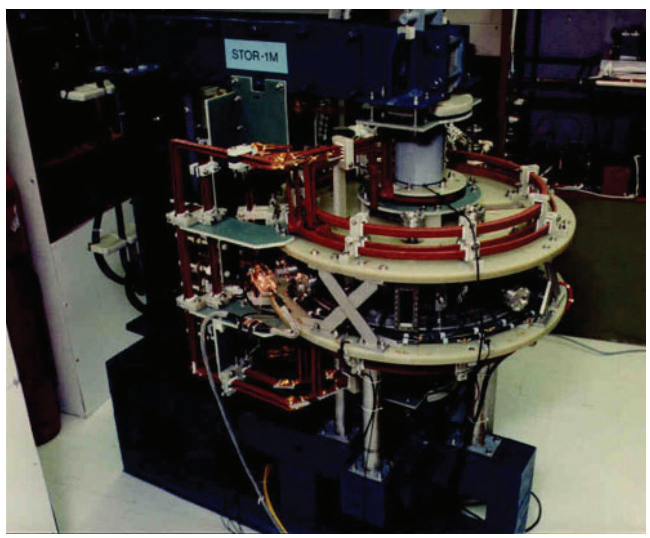
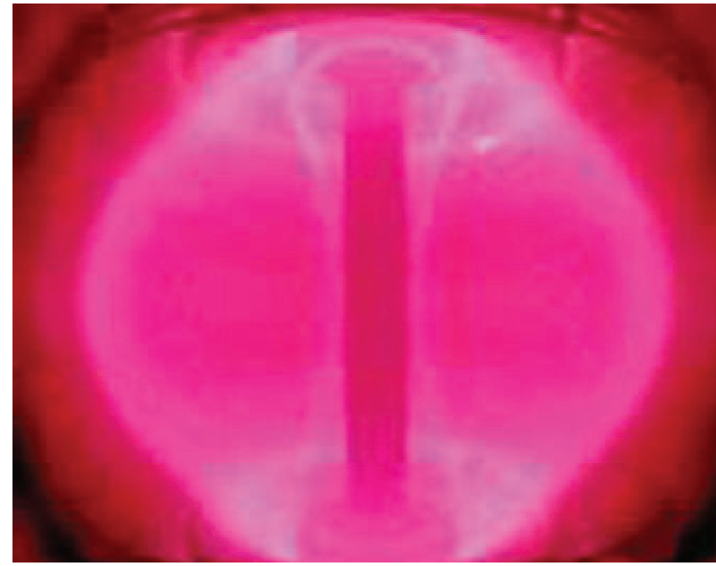
Farrell Edwards: Dr. Edwards has spent the duration of his post graduate career (CalTech–experimental nuclear physics) as a successful teacher and researcher in USU's Physics Department. As a testament to his refreshing approach to teaching physics, Farrell has received the Teacher of the Year Award for both the College of Science and the entire university. In addition, in his former role as department head, he was in part responsible for the formation of the Center for Atmospheric and Space Science (CASS). Dr. Edwards research interests include theoretical and experimental plasma physics and electromagnetism as well as fundamental physics topics such as the origin of inertia. Presently, Farrell is directing the construction of a hybrid electrostatic/magnetic plasma confinement device at the Plasma Physics Laboratory on USU's Innovation Campus. The construction of this device follows Dr. Edwards's derivation of a novel, non quasi-neutral, minimum energy state for confined plasmas. Equipment on loan from the University of Saskatchewan has accelerated construction and first plasma is expected in late 2006.





Eric Held: Following graduate study in plasma physics at the University of Wisconsin, Dr. Held did a brief stint in the Theoretical Division at Los Alamos National Laboratory before landing a physics faculty position at Utah State. Since that time, Eric has been active in assisting Dr. Edwards with his plans to develop a hybrid electrostatic/magnetic plasma confinement device. In addition, Dr. Held collaborates with a number of national magnetic fusion projects including the NIMROD Team, which is developing a state-of-the-art plasma fluid code, the Center for Extended Magnetohydrodynamic Modeling (CEMM) and the Plasma Science and Innovation Center (PSI-Center). From a theoretical standpoint, Dr. Held's contribution focuses on the rigorous derivation and implementation of parallel kinetic closures in plasma fluid codes such as NIMROD. Imparting kinetic physics to fluid models has become increasingly important as magnetic fusion experiments progress towards higher temperature, fusion-grade plasmas.