

methodology, and large scale data management and visualization. The development of new computer and computational science techniques will allow scientists to use the most advanced computers without being overwhelmed by the complexity of rewriting their codes with each new generation of high performance architectures.

(c) Network Environment Research

Research to develop and deploy high-performance network and collaborative technologies to support distributed high-end science applications and large-scale scientific collaborations. The current focus areas include but are not limited to ultra high-speed transport protocols, dynamic bandwidth allocation services, network measurement and analysis, cyber security systems, and advanced application layer services that make easy for scientists to effectively and efficiently access and use distributed resources, such as advanced services for group collaboration, secure services for remote access of distributed resources, and innovative technologies for sharing, controlling, and managing distributed computing resources. Program Contact: (301) 903-5800.

5. Fusion Energy Sciences

The Fusion Energy Sciences (FES) program supports the Department's Energy Security and World-Class Scientific Research Capacity goals. The FES program goal is to advance plasma science, fusion science, and fusion technology—the knowledge base needed for an economically and environmentally attractive fusion energy source. FES supports basic and applied research, encourages technical cross-fertilization with the broader U.S. science community, and uses international collaboration to accomplish this goal.

The FES program contributes to the Energy Security goal through participation in ITER, an experiment to study and demonstrate the sustained burning of fusion fuel. This proposed international collaboration will provide an unparalleled scientific research opportunity and will test the scientific and technical feasibility of fusion power; ITER is also the penultimate step before a demonstration fusion power plant. Assuming a successful outcome of ongoing ITER negotiations, in Fiscal Year 2005, FES scientists and engineers will be supporting the technical R&D and preparations to start project construction in Fiscal Year 2006.

The FES program contributes to the World-Class Scientific Research

Capacity goal by managing a program of fundamental research into the nature of fusion plasmas and the means for confining plasma to yield energy. This includes: (1) Exploring basic issues in plasma science; (2) developing the scientific basis and computational tools to predict the behavior of magnetically confined plasmas; (3) using the advances in tokamak research to enable the initiation of the burning plasma physics phase of the FES program; (4) exploring innovative confinement options that offer the potential of more attractive fusion energy sources in the long term; (5) developing the cutting edge technologies that enable fusion facilities to achieve their scientific goals; and (6) advancing the science base for innovative materials to establish the economic feasibility and environmental quality of fusion energy.

The overall effort requires operation of a set of unique and diversified experimental facilities, ranging from smaller-scale university programs to large national facilities that require extensive collaboration. These facilities provide scientists with the means to test and extend theoretical understanding and computer models—leading ultimately to an improved predictive capability for fusion science.

In Fiscal Year 2005, operation of fusion facilities will be increased to create greater opportunity for scientists to address the large backlog of proposed experiments, many of them relevant to ITER design and operation. Fabrication of the National Compact Stellarator will also continue with a target of Fiscal Year 2007, for the initial operation of this innovative new confinement system which is the product of advances in physics understanding and computer modeling. In addition, work will be initiated on the Fusion Simulation Project—a joint effort with the Office of Advanced Scientific Computing Research—to provide an integrated simulation and modeling capability for magnetic fusion energy confinement systems over a 15-year development period.

There will be three performance measures, for 10 years out, that will demonstrate that progress is being made towards meeting the overall program goal. These measures are:

1. Predictive Capability for Burning Plasmas: Develop a predictive capability for key aspects of burning plasmas using advances in theory and simulation benchmarked against a comprehensive experimental database of stability, transport, wave-particle interaction, and edge effects.

2. Configuration Optimization: Demonstrate enhanced fundamental

understanding of magnetic confinement and improved basis for future burning plasma experiments through research on magnetic confinement configuration optimization.

3. Inertial Fusion Energy and High Energy Density Physics: Develop the fundamental understanding and predictability of high energy density plasmas for potential energy applications.

Research Division

This Division is responsible for overseeing the Science and Technology subprograms as well as most of the facility operations subprogram (not including ITER) within the FES. The Science subprogram seeks to develop the physics knowledge base needed to advance the FES program. Research is conducted on medium to large-scale confinement devices to study physics issues relevant to fusion and plasma physics and to the production of fusion energy. Experiments on these devices are used to explore the limits of specific confinement concepts, as well as study associated physical phenomena.

Specific areas of interest include: (1) Reducing plasma energy and particle transport at high densities and temperatures; (2) understanding the physical laws governing stability of high pressure plasmas; (3) investigating plasma wave interactions; (4) studying and controlling impurity particle transport and exhaust in plasmas; and (5) understanding the interaction and coupling among these four issues in a fusion experiment.

Research is also carried out in the following areas: (1) Basic plasma science directed at furthering the understanding of fundamental processes in plasmas; (2) theory and modeling to provide the understanding of fusion plasmas necessary for interpreting results from present experiments, planning future experiments, and designing future confinement devices; (3) atomic physics and the development of new diagnostic techniques for support of confinement experiments; (4) innovative confinement concepts; and (5) high energy density physics and issues that support the development of Inertial Fusion Energy (IFE). The high energy density physics necessary for IFE target development is carried out by the Office of Defense Programs in the Department of Energy's National Nuclear Security Agency.

The Technology subprogram supports the advancement of fusion science in the nearer-term by carrying out research on technological topics that: (1) Enable domestic experiments to achieve their full performance potential and scientific