U.S. DEPARTMENT OF ENERGY
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FES SciDAC-3 Project Introductions

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FES Mission & Strategic Goals

Mission

The mission of the Fusion Energy Sciences (FES) program is to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundations needed to develop a fusion energy source. This is accomplished by studying plasmas under a wide range of temperature and density conditions, developing advanced diagnostics to make detailed measurements of plasma properties, and creating theoretical and computational models to resolve the essential physics ideas and principles.

Strategic Goals

- Advance the fundamental science of magnetically confined plasmas to develop the predictive capability needed for a sustainable fusion energy source.
- Support the development of the scientific understanding required to design and deploy the materials needed to support a burning plasma environment
- Pursue scientific opportunities and grand challenges in high energy density plasma science to explore the feasibility of the inertial confinement approach as a fusion energy source, to better understand our universe, and to enhance national security and economic competitiveness.
- Increase the fundamental understanding of basic plasma science, including both burning plasma and low temperature plasma science and engineering, to enhance economic competiveness and to create opportunities for a broader range of science-based applications.

FES & SciDAC

- FES has been an enthusiastic participant in SciDAC since its inception, reflecting the important role that high-performance computing has played in fusion research since the early days of the fusion program
- The plasma science of magnetic confinement is characterized by multiphysics, multiscale problems with strong anisotropies and nonlinearities, in complex geometries and magnetic topologies; simulations on leadership class computing resources have strong potential to advance the FES mission
- Similar challenges exist in materials science; advanced simulations can help bridge the gap from the existing parameter space to the fusion energy regime
- Partnerships between fusion scientists and computational scientists have been very productive, accelerating the rate of scientific discovery in fusion plasma science
- FES has significant investments in the SciDAC program
  - In addition to the new SciDAC-3 projects, five other “out of cycle” SciDAC Centers are also supported

FES SciDAC-3 Projects

- Center for Edge Physics Simulation (EPSI) – CS Chang (PPPL)
  - Apply first-principles simulation codes to address the multiphysics and multiscale challenges of the plasma edge region in magnetically confined plasmas → *important for ITER and burning plasmas*
- Plasma Surface Interactions: Bridging from the Surface to the Micron Frontier through Leadership Class Computing – Brian Wirth (ORNL & UTK)
  - "Develop and deploy validated, high-performance simulation tools capable of predicting the performance of tungsten-based plasma facing components in a burning fusion plasma environment" → *important for ITER and beyond*