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Fusion Energy Sciences Introduction

Presented at the 2014 SciDAC PI Meeting

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Office of Science

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FES Mission & Strategic Goals

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

FES 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

Current focus of FES SciDAC program

Advanced simulations important for meeting strategic goals

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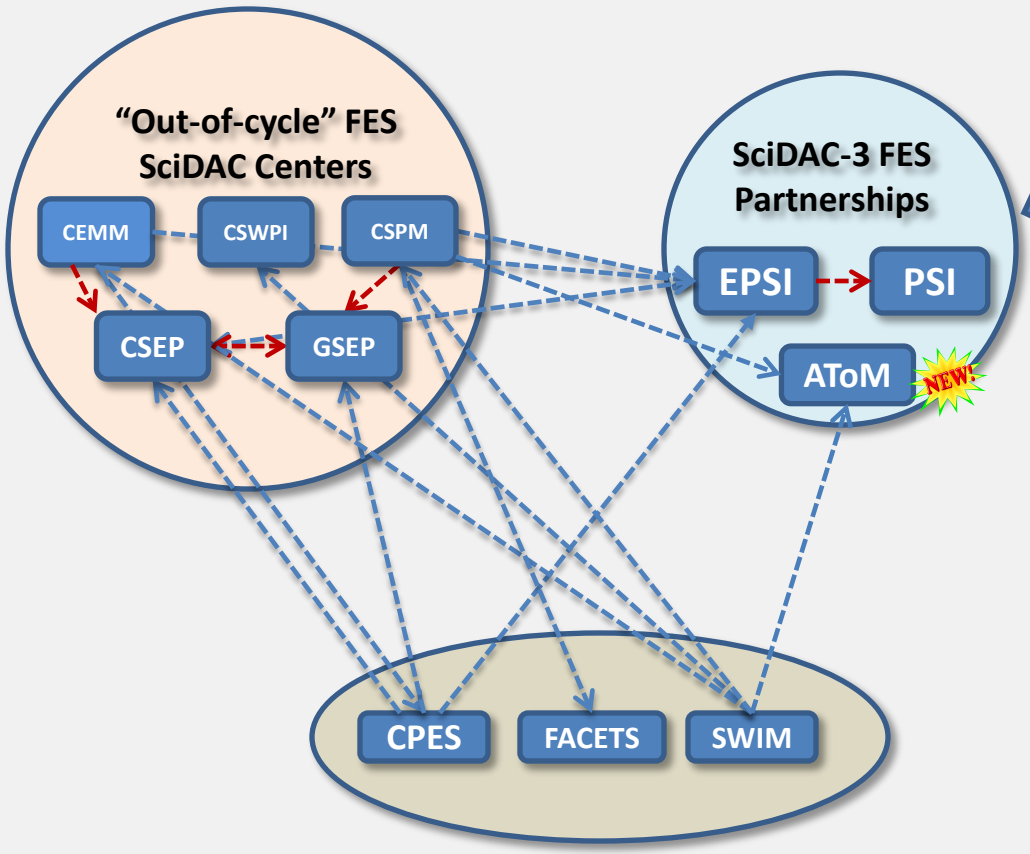
The FES SciDAC Portfolio



SciDAC-3 Institutes:
FastMATH, QUEST, SUPER & SDAV

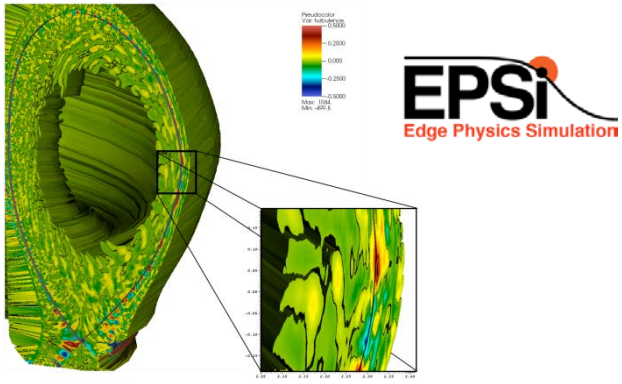
SciDAC-3
EPSI: *Edge Physics Simulation*
PSI: *Plasma Surface Interactions*
AToM: *Advanced Tokamak Modeling*

CEMM: *Center for Extended MHD Modeling*
CSWPI: *Center for Simulation of Wave-Plasma Interactions*
CSPM: *Center for the Study of Plasma Microturbulence*
CSEP: *Center for Simulation of Energetic Particles*
GSEP: *Center for Gyrokinetic Simulation of Energetic Particles*
CPES: *Center for Plasma Edge Simulation*
FACETS: *Framework Application for Core-Edge Transport Simulations*
SWIM: *Simulation of Wave Interactions with MHD*

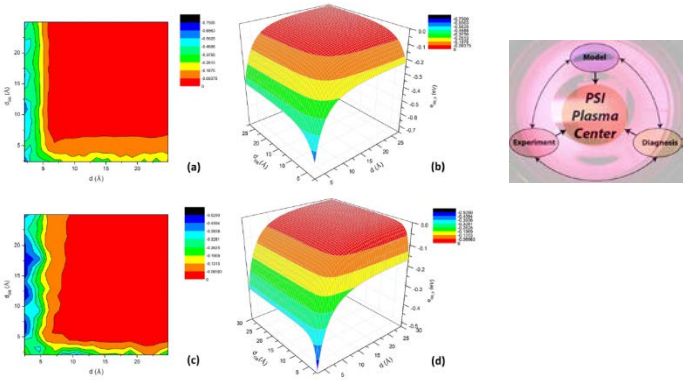
Continuing Projects

- The two ongoing FES SciDAC-3 projects continue to make progress addressing issues of importance to burning plasmas and ITER:

  - The Center for Edge Physics Simulation (EPSI) focuses on the physics of the plasma edge, a region critical for the performance of tokamak plasmas



  - The Plasma Surface Interactions (PSI) Center focuses on the plasma-material interaction challenge, which is among the most critical issues in fusion research

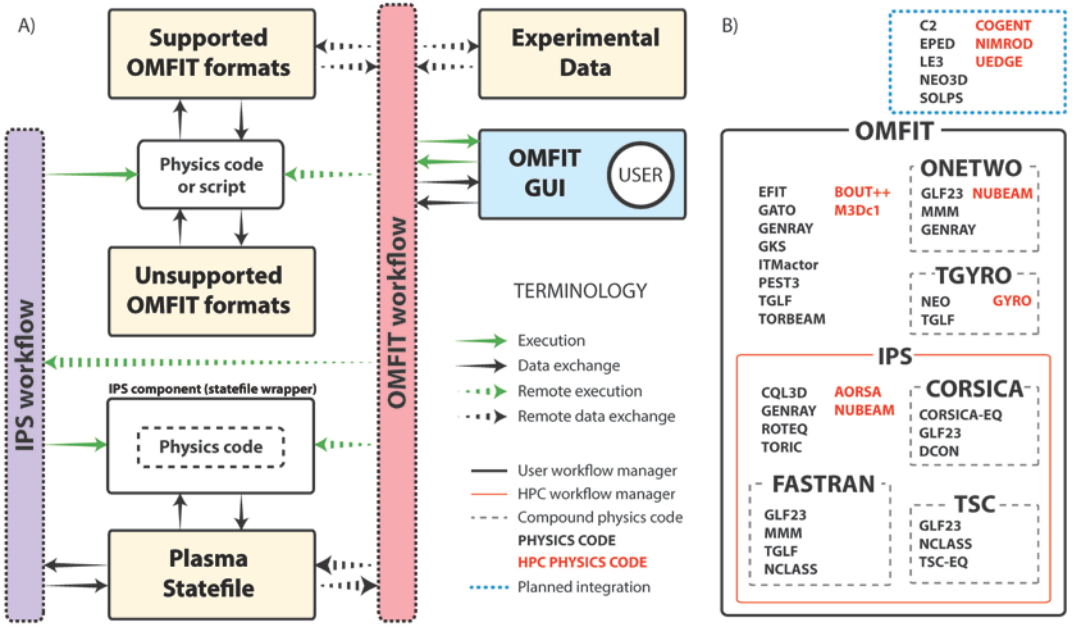


New Project in Integrated Modeling

- The additional funding in the FY 2014 appropriation allowed FES and ASCR to launch a third partnership in multiscale integrated modeling
  - A Funding Opportunity Announcement (FOA) and companion Lab Notice were issued in early March; proposals were submitted by May 2
  - Topic was included in original SciDAC-3 competition, but no award was made in due to budget constraints
  - A first step toward Whole Device Modeling (WDM), which is a long-term goal of fusion simulations
  - The Advanced Tokamak Modeling (AToM) project was selected for a three-year award
    - Led by General Atomics (PI: Jeff Candy) with participation from LLNL, ORNL, and the University of California, San Diego (UCSD)
    - Partnerships with FASTMath and SUPER SciDAC Institutes

AToM

- The goal of the AToM project is to enhance and extend US capability to predict and optimize the performance of magnetic fusion energy systems, via a program of integrated simulation and modeling.
- A number of computational tools, including a workflow manager (OMFIT), computational framework (IPS), and high performance simulation codes (GYRO/TGYRO, COGENT), along with the research products and expertise of the FASTMath and SUPER SciDAC institutes, will together enable simulations of complex plasma behavior, and extensive validation against experimental data.



- Will enable advanced integrated simulations which couple core, pedestal and scrape-off-layer physics, in order to study important interactions between regions of the plasma, and improve capability to predict, and further optimize, performance of the fusion plasma