

U.S. Fusion Energy Sciences Program

Presented to the

Fusion Energy Sciences Advisory Committee

By

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Budget Schedule

- o President **addresses** Congress tonight
- o “**Blueprint**” budget **issued tomorrow**
- o OMB hearings?
- o **Detailed budget** issued **April 3**

The NSF/DOE Partnership in Basic Plasma Science and Engineering

- o The **partnership grew** out of the **restructuring of the fusion energy program** and the **initiation of a general plasma science program** within OFES
 - Five year memo of understanding signed in late 1996
 - Major announcements of opportunity in FY 1997 and FY 2000
 - In “off” years, NSF and DOE jointly review basic plasma science proposals submitted to NSF Physics and other Divisions
 - Since 1997, almost 500 proposals have been, or are being, reviewed under the partnership
 - OFES total funds in this time (through FY 2000) more than \$16M
 - OFES has funded or jointly funded with NSF more than 50 proposals
 - Negotiations to renew the Partnership will begin this summer
 - Joint funding of plasma science centers will be a part of the discussions

Scientific Discovery for Advanced Computing

- o OFES planning to **establish topical centers** in **3 of the following areas**:
 - Turbulence and transport
 - Macroscopic equilibrium and stability
 - Magnetic reconnection
 - Electromagnetic wave/particle
 - Boundary layer effects in plasmas
 - Electromagnetic fields and beam dynamics in particle accelerators

- o Topical centers to be **selected using a comparative peer review process**
 - Fusion Energy Sciences Notice published January 3, 2001
 - 20 preapplications/preproposals received on or before January 31
 - 14 encouraged to submit full applications/proposals by March 15
 - Peer reviews to be completed by the end of April

- o Planned funding **~\$3 million per year**

SciDAC Evaluation Criteria

- o **Application Proposals** will be **evaluated against** our **standard criteria**:
 1. Scientific and/or technical merit of the project;
 2. Appropriateness of the proposed method or approach;
 3. Competency of the applicant's personnel and adequacy of the proposed resources; and
 4. Reasonableness and appropriateness of the proposed budget

- o In addition, **Scientific and Technical Merit**, **will include**
 - The importance of the proposed project to the mission of the Office of Fusion energy Sciences;
 - The potential of the proposed project to advance the state-of-the-art in computational modeling and simulation of plasma behavior;
 - The need for extraordinary computing resources to address problems of critical scientific importance to the fusion program and demonstrated abilities of the applicants to use terascale computers; and
 - The likelihood that the models, algorithms, and methods, that result from this effort will have impact on science disciplines outside of fusion research

SciDAC Evaluation Criteria (continued)

- o Appropriateness of Proposed Method or Approach, will also consider:
 - Quality of the plan for **effective collaboration** among members of the center;
 - Quality of plan for **ensuring communication** with other advanced computation efforts;
 - Viability of plan for **verifying** and **validating the models developed**, including close coupling with experiments for ultimate validation; and
 - Quality and clarity of **proposed work schedule** and **deliverables**.
- o Further, it is expected that the **ultimate product** of a **topical center** will be a **single, sophisticated code** or, if dictated by the complexity of the physical system being modeled, a **fully integrated set of codes**

Progress Toward an Effective ITPA (International Tokamak Physics Activity)

- o ITPA Objective: **cooperation in development of physics basis of burning tokamak plasmas**
 - Includes databases, modeling, analysis and workshops
 - Provides access to all relevant databases, including ITER, for all participants
- o Reflects common desire to **work together**: US, JA, EU, RF
 - On basis broader than ITER
 - On more effective basis than last two years' International Preparatory Meetings
- o Arrangement will **use existing mechanisms**
 - Legal formalities based on bilateral agreements
 - Coordinating Committee: US Members-Oktay, Sauthoff, Stambaugh
 - Seven Topical Science Groups: US Members to be identified from labs/universities
 - Endorsed by IAEA-IFRC (10/00 position paper was ITPA basis) and IEA-FPCC
- o Next Steps:
 - **Complete formal discussions** with RF
 - Seek **FESAC endorsement**

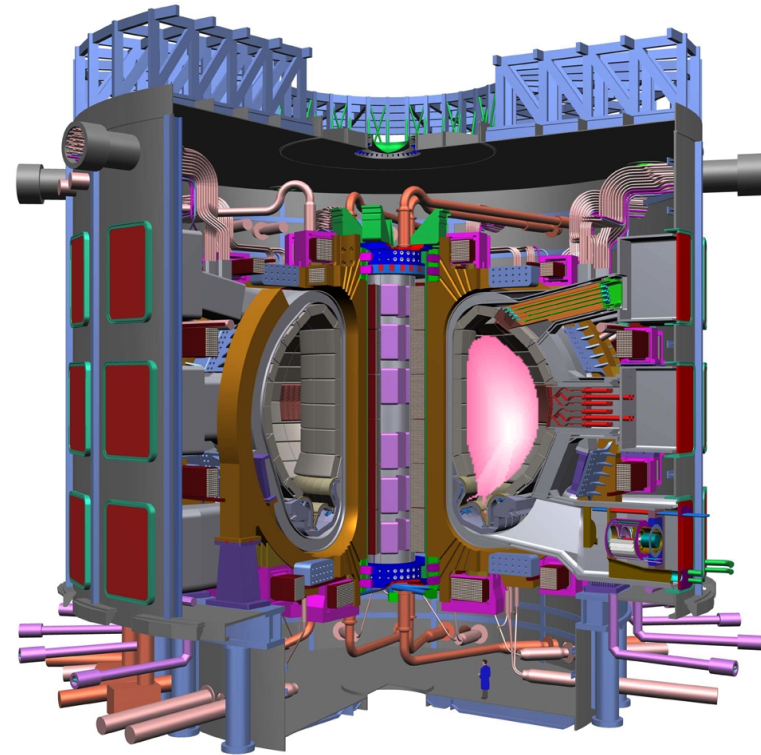
Physic Topical Areas for the ITPA

- o Confinement Database
- o Transport Physics
- o Pedestal Physics
- o Diverter Physics
- o Diagnostics
- o MHD
- o Heating, Current Drive and Energetic Particles

ITER Update

Merging of Fusion Science and Fusion Energy

- o ITER Parties (EU, JA and RF) are completing design for reduced cost and technical objectives
 - ITER would be first burning plasma physics device
- o Parties in Exploration now, preparing ideas on ITER Legal Entity and readying site offers
- o Parties want return of the U.S.
- o Please visit ITER Web Site www.iter.org
- o IEA Implementing Agreements could be supportive



Fusion Power: 500MW
Burn Pulse: 400-3600 sec

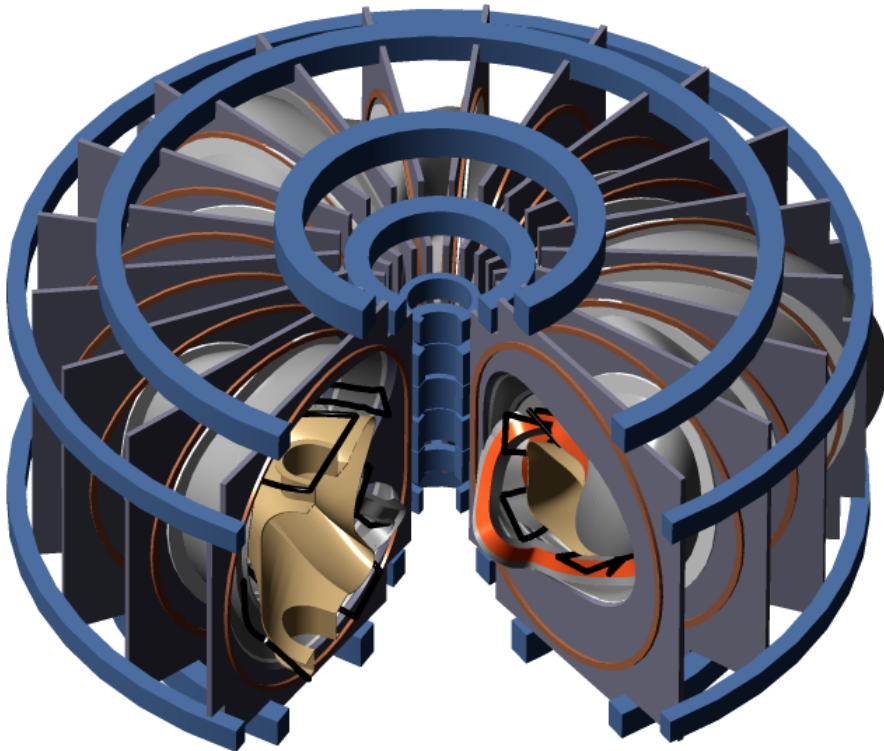
Compact Stellarator (CS) Program

- o FESAC Priorities and Balance Review in 1999 concluded:
 - o “The CS is not ready at this time for Proof of Principle (PoP) designation because of one important technical concern (“robustness”) about the National Compact Stellarator Experiment (NCSX). The FESAC subpanel believes that this concern will be addressed in the near future. The subpanel also believes that in the long run the NCSX promises a high probability of achieving success.”
 - o The subpanel on PoPs also recommended that other parts of the Compact Stellarator PoP Program, such as the Auburn Compact Toroidal Hybrid (CTH) and the Quasi-Omnigenous Stellarator (QOS) effort led by ORNL should be evaluated through the normal Concept Exploration (CE) review Process

Compact Stellarator (CS) Program (continued)

- o Current Status
 - **NCSX Physics Validation Review** (PVR) is scheduled for March 26-28
 - **FESAC Subpanel** will **participate** in the **PVR** and report to FESAC on “robustness” at the May meeting
 - **Project Validation Review** for NCSX is **scheduled for late spring** if peer review is successful and “robustness” issue is resolved
 - QOS review as a **CE proposal** scheduled for April 24
 - Auburn’s Compact Toroidal Hybrid experiment **was approved** last summer and is now **under construction**

Compact Stellarators will Test Many Aspects of Fusion Science



- o Macroscopic Stability:
 - **When and why no disruptions?**
Why is $\beta > \text{theory}$?
High β , 3-D stability to kink, ballooning, neoclassical tearing, vertical displacement.
- o Microturbulence and Transport:
 - **Is quasi-symmetry effective at high Ti?**
Challenge Er shear understanding via ripple control.
High Ti, flexible coil system
- o Wave-particle Interactions:
 - **Do we understand 3-D fast ion resonances, *AE modes in 3-D?**
Good fast ion confinement
- o Plasma-boundary interaction:
 - **Effects of magnetic stochasticity.**
High power, flexible coil system

Auburn U., Columbia U., LLNL, NYU, ORNL, PPPL, U. Texas, UCSD, U. Wisconsin
Australia, Japan, Germany, Russia, Switzerland

Background

Compact Stellarator (CS) Program Design Effort

- o Began in 1998
- o Collaboration among PPPL, ORNL, Auburn, Columbia, UCSD, LLNL, NYUU, U of Texas, U of Wisconsin, Austria, Germany, Switzerland, Russia, Japan, Australia, Spain
- o Motivations
 - Obtain attractive stellarator features--steady state, less susceptible to disruptions--in compact geometry
 - Investigate toroidal transport in controlled environment
 - Study rotational transform produced by both plasma current (tokamak) and external coils (pure stellarator)
 - Increase participation in the International Stellarator Program