Status Report
FESAC Panel on Priorities

For further information, please access FESAC Priorities Panel website at:

http://www.mfescience.org/fesac/index.html

FESAC Charge on Priorities
from Dr. Ray Orbach

- **focus the program in a more complete and fundamental way than we have done before.**
- **Identify the major science and technology, ….recommend how to organize campaigns to address those issues, and recommend the priority order for these campaigns.**
- **take account of fusion programs abroad and that includes ITER as an integrated part of the whole.**
- **Assume that funding for ITER construction is provided in addition to (base program) funds.**
- **Include Inertial Fusion and relevant aspects of High Energy Density Physics…**
- **Look at the program through 2014, the year ITER operation is expected to begin.**

FESAC Program Priorities Panel

Chair: **Charles Baker, *University of California, San Diego***
Vice-Chair: **Stewart Prager, *University of Wisconsin at Madison***

Mohamed Abdou
University of California, Los Angeles

Lee Berry
Oak Ridge National Laboratory

Riccardo Betti
University of Rochester

Vincent Chan
General Atomics

Darren Craig
University of Wisconsin at Madison

Jill Dahlburg
Naval Research Laboratory

Ronald Davidson
Princeton Plasma Physics Laboratory

James Drake
University of Maryland

Rich Hawryluk
Princeton Plasma Physics Laboratory

David Hill
Lawrence Livermore National Laboratory

Amanda Hubbard
Massachusetts Institute of Technology

Grant Logan
Lawrence Berkeley National Laboratory

Earl Marmar
Massachusetts Institute of Technology

Michael Mauel
Columbia University

Kathryn McCarthy
Idaho Nat'l Eng. & Environmental Laboratory

Scott Parker
University of Colorado at Boulder

Ned Sauthoff
Princeton Plasma Physics Laboratory

Ronald Stambaugh
General Atomics

Michael Ulrickson
Sandia National Laboratories

James Van Dam
University of Texas at Austin

Glen Wurden
Los Alamos National Laboratory

Michael Zarnstorff
Princeton Plasma Physics Laboratory

Steven Zinkle
Oak Ridge National Laboratory

Panel Work Plan

- **Step 1 -** **Develop overarching themes, topical scientific and technical questions, and decision criteria.**
  Initial step completed— community feedback received.

- **Step 2 -** **Develop research approach/thrusts for each question .**
  Underway. Six working groups established.
  First drafts done.
  Next meetings of the panel: June 17-19

Interim Report—July, 2004

- **Step 3 -** **Develop campaigns and priorities**
  Panel discussing basic approach and process.
  Interact with community

Final Report—December, 2004

Overarching Themes

01. Understand the dynamics of matter and fields in the high-temperature plasma state.

02. Create and understand a controlled, self-heated, burning starfire on earth.

03. Make fusion power practical.

Topical Questions

Theme: Macroscopic Plasma Behavior

T1. How does magnetic field structure affect plasma confinement?

T2. What limits the maximum pressure that can be achieved in laboratory plasmas?

T3. How much external control versus self-organization will a fusion plasma require?

Theme: Multi-scale Transport Behavior

T4. How does turbulence cause heat, particles, and momentum to escape from plasmas?

T5. How are large-scale electromagnetic fields and mass flows generated in plasmas?

T6. How do magnetic fields in plasmas rearrange and dissipate their energy?

Theme: High-energy Density Implosion Physics

T7. How can high energy density fusion plasmas be assembled and ignited in the laboratory?

T8. How do hydrodynamic plasma instabilities affect implosions to high energy density?

Topical Questions (cont'd)

Theme: Plasma Boundary Interfaces

T9. How can we interface a 100 million degree burning plasma to its room temperature surroundings?

Theme: Waves and Energetic Particles

T10. How can heavy ion beams be compressed to the high intensities required for creating high energy density matter?

T11. How do electromagnetic waves interact with plasma?

T12. How do high energy particles interact with plasma?

Theme: Fusion Engineering Science

T13. How does the challenging fusion environment affect plasma chamber systems?

T14. What are the ultimate limits for materials in the harsh fusion environment?

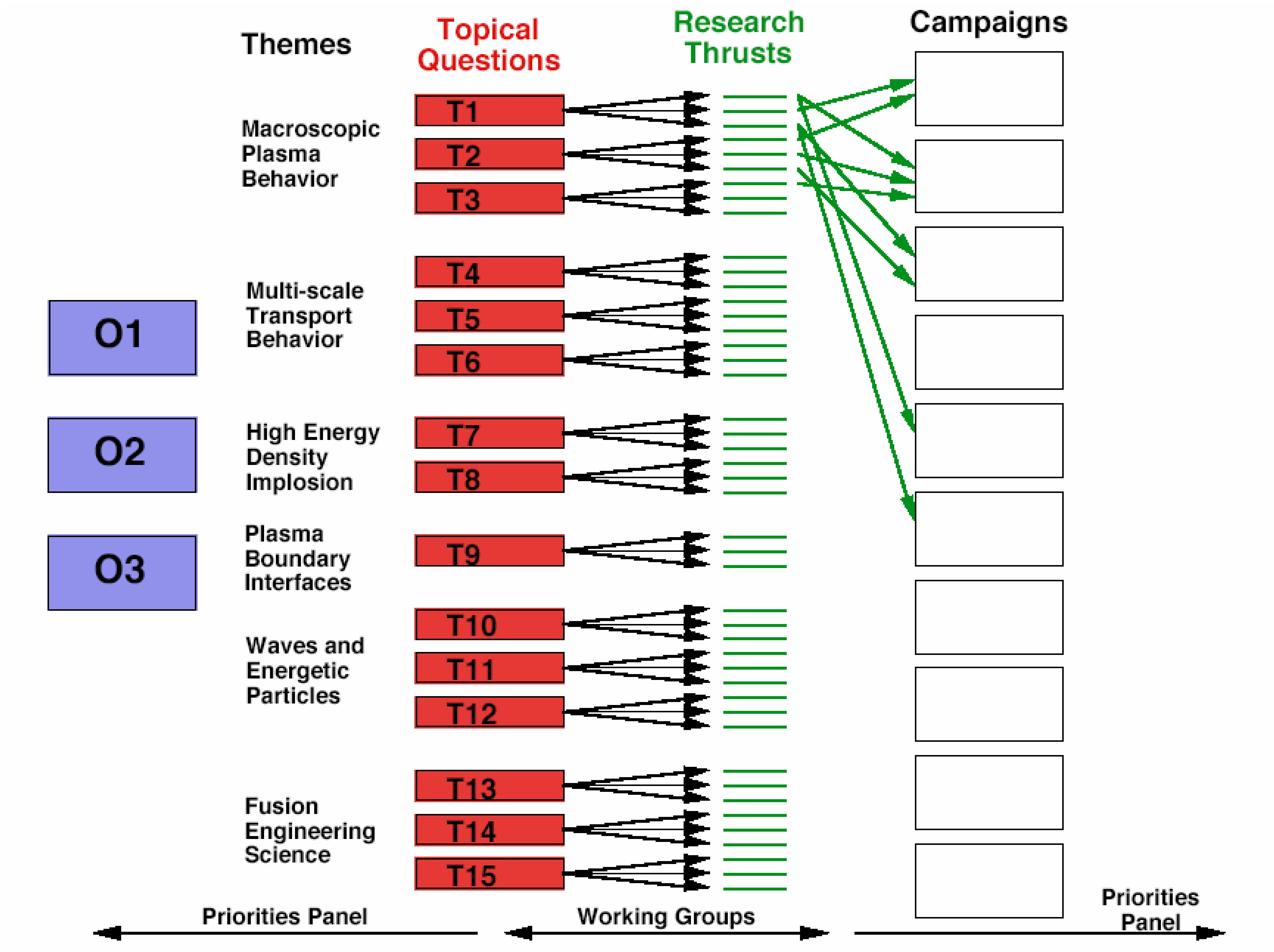
T15. How can systems be engineered to heat, fuel, pump and confine steady-state or repetitively pulsed burning plasmas?

Present Activity

- Research approaches formulated by working groups
- Assessed at June 17 - 19 panel meeting

FESAC Priorities Panel - Working Group Chairs & Co-Chair

Working Group	Candidate Chairs / Vice Chairs	Email Addresses
Macroscopic Plasma Behavior	J. Navratil (C)/ M. Zarnstorff (VC)	navratil@columbia.edu zarnstorff@pppl.gov
Multi-scale Transport Behavior	P. Terry (C)/ E. Marmar (VC)	pwterry@wisc.edu marmar@psfc.mit.edu
High-energy Density Implosion Physics	M. Tabak (C) R. Betti (VC)	tabak1@llnl.gov betti@lle.rochester.edu
Plasma Boundary Interfaces	S. Allen (C) M. Ulrickson (VC)	allens@fusion.gat.com maulric@sandia.gov
Waves and Energetic Particles	E. Valeo (C) G. Logan (VC)	evaleo@pppl.gov BGLogan@lbl.gov
Fusion Engineering Science	Group A (Materials and Chamber Technology) M. Abdou (Co-C) S. Zinkle (Co-C)	 abdou@fusion.ucla.edu zinklesj@ornl.gov



Themes
Topical Questions
Research Thrusts
Campaigns
Macroscopic Plasma Behavior
Multi-scale Transport Behavior
High Energy Density Implosion
Plasma Boundary Interfaces
Waves and Energetic Particles
Fusion Engineering Science
O1
O2
O3
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
Priorities Panel
Working Groups
Priorities Panel

The Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas (CMSO)

An NSF Physics Frontier Center,

established in partnership with DOE

Purpose:

To understand major plasma physics problems critical to laboratory and astrophysical plasmas

Unites

Laboratory and astrophysical scientists

Experiments, theory, and computation

- Initiated Sept, 04
- Funded for five years

Physics Topics

- Dynamo
- Magnetic reconnection
- Angular momentum transport
- Ion heating
- Magnetic chaos and transport
- Magnetic helicity conservation and transport

Spans plasma phenomena in solar wind, sun, accretion disks, galactic clusters…

Center Members

- 24 initial members, 6 institutions (plus some 20 postdocs and students)
- Equal amounts of lab physicists and astrophysicists
- Experimenters, theorists, computational physicists

Institutions

The University of Wisconsin
Princeton University
The University of Chicago
Science Applications International Corp
Swarthmore College
Lawrence Livermore National Laboratory

Includes experiments:
MST (UW), MRX (PPPL), SSX (Swarthmore), SSPX (LLNL)

Core Center Tasks

1. Compare astrophysical and lab phenomena

2. Compare results from different experiments

3. Perform joint experiments and develop joint diagnostics

4. Apply theoretical and computational tools developed in one venue to other situations

Hopefully generate new ideas for astrophysical phenomena

Relation to DOE MST Work

- Strongly complementary and cross-fertilizing
- Enhances progress in fusion goals
- Enlarges scientific impact of MST results
- Great fusion outreach

The Center is a partnership between NSF and OFES

- Overlapping scientific goals
- OFES supports all facilities, prior code development