

**PLANS FOR  
FUSION ENERGY SCIENCES SUMMER STUDY 2002**

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American Physical Society - Division of Plasma Physics  
2001 Annual Meeting, Long Beach, CA  
29 October - 2 November 2001



The Fusion Summer Study 2002 will be a forum for the critical assessment of major next-steps in the fusion energy sciences program, and will provide crucial community input to the long range planning activities undertaken by the DOE and the FESAC. It will be an ideal place for a broad community of scientists to examine goals and proposed initiatives in burning plasma science in magnetic fusion energy and integrated research experiments in inertial fusion energy.

This meeting is open to every member of the fusion energy science community and significant international participation is encouraged.



### **Objectives of the Fusion Summer Study:**

- 1) Review scientific issues in burning plasmas to establish the basis for the following two objectives. Address the relation of burning plasma in tokamaks to innovative MFE confinement concepts and of ignition in IFE to integrated research facilities.
- 2) Provide a forum for critical discussion and review of proposed MFE burning plasma experiments (e.g. IGNITOR, FIRE, and ITER) and assess the scientific and technological research opportunities and prospective benefits of these approaches to the study of burning plasmas.
- 3) Provide a forum for the IFE community to present plans for prospective integrated research facilities, assess present status of the technical base for each, and establish a timetable and technical progress necessary to proceed for each.



### **Background:**

The 2002 Summer Study will build on earlier planning activity at the 1999 Fusion Summer Study and the scientific assessments at the UFA sponsored Burning Plasma Science Workshops (Austin, Dec 2000; San Diego, May 2001). The scientific views of the participants developed during the 2002 Summer Study preparation activities and during the 2002 Summer Study itself, will provide critical fusion community input to the decision process of FESAC and DOE in 2002-2003, and to the review of burning plasma science by the National Academy of Sciences called for by FESAC and Energy Legislation which was passed by the House of Representatives [H. R. 4].

### **Output of the Fusion Summer Study:**

An executive summary based on summary reports from each of the working groups will be prepared as well as a comprehensive proceedings of plenary and contributed presentations.

# PLAN PRESCRIBED IN HR4

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a) PLAN FOR UNITED STATES FUSION EXPERIMENT- The Secretary, on the basis of full consultation with the Fusion Energy Sciences Advisory Committee and the Secretary of Energy Advisory Board, as appropriate, shall develop a plan for United States construction of a magnetic fusion burning plasma experiment for the purpose of accelerating scientific understanding of fusion plasmas. The Secretary shall request a review of the plan by the National Academy of Sciences, and shall transmit the plan and the review to the Congress by July 1, 2004.

(b) REQUIREMENTS OF PLAN- The plan described in subsection (a) shall--

(1) address key burning plasma physics issues; and

(2) include specific information on the scientific capabilities of the proposed experiment, the relevance of these capabilities to the goal of practical fusion energy, and the overall design of the experiment including its estimated cost and potential construction sites.

(c) UNITED STATES PARTICIPATION IN AN INTERNATIONAL EXPERIMENT- In addition to the plan described in subsection (a), the Secretary, on the basis of full consultation with the Fusion Energy Sciences Advisory Committee and the Secretary of Energy Advisory Board, as appropriate, may also develop a plan for United States participation in an international burning plasma experiment for the same purpose, whose construction is found by the Secretary to be highly likely and where United States participation is cost effective relative to the cost and scientific benefits of a domestic experiment described in subsection (a). If the Secretary elects to develop a plan under this subsection, he shall include the information described in subsection (b), and an estimate of the cost of United States participation in such an international experiment. The Secretary shall request a review by the National Academies of Sciences and Engineering of a plan developed under this subsection, and shall transmit the plan and the review to the Congress not later than July 1, 2004.

# FESAC BP REPORT RECOMMENDATION 3

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The U.S. Fusion Energy Sciences Program should establish a proactive U.S. plan on burning plasma experiments and should not assume a default position of waiting to see what the international community may or may not do regarding the construction of a burning plasma experiment. If the opportunity for international collaboration occurs, the U.S. should be ready to act and take advantage of it but should not be dependent upon it. The U.S. should implement a plan as follows to proceed towards construction of a burning plasma experiment:

- Hold “Snowmass-style” community meeting
- Carry out uniform technical assessment by NSO activity
- Request FESAC “action panel” to select preferred BP option
- National Research Council review of BP plans
- Initiate and outreach effort with broader science community, policy makers, environmental community, and public



# FESAC SNOWMASS RECOMMENDATION

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Hold a “Snowmass” workshop in the summer 2002 for the critical examination of proposed burning plasma experiments and to provide crucial community input and endorsement to the planning activities undertaken by FESAC.

First, while most of the MFE community has already agreed that we are technically ready to proceed with a burning plasma experiment, there must be a critical mass of fusion energy science community support that confirms that the time to proceed is now and not some undefined time in the future.

Second, the community should carefully examine, on a scientific and technological basis, the viability of each of the burning plasma options presented, particularly ITER-FEAT, FIRE, and IGNITOR. The goal is for the proponents of each option to convince the community that their respective option is sufficiently well advanced that if built, it would have a high probability of success.

Third, the community should agree that under the assumption that every member has had the opportunity to express his or her opinions in a public forum, the community as a whole will support whatever decision is ultimately made.

At the workshop there is no need to have extensive discussions of “general” burning plasma science issues (these discussions have already taken place). Also, it should not be a goal of the workshop to select the “best” option, as this will likely not be possible and might lead to counterproductive polarization within the community. The emphasis should be on establishing the credibility of success of each design with respect to its stated scientific mission, cost estimate, and time schedule.



**Department of Energy**  
Germantown, MD 20874-1290

TO: Distribution

SUBJECT: Preparations for Snowmass Meeting

As most of you are aware, plans are being made to convene a major community meeting at Snowmass, Colorado in July of 2002 (<http://lithos.gat.com/snowmass/>). While this meeting can be seen as a follow on to the 1999 Snowmass meeting, the intent is to have a more focused assessment of major next steps in the fusion program. In particular, this meeting will provide an opportunity for wide-ranging community discussions regarding the scientific issues associated with burning plasma experiments, especially those that might be associated with the major magnetic fusion experiments that have been proposed: ITER, FIRE, and IGNITOR. At the same time, the IFE segment of the fusion community will be meeting to consider plans for prospective integrated research experiments and next steps within that approach to fusion.

We have seen this meeting evolve through community discussions, workshops, and FESAC deliberations. I want to lend the full support of the Office of Fusion Energy Sciences to this endeavor. For that purpose and in response to the recommendations of FESAC, we have set aside nearly \$1 million of FY 2002 funding to assist with technical assessments that should take place before the meeting. We also ask that the fusion program leaders support this activity by making key staff available as much as is practicable without sacrificing other important objectives.

I have also asked OFES staff to assist with these additional responsibilities by recognizing the need to divert existing resources (within the constraint noted above) in support of the Snowmass program. I am certain that with open communications we can manage this process in a balanced way. If you have any questions regarding additional resources or redirection of existing activities, please raise them with your OFES program manager. When necessary, John Willis or Mike Roberts will be pleased to clarify priorities.

N. Anne Davies  
Associate Director  
for Fusion Energy Sciences  
Office of Science



# Snowmass Working Group Structure

## Burning Plasma/Next-Step

	Normal Conductor Tokamak		Superconducting Tokamak	
	<b>B1</b> FIRE	<b>B2</b> IGNITOR	<b>B3</b> ITER	<b>B4</b> BP Contribution to ICCs
<b>Physics WG</b> <b>P1</b> Wave-Particle Interactions <b>P2</b> Alpha Physics <b>P3</b> MHD <b>P4</b> Transport <b>P5</b> Boundary Physics				
<b>Technology WG</b> <b>T1</b> Magnets <b>T2</b> PFC/Heat removal <b>T3</b> Heating/CD <b>T4</b> Vacuum Vessel/Remote <b>T5</b> Safety/Tritium/Materials <b>T6</b> Cost				
<b>Experimental Approach and Objectives</b> <b>E1</b> Diagnostics <b>E2</b> Integrated Scenarios/ Ignition Physics/Burn Control <b>E3</b> Physics Operations <b>E4</b> Development Path				

## 2002 Fusion Summer Study MFE Working Groups

### Physics WG [Prager, U. Wisc.]

- P 1 Wave-Particle Interactions  
[Batchelor, ORNL; Porkolob, MIT]
- P 2 Energetic Particles/Alpha-Physics  
[Nazikian, PPPL; Van Dam, U. Texas]
- P 3 MHD  
[Hegna, U. Wisc.; Strait, GA]
- P 4 Transport  
[Synakowski, PPPL; Waltz, GA]
- P 5 Boundary Physics  
[Allen, LLNL; Pitcher; MIT]

### Technology WG [Baker, UCSD]

- T 1 Magnets  
[Martovetski, LLNL; Minervini, MIT]
- T 2 PFC/Heat Removal  
[Mattas, ANL; Ulrickson, Sandia]
- T 3 Heating/Current Drive  
[Rasmussen, ORNL; Temkin, MIT]
- T 4 Vacuum Vessel/Remote Handling  
[Nelson, ORNL; Parker, MIT]
- T 5 Safety/Tritium/Materials  
[Petti, INEL; Zinkel, ORNL]
- T 6 Cost [TBD]

### Experimental Approach and Objectives WG [Taylor, GA]

- E 1 Diagnostics  
[Boivin, GA; Fonck, U. Wisc.; Young, PPPL]
- E 2 Integrated Scenarios/Ignition Physics/Burn Control  
[Kessel, PPPL; Politzer, GA]
- E 3 Physics Operations  
[Hill, LLNL; Wesley, GA]
- E 4 Development Path  
[Najmabadi, UCSD; Schoenberg, LANL]

### Burning Plasma/Next-Step WG [Nevins, LLNL]

- B 1 FIRE  
[Meade, PPPL; Thome, GA]
- B 2 IGNITOR  
[Coppi, MIT; Bombarda, MIT]
- B 3 ITER  
[Perkins, PPPL; TBD]
- B 4 ICCs  
[Hooper, LLNL; Jarboe, U. Wash.]

# 2002 Fusion Summer Study IFE Working Groups

## Target Physics WG [M. Tabak, LLNL]

IP1 Fast Ignition Targets [J. Dahlburg, GA; TBD]

IP2 Gain Curves [R. Town, LLE; M. Herrmann, LLNL]

IP3 Stability [R. Betti, LLE; A. Schmitt, NRL]

IP4 Symmetry [D. Callahan, LLNL; TBD]

IP5 Beam-Target Interaction [J. Fernandez, LANL; T. Mehlhorn, SNLA]

## IFE Chamber/Target Technology WG [P. Peterson, UCB]

IT1 IFE Chamber Response – Microsecond Phenomena [R. Peterson, U.Wisc; M. Ulrickson, Sandia]

IT2 IFE Chamber Clearing/Recovery – Millisecond Phenomena [N. Morley, UCLA; R. Raffray, UCSD]

IT3 IFE Chamber Safety/Environment/Reliability – Quasi-Steady Phenomena [J. Latkowski, LLNL; D. Petti, INEEL]

IT4 IFE Target Fabrication/Injection [D. Goodin, GA; A. Nobile, LANL]

IT5 IFE Integrated Chamber/Focusing System Design and Modeling [M. Tillack, UCSD, W. Meier, LLNL]

## Driver Physics and Technology; Next Steps WG [W. Meier, LLNL]

D1 Lasers [S. Payne, LLNL; S. Obenschain, NRL]

D2 Accelerators [Steve Lund, VNL; TBD]

D3 Z Pinch [Craig Olson, Sandia; TBD]

D4 Fast Ignition Drivers [M. Campbell, GA; TBD]

D5 Other Drivers (Place Holder)

# WHAT ARE THE KEY ISSUES

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- CRITICAL BURNING PLASMA PHENOMENA AND EXPERIMENTAL REQUIREMENTS
- SCIENTIFIC BASIS FOR PROCEEDING WITH A BURNING PLASMA EXPERIMENT: IS **NOW** THE TIME?
- HOW GENERIC ARE BURNING PLASMA STUDIES CARRIED OUT IN A TOKAMAK?
- TECHNICAL ASSESSMENT OF BURNING PLASMA EXPERIMENT OPTIONS
- BUILD CONSENSUS FOR U.S. PLAN FOR BURNING PLASMA STUDIES

# HOW DOES SNOWMASS FEED INTO FESAC AND NRC REVIEWS?

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- CLEAR ARTICULATION OF SCIENTIFIC BASIS FOR PROCEEDING WITH A BURNING PLASMA EXPERIMENT.
- IDENTIFICATION OF PRINCIPAL NEW PHYSICS PHENOMENA AND REQUIREMENTS FOR THEIR STUDY.
- CLEAR UP MISCONCEPTIONS & EDUCATE COMMUNITY ABOUT BURNING PLASMA OPTIONS.
- ESTABLISH A COMMON TECHNICAL BASIS FOR EVALUATION OF OPTIONS AND DECISIONS.

# Recommended US Plan for Burning Plasmas

