

Burning Plasma Bringing a Star to Earth

Final Report of the
Burning Plasma Assessment Committee

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The take-home message

- A burning plasma experiment is critically needed to advance fusion science
 - Join ITER
 - If ITER doesn't go forward, reassess to move ahead
- An effective burning plasma experiment cannot be done on a flat budget
 - Augmentation of the U.S. program is required
- Priorities must be set for a balanced program
 - Community should focus on realistic opportunities, and identify and prioritize the critical questions

Scope of the committee's work

- Assess plans for a burning plasma experiment (BPX) program
 - Assess value of and need for BPX
 - Assess scientific and technical readiness
 - Identify plan for optimized results
- Issues outside of scope
 - Inertial confinement fusion
 - How to (best) develop fusion power
 - Fusion-reactor-specific technology

Committee membership

"Outside" Experts	"Fusion/BPX" Experts
John Ahearne, Duke/Sigma Xi, <i>co-chair</i>	Raymond Fonck, U Wisconsin, <i>co-chair</i>
John Bahcall, IAS	Stephen Cowley, Imperial College
Gordon Baym, U Illinois	William Nevins, LLNL
Ira Bernstein, Yale	Ron Parker, MIT
Edward Frieman, SIO	Tony Taylor, GA
Joseph Hezir, EOP Group, Inc.	Michael Ulrickson, Sandia
Ellen Zweibel, U Wisconsin	Michael Zarnstorff, Princeton
Burton Richter, Stanford	
Walter Gekelman, UCLA	
Claudio Pellegrini, UCLA	
Cliff Surko, UCSD	

Need for a BPX

- Burning plasma experiment is a necessary scientific milestone on the road to the development of fusion power
- BPX is a critical missing element of the current program

Scientific value of a BPX

- Development of fusion energy science
 - Plasma turbulence, transport at large scales
 - Alpha-particle effects on confinement and stability
 - Stability limits in presence of self-heating
 - Behavior and control of self-sustained (burning) plasma
- Basic plasma physics & general scientific interest
 - Laboratory astrophysics, extreme conditions
 - Self-organizing complex systems

Technological value of a BPX

- Will enable
 - Initial study of materials behavior and integrity
 - Tritium processing and inventory control
 - High-heat-flux components
 - Partial study of (breeding) blanket design/testing
 - Remote handling

Readiness for a BPX

- U.S. fusion science program is scientifically and technically ready to undertake a BPX
 - Have confidence in understanding projections and operational boundaries
 - Necessary components can be manufactured and adequate drive technologies exist

Strategically balanced program

- BPX is a necessary but not sufficient step toward fusion energy
- Developing science base for fusion requires both a BPX and concept development and optimization
 - Address the range of primary issues of fusion science
- In context of ITER participation, balance is essential
 - To optimize the scientific output
 - To best understand and exploit the outcomes for the fusion program as a whole

Elements of a balanced program

- Robust program of theory and simulation, coupled with experimental verification
- Direct support of ITER activities
 - Optimize and accelerate ITER benefits
- Concept Optimization Research
 - Portfolio of investigations across related magnetic configurations
- Recruitment, training, and retention of scientific and technical staff

Recommendations: ITER (1)

- The United States should participate in a burning plasma experiment
- The best option is ITER
- If ITER develops, fulfilling the U.S. commitment should be the top priority in a balanced program

Recommendations: ITER (2)

- Level of involvement in ITER should guarantee:
 - Access to all data from ITER
 - Right to propose and carry out experiments
 - Role in producing the high technology components
- If ITER negotiations fail
 - United States should reassess options, but continue to pursue goal of a BPX with international partners

Recommendations: Program Balance

- A strategically balanced fusion program should be developed, including:
 - Participation in ITER
 - Strong domestic fusion science and technology portfolio
 - Integrated theory and simulation program
 - Support for plasma science

Recommendations: Setting Priorities

- Scope, content, and level of U.S. activity in fusion should be defined through prioritized balancing procedure
- OFES and the community will have to make serious priority judgments
 - BPX/ITER and other program elements all have merit, *but* must account for realistic budgetary situations
- Led by OFES, fusion science community should
 - Identify and prioritize critical scientific questions
 - Accept and manage limitations on levels of activity

Budget implications

- Funding trajectory should be developed that
 - Captures the long-term benefits of joining ITER
 - Retains a strong scientific focus on the long-range goal of the program
- Flat budget for OFES with a BPX will degrade the scientific research support in the fusion program
- At the minimum, augmentation of the U.S. program covering all the U.S. ITER construction and operating costs would be required

Conclusion

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