# Long-Term Collaboration Opportunities

M.C. Zarnstorff

*Princeton Plasma Physics Laboratory*

**US-KSTAR Workshop**

**San Diego, CA**

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# Outline

- US fusion long-term planning
- International Collaboration Working Group
- KSTAR long-term opportunities

# US Fusion Strategic Planning Process

Planning for program to accompany ITER participation

Planning for research needed for steps beyond ITER

FESAC Panel Reports

- "Priorities, Gaps, and Opportunities: Towards A Long-Range Strategic Plan For Magnetic Fusion Energy" (Oct. 2007)

- "Toroidal Alternates Panel" (Dec. 2008)
  - Issues and priorities for Stellarator, ST, RFP, Spheromak, FRC

Research Needs Workshops (ReNeW):

Identify initiatives and actions, elements for strategic plan

- MFE (now – June 2009)

# Research Needs 'Themes'

1. **Burning plasma in ITER**

   Control; Measurements; Off-normal events; Alpha-effects; Reactor conditions; Self-heating

2. **High-Performance Steady State**

   Off-normal events; Integrated high-performance; Predictive modeling; Measurements; Control; Magnets; Aux systems

3. **Plasma Material Interface**

   Plasma facing components; Plasma wall interactions; Internal components

4. **Fusion Power**

   Materials; Fuel cycle; Power extraction; Safety; RAMI

5. **Magnetic Configuration Optimization**

   Stellarator; ST; RFP; FRC; Compact tori

—*Ordered by priority for themes 2, 3, & 4*

# International Collaboration WG

Evaluate and prioritize the opportunities for US collaboration on EAST, KSTAR, JET, and JT60SA to prepare for US participation on ITER and to address the issues and gaps discussed in the recent report "Issues, Gaps, and Opportunities: Towards a Long-Range Strategic Plan for Magnetic Fusion Energy", DOE-SC-0102. Report before the Resource Needs Workshop, planned for June 2009.

Members:

M. Zarnstorff, E. Synakowski, T. Luce, D. Whyte

S. Milora, C. Kessel, D. Humphreys, S. Sabbagh .

# Likely Roles for KSTAR

1. Burning plasma in ITER
   - Control; Measurements; Off-normal events; Alpha-effects; Reactor conditions; Self-heating
2. High-Performance Steady State
   - Off-normal events; Integrated high-performance; Predictive modeling; Measurements; Control; Magnets; Aux systems?
3. Plasma Material Interface
   - Plasma facing components?; Plasma wall interactions?; Internal components?
4. Fusion Power
   - Materials; Fuel cycle; Power extraction; Safety; RAMI
5. Magnetic Configuration Optimization
   - Stellarator; ST; RFP; FRC; Compact tori

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# What must we learn?

**ITER: 500 MW for 400s, gain > 10**

- Extension of ITER scenarios to long-pulse
- Control with superconducting coils

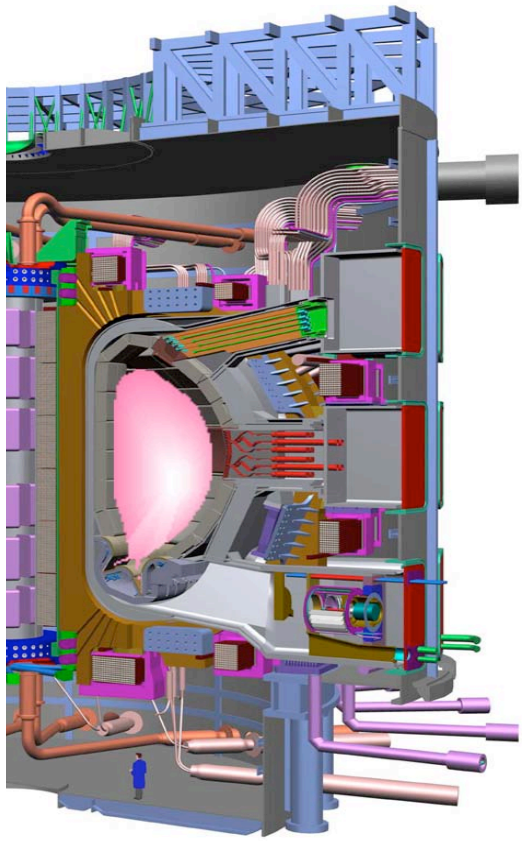
**DEMO: ~2500 MW, continuous, gain > 25,**
**~ same size and field.**

- Higher pressure, by at least factor of ~2.2
- Steady state with little externally driven current
  No inductive current
- Essentially no disruptions or ELMs

- Stable confinement of fusion produced $\alpha$-particles
- Compatible divertor operation

- Steady state high heat flux plasma facing components

*Demonstrate reliability and potential for attractive economics*



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