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International Collaboration on Plasma Science and Control

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The objective of this White Paper is to propose guidelines on a strategy for international collaboration on research in plasma and fusion sciences. Potential benefits from the International Collaboration include gaining access to international magnetic fusion capacities not available in US, such as in long-pulse, steady-state research in superconducting advanced tokamaks and stellarators; in steady-state plasma confinement and control science; and in plasma-wall interactions.

The following are a set of suggested research modes for US participation in international collaborations

- Play a key role in or take responsibility for parts of program at foreign facilities which will exercise US scientific capability and/or leadership; will maintain and develop key US strengths; will fill gaps in existing US facilities and research program, and will seize emerging opportunities for further steps towards fusion energy in domestic or international programs.
- Different national programs have different goals and constraints. We should not use a “one size fits all" approach, but instead negotiate arrangements best suited to the combination of our international collaboration goals and the various international facilities involved.
- Promotion of International Collaboration – FES should make use of incentives to promote more international collaborations and to prepare for US participation in ITER experiments in the next decade. One approach could involve making funding available for projects that target strategic goals in the international collaboration area for collaborative research at sites in the US or in other countries. FES might also consider providing matching funds for collaborations in which there is funding from other countries.
- US fusion interests in international collaborations can be well served by forming focused US physics teams combining theory, modeling/simulations and experiments/diagnostics, charged with pursuing new initiatives, assuming leadership and developing fundamental understanding of plasma science and control in a few key areas relevant to unique international facilities, e.g., the international superconducting tokamaks. The US national teams could be formed into projects with participation from the national laboratories, universities, and industries.
    - Choose those collaboration projects which have technical importance to the US fusion program
    - Form national teams based on our leading positions in the areas of detailed measurement of underlying processes, theory and modeling, and advanced and integrated simulation
    - Utilize our leading positions in theory, simulation and predictive modeling capabilities to develop international collaborations that exploit expertise and capability developed in the SciDAC and prototype Fusion Simulation Program projects, and fusion theory community with an emphasis on validation of physics models using data from the international superconducting facilities.
        - Develop a physics database and predictive capabilities for plasma control and operational scenarios.
        - Develop a physics database and predictive capabilities for the plasma/material science governing plasma-surface interactions, the processes beyond the last closed flux surface, including the open-field-line plasma physics and material wall, and develop integrated understanding how these processes couple back to influence overall plasma confinements and stability.

The suggested elements and priorities for prospective international collaboration projects would include:

- Allow the US international team to retain significant independence and control in key areas, have the ability to negotiate with hosts to set aside certain portions of their program priorities for the international collaboration project; maintain a clearly independent scope that can be maintained over time
- Research projects that take particular advantage of unique international facilities or expertise
- Projects that provide opportunities for US leadership
- Potential for impact by US participation or partnership