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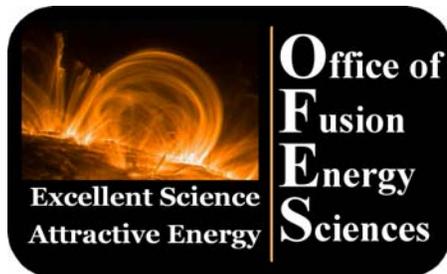
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# International Collaboration and ITER Physics – an Overview

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# *International Collaboration and contributions to ITER Physics are now critical more than ever*

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- International collaboration is an integral part of OFES program; it enables access to a wide range of facilities, allowing extensive studies and research coordination:
  - The International Tokamak Physics Activity (ITPA) identifies key issues and facilitates coordination through topical groups
  - The IEA-Tokamak agreements facilitates personnel/hardware exchanges and joint experiments in ITPA key areas
  - Bilateral exchanges and IAEA meetings provide additional programmatic exchanges and workshops.
- A likely decision to proceed with ITER will focus international collaboration:
  - Strengthen research on key areas for ITER design and operations
  - Develop the ITER research paradigm
  - Build ITER research program through international topical groups

***Scope of Collaborative experiments, theory and modeling, and hardware development extend to a wide range of topics on all major international tokamaks***

Scope	International Tokamaks
On-site assignment, Physics ops.	JET
Transport modeling studies	JET, Tore Supra (TS)
Particle Control, PWI, He-Ash removal	TS, TEXTOR, AUG, JET
NTM and RWM stabilization	AUG
Stochastic Fields	TEXTOR, TS
ITPA Joint Experiments	JET, JT-60U, AUG, TEXTOR, TS
Diagnostic Development	JET, JT-60U, TEXTOR, AUG, KSTAR
ICRF and TAE Antennae Development	JET
Negative Neutral Beam Development	JT-60U
Steady-State, Plasma Control Issues, RF	KSTAR, EAST
Burning Plasma Physics	

## ***International Collaboration is carried out through three primary program areas***

- The Science budget includes a line for International collaborations (about \$4.9 M in FY 04 and FY 05 )
  - Primarily for PPPL and ORNL, and for smaller scale collaborations from MIT, GA, LLNL, and universities on foreign tokamaks and stellarators
- Major facilities (DIII-D, C-MOD, and NSTX) support related collaborations through their program funds
  - ITPA, personnel exchanges, workshops...
  - a substantial collaboration between DIII-D and EAST in China is being developed to benefit both programs
- Diagnostics Program supports some collaborative activities on JET, AUG, and TEXTOR, LHD.

***Distribution of Budget for International Collaborations by  
U.S. Institutions (\$ K)  
(Major program activity shown in parenthesis)***

Institution	FY 03	FY 04	FY05	FY06
PPPL (JET, JT-60U)	3,081	2,674	2,712	2,712
ORNL (TS, TEXTOR)	1,044	1,479	1,479	1,479
GA (KSTAR, EAST)	275	314	314	314
MIT (AUG)	174	173	173	173
LLNL	22	22	22	22
Wisconsin		170	170	170
Texas	100			
Colorado		30	30	30
<b>TOTALS</b>	<b>4,696</b>	<b>4,862</b>	<b>4,900</b>	<b>4,900</b>

***Distribution of IC Budget by  
International Programs  
(U.S. Coordinators shown in parenthesis)***

International Program	FY 03	FY 04	FY 05	FY 06
JET (R. Nazikian)	3,105	3,173	3,011	2,990
JT-60U (R. Nazikian)	227	191	191	191
TORE SUPRA (P. Mioduszewski)	280	272	272	272
ASDEX-UG (E. Marmar)	85	84	84	84
TEXTOR (D. Hillis)	85	84	84	84
K-STAR (J. Wesley)	457	488	488	509
CHINA-EAST (V. Chan)	100		200	200
LHD	357	250	250	250
TJ-II		320	320	320
<b>TOTALS</b>	4,696	4,862	4,900	4,900

*International Collaboration has expanded substantially  
through the International Tokamak Physics Activity  
(ITPA)*

- ITPA includes ITER Parties - CH, EU, JA, RF, US
  - KO in application process
- About 100 U.S. scientists are involved in ITPA topical groups
  - (R. Stambaugh, N. Sauthoff, and E. Oktay are U.S. coordinators)
- ITPA focus is on seven topical areas
  - Identifies High Priority Research (HPR) topics in burning plasma physics, emphasizing tokamak plasmas;
  - Activities include experiments, data analysis, theory & modeling;
  - Broader than ITER physics issues (STs and stellarators participate)
- IEA tokamak agreements implement ITPA HPR topics through Joint Experiments on tokamaks world-wide
  - Substantial increase in collaborations among JET, JET-60U, DIII-D, C-MOD, ASDEX-UG, TEXTOR, TORE-SUPRA, NSTX, MAST

***Issues for the community to consider in the areas of  
International Collaboration and Support for ITER Physics***

- Closer integration of international collaboration with the ‘domestic’ program
- Future direction of ITPA, Burning Plasma Physics, and their role in ITER Physics
- Priorities for collaborations on steady state issues on ongoing facilities and on facilities in construction
- Process for community participation in International Collaborations

***Opportunity to enhance integration of  
International Collaboration and ITER Physics  
with the 'Domestic' Program***

- ITPA Topical Structure is proving to be very effective to organize the international tokamak science research;
  - Transport Physics
  - Confinement Database & Modeling
  - Pedestal & Edge Physics
  - Divertor & Scrape –off-Layer Physics
  - MHD, Disruption & Control
  - Steady State Operations and Energetic Particles
  - Diagnostics
- Should we adopt a similar structure in the US program to align with the ITPA activities and interface it to the U.S. ITPA Topical Groups?
  - In what ways should our US research planning be topical?

## ***ITPA, Support for ITER Physics, and Burning Plasma Physics***

- The future role and direction of ITPA is tightly coupled to the ITER discussions;
- ITPA is extended up to 2 years to continue its broad approach to tokamak burning plasma physics;
- ITER International Team (IT) develops ITER Physics needs
- In the U.S. there are discussions to identify a Burning Plasma Program
- The interaction between ITER Physics, ITPA, international collaborations, and Burning Plasma Physics Program should to be strengthened;

***Priorities for Collaborations on Steady State Issues  
Balance between ongoing experiments and  
New Superconducting Tokamaks***

- We also need to consider Steady State as a major integrating topical area like burning plasma physics
- Korea and China are building two important tokamaks for contributions to physics and technology of steady state operations
  - First plasma in EAST in China in ~ 2005
  - First plasma in KSTAR in Korea ~ 2006
  - Japan planning SC upgrade of JT-60U
- Long pulse experiments in Tore Supra, JT-60U, LHD
- How best to participate in these current and future facilities, filling a gap in the U.S. program

## ***Process for broader community participation in International Collaborations***

- A substantial number of U.S. researchers are already involved in ITPA and international collaborations;
- Some university researchers do not have sufficient resources; requests should be included in their grant applications.
- We are open to suggestions on improving the process for expanding community participation in ITPA, ITER Physics, and International Collaborations.

***Ned Sauthoff, will provide further details on ITER  
Physics, ITPA, and International Collaborations***

- International Collaborations, ITPA, and ITER  
Physics in transition...