



U.S. Department of Energy's  
**Office of Science**

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# **Fusion Energy Sciences Program Update**

University Fusion Association Meeting  
Orlando, FL  
November 12, 2007

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for  
Office of Fusion Energy Sciences

[www.ofes.fusion.doe.gov](http://www.ofes.fusion.doe.gov)

APS/DPP 111207-se 1





# Topics

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- Budget status
- Grants and Solicitations
- ITER
- HEDLP Joint Program
- Plasma Science
- Issues and Plans



# FY 2008 Fusion Energy Sciences Congressional Budget Request

(\$ Millions)

	FY 2006 <u>Actual</u>	FY 2007 <u>Sept AFP</u>	FY 2008 <u>CONG</u>
Science	148.7	144.6	159.6
Facility Operations	104.2	146.3	247.5
Enabling R&D	<u>27.8</u>	<u>20.8</u>	<u>20.8</u>
<b>OFES Total</b>	<b>280.7</b>	<b>311.7</b>	<b>427.9</b>
DIII-D	55.1	56.7	59.7
C-Mod	21.5	22.3	23.5
NSTX	34.2	33.5	36.1
NCSX	17.8	16.6	16.6
ITER	24.6	60.0	160.0
Non-ITER	256.1	251.7	267.9



## OFES University Funding FY 2007-2008 (\$ Millions)

Program Element	FY 2007	FY 2008
	<u>Sept Plan</u>	<u>Oct Plan</u>
• C-Mod Research and Operations	21.2	21.2
• Collaborations on DIII-D & NSTX	4.2	4.4
• Innovative Confinement Concepts	16.7	17.1
• Theory and SciDAC	11.9	10.7
• General Plasma Science	9.5	9.8
• Technology	7.8	8.0
• HEDLP	1.8	1.9
• Intl, Diagnostics, HBCU, Other	<u>4.3</u>	<u>4.8</u>
• Total University Funding	76.8	78.1



## FY 2008 Appropriations

- **House Mark**

- The Committee recommendation for fusion energy sciences is \$427,850,000, the same as the budget request, and reflecting the \$100,000,000 growth in the budget for ITER.
- The Committee **does not support funding for a new program in High Energy Density Physics (HEDP) and provides no funds for this research area.** (Resources for HEDP should be redirected to other programs).
- The Committee notes that major growth in support for ITER ... is affecting the overall funding picture for Fusion Energy Sciences and for the Office of Science as a whole. When direct funding for ITER is excluded, Fusion Energy Sciences increases by just 3.8 percent and the increase requested for the Office of Science, while still large, is 13.4 percent rather than 15.8 percent. If delays in ITER associated with international cooperation reduce the amount that can be spent on ITER in fiscal year 2008, the Committee directs the Office of Fusion Energy Sciences to invest the funds made available in Theory, materials research within Enabling R&D, Alternative Concept Experimental Research and operating time at the three U.S. user facilities rather than retaining the money for ITER and carrying it over to future fiscal years.

- **Senate Mark**

- Committee recommends \$427,850,000.
- High Energy Density Plasma Laboratory Program- The Committee **is pleased that the Department has developed a multidisciplinary research program, which this Committee has been an advocate for the past several years.** The Committee believes this program will provide greater interaction between the Office of Science researchers and the NNSA scientists and provide greater access to user facilities such as the Z machine, NIF and Omega. ... The Committee encourages the Department to increase their investment in this modest program to ensure its future success. The Committee supports the budget request of \$12,281,000 for the Office of Science. The Committee notes a similar amount has been included in the NNSA program.



## FY2008 CR

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- The Department is operating under a Continuing Resolution
  - CR in effect until November 16, likely another CR coming
  - “Standard” CR, i.e. no new starts, funding at FY 2007 level, etc.
- We have no information on final FY 2008 funding expectations
- OFES expects no real impact on the program unless CR needed beyond March 1



## Grants and Solicitations

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- Theory
  - Review complete, 44 applications submitted, 17 funded
- SciDAC
  - Review complete, 9 applications submitted, 5 funded
- Diagnostics Development
  - Review panel met week of November 5
  - Funding decisions expected in early December, current grants will be given no cost extensions
- Plasma Physics Junior Faculty
  - Review in progress, funding decisions in Spring of 2008
- NSTX Physics Collaborations
  - Review in progress, funding decisions in January 2008



## ITER Project Status

- Step 1 All ITER Parties have completed their process for final approval and acceptance of the ITER Agreement and have deposited their instruments of acceptance with the IAEA
- Step 2 Ratification occurred on October 24, 2007 (a date created by a 30-day window following the last party's completion of the deposit of acceptance). **ITER Organization is legal entity.**
- Step 2b The U.S. will fulfill commitment for Privileges and Immunities through the International Organization Immunities Act Designation, which is well underway at the Department of State. All other Parties completed this commitment through their ITER Agreement process
- Step 3 First Formal Meeting of the ITER Council will be held this month





## ITER Design Review

- ITER Organization's Design Review concluded by November 2007; U.S. views:
  - Result will be a “reference design” which will serve as the basis for much further work
  - Many Design Change Requests still under development to resolve key design issues in 2008
  - ITER Council will require a comprehensive baseline design and Integrated Project Schedule (with cost impacts) by mid-2008. This will be difficult – lots of work remains
  - Many thanks to USBPO, VLT, USIPO for guiding U.S. help in this!
- U.S. ITER Project is focused on helping complete the designs for US-supplied hardware as quickly as possible.
  - We are also providing ITER Organization with project management support



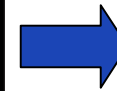
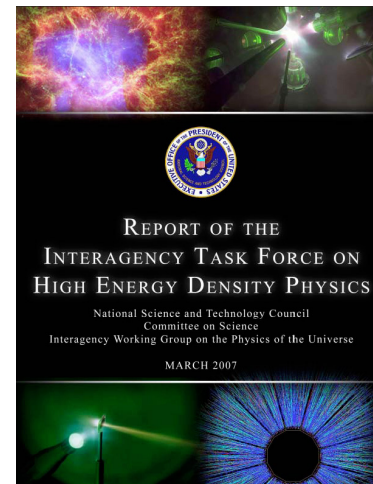
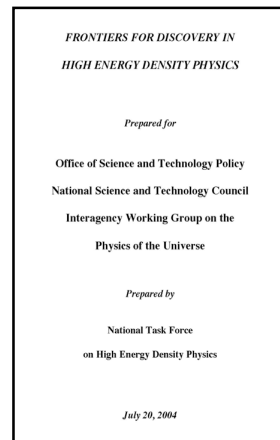
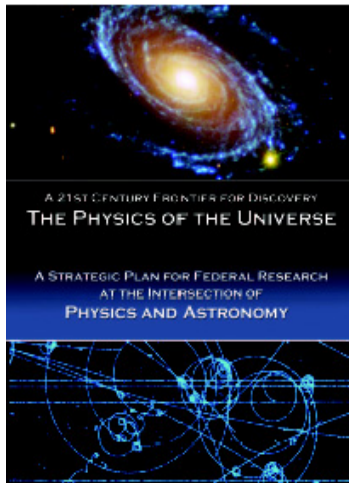
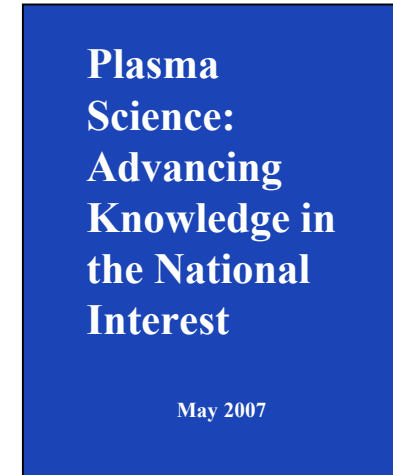
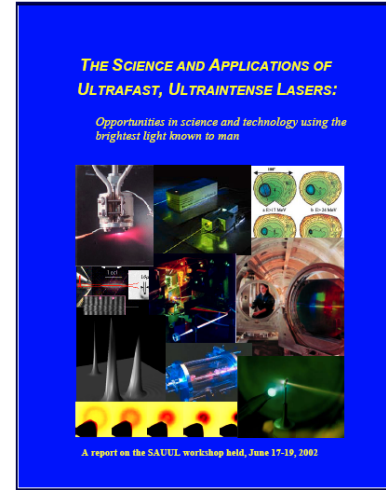
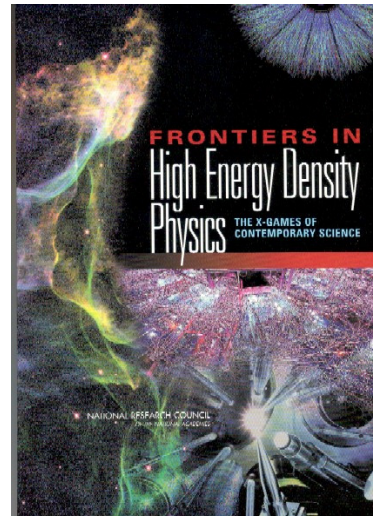
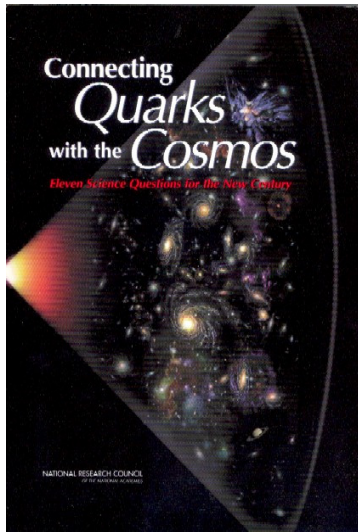
## ITER – Details on Activities

- Numerous project management and technical meetings to be attended by OFES, USIPO and fusion community participants
- Numerous schedule-related workshops to be attended by USIPO WBs managers, in various areas of focus, including:
  - Machine Assembly
  - Magnets
  - Heating and Cooling Systems
  - Vacuum
  - Buildings
  - And more...
- Week of November 5, 2007
  - STAC November 5-7 – Cadarache
    - US representatives: Goldston, Milora, Taylor, Van Dam, Oktay
  - MAC November 7-8 – Cadarache (Bob Iotti, Chair, CH2MHill/DOE Idaho)
    - Chair: Iotti
    - US representatives: Baker, Hawryluk, Hoy, Sauthoff, (Moses)
  - CP November 9-10
    - US representatives: Harding, Vanek, Fonck, Hoy, Stevens, Glowienka
- November 27-28, 2007 – First formal ITER Council meeting
  - Advance tough issues (Baseline Design, Schedule, Cost & Impacts)
  - Finalize documentation under ITER Agreement
  - Begin planning for Spring Council Decisions
  - Representatives: Orbach, Harding, Fonck, Rottier (State Dept.)



# Importance of fundamental High Energy Density Physics (HEDP)

National Academy/workshop reports



Federal response





# HEDP-Research Topics & Related Federal Research Categories

<b>Federal Research Categories</b>	<b>Research Examples</b>
Astrophysics (NASA, NSF)	Astrophysical jets Neutron star interiors Core-collapse supernovae
High Energy Density Nuclear Physics (DOE/NP)	Quark-gluon plasmas; Nuclear astrophysics
<b>High Energy Density Laboratory Plasmas (DOE/NNSA, DOE/FES)</b>	<b>Radiative hydrodynamics</b> <b>Laser-plasma and beam-plasma interaction</b> <b>Fusion burn</b> <b>Materials under extreme conditions</b> <b>Dense plasmas in ultrahigh fields</b> <b>Laboratory astrophysics</b>
Ultrafast, Ultraintense Laser Science (NSF, DOE/BES)	Ultraintense x-rays for material science studies; applications of ultraintense lasers to chemistry and materials; advanced accelerators

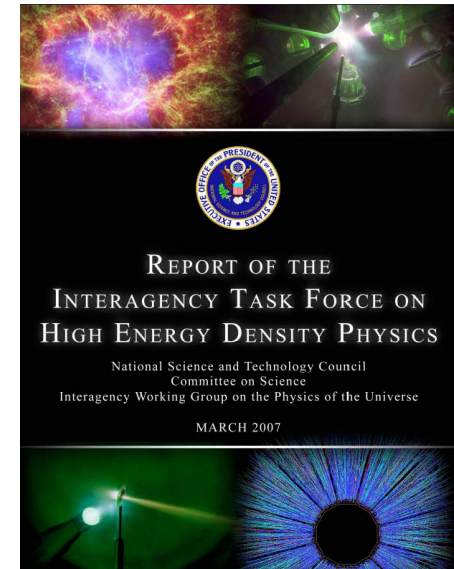


## HEDLP Update

- Report of the interagency Task Force on HEDP has been released.
  - First International Conference in HEDP to be held with APS April Meeting 2008 in St. Louis, MO
- Increasing international interest in inertial fusion and ignition physics, and facilities for fast ignition
  - OMEGA EP (30 kJ long/5 kJ short)
  - FIREX-1 (10 kJ/10 kJ)
  - HiPER 3-year design phase (200 kJ/70 kJ)
  - An International Fast Ignition Committee (IFIC) formed to coordinate international research in fast ignition

Next step: FESAC charge to help map near- and mid-term program

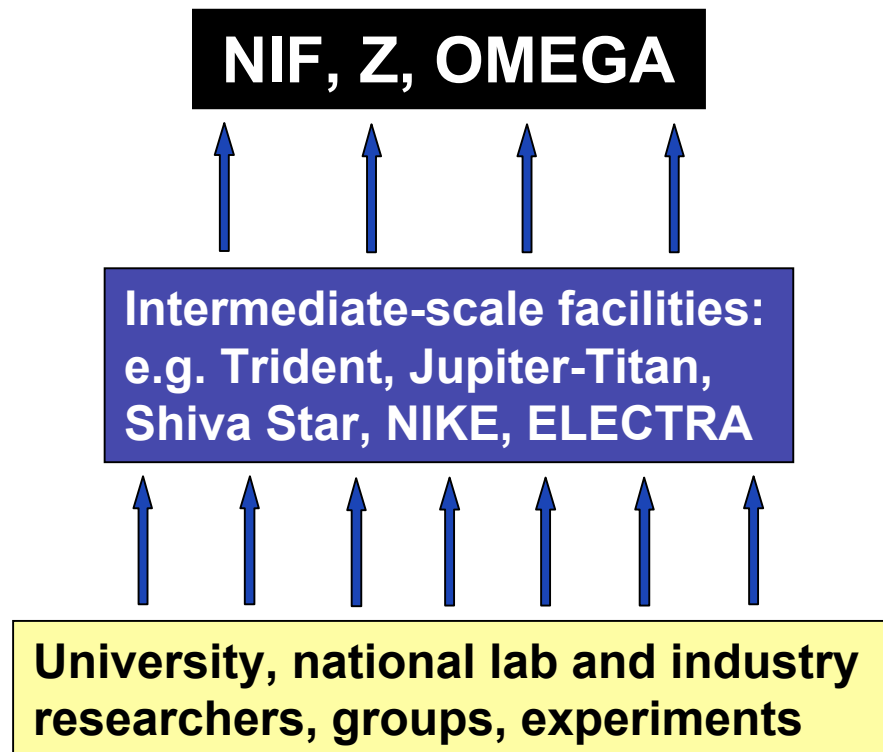
- MOU between OFES and NNSA is being drafted for use of FESAC as FACA advisory inputs for the Joint Program





## SC/NNSA Joint Program in HEDLP

- **Initial main scientific themes<sup>1</sup>:**
  - Create, probe, and control new states of matter in HEDLP
  - Address challenges in inertial fusion energy sciences
- **Program evolution will be guided by Advisory Committee and planning exercises**
- **First joint solicitation planned for Spring 2008**
  - Details are being developed



1. Recommended by community HEDLP Workshop at the Argonne National Lab (May 23–24, 2007) **Chaired by Dr. Robert Rosner and Dr. John Browne**





# Magnetic Fusion Energy Sciences Program Evolving to New Phase

- Entering a time of transition to the ITER/Burning Plasma Era
  - Past decade: consolidation & redirection, with excellent scientific progress
  - Next decade: to a major step(s) in state-of-the-art in fusion science?
- Must start addressing growing issues in the program
  - What should the domestic program look like?
  - How can we capture a qualitatively new level of sciences in the domestic program?
  - What are the compelling science and technology issues?
  - What are the opportunities in which the US can take a world leadership role?
  - What must we do to effectively steward plasma physics and HEDLP?
- What are elements of a 5, 10, and 20-year strategic plan?
  - MFE driven by mission-related science needs
  - Plasma sciences must be more generally defined
- Use recent opportunities/gaps subpanel report ...
- Need to define a dynamic evolution in research and facilities



## Directions for Next 5 Years Are Apparent

- Support ITER construction and organization development
  - Burning plasma physics and engineering to prepare for ITER experiments
- Identify most promising areas in fusion energy sciences for world leadership during the ITER era. e.g.,
  - Initiate program(s) to provide world-class domestic facilities
  - Establish coordinated computation, theory and experimental campaigns to develop integrated simulation capabilities
- Strengthen stewardship of plasma science and high energy density laboratory plasmas (HEDLP)
  - Provide focus area of Federal support for plasma sciences
  - Support evolution of HEDLP through period of ignition science; plot course for increasing emphasis on IFES after NIF ignition demonstration
- Baseline Budget guidance:
  - American Competitiveness Initiative (ACI) provides context for funding envelope
  - MFE: ITER construction + ~constant \$ for research and operations
  - Plasma Science, HEDLP/IFES: compete for some ACI-funded growth?





## Issues for the Next 5 Years

- **Chronic/Existing Issues**
  - Using and upgrading major facilities
  - Support of theory program
  - Support of engineering science and materials
  - Support for plasma physics and HEDLP / Inertial Fusion Energy Sciences
  - Support for diagnostic development
  - Workforce demographics
- **Capturing Opportunities => New Initiatives/Issues**
  - Low-temperature plasma physics (NRC Plasma 2010)
  - Design next-step facility(ies) in the US
  - Fusion Simulation Project
  - Momentum towards IFES/HEDLP from NIF campaign
  - ITER Research Program and Upgrades (e.g., Test Blanket Module)
- **Examine and adjust resource distribution to address these issues?**



## There is Urgency to Develop 5-20 year Vision and Plan

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- While planning is a continuing process and never complete, there is a need for general plan support budget planning now
  - Near-term for budget process; can have ambiguities
  - Longer-term to set program directions; need more details
- OFES now working on internal 10-year planning exercise
  - Use wealth of community studies (e.g., latest FESAC studies)
  - Pursue contributions from research community members
  - Consider white-papers, short-term workshop(s), if needed
- Update as more extensive community discussion evolves
  - Workshops as needed
  - FESAC subpanel studies



## Needed Planning Activities...

- Identify scientific challenges and opportunities
  - Develop prioritized list of compelling initiatives
- Possible workshop topics and/or charge areas for FESAC
  - HEDLP & IFES (w/NNSA)
    - *Next 10 years: before and after NIF ignition campaign*
  - Alternate investigations in MFES
    - *Role in ITER era*
  - Plasma Sciences
    - *NRC Plasma 2010 follow-up*
  - Fusion materials and engineering sciences
    - *Framing underlying scientific issues and technical challenges*
  - Next major domestic initiative(s) or facility(ies)
- Long term
  - Consolidation and distribution into an integrated program plan
- Other issues coming up
  - Governance of national facilities
  - Integration of Universities in national programs
    - *FESAC or UFA...*



## Basic Plasma Science

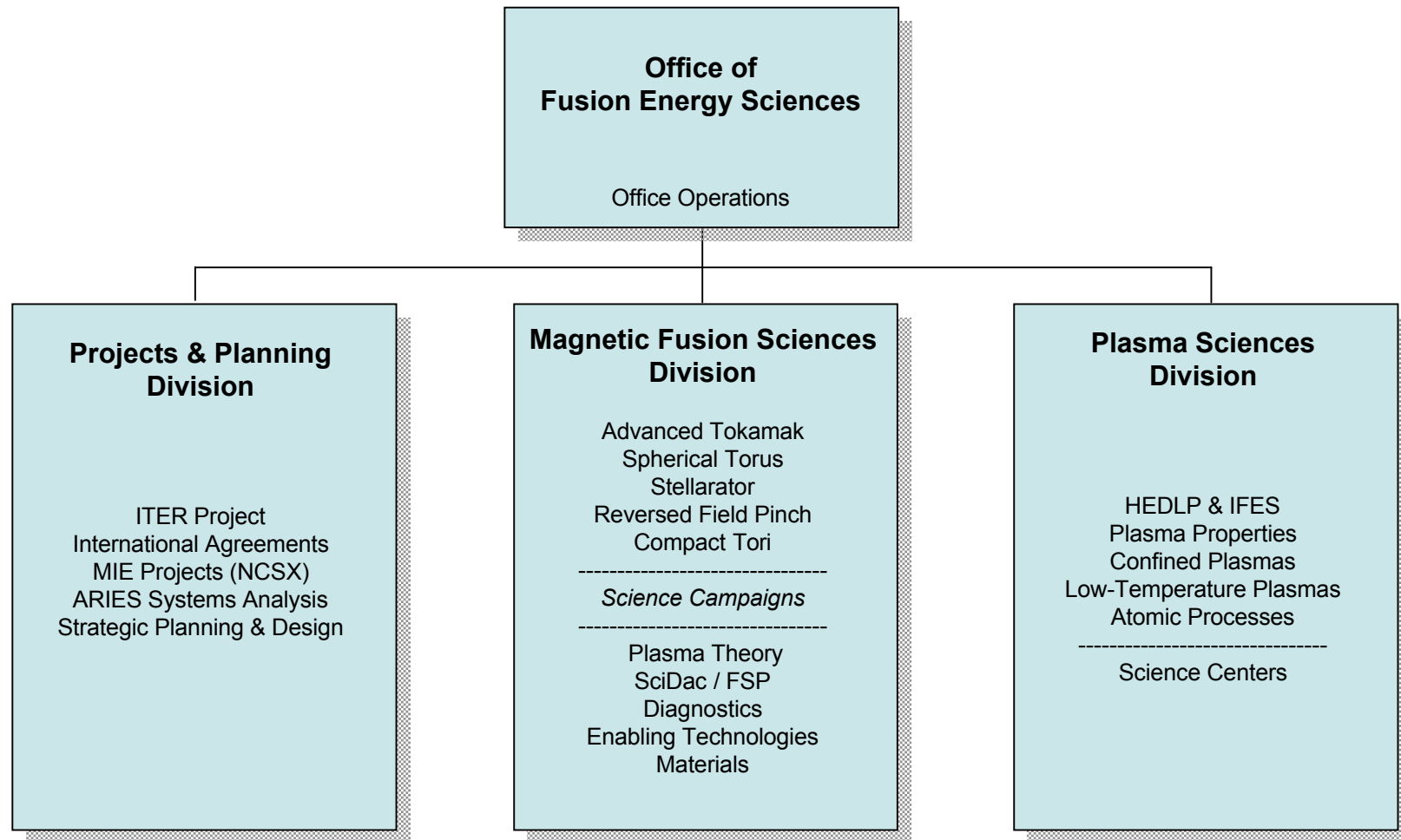
- New national Academies Plasma 2010 Decadal Study released:
  - Central recommendation:  
**“To fully realize the opportunities in plasma research, a unified approach is required. Therefore, the Department of Energy’s Office of Science should reorient its research programs to incorporate magnetic and inertial fusion energy sciences, basic plasma science, non-mission-driven high-energy density plasma science, and low-temperature plasma science and engineering.”**
- OFES will develop plans to address these needs, but will require research community help!
  - Define and prioritize exciting campaigns and initiatives for plasma sciences and HEDLP
  - Considering workshop(s), FESAC charges, etc.
  - Suggestions welcome

Plasma  
Science:  
Advancing  
Knowledge in  
the National  
Interest

May 2007



# Draft, Conceptual OFES Organization



- Organize via concepts/topical areas rather than specific facilities
- Cross-cut with coordinated campaigns on identified priority issues



## OFES Staffing Plans

- General needs independent of changes to organizational structure
- FY 2007:
  - Recruited a Physical Scientist and an Admin Support person to OFES
- FY 2008: (pending CR end)
  - Fill division head positions (2/3)
  - Recruit three technical staff members and one program assistant to OFES
  - Recruit one technical staff member and one program assistant to DOE ITER Project Office at Oak Ridge
- **Encourage qualified candidates to visit the OFES Booth at the Job Fair!**



## Summary

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- Waiting for info on budget and CR
- Increasing numbers of proposals being received
- ITER is becoming a real, legal entity
  - Design review process making progress, but challenges...
- HEDLP program gathering momentum
- Program and OFES structure under consideration
- Multi-tiered planning process needed
  - Address increasing demands on budget
  - To coordinate with FESAC and community
  - Short-term and long-term