Update on the Fusion Energy Sciences Program

James W. Van Dam
on behalf of
DOE-SC Fusion Energy Sciences

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University Fusion Association Meeting
November 16, 2015

1. Budget

Recent history of Fiscal Year budgets

- **FY 2014**
  - Began with 6-week government shutdown (due to Sequestration)
  - Ended with a strong budget
- **FY 2015**
  - Began with a Continuing Resolution (until Dec 11)
  - Ended with a strong budget
- **FY 2016**
  - Began with a Continuing Resolution (until Dec 11)
  - Sequestration has been negotiated; waiting for an approved budget
- **FY 2017**
  - Awaiting OMB pass-back on proposed budget; release in Feb 2016

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House and Senate marks for FY 2016 budget

- **From the Senate Energy and Water Development mark [May 2015]**
  - The Committee recommends $270,168,000 for Fusion Energy Sciences.
  - The Committee recommends no funding for the U.S. contribution to ITER.
  - One program-specific mark

- **From the House Energy and Water Development mark [April 2015]**
  - The Committee recommends $467,600,000 for Fusion Energy Sciences, $100,000 above fiscal year 2015 and $47,600,000 above the budget request. Within available funds, the recommendation provides not less than $69,500,000 for the National Spherical Torus Experiment (NSTX); not less than $80,000,000 for DIII–D; and not less than $18,000,000 for Alcator C–Mod.
  - Specific marks for several other programs
  - The Committee recommends $150,000,000 for the U.S. contribution to the ITER project, the same as fiscal year 2015 and the budget request.
  - The success of ITER depends on making continued project management progress and the Committee includes funding for the ITER Council to continue its implementation efforts. Should the ITER Council fail to reform the project management culture, the Committee will be forced to reconsider its support for the international project.

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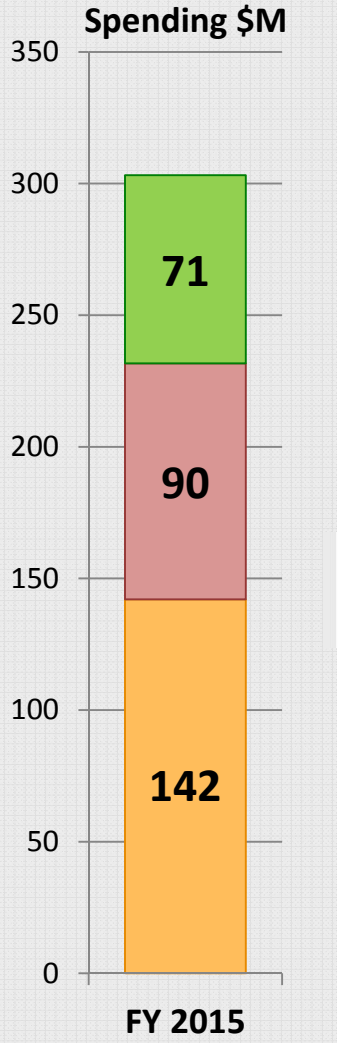
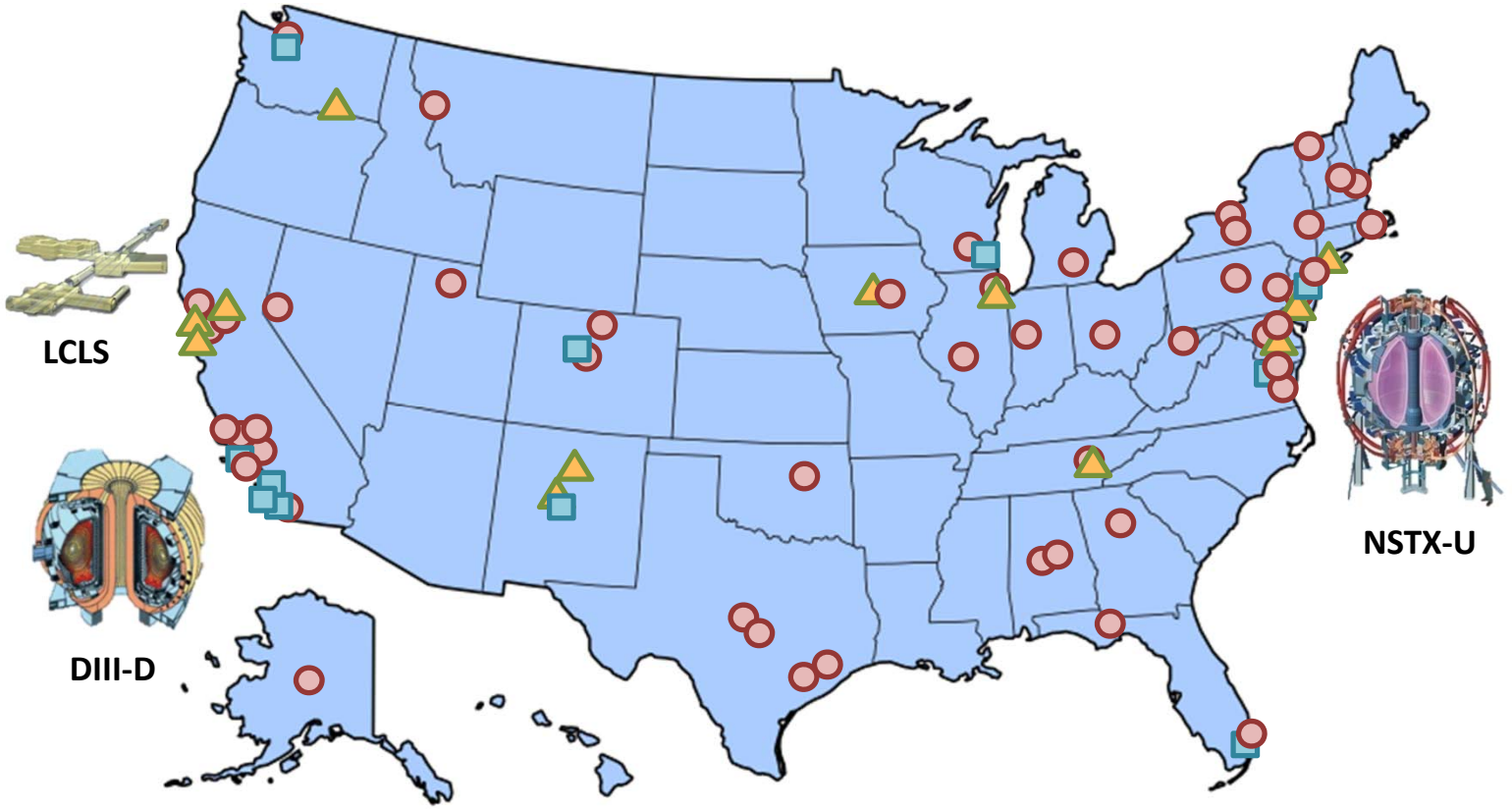
FES research is carried out at a diversity of US institutions



53 universities

12 businesses

10 laboratories



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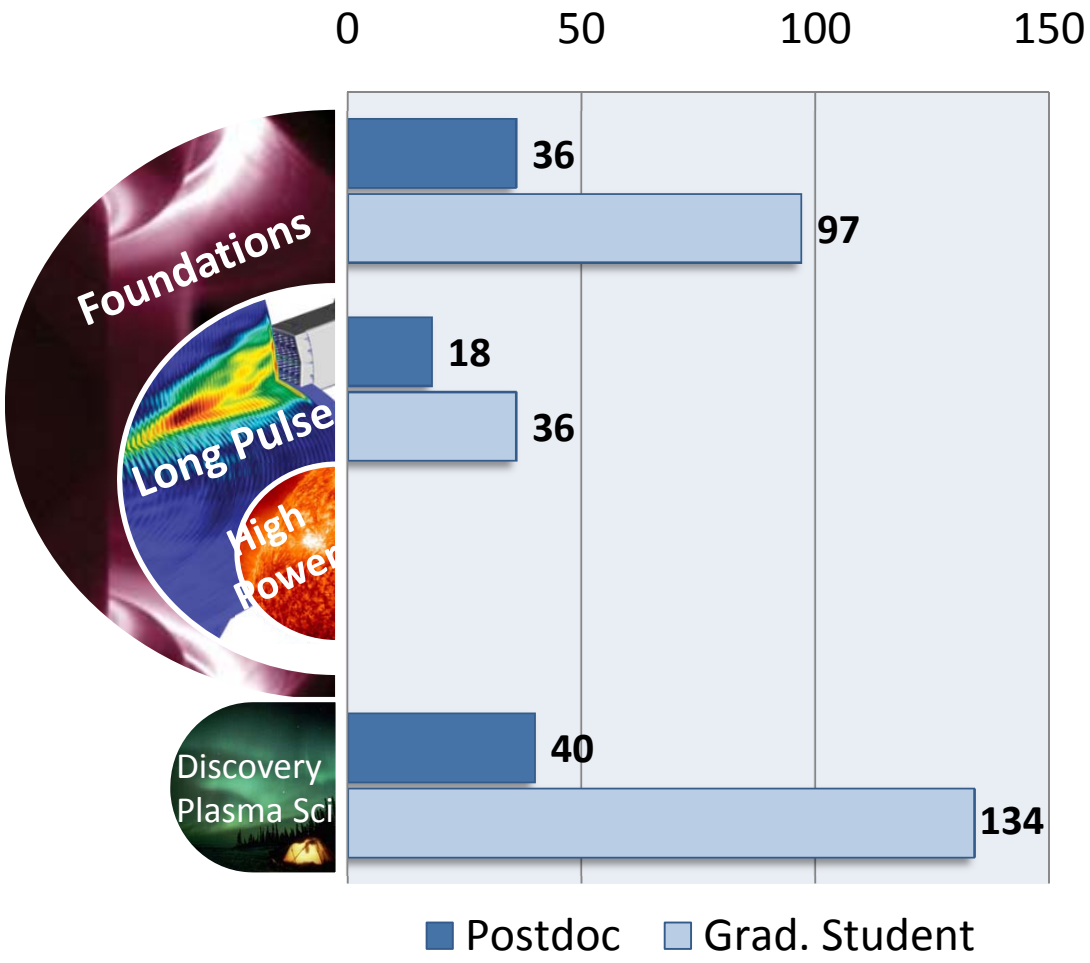
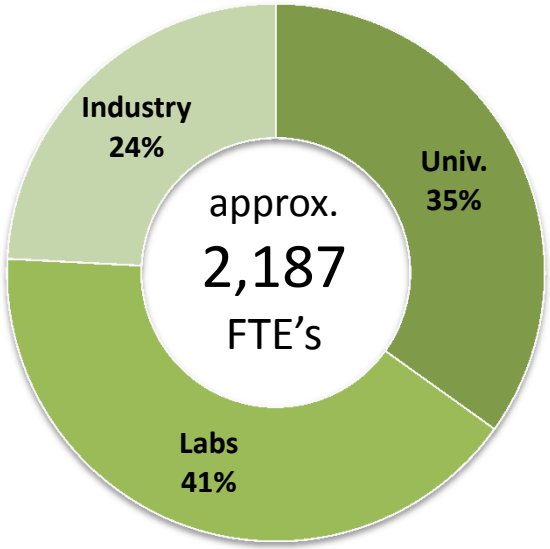
Summary of FES research participants in FY 2015

Graduate Student and Postdoc FTE Estimates in FY 2015



Scientific Employment Estimate in FY 2015



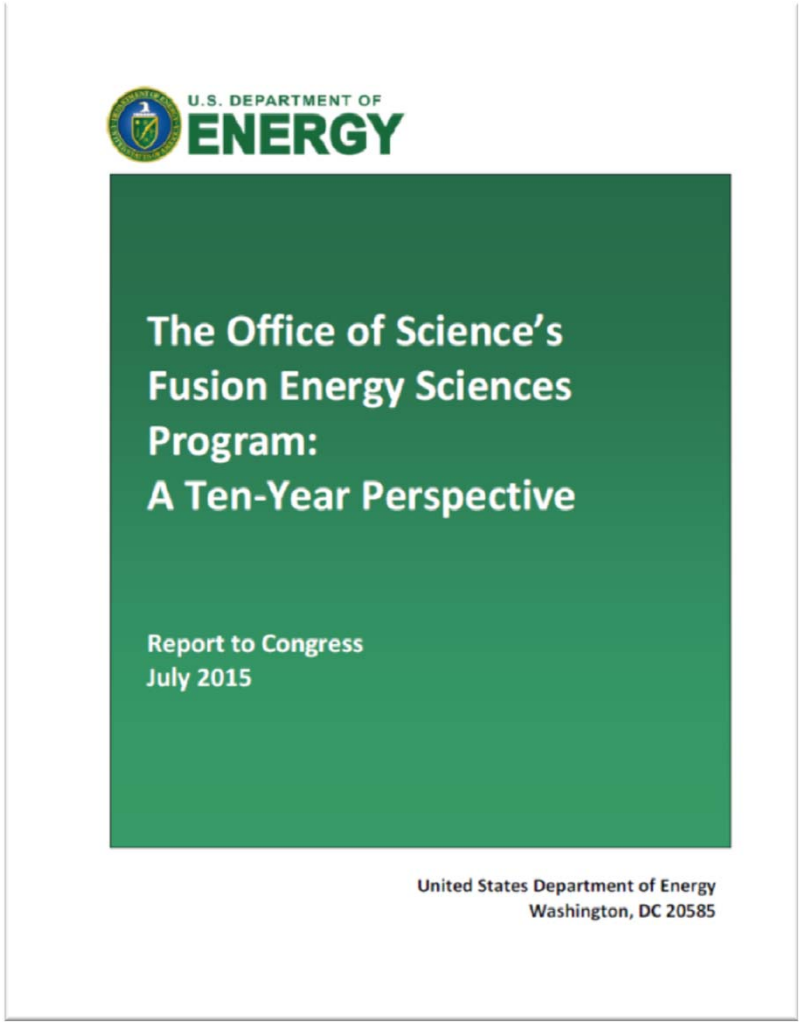
2. Current Events

FES strategic plan

Major themes of the FES strategic plan

- ***Massively parallel computing*** with the goal of validated whole-fusion-device modeling will enable a transformation in predictive power, which is required to minimize risk in future fusion energy development steps.
- ***Materials science*** as it relates to plasma and fusion sciences will provide the scientific foundations for greatly improved plasma confinement and heat exhaust.
- Research in the prediction and control of ***transient events*** that can be deleterious to toroidal fusion plasma confinement will provide greater confidence in machine designs and operation with stable plasmas.
- Continued stewardship of ***discovery in plasma science*** that is not expressly driven by the energy goal will address frontier science issues underpinning great mysteries of the visible universe and will help attract and retain a new generation of plasma/fusion science leaders.
- ***FES user facilities*** will be kept world-leading through robust operations support and regular upgrades.

- The strategic plan responds to several recent Congressional requests, viz., concerning a strategic plan (FY14), a fusion simulation program (FY14), and community workshops (FY15). It also responds to four legacy reporting requirements.
- The plan is presently going through concurrence in the Administration.



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Community engagement workshops

- Following the FESAC *Strategic Planning and Priorities Report* (2014), FES sought further community input about scientific challenges and opportunities through a series of technical workshops in 2015 on priority research areas.
- Be sure to attend the workshop summaries at the Thursday evening town hall meeting (7:30 p.m.)

Workshop	Date	Location	Chair / Co-Chair
Workshop on Plasma-Materials Interactions	May 4-7	PPPL	Rajesh Maingi (PPPL) / Steve Zinkle (Tennessee)
Workshop on Integrated Simulations for Magnetic Fusion Energy Sciences	June 2-4	Rockville, MD	Paul Bonoli (MIT) / Lois McInnes (ANL)
Workshop on Transients	June 8-12	General Atomics	Charles Greenfield (GA) / Raffi Nazikian (PPPL)
Workshops on Plasma Science Frontiers (two)	August 20-21 & Oct. 22-23	Washington, DC area	Fred Skiff (Iowa) / Jonathan Wurtele (UC Berkeley)

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Recent FESAC report on non-fusion-energy applications

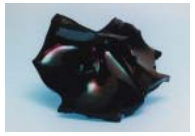
A FESAC subcommittee prepared a report, which was approved by FESAC in July. The final edited, formatted version of the report is available on the FES website.

Basic Materials Science: FES researchers have created dusty plasmas to generate nucleation 'factories' for the production of nanoparticles and nanocrystals developed for efficient solar cells and fuel cells. DOE Basic Energy Sciences Energy Frontier Research Centers. *Photo courtesy of Los Alamos National Lab with the University of Minnesota.*

Medical/Health: Atmospheric and non-neutral plasma physics as well as FES technology spinoffs have enabled a wide range of new medical procedures ranging from plasma surgery to non-evasive imaging to cancer therapy. Plasma tissue welding. *Photo courtesy of Ion Med Ltd.*

National Security: The Electromagnetic Aircraft Launch System, a spinoff from FES development of precision control of sequencing mag - nets, is now replacing the Navy's steam catapults on air - craft carriers. USS Gerald Ford was the first carrier to use the Electromagnetic Aircraft Launch System. Electromagnetic Aircraft Launch Systems. *Photo courtesy of General Atomics.*

Transportation: Safer, more efficient jet engines have been created by spray coating their turbine blades with a ceramic powder that was injected into a flowing plasma jet. Plasma spray-coating improves jet engine turbine blade efficiency and safety. *Photo courtesy of JETPOWER.*



Waste Treatment: FES researchers have developed commercial plasma arc heating technologies to transform hazardous waste into vitrified products—a stable, solid form suitable for safe long-term disposal. Plasma arc vitrification. *Photo courtesy of Pacific Northwest National Laboratory.*

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This year's outgoing FESAC members

Bruce Cohen

Chris Keane

Bob Rosner

Steve Zinkle

Retiring Member	Institution	On FESAC Since
Bruce Cohen	LLNL	January 2009
Christopher Keane	Washington State	August 2010
Robert Rosner	University of Chicago	August 2010
Stephen Zinkle	ORNL	January 2009

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New FESAC members as of June 3

Robert Cauble (LLNL)

Kristina Lynch (Dartmouth)

Stephen Knowlton (Auburn)

Brian Wirth (Tennessee)

New FESAC deputy chair

- Don Rej (LANL)

Change in the 3 *ex officio* members

- Chair of APS-DPP
- Chair of ANS-FED
- President, IEEE-Nuclear and Plasma Science Society (formerly, IEEE-USA President)

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Regarding the next FESAC meeting

- **Next meeting is being planned for January 13-14, 2016**
  - Location details in the DC area will be announced soon

- **Some potential agenda items:**
  - Talk by Under Secretary of Science and Energy
  - Talk by the Director-General of the ITER Organization
  - Reports from the 2015 community engagement workshops, and discussion by FESAC
  - No new charge is anticipated at this meeting

FESAC Committee of Visitors

Status

- COV had 15 members, chaired by Prof. A. Bhattacharjee
- Onsite meeting was held December 2-4, 2014 at DOE-GTN
- Final report was received May 4
- FES written response is in concurrence

Scope of the COV review (FY 2010-2013)

- The panel should consider and provide evaluation of:
  - ***Process***: The efficiency and quality of the processes used by FES to solicit, review, recommend, monitor, and document awards and declinations for universities, national laboratories, and industry
  - ***Quality and Standing***: The breadth, depth, and quality of the resulting program portfolio, and providing an evaluation of the program's national and international standing
  - ***Project Management***: FES's management of its portfolio of line item construction and Major Items of Equipment projects, including the U.S. Contributions to ITER project
- The panel should also comment on FES's progress in addressing action items from the previous COV review

FESAC Committee of Visitors

Examples of COV recommendations and FES responses

Recommendation	Response
Revise VLT structure to move leadership of the program to outside of FES.	FES will appoint a new VLT director, outside of FES,.
Offer regular, targeted FOAs for research on DIII-D and future major tokamak facilities as well as the EPR program	FES issued a new DIII-D collaborative research FOA on July 22. An FOA for the small-scale AT, ST, and stellarator s (formerly EPR) was issued on June 1.
Encourage more site visits as travel budgets allow	If travel budgets allow, FES will increase the number of such visits.
Encourage the use of open-source codes and open proxy applications	FES continues to encourage this
Restore the annual Budget Planning Meetings (or variant thereof).	FES is considering options for a meeting that will provide budgetary information needed by FES and allow sharing of program plans across the U.S. community.

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Inter-office/inter-agency programs

- **Partnership programs:**
  - NSF-DOE Partnership in Basic Plasma Science and Engineering
    - Memo of Understanding was recently renewed to Dec 20, 2021
  - NNSA-SC Joint Program in High Energy Density Laboratory Plasma

- **Career development programs:**
  - National Undergraduate Fellowship (NUF) program
    - Run by PPPL for FES; in FY 2015, combined into the SC SULI program (at labs + GA)
  - Graduate Student Research Awards (SC)
  - ORISE Postdoctoral Research Awards (FES)
  - Early Career Research Awards (SC)

- **Small Business Innovation Research/Technology Transfer**
  - Run by SBIR program within Office of Science
  - Funding is statutorily set at 3.3% of noncapital funding in FY 2015
  - Commercialization is now required as a key review criterion

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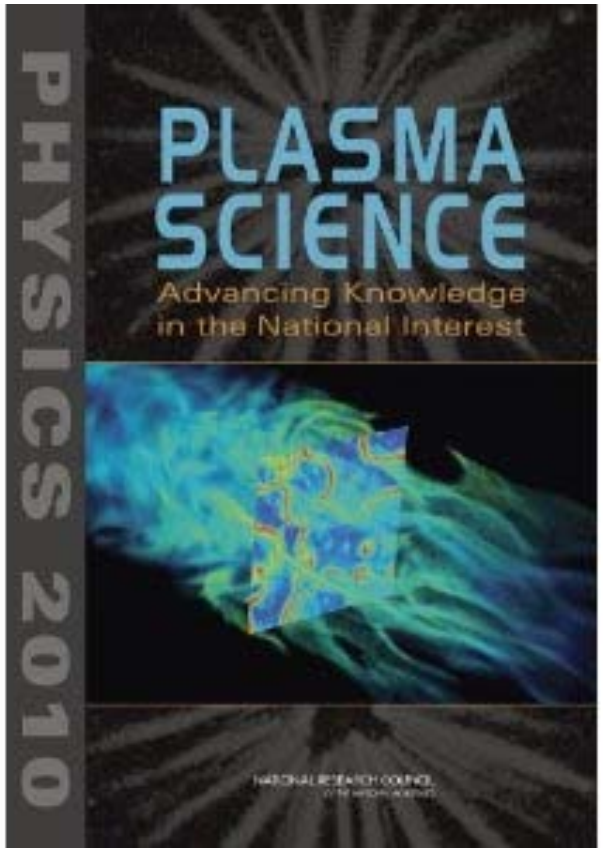
2020 Plasma Decadal Survey



2010 Plasma Decadal Survey
(chair: Steve Cowley)

- **Mechanism:**
  - To be organized by the Plasma Science Committee of the National Research Council (National Academy)
- **Status:**
  - FES is currently discussing the charge with NRC

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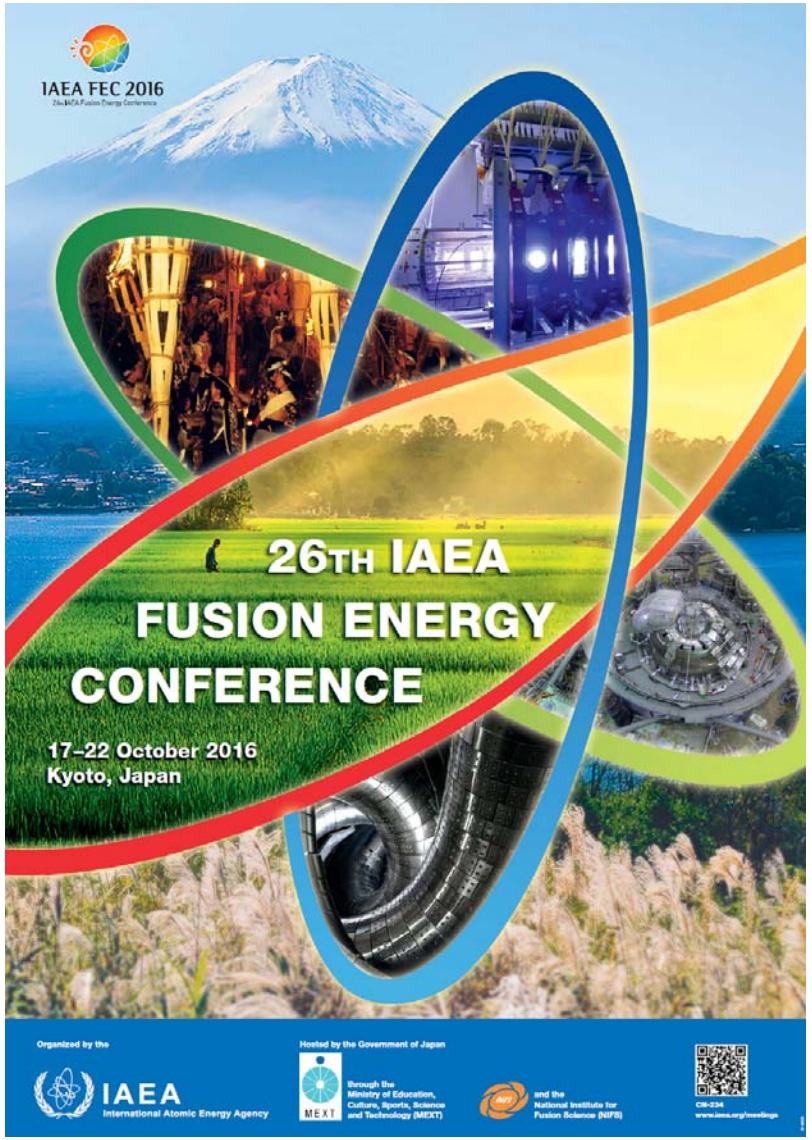
2016 IAEA Fusion Energy Conference

- **26th IAEA Fusion Energy Conference (FES 2016)**
  - To be held in Kyoto, Japan, 17-22 October 2016
- **US paper selection**
  - Mark Foster (FES) is the lead
  - Short abstracts and two-page extended synopses (including ITPA and ITER-related submissions) must be submitted to U.S. Paper Selection Committee by **January 18, 2016**
  - US Paper Selection Committee meeting will meet the first week in February
- **IAEA FEC International Programme Committee**
  - Will meet in Vienna in April
  - US to be represented by five persons



3. Research Highlights

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JRTs & Theory Performance Targets

Joint Research Targets

FY 2015 Joint Research Target (completed)

Conduct experiments and analysis to quantify the impact of broadened current and pressure profiles on tokamak plasma confinement and stability.
[JRT Team was led by Mario Podesta (PPPL)]

FY 2016 Joint Research Target (underway this year)

Conduct research to detect and minimize the consequences of disruptions in present and future tokamaks, including ITER
[JRT team is being led by Bob Granetz (MIT)

Theory Performance Targets

FY 2015 Theory & Simulation Performance Target (completed)

Perform massively parallel plasma turbulence simulations to determine expected transport in ITER.
[Theory Performance Target team was led by Jeff Candy (GA)]

FY 2016 Theory & Simulation Performance Target (underway this year)

Predicting the magnitude and scaling of the divertor heat load width in magnetically confined burning
[Theory Performance Target team is being led by C. S. Chang (PPPL)]

Final report for FES 2014 Joint Research Target
Quantify plasma response to non-axisymmetric (3D) magnetic fields in tokamaks
E. J. Strait et al. (31 contributors), 30 September 2014
http://science.energy.gov/~/media/fes/pdf/program-news/JRT_Final_2014_rs.pdf

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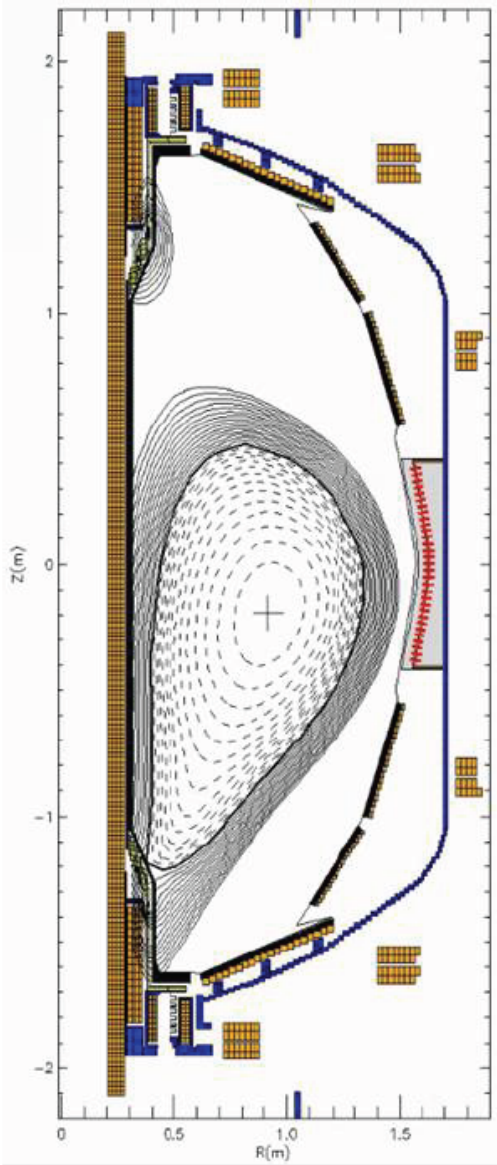
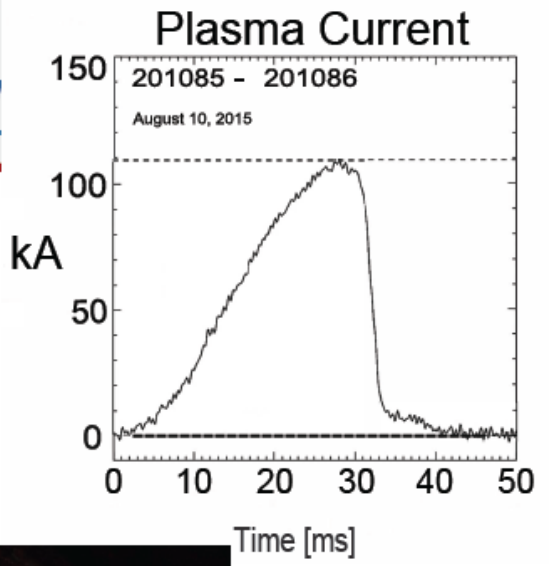
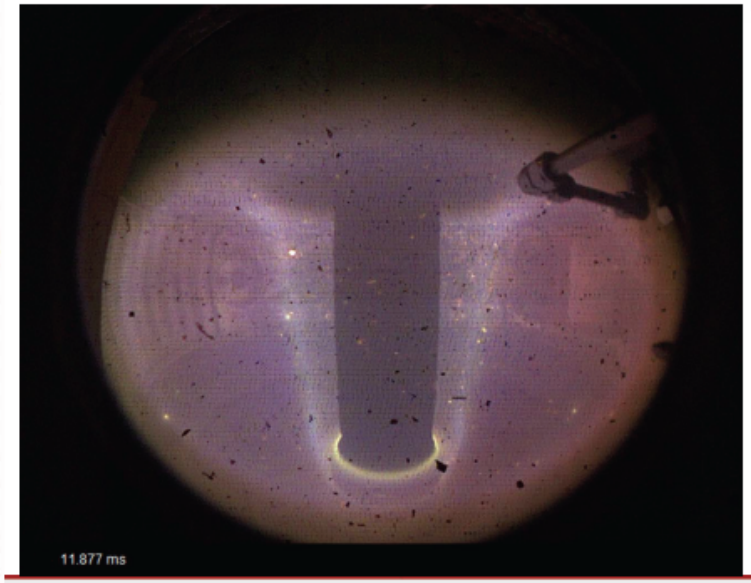
Highlight: NSTX Upgrade project completed



8/10/2015
!! 110 kA Plasma !!

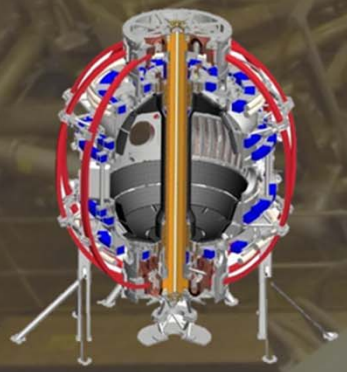
EFIT Reconstruction of the Plasma Shape Available on Very 1st Shot!
[S. Sabbagh Columbia University]





Fast Color Camera Image
[F. Scotti, LLNL]

NSTX-U Project



NSTX-U is the world's highest-performance spherical torus

	NSTX	NSTX-U
Toroidal Field	< 0.5 T	< 1.0 T
Plasma Current	< 1 MA	< 2 MA
Pulse Length	~1.0 s	~ 5 s
NB Heating	5-9 MW	10-18 MW

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Highlight: Multi-scale gyrokinetic simulations with actual ion-to-electron mass ratio

the Science:

Computer simulations of ion transport and confinement in high-temperature tokamak plasmas are now fairly standard, but the simultaneous simulation of the transport of electrons has been very difficult due to their factor-of-2000 mass difference with ions.

Recently, gyrokinetic simulations of both ion and electron transport dynamics, involving widely disparate time and space scales, have been successfully performed for the first time with realistic mass ratio. The simulations used 100 million CPU hours, mostly on the Edison supercomputer at the National Energy Research Supercomputer Center (NERSC) user facility.

the Impact:

The results demonstrate that such multi-scale simulations are required to match with the experimentally measured ion and electron thermal fluxes and profiles and thus resolve a longstanding mystery of electron heat conduction in tokamaks

N.T. Howard et al., submitted to *Nature Physics*

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Highlight: Vertical control experiments via remote operation of EAST 3rd shift from GA

GA Remote Control Room:

Display hardware and software to provide control room experience remotely

Real-time audio/video, streaming of data during shot, display of real-time boundary/ signal traces

GA Science Collaboration Zone:

Dedicated network and cyberspace for between-shot transfer of data to GA

DIII-D provides EAST data repository for all U.S. collaborators

Data mirror at GA serves all US collaborators

First full 3rd shift remote operation July 22 & 23:

Two 3rd shift periods (overnight in China)

Triggered vertical displacement events to assess growth rates, controllability

Validated EAST models & quantified stability effects of new passive plate/coil geometry

By FY 2017, experiments during EAST 3rd shift will enable US scientists to execute full EAST campaign each time EAST runs

General Atomics Remote Control Room supports 3rd shift operation of EAST by US scientists

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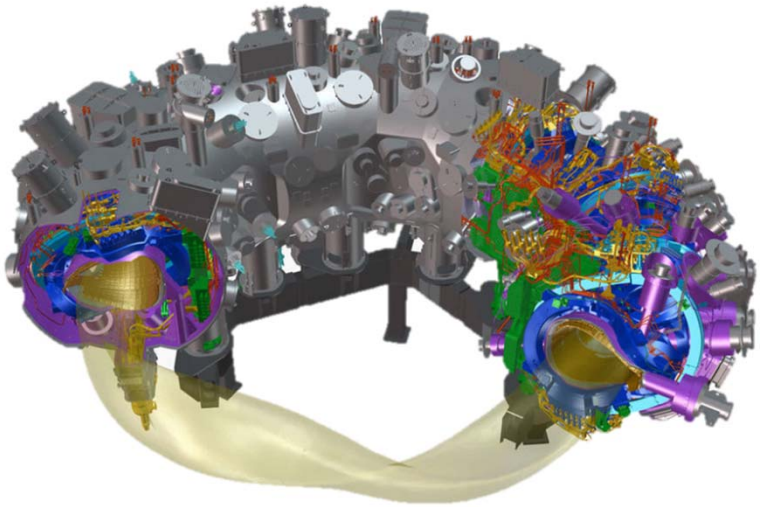
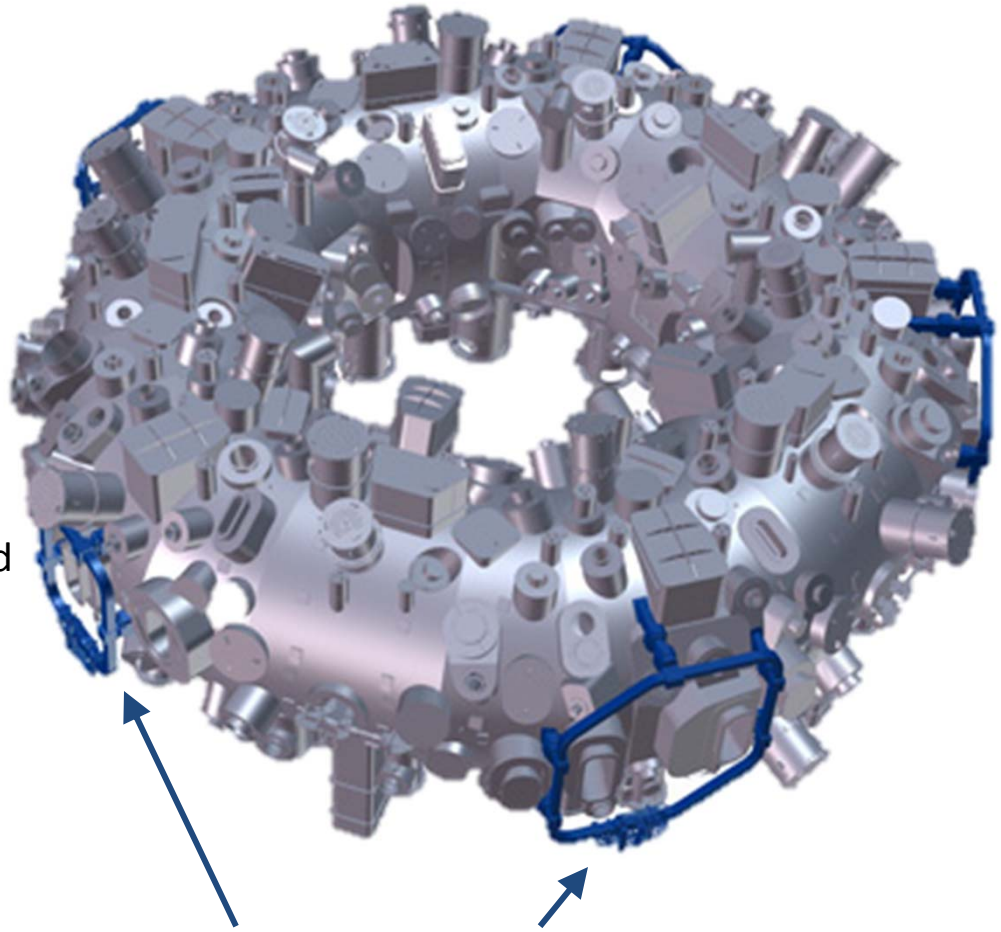
Highlight: In-kind contribution from U.S. for Wendelstein 7-X



The 2,400-pound **trim coils** have been produced at PPPL for the Wendelstein 7-X stellarator, or W7-X, that the Max Planck Institute for Plasma Physics (IPP) has built in Greifswald, Germany. When the machine begins operating in 2015, he powerful coils will fine-tune the shape of the superhot, charged plasma gas that W7-X will use to study conditions required for fusion. In exchange for the coils, U.S. scientists will be able to lead and carry out experiments on W7-X.



Trim coils (5 total)

A recent set of magnet tests on the **W7-X stellarator** has confirmed the accuracy of its three-dimensional magnetic configuration and its technical readiness for plasma operation

After confirming the proper functioning of the coils, the magnetic flux surfaces were measured (see figure), using an electron beam that clearly showed six magnetic islands around the poloidal cross-section, as predicted.

These measurements confirm that the W7-X magnet system has been built and assembled with the accuracy required for good plasma confinement.

The start of plasma operations is expected soon.

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Highlight: Simulations of fusion's harsh environment

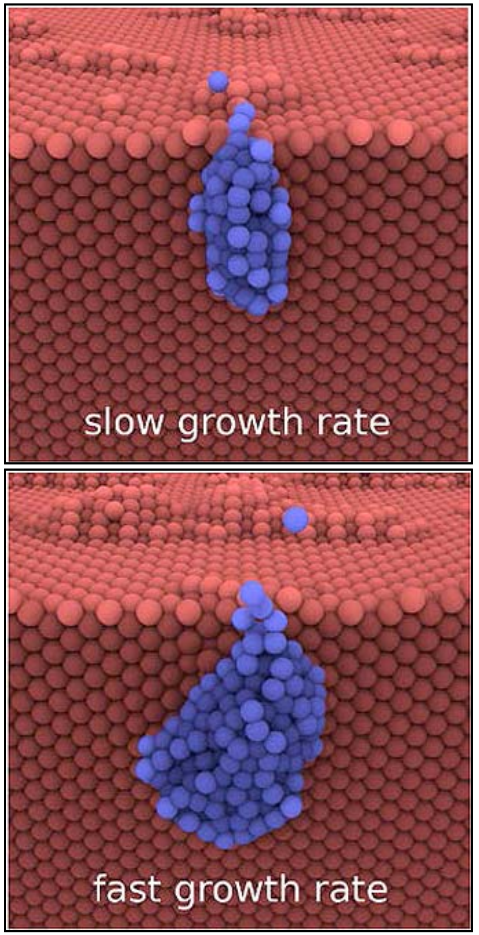
the Science:

Helium bubbles are detrimental to plasma-facing materials such as tungsten. Understanding how helium bubbles form and grow is important for predicting large-scale material response to the extreme fusion environment. The helium simulations find a qualitatively different growth mode when helium arrival rates approach experimental values.

When simulated helium bubbles grow quickly, the surrounding tungsten cannot respond, leading to over-pressurized bubbles that burst violently when they reach the surface. When the bubbles grow more slowly, the tungsten atoms pressed against the bubble's surface can diffuse around it, leading to a smaller bubble when it ultimately bursts.

the Impact:

These results highlight the importance of accounting for all relevant kinetic processes and how these kinetic processes enhance the interaction of, in this case, the helium bubble with the local microstructure. The results further have consequences for the nucleation of surface morphology on the tungsten, which is ultimately the source of fuzz, a nanostructured "steel wool"-like structure that causes significant degradation in performance of the material.



L. Sandoval et al., Phys. Rev. Lett (2015)

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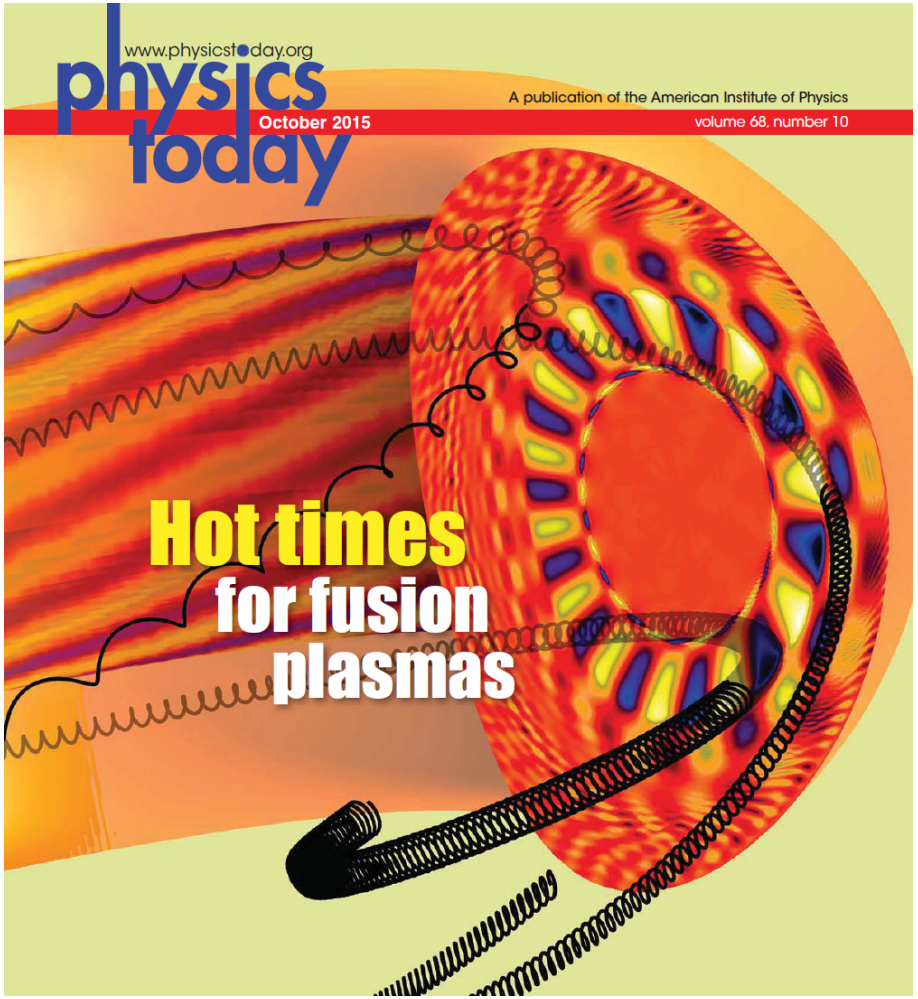
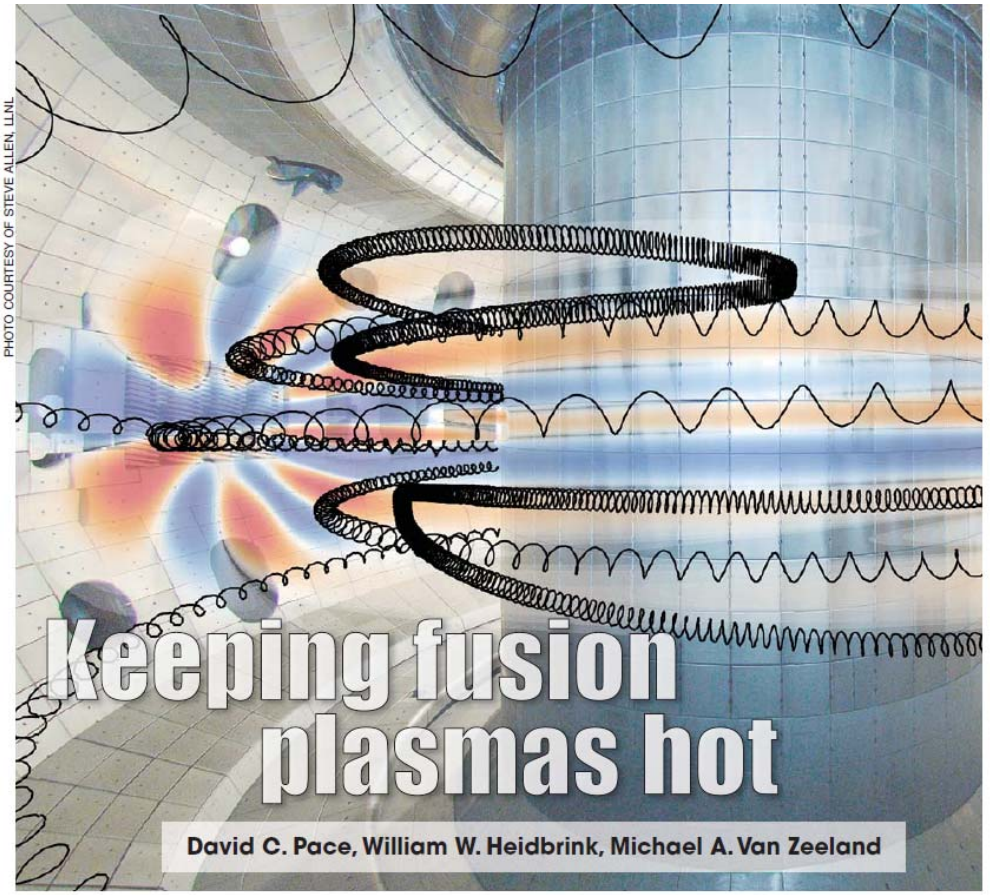
Highlight: Fast particle physics review article on cover of *Physics Today*





Interactions between electromagnetic waves and the most energetic ions in a plasma can perturb the orbits of those ions enough to expel them from the confining magnetic field.

4. People

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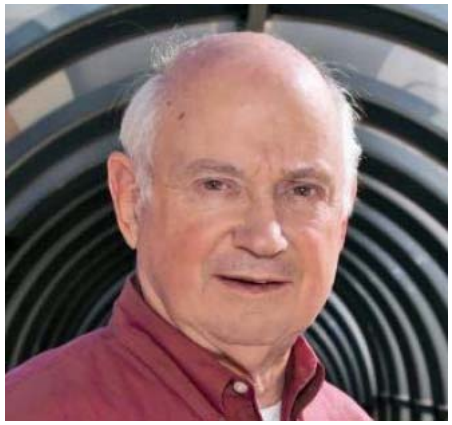
Community leadership changes



Smith

Cohen

Hill

Whyte

- **PPPL:**
  - A.J. Stewart Smith: will retire as Princeton University VP for PPPL (Feb 2016)
  - Adam Cohen: Deputy Director for Operations → DOE Deputy Under Secretary for Science and Energy
- **General Atomics:**
  - Dave Hill: new Director of DIII-D National Fusion Program
- **MIT:**
  - Dennis Whyte: new Director of the Plasma Science Fusion Center

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DOE leadership changes


Sherwood-Randall


Orr


Cohen


Murray

- **Deputy Secretary:**
  - Elizabeth Sherwood-Randall (began Oct 6, 2014)
- **Under Secretary for Science and Energy:**
  - Franklin “Lynn” Orr (began Dec 17, 2014)
- **Deputy Under Secretary for Science and Energy:**
  - Adam Cohen (began Nov 2, 2015)
- **New presidential nominee for Director of the Office of Science:**
  - Cherry Murray (Harvard University)

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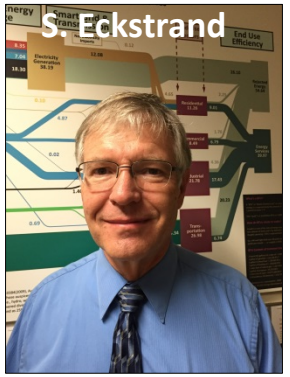
FES personnel changes

- **Program manager retirement:**
  - Steve Eckstrand (Dec 2014): 39 years at FES (NSTX, Intl, TFTR, etc.)
- **New program managers**
  - Daniel Clark: fusion materials
  - Josh King: NSTX-U
- **Short-term**
  - Bob Bartolo (AAAS Fellow) and Eric Edlund (detailee)
- **Summer interns**
  - Cynthia Li (Columbia) and Darius Stanton (Duke)
- **New job postings**
  - GPS/HEDLP program manager (applications being processed)
  - MFE program manager (posted on November 16)



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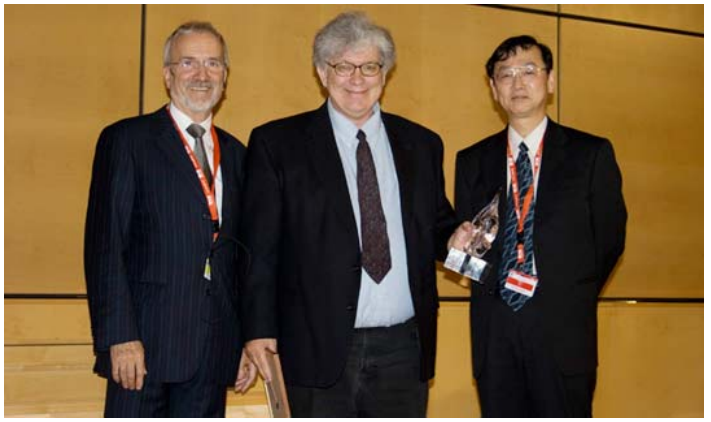
Recent *Nuclear Fusion* Prizes

2014: Phil Snyder (GA)

2013: Dennis Whyte (MIT)

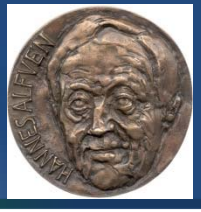
2010: John Rice (MIT)

2009: Steve Sabbagh (Columbia)

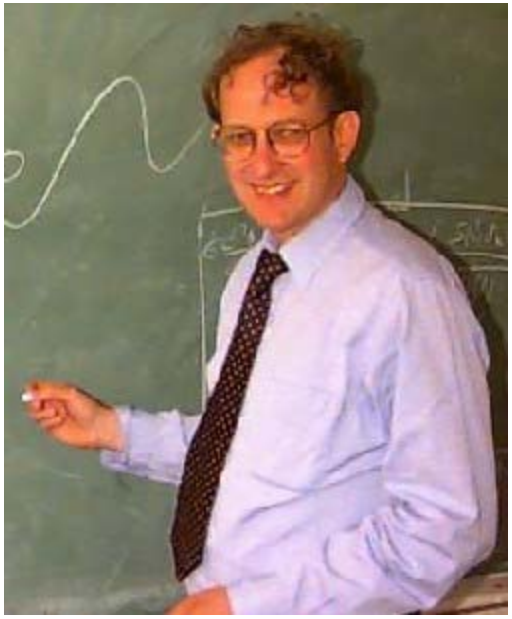


2008: Todd Evans (GA)

2006: Tim Luce (GA)



2015 EPS Alfven Prize



Hannes Alfven Prize of the European Physical Society awarded to Prof. Nathaniel Fisch (PPPL)

- Fisch was cited "*for his contributions to the understanding of plasma wave-particle interactions and their applications to efficiently driving currents with radio-frequency waves*."
- He received the award at the 2015 EPS Division of Plasma Physics Meeting (June, Lisbon)
- NOTE: This prize was also awarded to U.S. scientists in 2013, 2012, 2011, 2010, 2008, and 2002 (since its inception in 2000).

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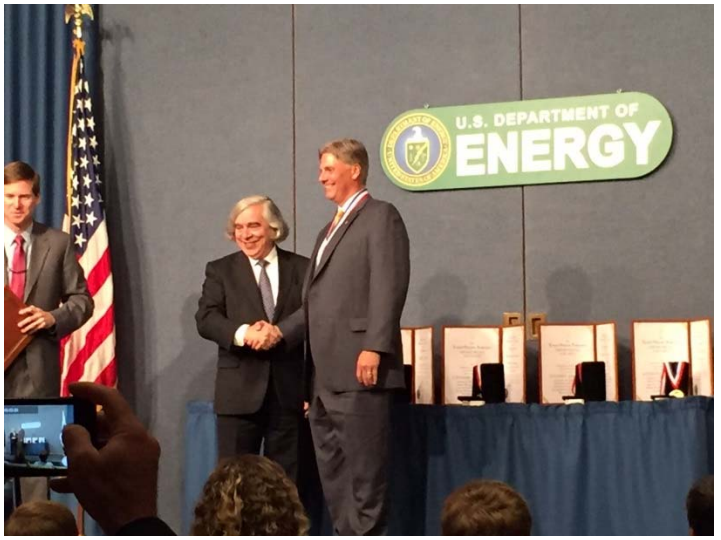
2014 E. O. Lawrence Award



E. O. Lawrence Award of the U.S. Department of Energy awarded to Prof. Brian Wirth (U. Tennessee-Knoxville)

- Wirth was cited "*for transformational advances in computational multiscale modeling of radiation effects in materials, and for their impact to fission and fusion energy technologies.*
- He received the award at a ceremony at the US Dept of Energy on July 23.

Early Career Research Program

- **FES operated Junior Faculty Award program during FY 1997-2008**
  - 95% (36 out of 38) awardees went on to achieve tenure
  - Solicitation was not held in FY 2009

- **Replaced by Office of Science-wide Early Career award program, beginning in FY 2010**
  - ARRA funds supported all awards (fully funded) in FY 2010
  - Program was expanded beyond tenure-track faculty to include "permanent" national lab junior researchers
  - Beginning with FY 2014, Early Career awards to university scientists must be full-funded (since $150K/yr X 5 yrs = $750K is less than $1M)

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2015 FES Early Career Awards

Dr. Oliver Schmitz (Wisconsin)
Plasma Material Interaction with Three-Dimensional Plasma Boundaries

Dr. Chad Parish (ORNL)
Damage Mechanism Interactions at the Plasma-Materials Interface

Dr. Lorenzo Mangolini (UC Riverside)
On the Interaction between Non-Thermal Plasmas and Small Metallic Particles

Dr. Luis Aparicio-Delgado (PPPL)
Active Impurity Control for Maximum Fusion Performance

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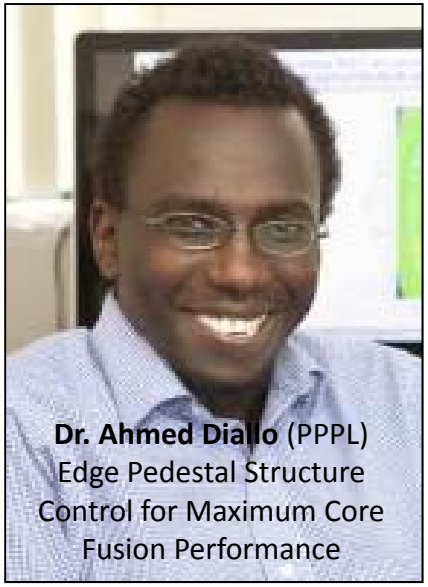
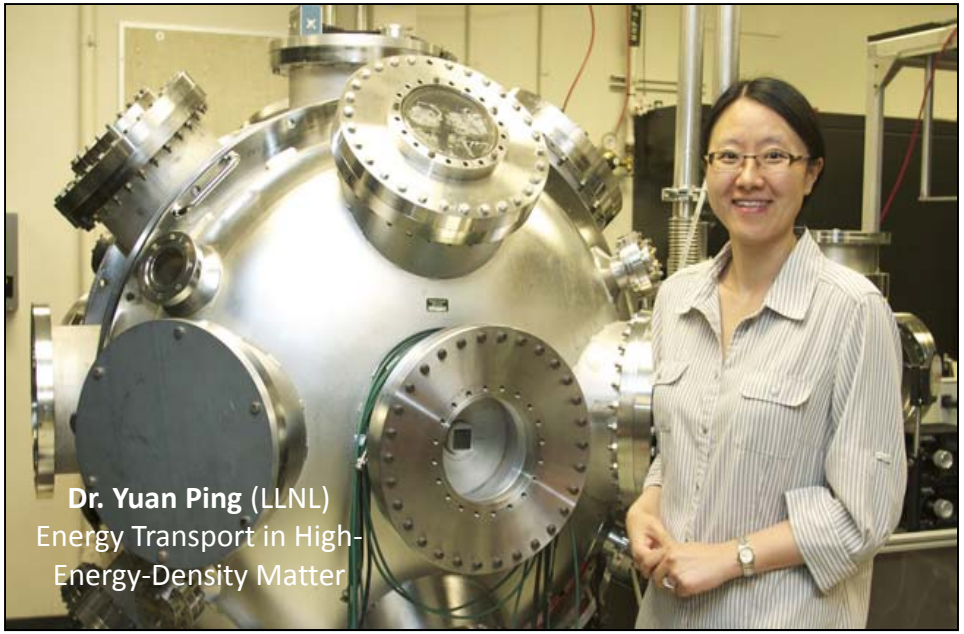
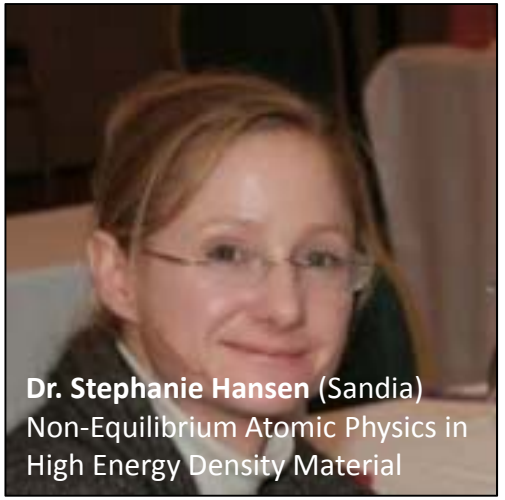
FY 2013-14 Early Career Awards for Fusion Energy Sciences



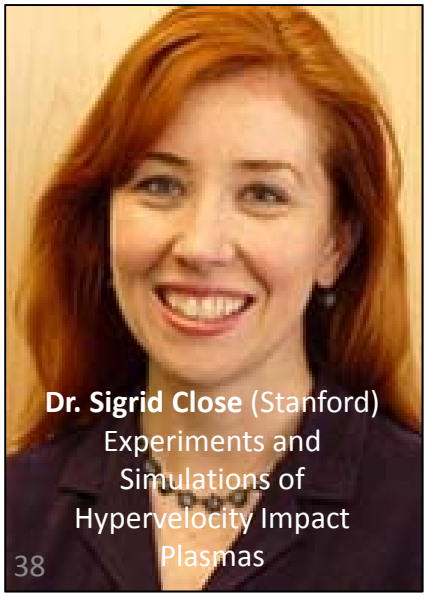
Dr. Ahmed Diallo (PPPL)
Edge Pedestal Structure Control for Maximum Core Fusion Performance



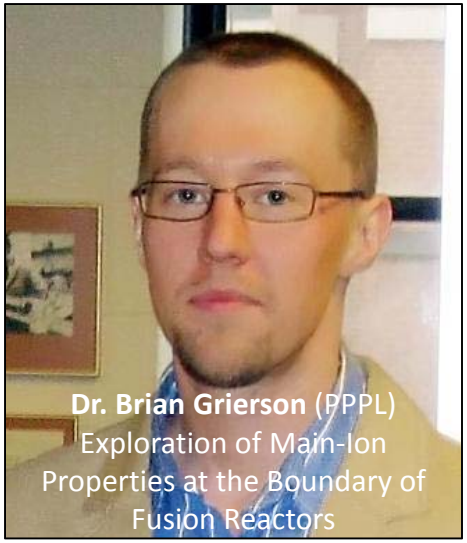
Dr. Yuan Ping (LLNL)
Energy Transport in High-Energy-Density Matter



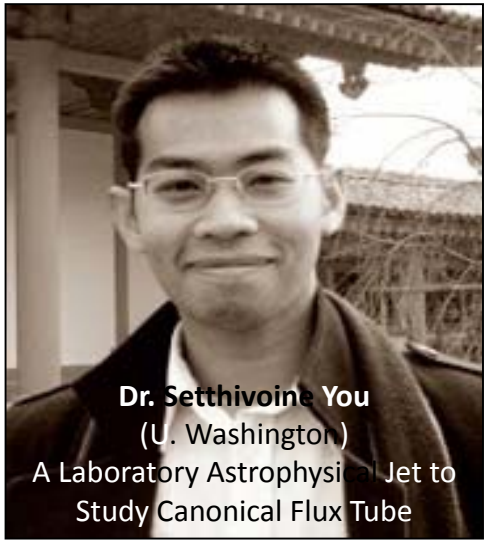
Dr. Stephanie Hansen (Sandia)
Non-Equilibrium Atomic Physics in High Energy Density Material



Dr. Sigrid Close (Stanford)
Experiments and Simulations of Hypervelocity Impact Plasmas



Dr. Brian Grierson (PPPL)
Exploration of Main-Ion Properties at the Boundary of Fusion Reactors



Dr. Setthivoine You
(U. Washington)
A Laboratory Astrophysical Jet to Study Canonical Flux Tube

Dr. Antoine Cerfon (NYU)
High-performance equilibrium solvers for integrated magnetic fusion simulations

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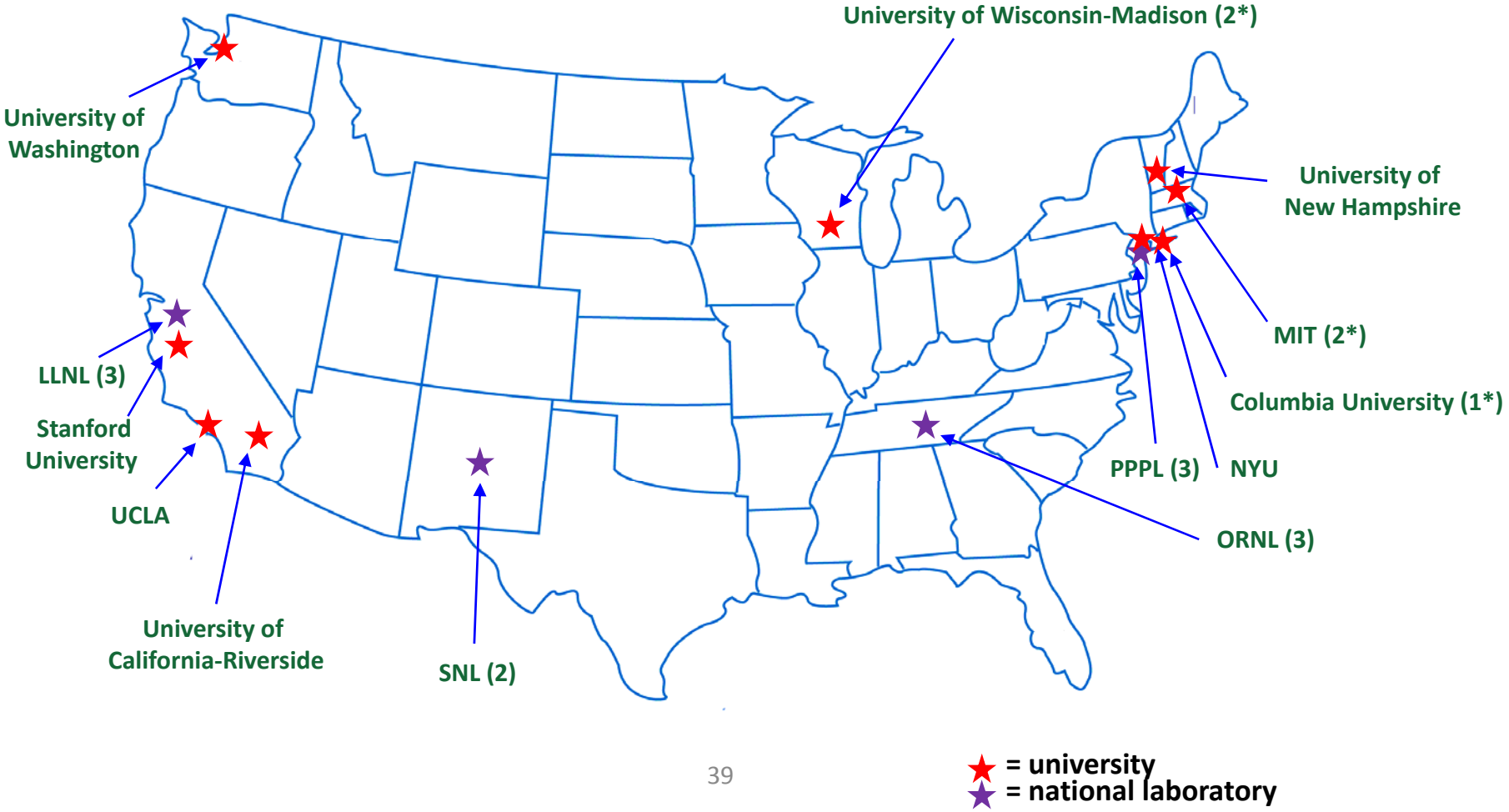
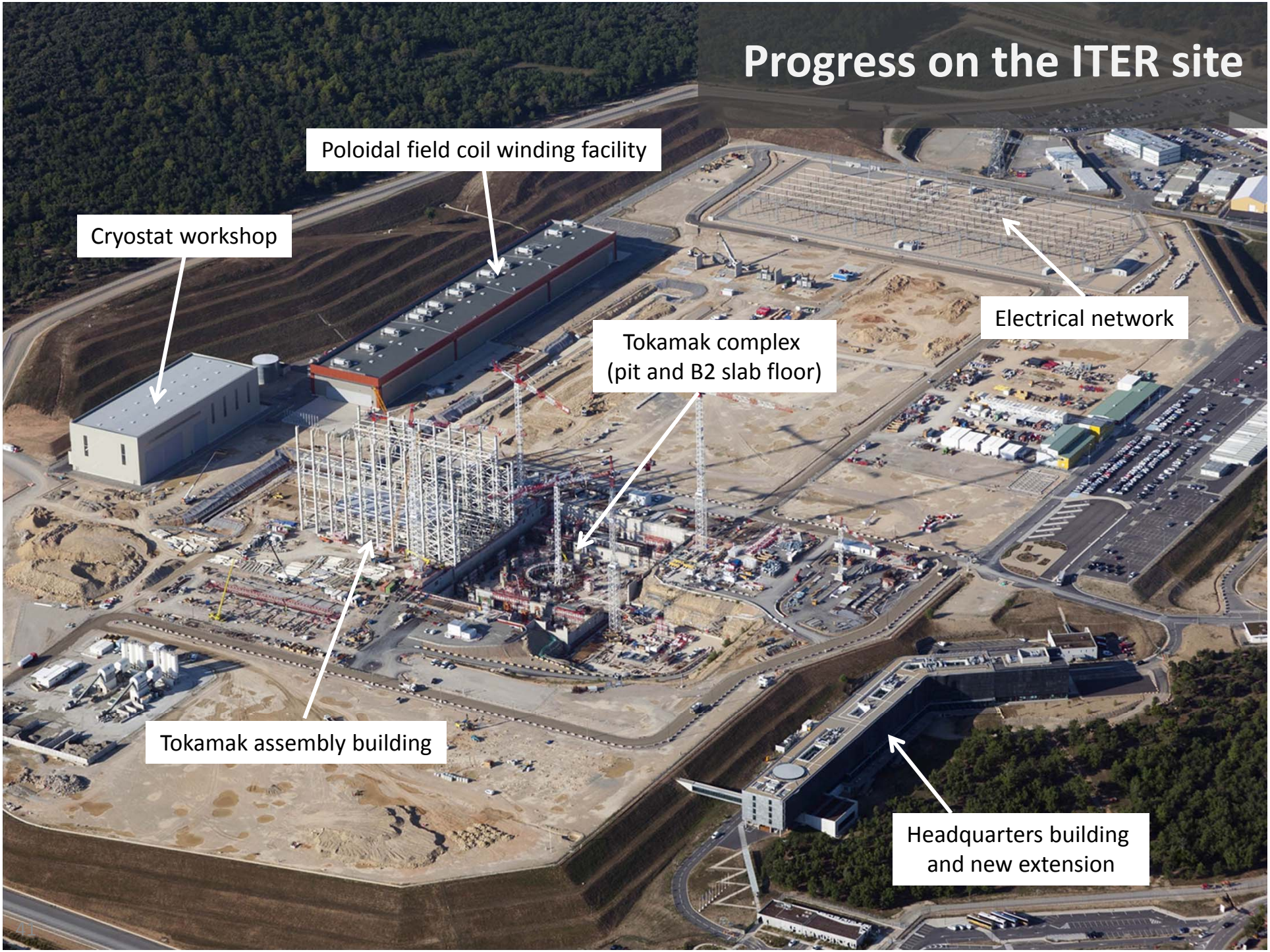
FES Early Career Awards by Institutions (FY 2011-2015)

Recent new universities in the program:

- Washington, Stanford, NYU, UC Riverside



5. Status of ITER


Progress on the ITER site
Poloidal field coil winding facility
Cryostat workshop
Electrical network
Tokamak complex
(pit and B2 slab floor)
Tokamak assembly building
Headquarters building
and new extension

First Pillars of Diagnostic Building

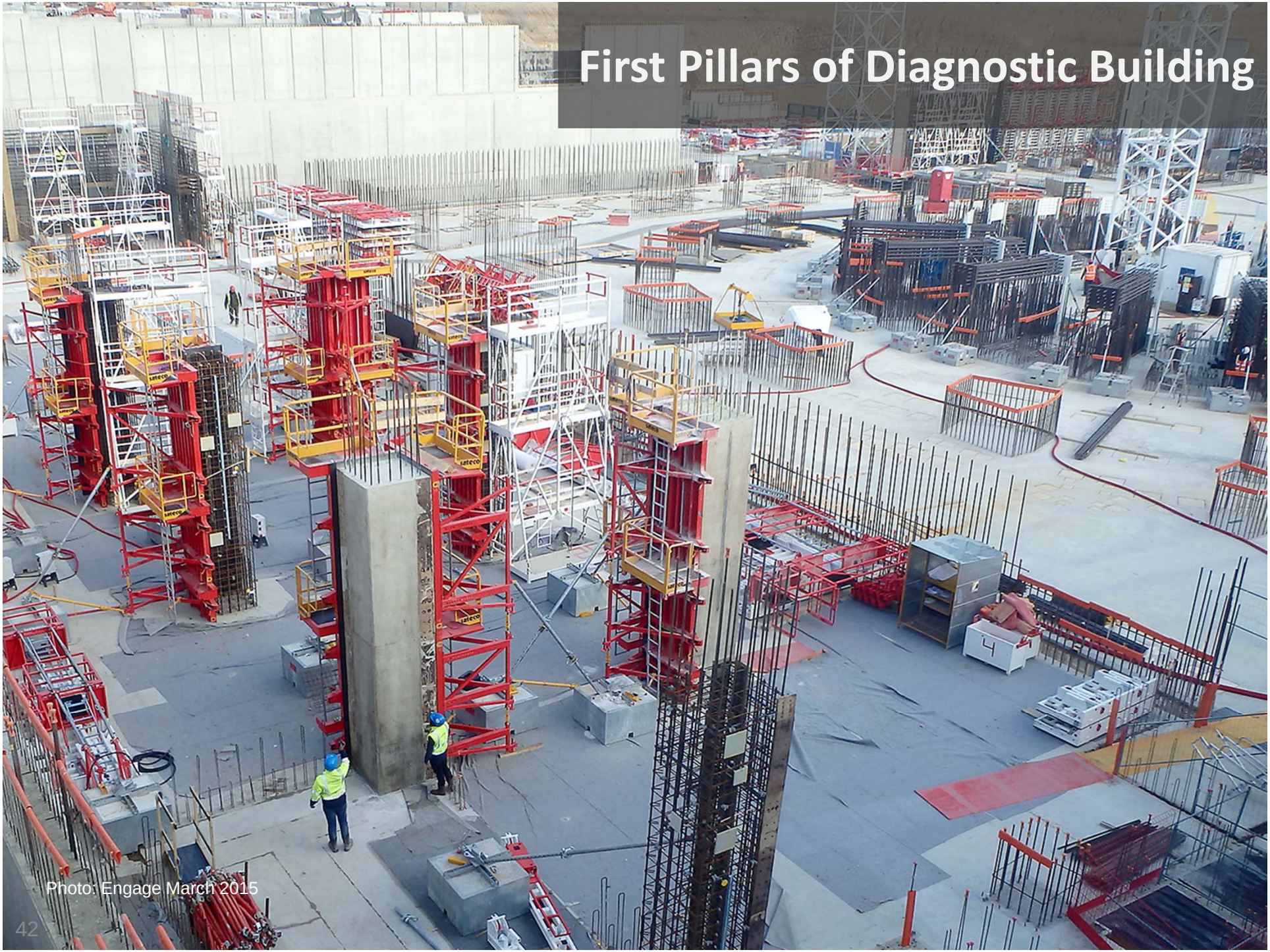


Photo: Engage March 2015

ITER Assembly Building Roof

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ITER site from the air

- Drone video of ITER work site

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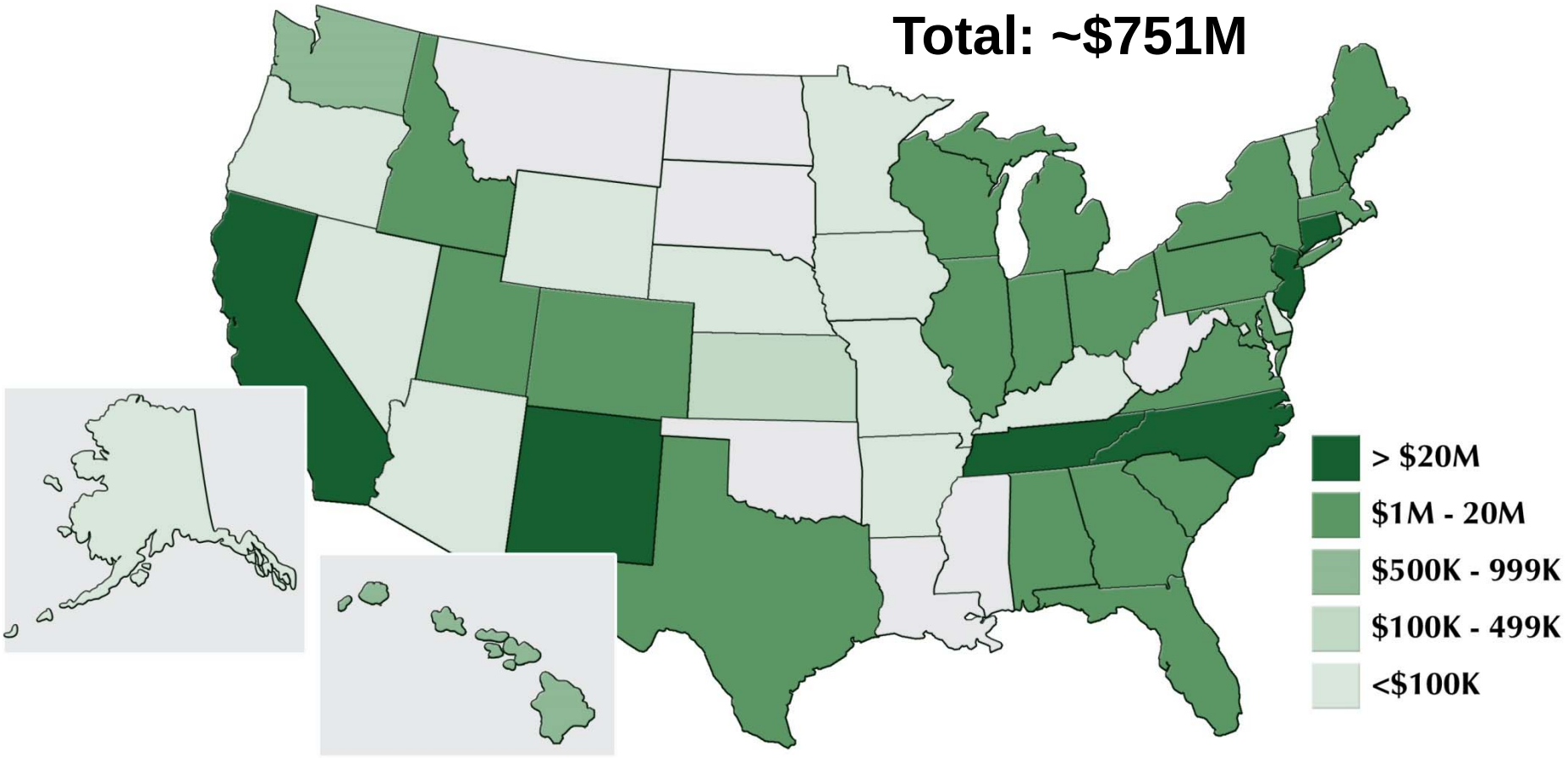
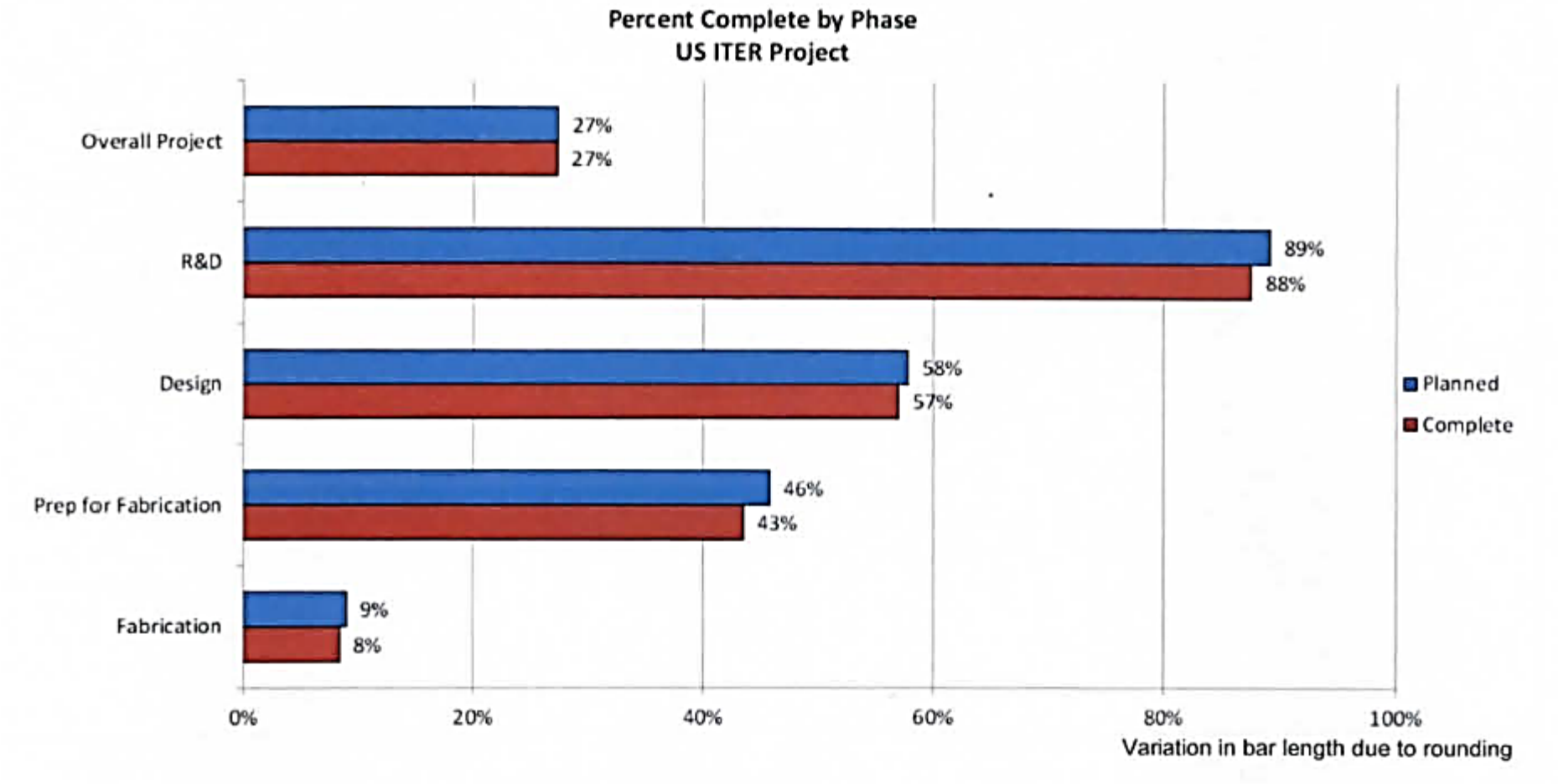
Over 80% of awards and obligations is being spent in the U.S.

As of June 2015, over $751M has been awarded to U.S. industry and universities and obligated to DOE national laboratories in 43 states plus the District of Columbia.



This data does not include contracts awarded to U.S. Industry by the EU (>$55M) and by Korea (>$23M).

Project execution is underway



Central solenoid fabrication facility ramping up at General Atomics in Poway, California

- 5 of 11 tooling stations in place
- 2 of 11 tooling stations in operation
- Mock-up winding completed
- First production module winding started

Completed Shipments of Toroidal Field (TF) Conductor to EU:

US TF 800 m sample (non-superconducting) conductor – *Delivered June 2014*

US TF 100 m active (superconducting) conductor – *Delivered July 2014*

US TF 800 m production (superconducting) conductor – *Delivered January 2015*

Upcoming Shipments:

US TF 100 m active conductor – *Packaged and ready for shipment*

US TF 800 m production conductor – *September/October 2015*

Close-up view of the Oxford 100 m active conductor before packaging.

Photo US ITER

A 61,000 gallon drain tank (below) is part of the first shipment of two tanks; the tanks were delivered to Fos-sur-Mer, France on April 26, 2015.

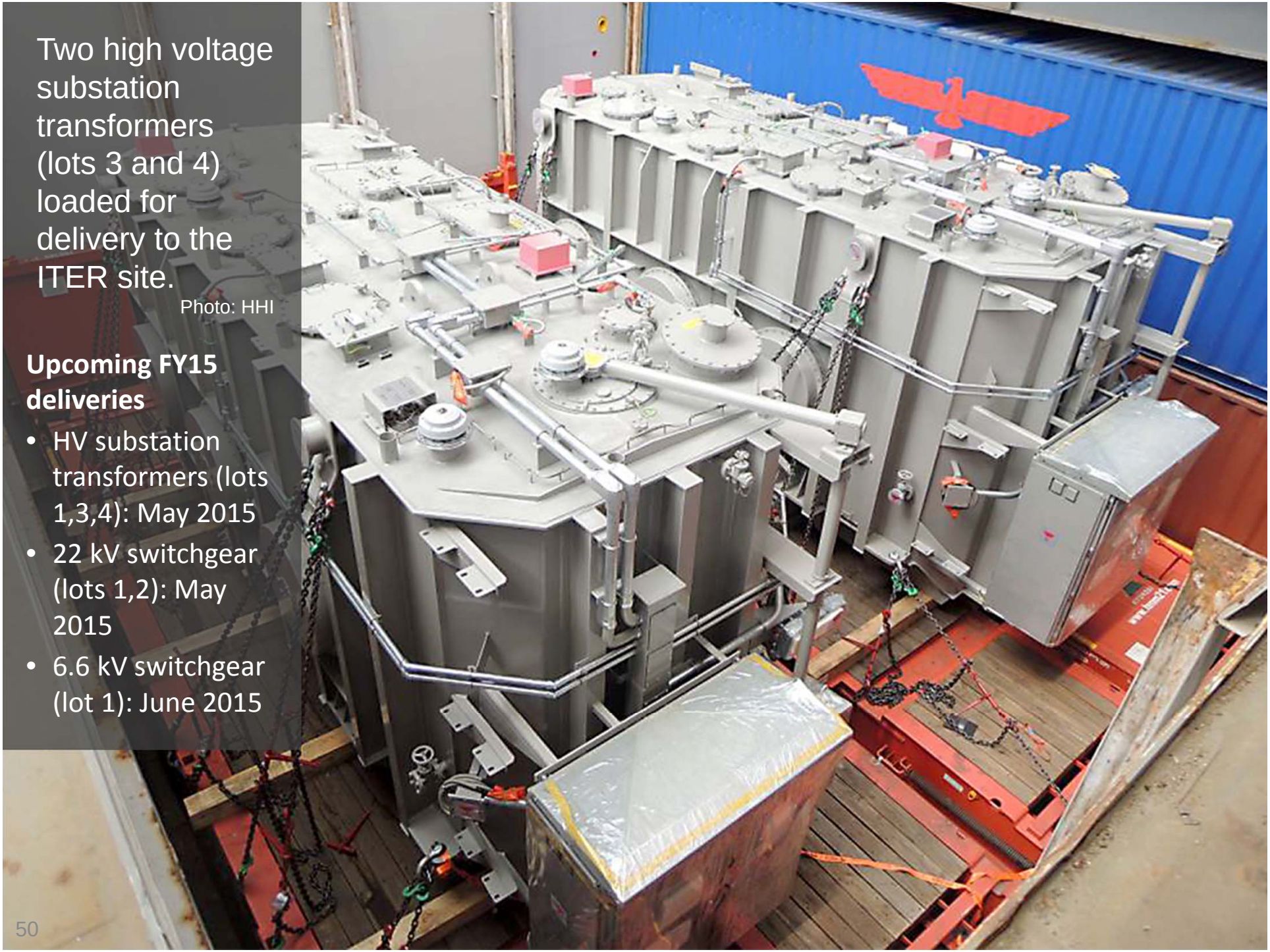
Photo: US ITER

Two high voltage substation transformers (lots 3 and 4) loaded for delivery to the ITER site.

Photo: HHI

Upcoming FY15 deliveries

- HV substation transformers (lots 1,3,4): May 2015
- 22 kV switchgear (lots 1,2): May 2015
- 6.6 kV switchgear (lot 1): June 2015



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Key Elements of DG Action Plan

ITER Director-General Bernard Bigot
photo ITER

- Director-General (appointed in March) is responsible for overall project
- Central Reserve Fund established
- Integrated IO-CT and IO-DA management including an Executive Project Board
- 200-day implementation plan underway addressing:
  - Organization
  - Project management
  - Engineering management
  - Construction management
  - Development of resource-loaded schedule and baseline
- The U.S. Administration is fully engaged and is monitoring the progress of these activities closely
- Dr. Bigot will speak at the FPA Annual Meeting (Dec 16-17) and the upcoming FESAC Meeting (Jan 13-14)

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ITER Advisory Committees and Council

- **STAC-19 charges**
  - Assess the technical aspects of Updated Long-Term Schedule
  - Assess progress on neutronics issues
  - Assess progress on in-vessel coils (for vertical stabilization and ELM control)
- **MAC Mtg:** Oct 27-29
- **ITER Council Mtg:** November 18-19

Participants at STAC Meeting

- **"Research in Support of ITER"** contributed oral session (Thurs AM, Nov 19)

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ITER International School

- **The ITER International School (IIS) is an annual event jointly organized by the Aix-Marseille University and the ITER Organization**
  - The primary objective of the IIS is to provide a regular forum for conducting a post-graduate training school in the area of fusion science for young researchers with a view to attracting them to participate in the scientific exploitation of ITER.

- **2015 ITER International School**
  - The 2015 edition will take place December 14-18 at the University of Science and Technology of China (USTC) in Hefei, China, hosted by USTC and the Academy of Sciences Institute of Plasma Physics (ASIPP)
  - The theme chosen for 2015 is *Transport and Pedestal Physics in Tokamaks*

- **USBPO scholarships**
  - Scholarships for U.S. students/postdocs to participate are available through the US Burning Plasma Organization

Aix*Marseille université
USBPO U.S. BURNING PLASMA ORGANIZATION
National Institute for Fusion Science

Thank you