PPPL PRINCETON PLASMA PHYSICS LABORATORY

PRINCETON UNIVERSITY

PPPL Perspective and Strategy

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PPPL Perspectives and Strategy

- Strong participation in ITER is essential for the US and the world fusion program
  - → ITER construction, predictive understanding of burning plasma
- Innovation is needed to create shared excitement and opportunity within the US community and with our stakeholders
  - → alternative approaches to our common challenges, with viable development path
  - → reduced cost and scale, but not excitement, for US next step
- Strong linkages with other science areas required for the long-term vitality of our community
  - → space plasma, HEDP, plasma chemistry, …

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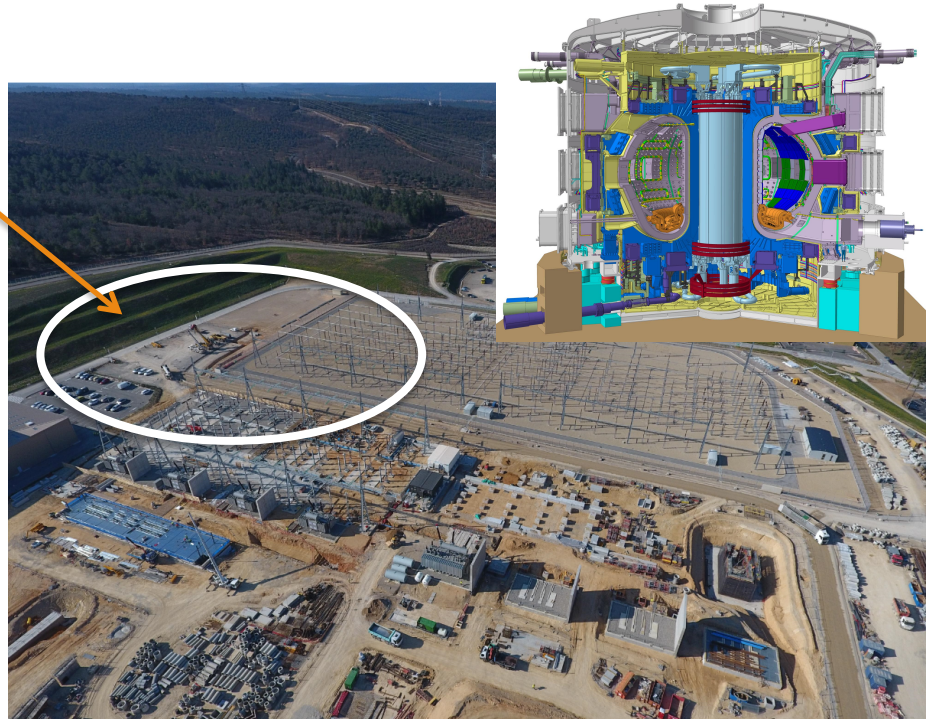
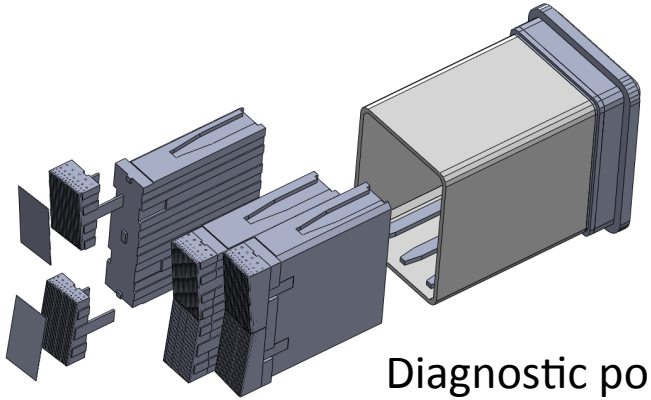
PPPL & the US Delivered Major Contributions to ITER in 2017

- ITER Steady State Electrical Network delivered ($35M)
- Operational in March, final shipment in September.
- PPPL also managed the US community effort in diagnostics





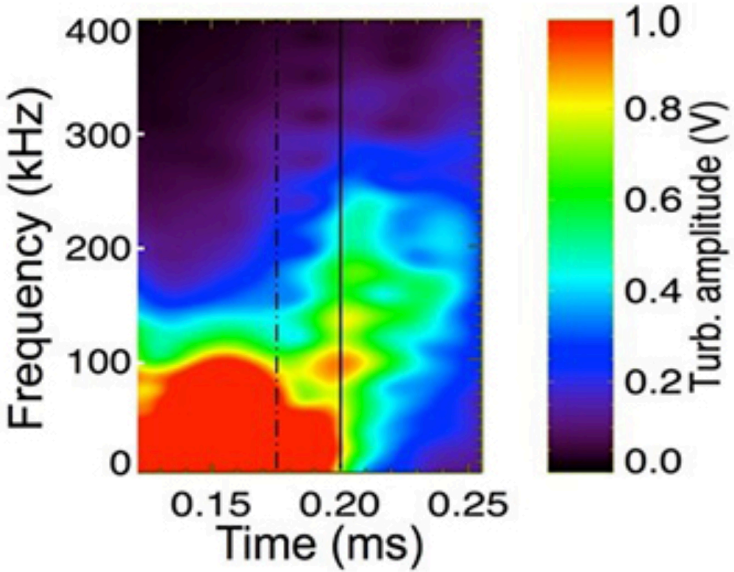
Diagnostic port plug

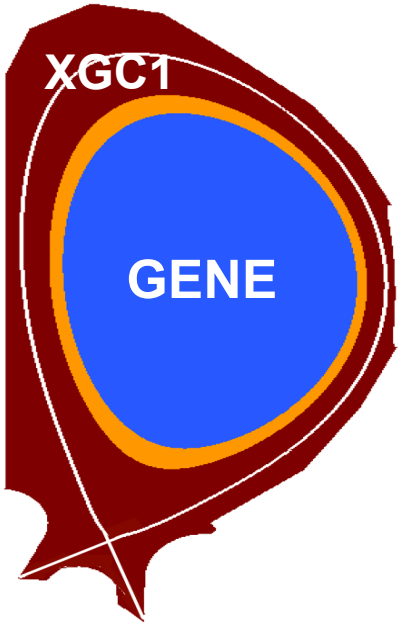
Exascale Project Is A Key Component of the PPPL Strategy for Predictive Understanding of Burning Plasma

- Fusion exascale project explores core-edge integration building on key SciDac models (GENE+XGC1)

- New insights gained from advanced multi-physics simulation on the path to exascale computing

L-H transition: XGC1 (PRL, 2017)

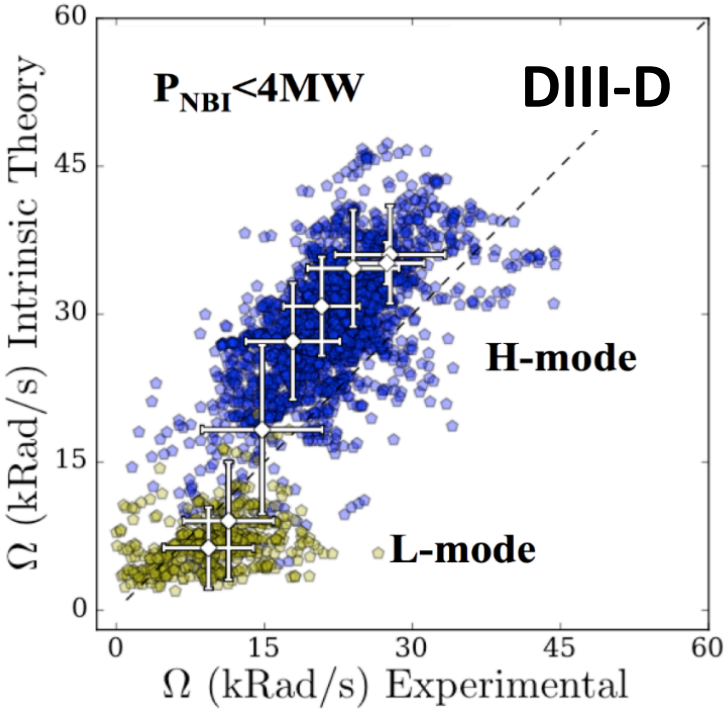




PPPL is Leading an Effort to Measure and Understand the Origin of Rotation in Tokamak Plasmas

- Intrinsic rotation plays a key role in confinement and stability
- PPPL collaborates with DIII-D to directly measure deuterium rotation at low torque, and to
- Validate models of rotation for extrapolation to ITER

Intrinsic rotation, Theory vs. experiment
APS invited 2017



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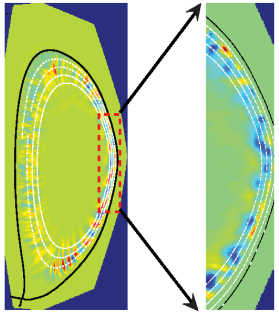
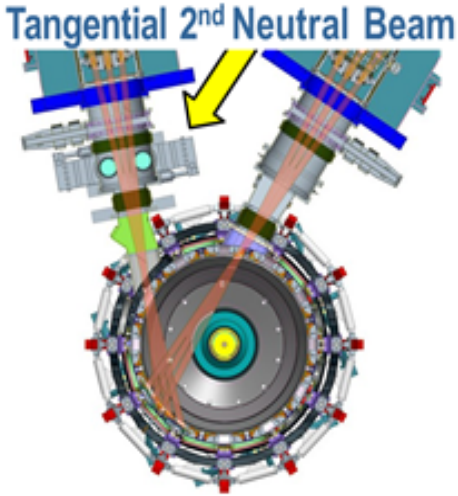
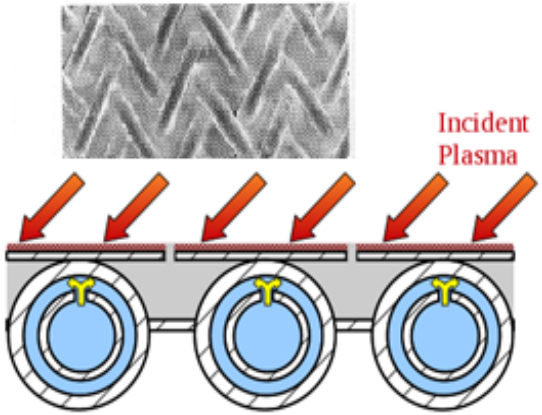
NSTX-U Will Pursue Transformative Ideas to Enable Accelerating Fusion Development



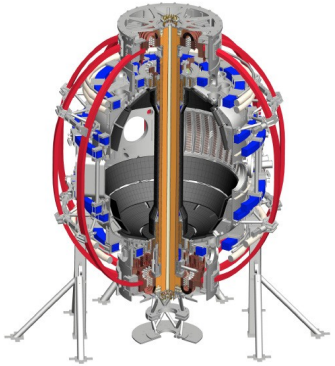
Extend ST physics understanding to fusion-relevant temperatures, contrast to larger A tokamaks



Demonstrate sustainment for future steady-state operation



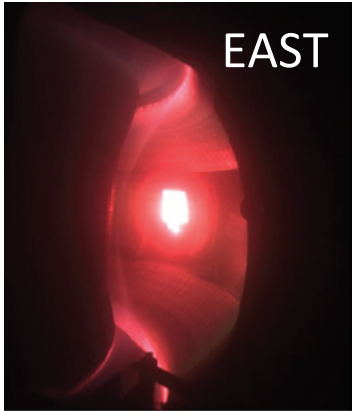
Test of liquid metals as transformative wall solution

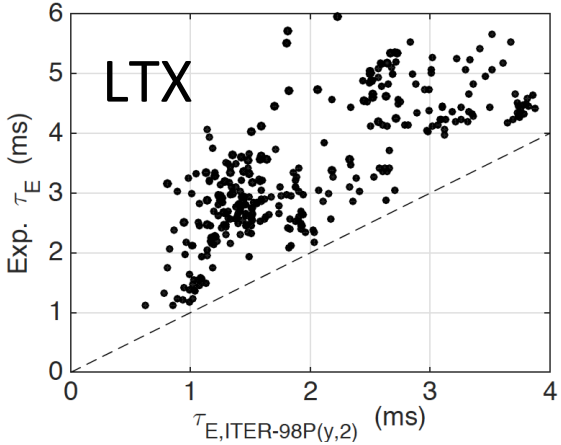


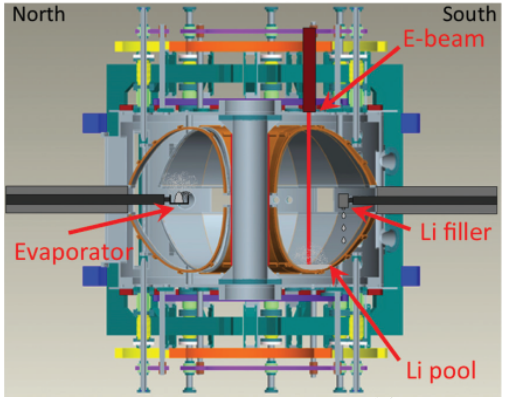
Highest Priority: Successful NSTX-U Recovery is essential for PPPL and the US fusion program

LTX-β To Come Online in 2017: Explore Physics of a Liquid Metal Boundary

- Extends LTX parameters by adding neutral beam & raising B_T by 70%
- International: New liquid lithium scraper developed and tested on EAST
- Beyond LTX-β; extension to NSTX-U

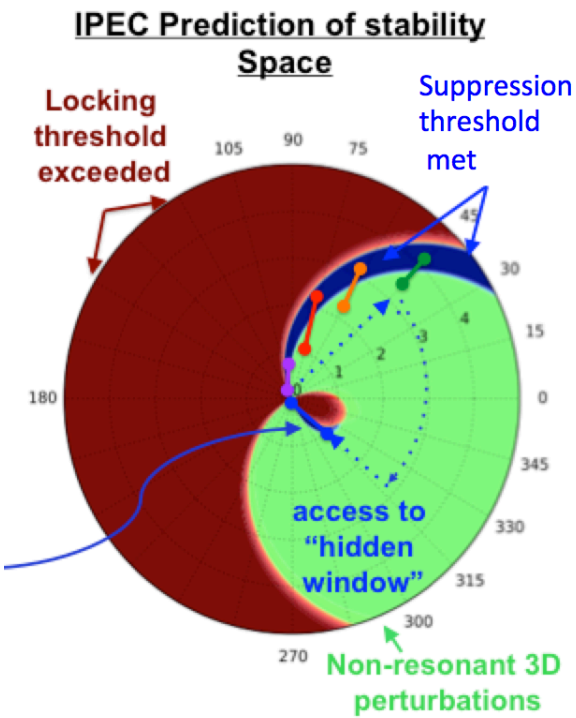




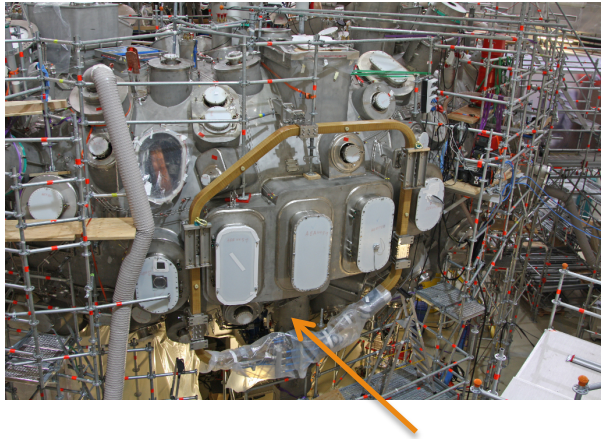


LTX-β

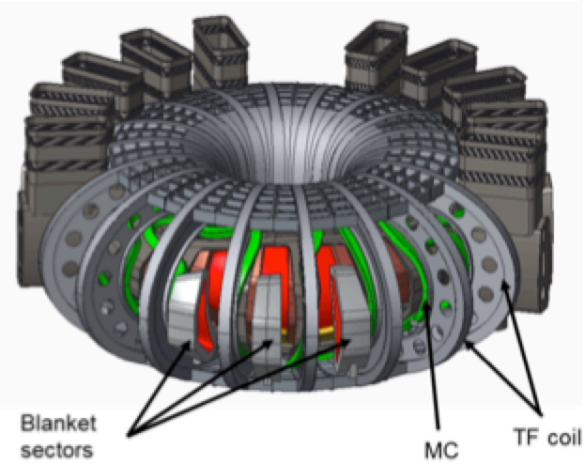
3D Physics Offers Innovative Opportunities for Improved Stability and Confinement



Validation of predictive models for ELM suppression in KSTAR



PPPL trim coil on W7-X



Exploration of straight outer-coil configuration for optimized stellarator

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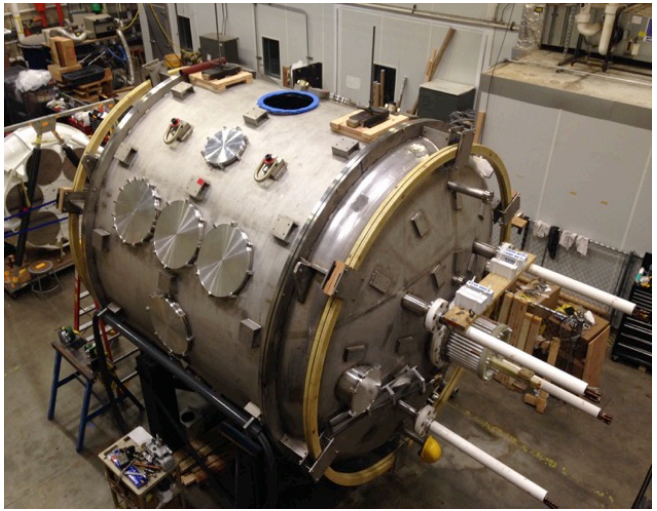
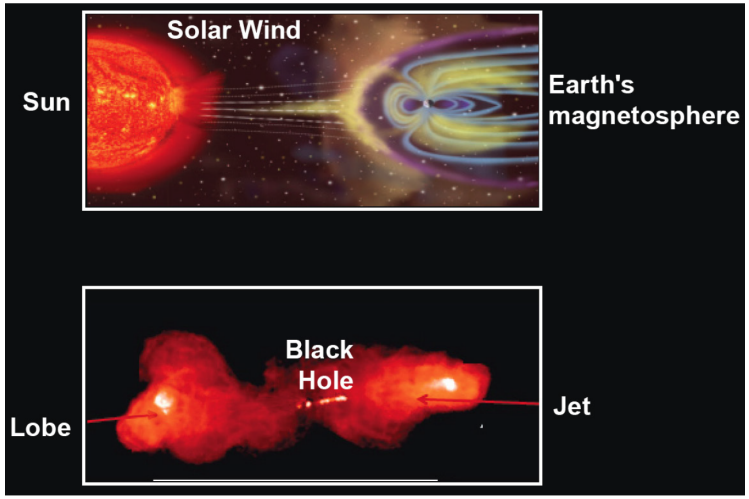
New Tools to Broaden Our Understanding of the Plasma Universe

- Fast reconnection underlies physics of stellar flares, astrophysical jets, fusion plasmas

- FLARE to come online in 2017, builds on pioneering MRX program





- Strong new initiatives in HEDP

→ X-ray imaging at NIF, …

- Low temperature plasma applications

→ Nano materials, plasma chemistry

PPPL Strategy is to focus on ITER, Transformative Ideas for Fusion and Expanded Connection to Other Fields

- Strong participation in ITER is a key element of the PPPL strategy
- PPPL pursues innovative approaches with the potential to reduce cost and scale of next step experiments
- Linkages to other science areas are expanding, providing exciting new opportunities