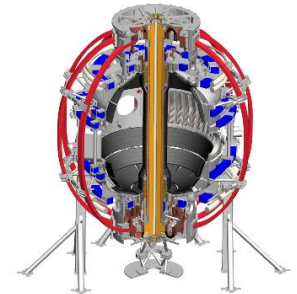


# Preparation for NSTX-U PAC meeting

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NSTX-U Physics Meeting  
PPPL LSB B318  
November 27, 2017



# Key findings of PAC-38

- PAC-38: ½ day videoconference on January 6, 2017
- Expressed concern about Recovery prioritization:
  - “It’s clear to the PAC that plans for collaborations outside NSTX-U during the recovery project shutdown period are extensive already.”
  - “the PAC feels very strongly that the recovery project should be given the highest priority and we encourage you to make sure that this message is very clear to the NSTX-U team”
- Helped motivate extension of 5 year plan to 7 years:
  - “...given the large delay in enacting the current 5YP, it seems self-evident that a large fraction of the planning for the next five years has already been done in preparing for the current 5 year period.”

# Overview of next PAC meeting

- PAC-39 goals:
  - Update PAC on significant events and changes during 2017
  - Update PAC on key recent NSTX-U/ST scientific results
  - Get feedback on long-term NSTX-U mission and strategy
- PAC-39 dates: January 9-10, 2018 (Tue-Wed)
  - PAC to attend PPPL in-person (weather permitting)
  - Day 1: NSTX-U presentations, PAC executive session
  - Day 2: AM: Answer any homework, PAC executive session, PM: debrief to NSTX-U team in early/mid afternoon

# PAC-39 Membership

	<b>Cary Forest</b>	<b>University of Wisconsin — PAC chair</b>
<i>new</i>	<b>Richard Buttery</b>	<b>General Atomics</b>
	<b>Ian Chapman</b>	<b>Culham Center for Fusion Energy</b>
	<b>Jerry Hughes</b>	<b>Massachusetts Institute of Technology</b>
	<b>Tony Leonard</b>	<b>General Atomics</b>
<i>new</i>	<b>Yijun Lin</b>	<b>Massachusetts Institute of Technology</b>
	<b>Piero Martin</b>	<b>Eurofusion and Consorzio RFX, University of Padua, Italy</b>
<i>new</i>	<b>Rachael McDermott</b>	<b>IPP Garching</b>
	<b>Kouji Shinohara</b>	<b>National Institutes for Quantum and Radiological Science and Technology</b>
	<b>George Sips</b>	<b>EFDA Close Support Unit, Culham Science Centre, UK</b>
	<b>Ezekial Unterberg</b>	<b>Oak Ridge National Laboratory</b>
	<b>Xueqiao Xu</b>	<b>Lawrence Livermore National Laboratory</b>
	<b>Dennis Youchison</b>	<b>Oak Ridge National Laboratory</b>
	<b>Phil Efthimion</b>	<b>Princeton Plasma Physics Laboratory</b>

# PAC-39 context

- When Recovery is successfully completed, NSTX-U will be most capable ST in world program
- However, significant time has passed since the NSTX Upgrade physics basis and mission was established
- Important to (routinely / periodically) revisit NSTX-U goals and standing w.r.t. the rest of the world program
  - Other research programs continuously advancing
- Challenges: Recovery scope itself, improving PPPL capabilities to build/manage major projects, & funding

# Tasks/charge questions for SG/TSG speakers (1)

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- Describe how STs world-wide and NSTX-U in particular will address critical issues in fusion science.
  - What are the 1-2 (just a few) most impactful contributions for your research area?
- Comment on the present, proposed, and expected capabilities of STs world-wide. How will NSTX-U be world-leading in your research area when operation resumes around 2020?

# Tasks/charge questions for SG/TSG speakers (2)

- What are the most important things learned since the original physics design of NSTX-U (2009) and/or since the last 5 year plan was written (2014)?
- How does this new understanding influence the impact or relevance of the near/medium-term research program of NSTX-U (2020-2025) and long-term vision? (2025-2030).
  - You may assume the 5 and 10 year visions are similar to what was proposed for the previous 5/7year plan.
  - Also, assume cryo-pumping will become available in the first 5 year period and other facility enhancement(s) in the 2<sup>nd</sup> 5 year period

# PAC presentation themes

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- The following slides contain my brainstormed ideas on possible themes for presentations
- SG/TSG leaders should develop/debate themes and motivations with highest impact and importance



# Possible themes for Core Science

- Transport
  - Unique physics regime + diagnostic capabilities - electron transport at high beta, low  $\nu^*$ . Highest large ST  $I_p$  and  $B_T$  for scaling studies.
  - New and unique high-k and turbulence diagnostic capabilities
- Energetic Particles:
  - Flexible (2<sup>nd</sup> NBI) and well-diagnosed device to develop predictive capability for AE instabilities and EP transport for burning plasmas
  - New GAE and TAE results from NSTX-U
- MHD
  - Unique access to RWM passive stabilization at low-A, low  $\nu^*$
  - Leaders in 3D, EF, NTV, physics, models (\*PEC, M3D-C1, ...)

# Possible themes for Boundary Science

- Pedestal
  - Highest ST  $I_p$ ,  $B_T$ , and pedestals – operate away from KBM branch
  - Pulse-burst laser for advanced studies of pedestal dynamics
- Divertor:
  - Challenging PFCs at full current and power, test SOL width scaling
    - XGC results on SOL width and implications for ITER
  - Recovery retaining tests of high flux expansion (snowflake/X)
- Materials and PFCs
  - Near-term: test of Li-wall pumping for low-recycling regimes
    - Upward evaporator for increased Li coverage, test very high confinement
  - Longer term: transition to high-Z tiles + Li coatings, then flowing LM

# Possible themes for Scenarios

- **Advanced scenarios and control**
  - Highest  $f_{BS}$ ,  $\beta_N$ ,  $f_{NI}$ ,  $\kappa$  and  $\delta$  for ST non-inductive scenarios
  - Leader in ST advanced profile control, boundary/shape control
- **Wave heating and current drive – possible applications:**
  - High core  $T_e$  for transport studies, increase NBCD, momentum-free e-heating, high-Z impurity expulsion (+ loss mechanisms)
  - Heating of low- $I_p$  targets for subsequent NBI ramp-up
  - Maintain ICRF technology and physics in the US
- **Solenoid-free start-up: Strategy without previous CHI**
  - Collaborations, LHI, plate CHI, ECH/EBW, combinations, ...

# Possible / draft PAC agenda

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- Project happenings since last PAC
- Research progress / highlights since last PAC
- ST / NSTX-U contributions to key FES missions
- Core SG/TSG presentation(s)
- Boundary SG/TSG presentation(s)
- Scenarios SG/TSG presentation(s)

Will be discussed in more detail with speakers ASAP