PAC Response

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and the NSTX-U Research Team

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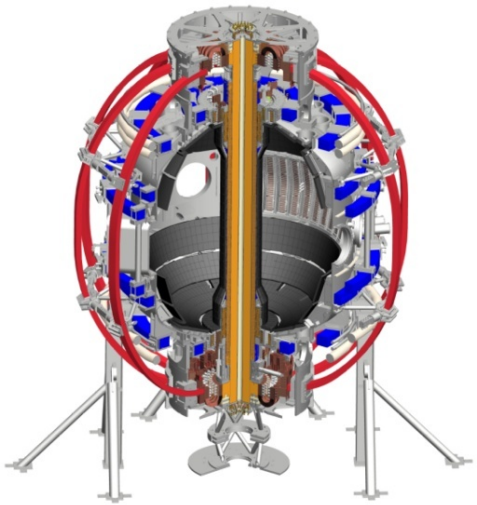

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PAC comments in brief and MS group responses

- "Given the urgency and importance of avoiding and mitigating disruptions in ITER, more importance should be placed on this subject."
  - The PAC recommendation will be kept in mind regarding prioritization of XPs at the first NSTX-U Research Forum.
  - The NSTX-U five year plan contains many tasks in disruption PAM.
  - A plan for what more we can do beyond these five year plan ideas will be brought together. Some initial additional ideas:
    - Have sufficient run time blocked out make an assessment of disruption avoidance under controlled conditions
    - Devote time to "controlled shutdown"
    - Make an assessment of how well we are avoiding disruptions in the startup

PAC comments in brief and MS group responses

- "More emphasis should be given to NTM stability / developing methods for tearing mode suppression"
  - We have the following plans for tearing modes in the 5-year plan:
    - Investigate rotation and rotation shear vs. TM/NTM in NSTX-U, compared with NSTX.
    - Investigate the β limit for TM/NTM onsets with varied rotation and rotation-shear.
    - Utilize the n = 1 resonant error fields to vary (neoclassical) tearing mode onset.
  - ECCD for TM suppression in NSTX-U will probably not be possible. However, lithium application successfully suppressed the most dangerous TMs in NSTX.
  - Long pulse, high-beta operation can further increase local bootstrap current fraction as well as decrease q_{min} or q_{shear} in the core. If profiles evolve toward NTM unstable states, in addition to lithium NSTX-U will be able to utilize q and rotation profile control for NTM control, for example by maintaining q_{min} above 2 to avoid the 2/1 mode.
  - To address NTM issues in ITER and next-step STs, dedicated experiments will also be proposed and performed along with theory and computational tool applications, such as resistive DCON with GGJ, viscous, drift-MHD layer models, MARS-F, M3D-C1, to validate models and predictions.

PAC comments in brief and MS group responses

- "Utilize metrics other than δB minimization for DEFC (e.g., minimize braking etc…)"
  - Already in NSTX we used other metrics, and this will continue. In NSTX minimization of braking was the most sensitive method for n=3 error field correction. With the new rotation controller, we will do this implicitly by "trimming out" the error field by applying static, or slowly changing RWM coil current. This will be evaluated consistently with RWM stability / RFA assessment.
  - For n=1 error field, locking avoidance will be important in low beta and density in the ramp-up stage, but minimizing braking and plasma response will be more important in high beta.
  - A new post-doc joining the MS group in a few months will take a lead role in experimental aspects of error field correction.
  - Finally, the motivation for doing this can be explored from a theoretical perspective as well, such as N. Logan has done for DIII-D to see if δB vs. NTV minimization is actually substantially different.

PAC comments in brief and MS group responses

- "Do modeling of the various mixes of rotation/fast ion profiles that can be achieved at sufficiently high beta and predict RWM damping rates"
  - J. Berkery plans to do this, working with S. Gerhardt and M. Podesta, who have already generated NSTX-U equilibria, TRANSP runs, and beam profiles.

- "Density assimilation versus poloidal location of MGI system, including injection in the private flux region… studies should be given high priority and proceed as soon as possible"
  - Effort is being made to ready the MGI system for the first experimental campaign. The PAC recommendation will be taken into account during runtime prioritization.

- "The PAC supports the NSTX-U team in requesting incremental funding to realize the NCC as soon as possible"
  - We thank the PAC for their significant insight, we strongly agree with the recommendation, and we will constantly assess the correct time to implement the NCC as funding allows.

backup / more detailed PAC comments…

Overall MS Group Comment

- Given the urgency and importance of avoiding and mitigating disruptions in ITER, more importance should be placed on this subject. Currently there is a JRT (“Assess disruption mitigation, initial tests of real-time warning, prediction”) in FY16; this belies somewhat the importance of this area and the key advances NSTX-U may provide in this field.
- More emphasis should be given to disruption avoidance and mitigation, elevated even above the JRT for FY16. This is an area of huge importance for future machines, and NSTX-U is well placed to contribute. The PAC commends the emerging links with theory and modeling in this area, and it is keen to see this grow in the near future.

Tearing Modes

- The historical NSTX focus on RWMs is retained for FY15-16, perhaps at the neglect of NTM stability studies. As NSTX-U begins to run much longer pulses at high beta, NTMs may become more prevalent and important to the pulse performance and sustainment. Consequently, more effort should be invested in developing methods for tearing mode suppression, especially in preparation of later operation with a metal wall since JET and ASDEX Upgrade have reported enhanced high-Z impurity peaking in the presence of NTMs, and the consequent performance degradation and even disruptions associated with this.
- More emphasis should be given to NTM stability in preparation for a high-Z wall, especially developing tools to suppress the mode given strong high-Z peaking observed with NTMs in JET. For long pulse with metal walls, this could be an additional driver for the ECH/EBW program.

RWM

- Since NBI is the main tool for changing fast ion distribution, the NBI-induced torque will also vary. The PAC suggests the team do modeling of the various mixes of rotation/fast ion profiles that can be achieved at sufficiently high beta and predict RWM damping rates.

Error Field

- The PAC supports the high priority given to error field correction in FY15. We recommend that you utilize metrics other than δB minimization for DEFC (e.g., minimize braking etc. as used for NCC design) and then utilize the best metric for error field correction routinely. There is scope to feed into the new rotation profile controller too.

Disruption Mitigation

- In FY16, NSTX-U will characterize density assimilation versus poloidal location of MGI system, including injection in the private flux region. These studies should be given high priority and proceed as soon as possible, even in FY15 if possible.

NCC

- The NCC would be a valuable tool for NSTX-U for EFC, rotation tailoring, pedestal/ELM control amongst others. The PAC agrees with the prioritization with respect to other enhancement projects (i.e., that the cryopump and the ECH are higher priority). The PAC supports the NSTX-U team in requesting incremental funding to realize the NCC as soon as possible, noting the risk that beginning work in 2017 for installation and realization after that may reduce the international impact.