FY-13 JRT Overview

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FY-13 JRT To Examine Stationary High-Performance Operating Regimes That Don't Have ELMs

- *Conduct experiments and analysis on major fusion facilities, to evaluate stationary enhanced confinement regimes without large Edge Localized Modes (ELMs), and to improve understanding of the underlying physical mechanisms that allow acceptable edge particle transport while maintaining a strong thermal transport barrier. Mechanisms to be investigated can include intrinsic continuous edge plasma modes and externally applied 3D fields. Candidate regimes and techniques have been pioneered by each of the three major US facilities (C-Mod, D3D and NSTX). Coordinated experiments, measurements, and analysis will be carried out to assess and understand the operational space for the regimes. Exploiting the complementary parameters and tools of the devices, joint teams will aim to more closely approach key dimensionless parameters of ITER, and to identify correlations between edge fluctuations and transport. The role of rotation will be investigated. The research will strengthen the basis for extrapolation of stationary regimes which combine high energy confinement with good particle and impurity control, to ITER and other future fusion facilities for which avoidance of large ELMs is a critical issue.*

Practically Speaking, What is This About?

- Candidate Regimes:
  - C-Mod: I-mode, and may try a QH-mode experiment.
  - DIII-D: QH mode, and will try an I-mode experiment.
  - NSTX: Small ELM regimes, observed “EHOs”, and data-mining for I-mode.
- Stationary?
  - Density nominally constant.
  - No ramping impurity accumulation as in traditional ELM-free H-mode.
  - Does not need to be stationary on the τ_{CR} time-scale.
- Out of scope: Direct RMP ELM suppression and pellet pacing.
  - But, if 3D field experiments can help us understand relevant aspects of transport, then this is in scope.
- Fundamental questions:
  - How do edge instabilities like the EHO and the WCM preserve the temperature pedestal while relaxing the density pedestal sufficiently to avoid ELMs? Under what conditions are these regimes accessible?
  - Are small-ELM regimes such as the NSTX type-V actually acceptable for ITER, and what is the access condition for this regime?
  - Can such regimes be externally driven?
  - How does the physics of these regimes (access, saturation) scale/extrapolate to ITER?

Facility Situation Makes Execution of This JRT Challenging

- NSTX will not have any new data.
  - Last shots taken in Oct. 2010…and next shots in spring 2015 under present budget guidance.
  - DOE accepts that old data would be used for the JRT contribution.
  - Much of the most relevant data already analyzed.
- C-Mod ends operations in FY-12 under the present budget guidance.
  - It is expected that the 2012 run will provide the C-MOD data for the JRT.
  - May be able to get more run-time in FY-13. (?)
- DIII-D runs in both 2012 & 2013.
  - Only 10 weeks in 2013 under present guidance.
    - JRT research will compete with many other critical tasks.

Some Theory Aspects of JRT13

- What determines the saturated amplitude and toroidal mode number of the EHO?
  - How does it change the rotation profile, and how does the rotation profile change provide saturation?
  - NTV requirements, optimal profile, for stimulating EHOs in a device with co-NBI.
- What is the physics of the WCM?
  - Does rotation play a role in the onset or saturation of this instability?
- How do modes like the EHO and WCM preferentially drive particle transport?
  - And how is it related to their saturated amplitude?
- What are optimum external field spatial distributions and frequencies to drive these modes externally?
- What is the physics basis for the accessibility regime of Type-V ELMs?