CY03 XPs Supporting Proposed MHD Stability and Mode Control Research

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Experimental Proposals: CY 2003+

- XP: Stabilization physics of resistive wall mode in high β_N ST
  - Sabbagh, et al., aimed to utilize CY03 enhanced RWM diagnostic set
  - Passive/active stabilization physics of the sustained, high β_N RWM
- XP: Aspect ratio effects on resistive wall mode stability (NSTX/DIII-D similarity experiment)
  - Sabbagh/Garofalo/Reimerdes et al., submitted to GA group Thrust #4 (Dec. 2002)
  - Rotation damping physics, critical rotation frequency, wall stabilization
- XP: Rotation damping physics of the resistive wall mode
  - Zhu, et al., supporting graduate student thesis
- XP: Current hole generation at low aspect ratio
  - Sabbagh, et al., aimed to generate reduced li at high β_N

Stabilization physics of resistive wall mode in high β_N ST

- Motivation
  - Determine / analyze high β_N RWM stabilization in ST geometry
- Goals
  - Stabilize RWM for long duration (t >> 10 τ_{wall}) at various $\beta_N > \beta_{N\ no\text{-}wall}$
    - Choose configuration with high V_ϕ
    - Operate at lowest sustainable l_i to maximize β_N / $\beta_{N\ no\text{-}wall}$
  - Determine dependence of rotation sustainment on q_{min}
  - Determine effectiveness of passive stabilization on β_N / $\beta_{N\ no\text{-}wall}$
  - Determine dependence of critical rotation frequency on β_N / $\beta_{N\ no\text{-}wall}$
  - Measure δT_e *evolution* during RWM using unequal TS pulse interval
  - Utilize initial active feedback system (when available)
  - Utilize RWM advanced diagnostic set to be available in 2003
    - RWM sensors, 2D USXR, MSE, etc.

Aspect ratio effects on resistive wall mode stability (NSTX/DIII-D similarity experiment)

- Motivation
  - Compare RWM physics between low and moderate A devices
- Physics addressed
  - Aspect ratio dependence of rotation damping
    - Non-resonant vs. resonant damping
    - Comparison of toroidal rotation profile evolution across machines
  - Aspect ratio dependence of critical rotation frequency
    - Dissipation mechanism, β_N dependence
    - Vary (or match) Alfven time, β_N
  - Aspect ratio dependence of wall stabilization effectiveness
    - Mode structure and coupling dependent on aspect ratio
    - Vary wall position and β_N

Rotation Damping Physics of the Resistive Wall Mode

- Motivation
  - Determine the physics of rotation damping by the resistive wall mode
    - Present theories include sound wave damping, Alfven wave resonances, ion Landau damping, TTMP
- Approach / Goals
  - Conduct experiment that will vary key physics parameters in RWM rotation damping theories
    - Present NSTX RWM data indicates that disappearance of low-order rational surfaces (by B_t scan) can alter rotation damping
  - Compare experimental results to all applicable theories
    - Including numerical models, if need be
  - Work with proponents of the most promising theories to determine alterations needed to match experiment
    - Aspect ratio effects and poloidal mode coupling are neglected in many models. NSTX might clarify the role of these effects.

Duration and Required / Desired Diagnostics

- Each XP could be completed in 1 – 1.5 run days
- Required
  - Flux loops and integrated poloidal Mirnov coil data
  - CHERS toroidal rotation measurement
  - Locked mode detector measurements
  - Thomson scattering
  - Diamagnetic loop
  - USXR
- Desired
  - MSE
  - Advanced RWM sensors
  - Advanced USXR diagnostics
  - Toroidal Mirnov array
  - Fast camera