CY 04 Resistive Wall Mode Experiments

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MHD Stability ET Group - Experimental Planning Session

Princeton Plasma Physics Laboratory

Experimental Proposals: CY 2004

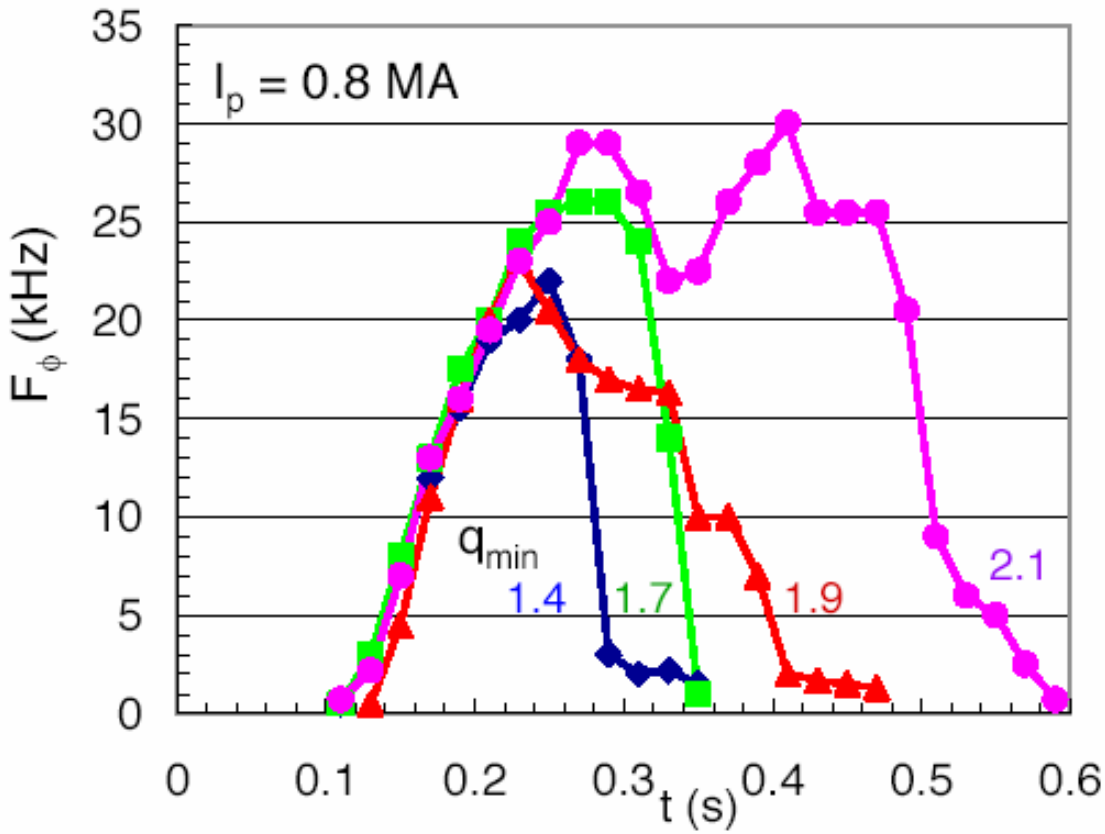
- XP: Dissipation physics of the resistive wall mode
- XP: Aspect ratio effects on resistive wall mode stability (NSTX/DIII-D similarity experiment)

Dissipation Physics of the Resistive Wall Mode

- Motivation
  - RWM energy dissipation mechanism(s) which allow stability above no-wall beta limit is (are) presently uncertain
- Goals
  - create operational regimes which preferentially couple energy from RWM to proposed dissipation mechanisms
    - proposed mechanisms include:
      - Alfven waves, sound waves, kinetic effects, viscosity, etc.
  - keep other parameters affecting stability constant
    - rotation, geometry, etc.
  - determine RWM stability vs predicted dissipation
    - maximum stable $\beta_N/\beta_{N\ \text{no-wall}}$
    - growth rate
  - compare experiment to analytic theory/computational results

RWM More Stable with Increased q_{min}

NSTX toroidal field scan



- Alfven continuum damping decreases with increasing n[1]

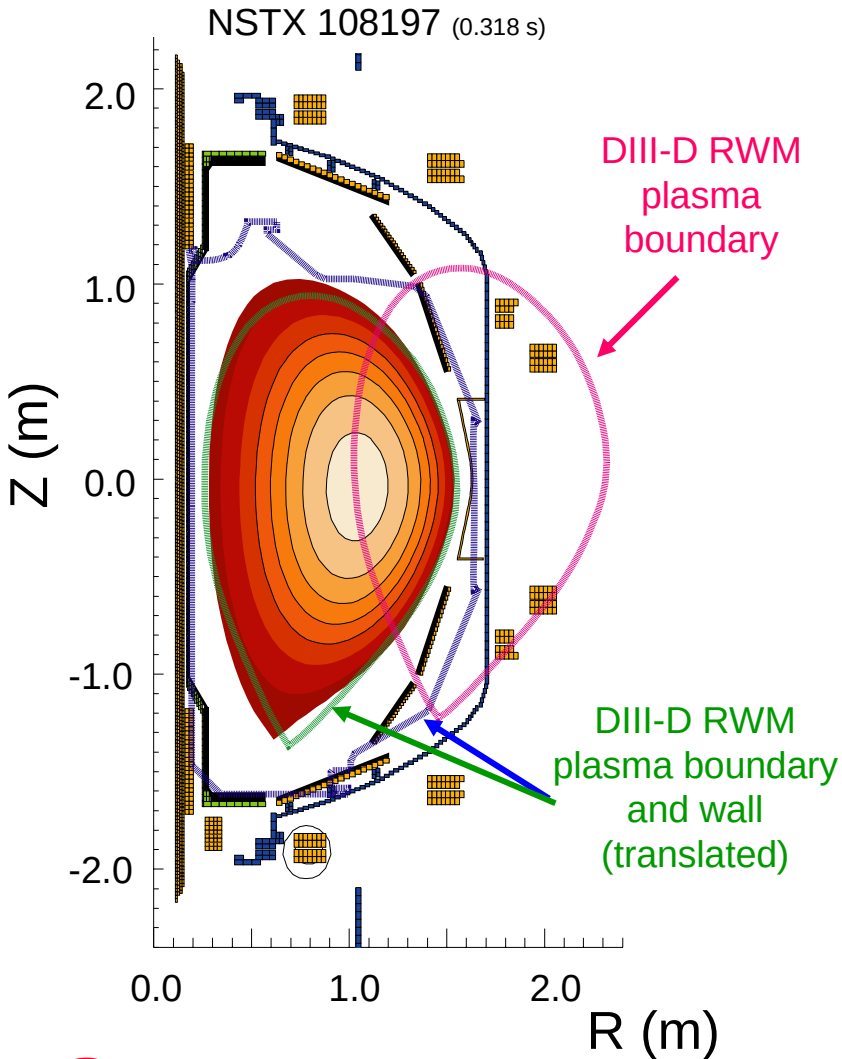
[1]Chu, et al., Phys. Plasmas **1** 1214 (1994)

Aspect Ratio Effects on Resistive Wall Mode Stability (NSTX/DIII-D similarity experiment)

- Motivation
  - Compare RWM physics between low and moderate A devices
    - Basic RWM observation similar in devices, but some key details differ
- Goals
  - Create similar discharges with different aspect ratios
    - Match poloidal cross-section and proximity to no-wall limit
  - Compare RWM physics at different aspect ratio
    - Rotation damping rate / critical rotation frequency / RWM growth rate
    - Radial variation of mode amplitude (rotation damping profile)
    - Trapped particle effects (Hu and Betti: explicit A dependence)
    - Resonant field amplification / MHD spectroscopy
    - Magnetic braking (test neoclassical toroidal viscosity theory)
  - Test present RWM stability theory
    - Compare MARS results to test stabilization / dissipation theories

DIII-D / NSTX Boundary already well matched

(Sontag, Reimerdes, Garofalo, Sabbagh, Strait, LaHaye, Okabayashi, Buttery, etc.)



- Approach
  - More closely match RWM generation
  - Utilize active control coil when available
  - Complementary experiment to be submitted to DIII-D Research Opportunities Forum
- Address stability with / without wall
  - Compare to MAST results in which plasma approaches no-wall limit
- History
  - XP was given high priority during last NSTX run
    - B_t problem postponed run

Duration and Required / Desired Diagnostics

- Each XP could be completed in 1.5 - 2 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