
NSTX/DIII-D RWM Similarity XP

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Similarity XP to Explore Aspect Ratio Effects on RWM Stability

- **Rotation damping**
 - ❑ different mode structure should give different damping profile
- **Critical rotation**
 - ❑ $\omega_\phi/\omega_A = 1/4q^2$ limit observed in NSTX
 - ❑ is this limit aspect ratio dependant?
- **RWM growth rate**
 - ❑ DIII-D observes dependence on C_β
- **Trapped particle effects**
 - ❑ Hu-Betti stability model has explicit A dependence

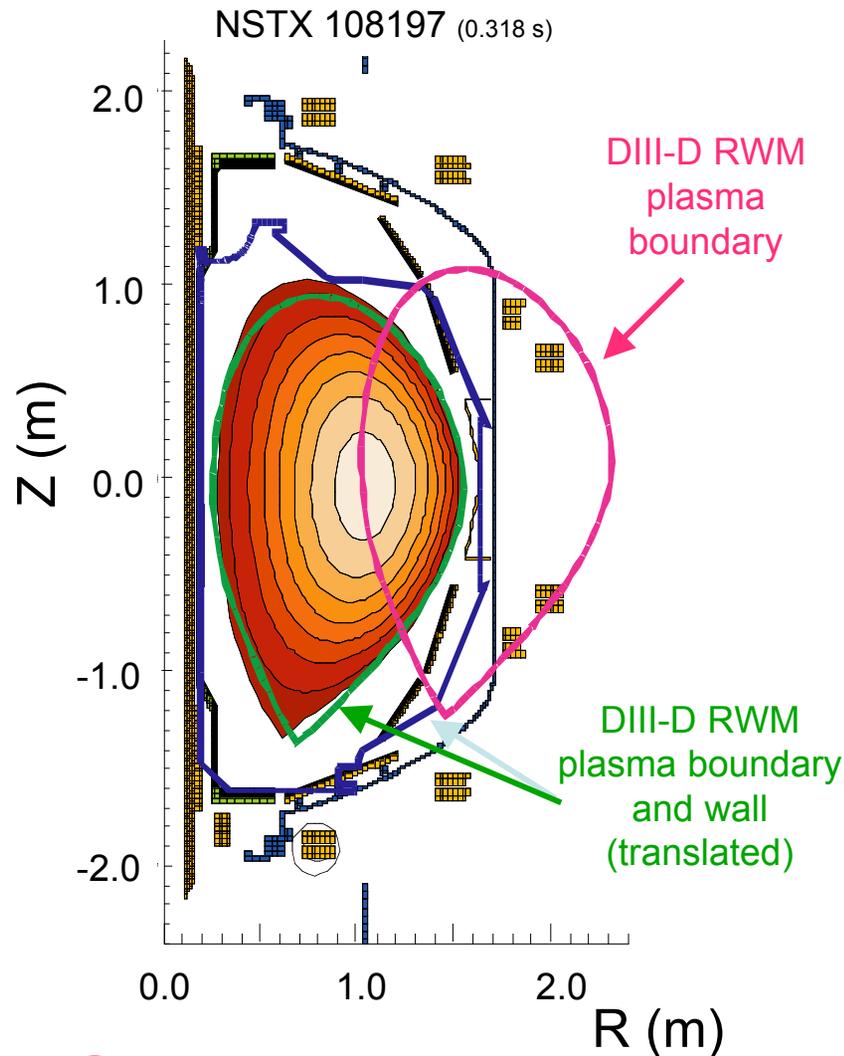
$$C_\beta \equiv \frac{\beta_N - \beta_{N_no-wall}}{\beta_{N_ideal-wall} - \beta_{N_no-wall}}$$

XP Has Both Active and Passive Components

- Active coil studies
 - ❑ magnetic braking
 - actively slow plasma below critical rotation
 - ❑ error field amplification (EFA)
 - examine EFA magnitude as a function of C_β
 - probe stable RWM growth rate and phase shift
 - ❑ MHD spectroscopy
 - look for resonance with RWM
 - found at ~ 10 Hz for DIII-D
- Passive studies
 - ❑ critical rotation
 - modulate beams to vary input momentum
 - ❑ rotation damping profile
 - mode structure changes at low A with C_β
 - ❑ growth rate

DIII-D / NSTX Boundary already well matched

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



- Approach
 - utilize active control coil when available
 - complementary experiment to run on DIII-D in August
- Requires target development
 - need high- β_N discharge with correct shape at 0.3 T

DIII-D/NSTX RWM similarity experiment

Proponents: Reimerdes, Garofalo, La Haye, Okabayashi, Strait / Sabbagh, Sontag

Goals: Compare RWM physics at low ($A_{\text{NSTX}} \sim 1.4$) and moderate ($A_{\text{DIII-D}} \sim 2.8$) aspect ratio.

- Dissipation mechanism (sound wave, kinetic).
- Stabilizing effect of trapped particles (Hu and Betti, APS 2003).
- Rotation damping (e.g. neoclassical viscosity).

Experiment: Design an experiment which leads to a quantitative comparison of the RWM physics at different A.

- **Match ideal MHD parameters:** shape, β with respect to no-wall and ideal wall limit, q-profile, pressure profile.
- **Measurement without control coils:** critical rotation, rotation damping profile, mode amplitude profile.
- **Measurement with control coils:** Resonant field amplification (RFA), rotation damping profile, plasma response profile.

NSTX: Allocated 1.5 days with high priority.



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