CY04 Passive/Active Resistive Wall Mode Stabilization XPs

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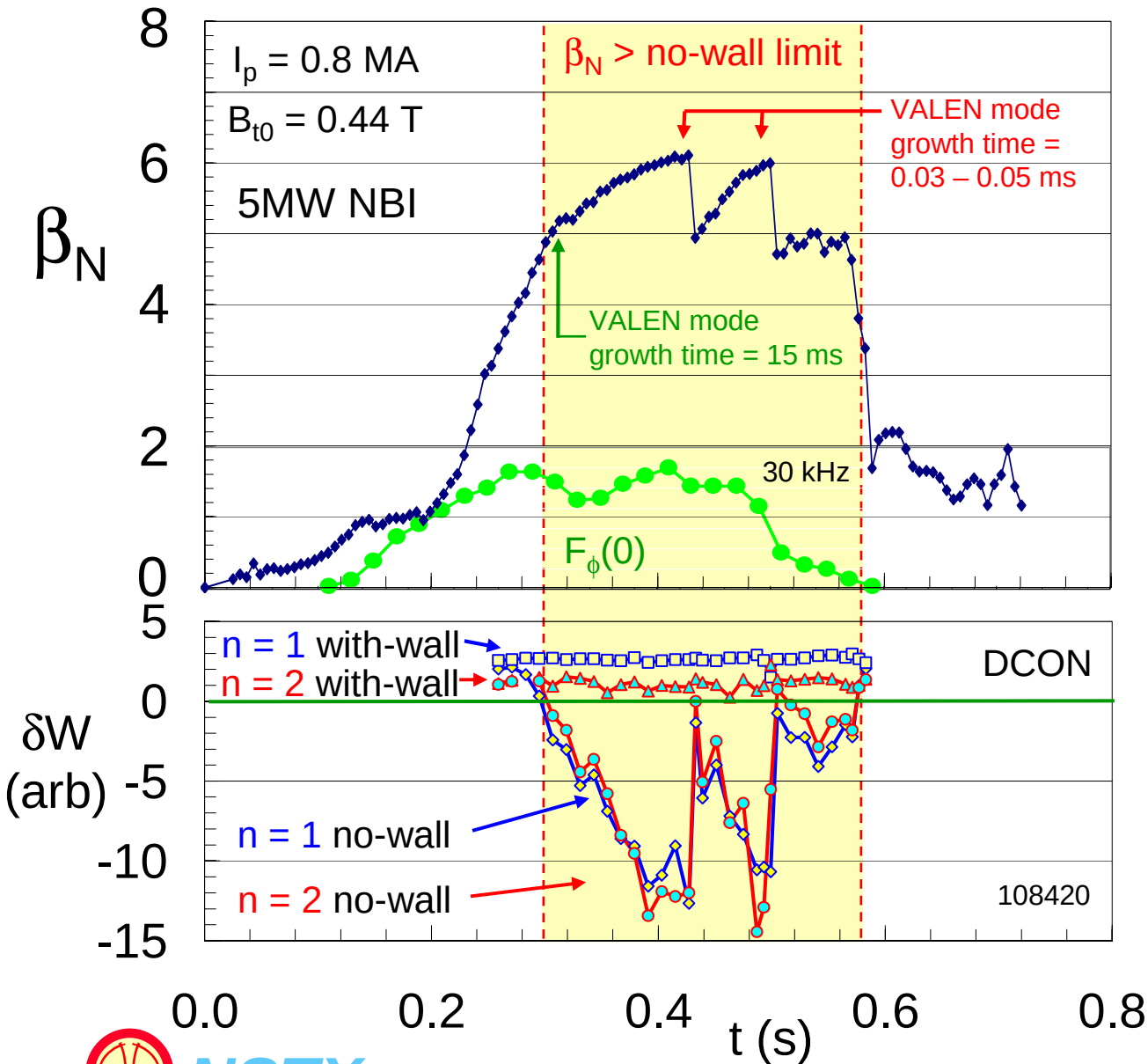
MHD Stability ET Group - Experimental Planning Session

Princeton Plasma Physics Laboratory

XP313: Passive Stabilization Physics of the Resistive Wall Mode in High β_N ST Plasmas

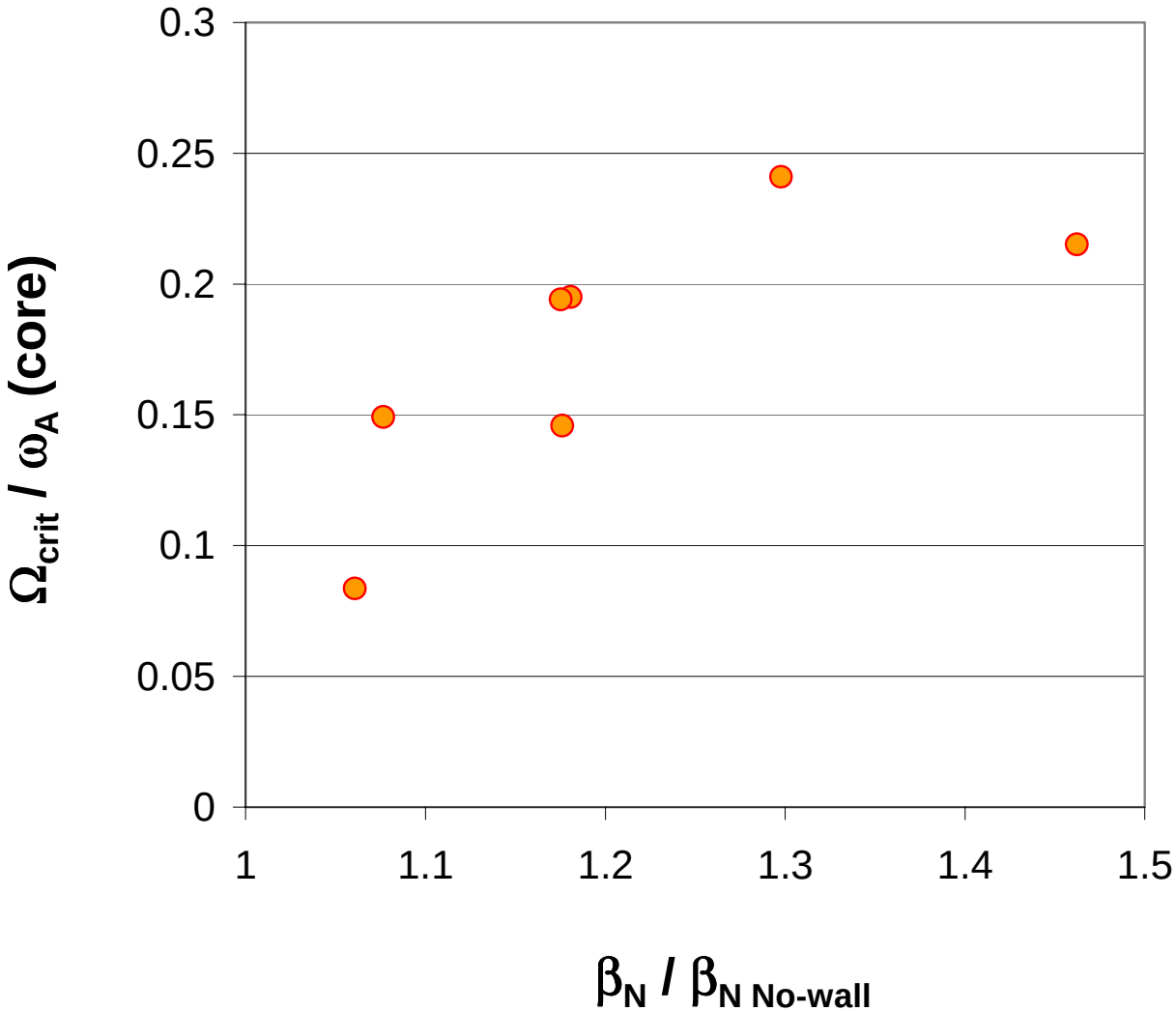
- Goals
  - Examine criteria and physics of RWM passive stabilization in high β_N ST plasmas, and compare to theory
    - Critical rotation frequency
    - Dependence of mode stabilization on q_{min}
  - Measure n > 1 resistive wall modes
    - Present high β_N plasmas are computed to be n = 2 unstable
  - Define RWM stability boundary in (F_ϕ, β_N) space
    - Dedicated experiment makes comparison to theory easier
    - Defines the operating space and criteria for active stabilization
  - Re-establish RWM in CY04 device
    - Support experiment on RWM dissipation mechanisms
    - Support experiment examining rotation damping (XP 314)
- XP was approved for the 2003 run

Both n = 1 and n = 2 computed no-wall limits are violated



- RWM not observed at high B_t
  - rotationally stabilized?
  - q dependence?
- Probe stability boundary
  - Vary / ramp B_t to probe stability in (V_ϕ, β_N) space
  - Take plasma out of H-mode to reduce $\beta_{Nno\text{-}wall}$

Critical rotation frequency depends on $\beta_N/\beta_{N\text{-Nowall}}$



- Expand present data set
- Make comparison to RWM stability theory
  - Fitzpatrick model
  - MARS code

XP: Initial active RWM control physics

- Goals
  - Initial observation of the effects of active mode control coil on the resistive wall mode in high β_N ST plasmas
    - Initial “shakedown” experiment
  - Increase RWM stability β_N limit, mode duration at B_t <= 0.35 T
    - Low frequency or pre-programmed dynamic error field correction
    - Compare to stability boundary under passive stabilization (XP 313)
  - Produce error field amplification
    - Utilize MHD spectroscopy to determine mode resonance
  - Impose magnetic braking with active coil
    - Compare to rotation damping under passive stabilization alone
    - Test induced error field penetration / rotation damping theories
- Requires operation with active mode control coil

Duration and Required / Desired Diagnostics

- Each XP could be completed in 1.5 run days
- Required
  - EFIT with flux iso-surface constraint (reduced error on q profile)
  - CHERS toroidal rotation measurement (with increased resolution)
  - Internal RWM sensors
  - Thomson scattering
  - Diamagnetic loop
  - USXR
- Desired
  - MSE
  - Advanced USXR diagnostics
  - Toroidal Mirnov array
  - Fast camera