XP17: Influence of Current Profile on MHD Stability at Low Aspect Ratio - Day 1 Update

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ET1 MHD Stability Group - 2001 Experimental Plans Session

Princeton Plasma Physics Laboratory

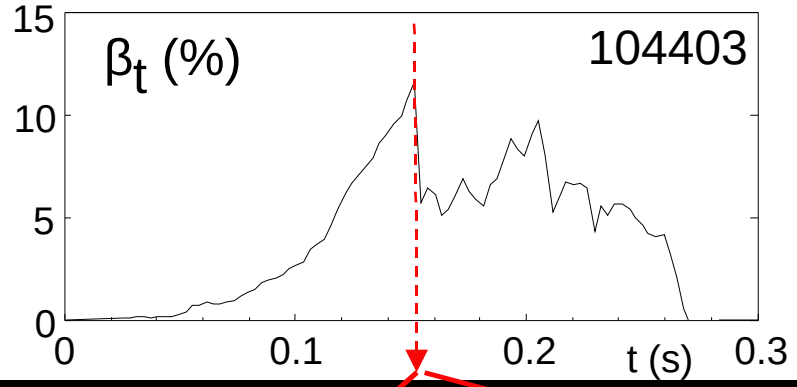
XP17: Influence of Current Profile Variation on MHD Stability at Low Aspect Ratio

- Goals
  - Establish configurations with broadest range of ℓ_i possible in NSTX for a given plasma cross-section.
  - Determine variation of the stability limit as a function of ℓ_i
  - Determine characteristics of limiting instabilities at low and high ℓ_i
    - compare to what has been found in high A devices
    - compare to what is expected from theory
  - Single out the effects of the pressure profile peaking (a key parameter) which will naturally occur in this database.
  - Determine if the kink/ballooning stability limit has an explicit dependence on aspect ratio, and compare to theory.

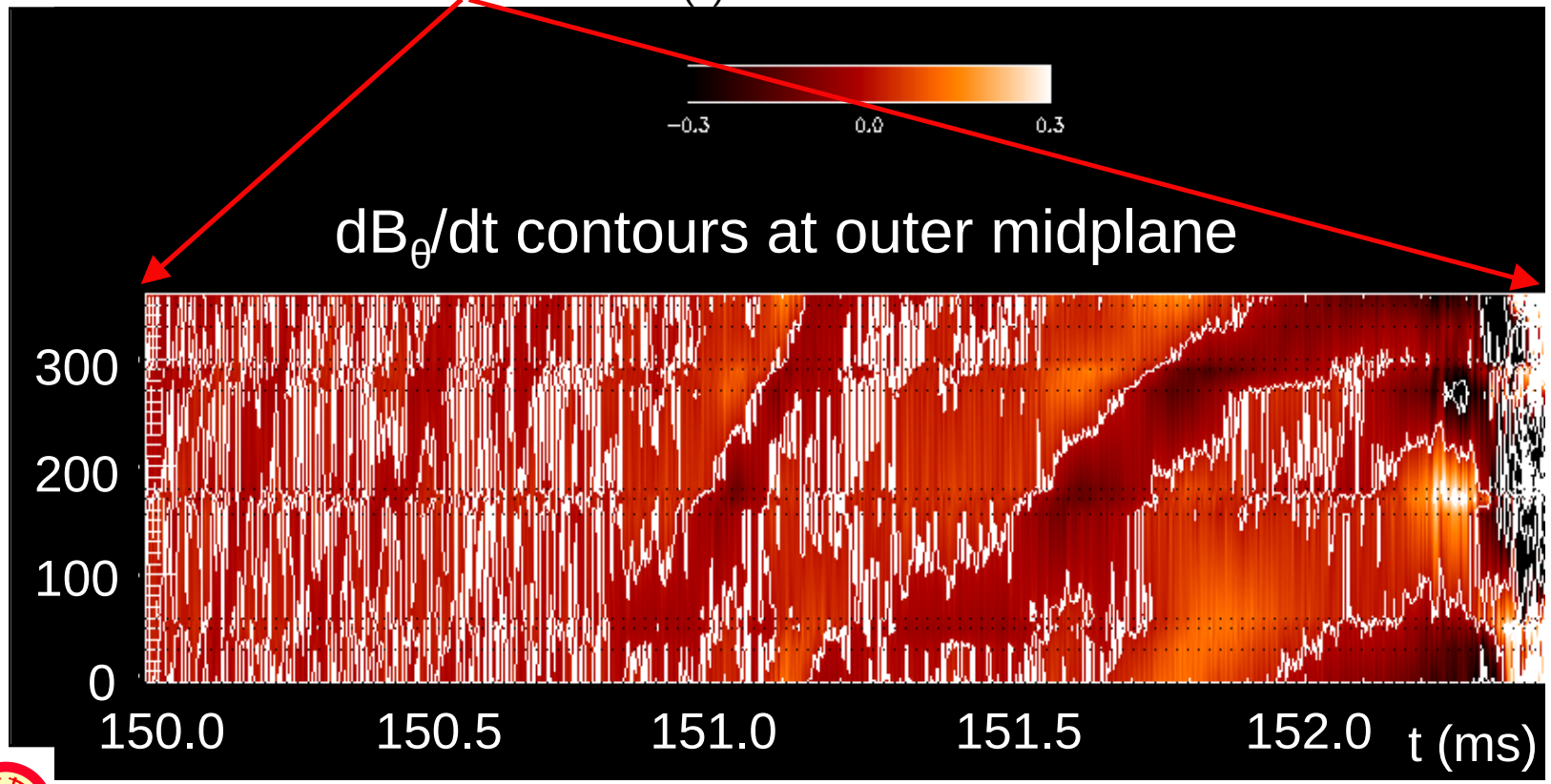
XP17 - Day 1 has addressed several goals

- Generated plasmas with a wide range of internal inductance ($0.5 \leq \ell_i \leq 1.1$) as prescribed in XP
- Stability limits reached in both low and high l_i plasmas
- Initial variation of maximum β_N vs. ℓ_i established
- Characteristics of instabilities at low/high ℓ_i established
  - low ℓ_i
    - fast β collapses observed
    - consistent with ideal MHD stability limit
  - high ℓ_i limit => slow rollover in β => tearing activity (neoclassical?)
- Increase of β_N limit at low A established
  - TFTR and DIII-D limits exceeded for fixed ℓ_i

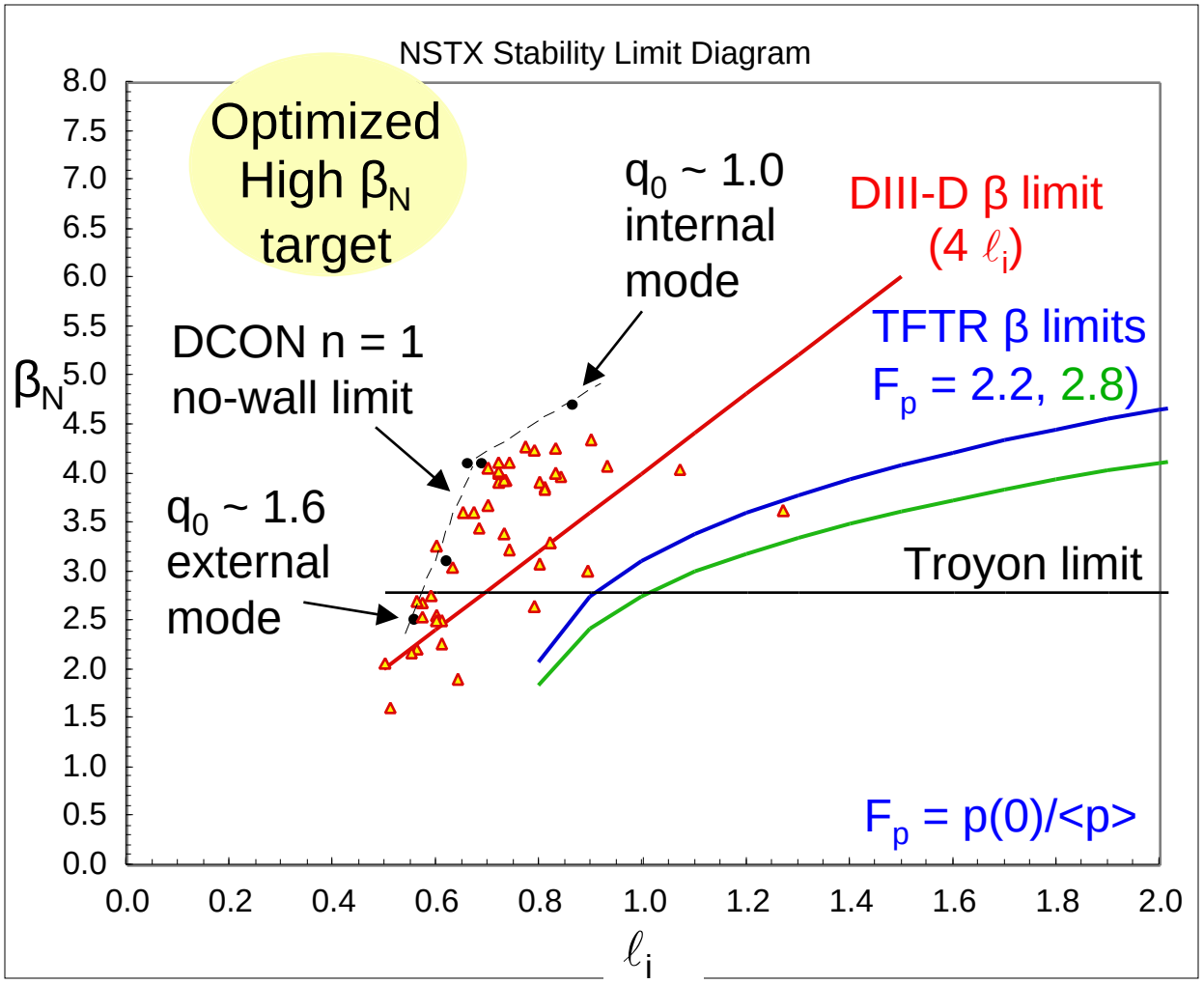
Fast β collapses occur in low ℓ_i plasmas



- *n* = 1 observed on toroidal Mirnov array
- $\beta_{N\,max}$ = 2.5
- τ_{wall} > 5 ms; τ_A ~ 5 μs



Dependence of β limit on J profile studied at low A



- Troyon limit, TFTR, and DIII-D β limits exceeded (β (EFIT))
- *n* = 1 ideal limit (DCON) in agreement with fast β collapses observed at $\ell_i \leq 0.8$
  - large outer gap => no-wall limit applies
- Ideal β_N limit is yet to be challenged at high ℓ_i
- Wall stabilization required to reach optimized target β_N
  - effective in low l_i plasmas with q(0) > 1

  (see talk by F. Paoletti, ET1 afternoon session)

DCON (A. Glasser)

S. Sabbagh XP 17

Next run will focus on expanding operating space

- Reach the gross plasma stability limit at high ℓ_i
  - Operate at $q_0 \geq 1.5$ (avoid sawteeth) and $\ell_i \geq 0.8$
- Determine effect of passive conducting wall on mode
  - Perform outer gap scan in $q_0 \geq 1.5$; low $\ell_i \leq 0.8$
  - Document increase in maximum β_N
- Reduce uncertainty in stability calculations
  - Utilize internal equilibrium profile information
  - Utilize divertor magnetics and passive plate current measurements
- This mode should be a resistive wall mode
  - This is the starting point of XP20 - Characterization of Resistive Wall Modes at Low Aspect Ratio