

Tearing/Kink Stability of Low- l_i NSTX Plasmas

J. Menard

NSTX Research Forum

MHD Experimental Task Group

November 28, 2001



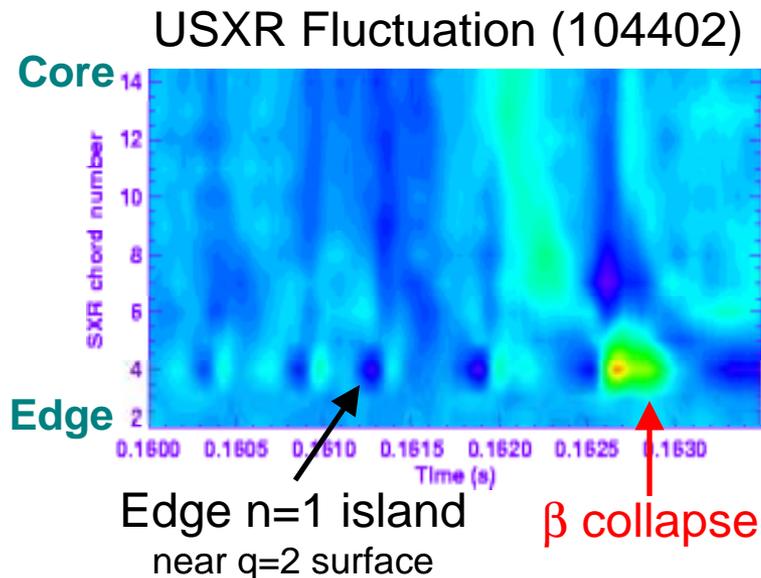
Stability of low- l_i plasmas

- Motivation

- Access to combined high β_N + high- f_{BS} scenario:

- Theoretically requires elevated $q(0)$, low- l_i operation ($l_i = 0.3-0.5$)
- Stability database (S. Sabbagh) suggests $\beta_N \leq 6 l_i \Rightarrow \beta_N \leq 3$
- Ideal MHD optimizations $\Rightarrow \beta_N \approx 5-6$ possible with “better” profiles
- **But, tearing/resistive-kink stability predictions presently unexplored**

- Data suggests 2/1 tearing mode important in such scenarios



HHFW + NBI shot

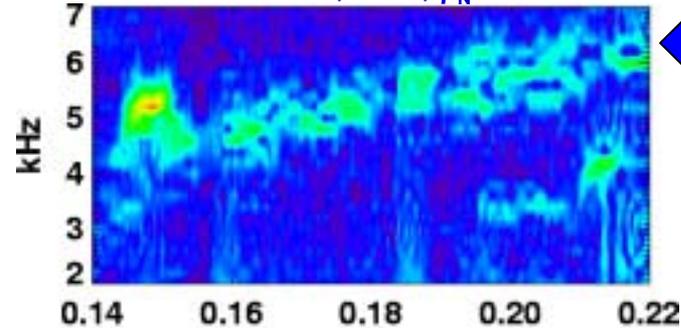
- $l_i = 0.55$, $q(0) = 1.4$
- $\beta_N = 2.7$
- 2/1 mode born, slows, locks
- Error field likely important

Modes during I_p ramp phase not well understood



- Data suggests 2/1 island often present even in “successful” shots

Shot 105051, 1MA, $\beta_N = 3.1$



← 2/1 mode evident on USXR (Stutman)

- Often seen on Mirnovs only at **onset**
 - **Growth/width apparently suppressed by rotation**
 - Plasma shown disrupts at $t=240\text{ms}$, $\beta_N = 3.1$
 - **May be feature of standard NSTX I_p ramp-up**
- Research objectives:
 - Characterize stability with reduced PF5 error-field
 - Study influence of l_i on tearing/kink mode stability by varying:
 - dI_p/dt (rarely changed during normal operation)
 - Early plasma size and elongation
 - Determine rotation threshold for mode growth suppression
 - Vary beam timing, source mix, and electron density
 - Toroidal field dependence (i.e. when q_{\min} passes through 2)
 - Utilize new diagnostics and tools to understand physics:
 - CHERS rotation, locked mode detector, PEST-3 (DCON?)