

XP1023: Optimized RWM control for high $\langle \beta_N \rangle_{\text{pulse}}$ at low collisionality and I_i

S.A. Sabbagh, J.M. Bialek, S.P. Gerhardt, R.E.
Bell, J.W. Berkery, B. LeBlanc, J.E. Menard, et al.

*Department of Applied Physics and Applied Mathematics,
Columbia University, New York, NY, USA*

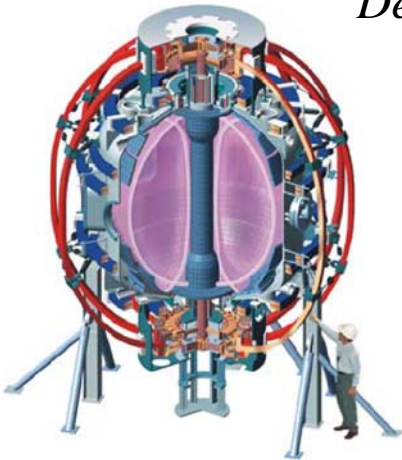
Princeton Plasma Physics Laboratory

NSTX Physics Meeting

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XP1023: Optimized RWM feedback control for high $\langle\beta_N\rangle_{\text{pulse}}$ at low collisionality and I_i

● Motivation

- Next-step ST devices (including the planned upgrade of NSTX) aim to operate at plasma collisionality and I_i below usual NSTX levels
- 2009 XP948 showed significantly higher RWM activity, lower β_N limit, in reduced I_i plasmas ($I_i \sim 0.45$ and below)

● Overall Goal

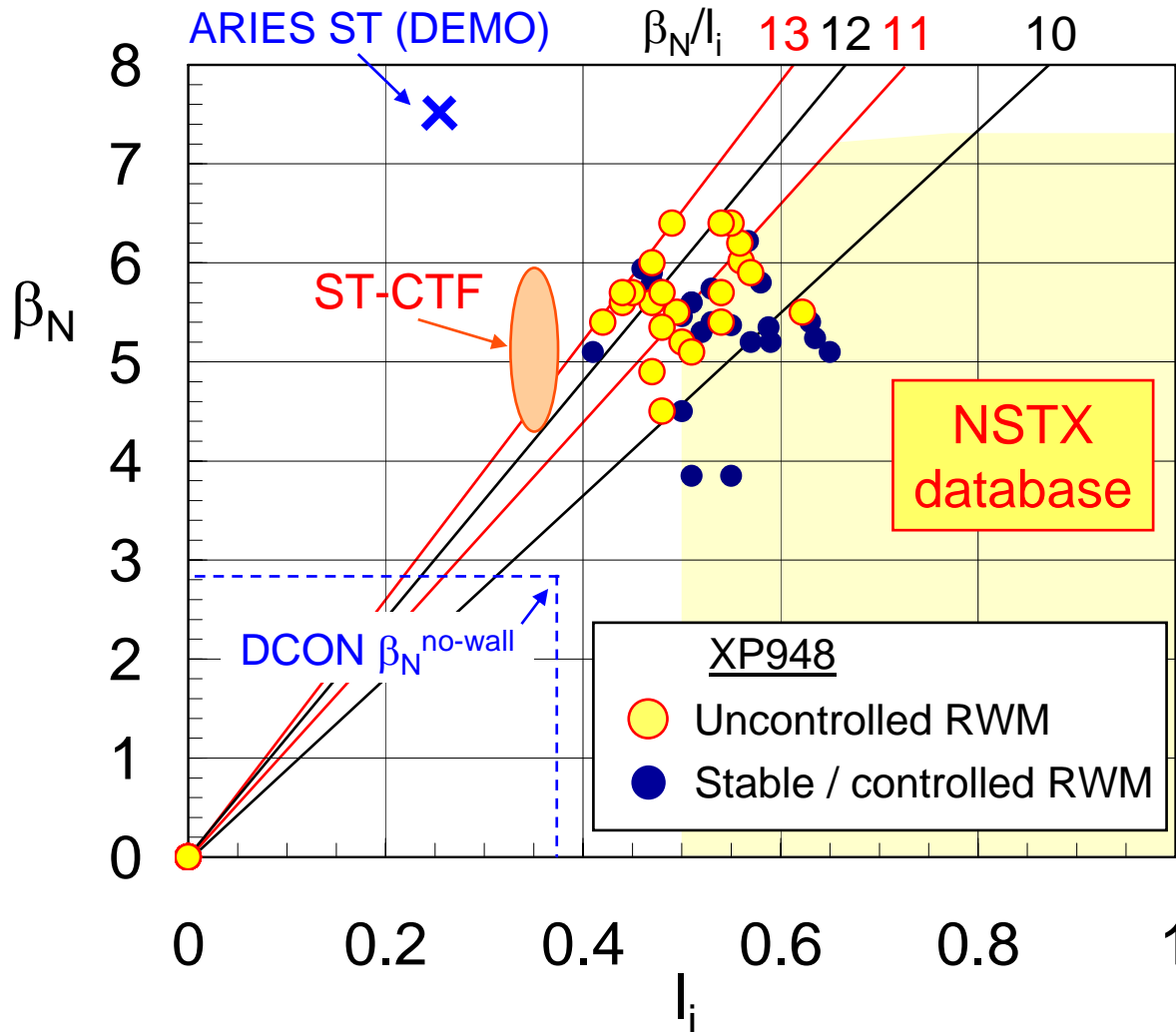
- Improve reliability of RWM stabilization at low I_i , understand impact of reduced plasma collisionality using new LLD capability

● Progress

- Generated reduced I_i target plasmas
- Generated unstable RWMs without manipulating plasma rotation
- Utilized new β_N feedback, new RWM control algorithms
- Insufficient τ_E to complete XP, but developed target for XP1020

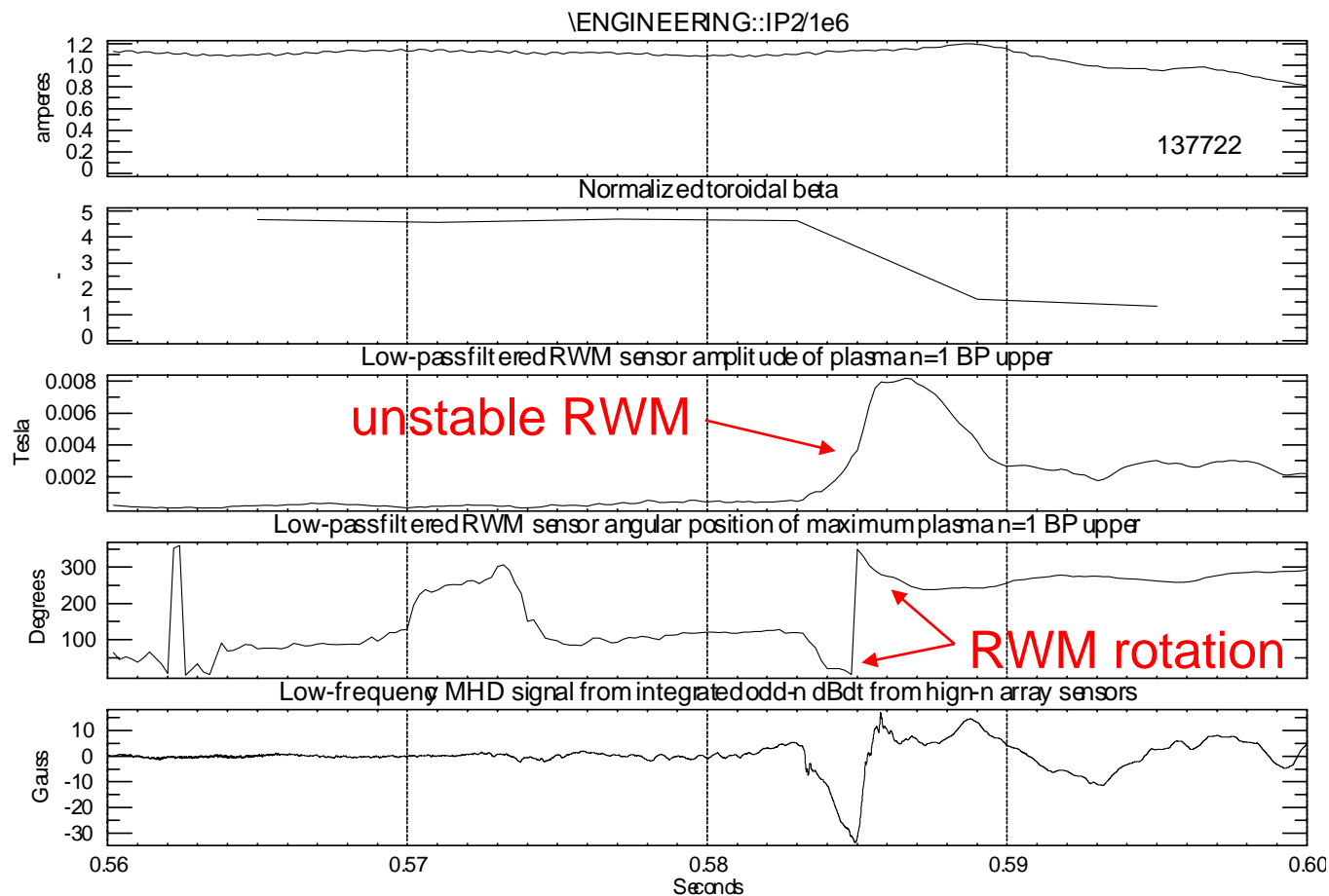


NSTX XP948 operated very low I_i , with high probability of RWM – can these plasmas be better controlled?



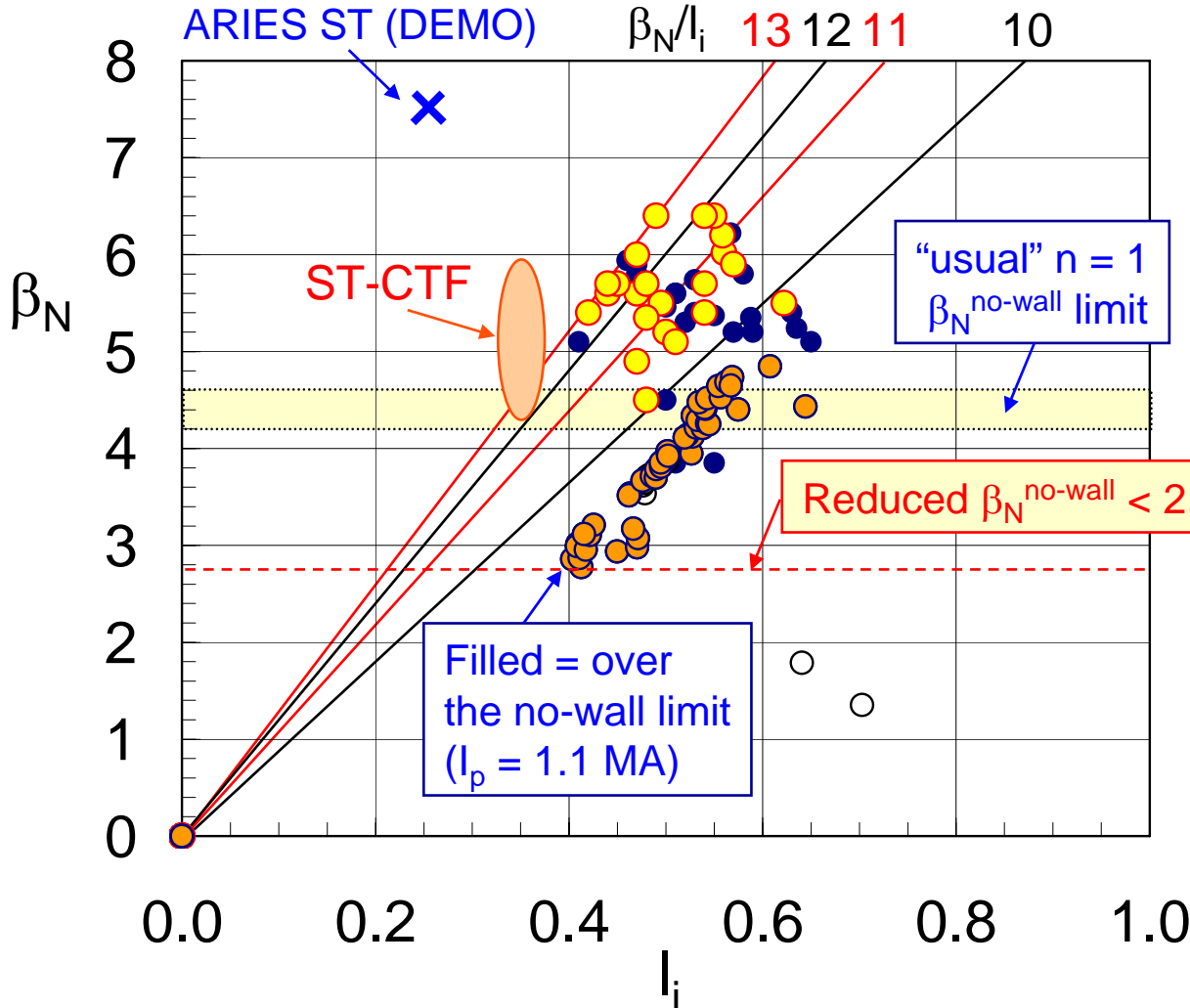
- Advancement in β_N/I_i toward targets
 - 2006 value: 11
 - XP948 (2009): 13
 - ST-CTF: 16
- Uncontrolled growing RWM occurred in about 50% of shots
 - ST-CTF target must be sustained indefinitely
- What value of I_i is the current-driven kink limit (unstable any β)?
 - DCON $n = 1$ no-wall limit for 135111 low: $\beta_N = 2.8$ ($I_i = 0.38$)

XP1023: unstable RWM created in low I_i target plasma



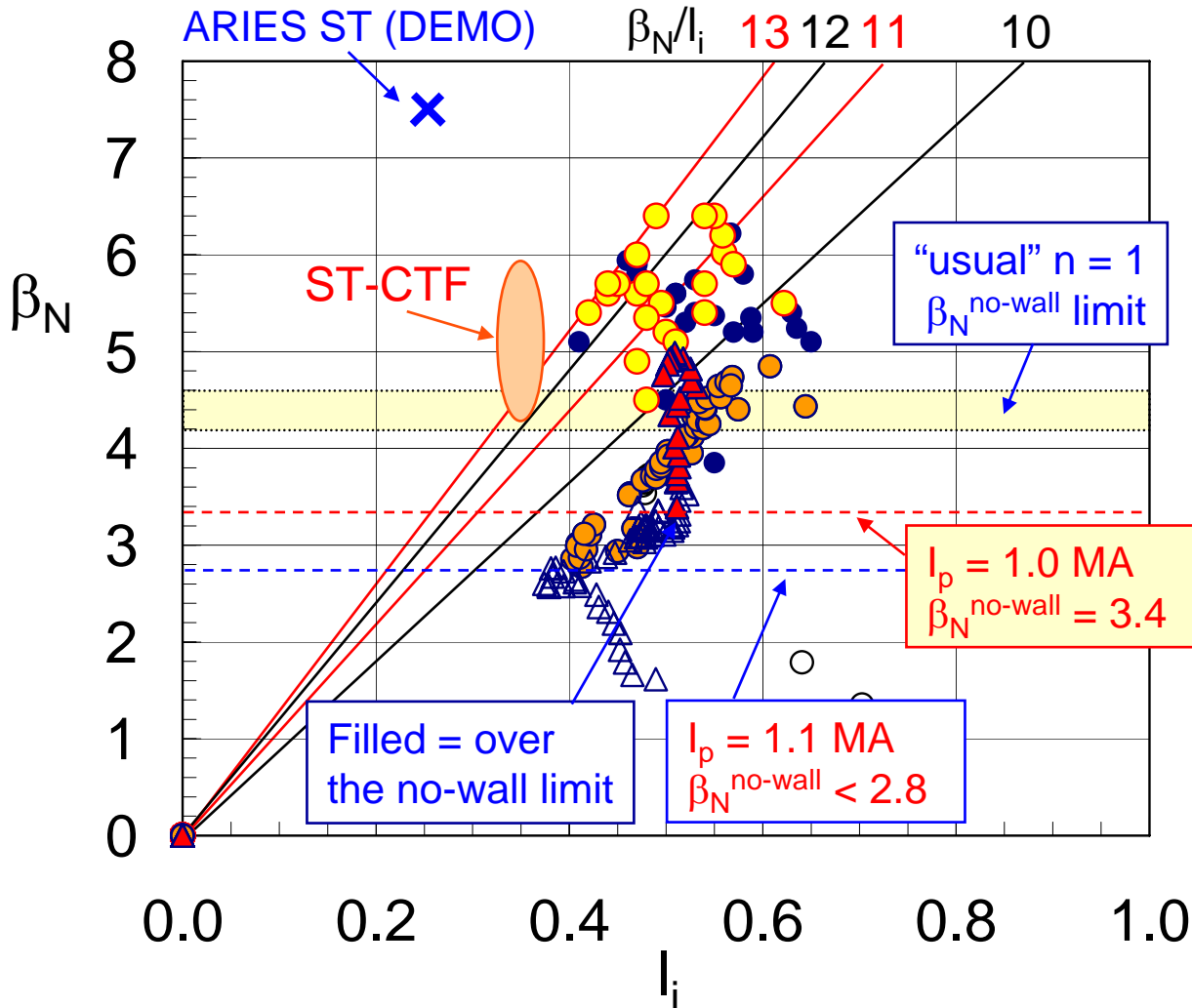
- Clear unstable RWMs produced
 - Although τ_E was low, unstable RWM generated without $n = 3$ braking

XP1023: new low I_i targets generated with reduced $n = 1$ ideal no-wall beta limit



- $I_p = 1.0$ and 1.1 MA target plasmas
- No-wall beta limit significantly reduced
 - $I_p = 1.1$ MA target: DCON $n = 1$ no-wall limit low for 137722: $\beta_N < 2.8$ ($I_i \sim 0.4$)
 - With single LITER, this target was not reliably reproduced last Thursday to use in XP1020

XP1023: new low I_i targets generated with reduced $n = 1$ ideal no-wall beta limit



- $I_p = 1.0$ and 1.1 MA target plasmas
- No-wall beta limit significantly reduced
 - $I_p = 1.1$ MA target: DCON $n = 1$ no-wall limit low for 137722: $\beta_N < 2.8$ ($I_i \sim 0.4$)
 - $I_p = 1.0$ MA target: DCON $n = 1$ no-wall limit low for 137804: $\beta_N = 3.4$ ($I_i \sim 0.5$)
- Unstable RWM without $n = 3$ braking
 - $I_p = 1.0$ target was reliable: moved on and used it in XP1020