
Progress on Wall Stabilized High Beta Calculations

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NSTX Results Review 09/19/01



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Leading to plasma operation above the no-wall -limit

MOTIVATION

- Identify set of equilibrium trajectories providing access to NSTX conceptual design target $n_N \sim 8$; $\tau \sim 40\%$; $l_i \sim 0.35$ $F_p \sim 1.7$

OUTLINE

- At high $l_i > 0.8$ weak wall stabilization - core localized modes
- At low $l_i \sim 0.5$ and low $n_N < 4$ weak wall stabilization - perturbed radial field maximizes in inboard section far from passive plates
- Kinetic EFIT at medium- $l_i \sim 0.74$ show core localized modes due to increased pressure peaking $F_p \sim 3.4$ compared to magnetics only ($F_p \sim 2.3$)

STRATEGY

- Use a profile merging technique between experimental points and design target to identify the accessible path



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High- equilibrium design goal: 40% target

Equilibrium parameters (EFIT*)

$R = 0.86$ m (achieved)

$a = 0.67$ m

$\beta = 2.0$

$\beta_p = 0.45$

$A = 1.27$

$I_p = 1$ MA

$B_T = 0.3$ T

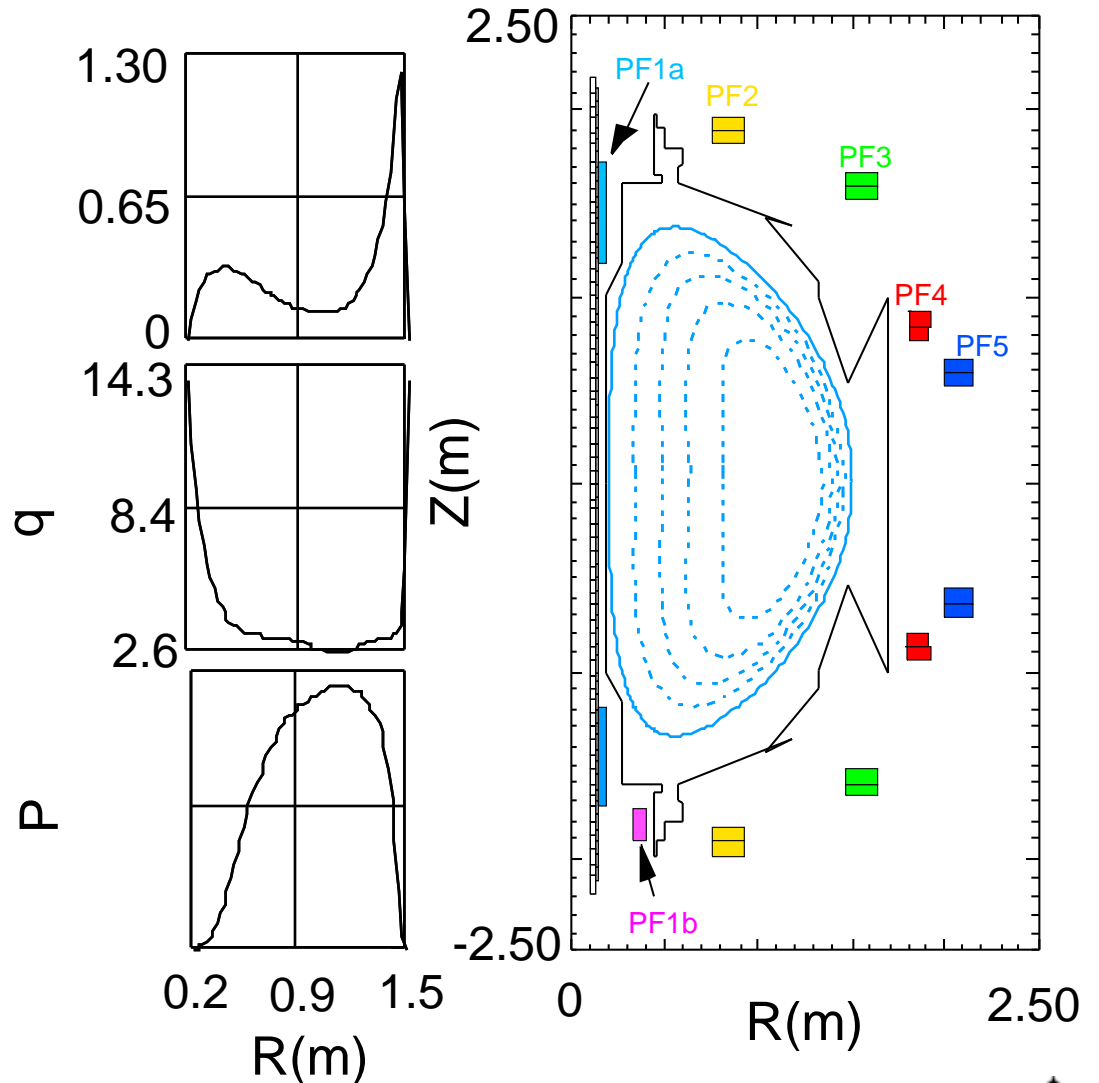
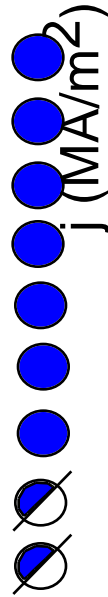
$f_t = 40.4\%$ (@ -limit)

$N = 8.1$ (@ -limit)

$F_p = 1.7$ (pressure peaking)

$l_i = 0.35$ (internal inductance)

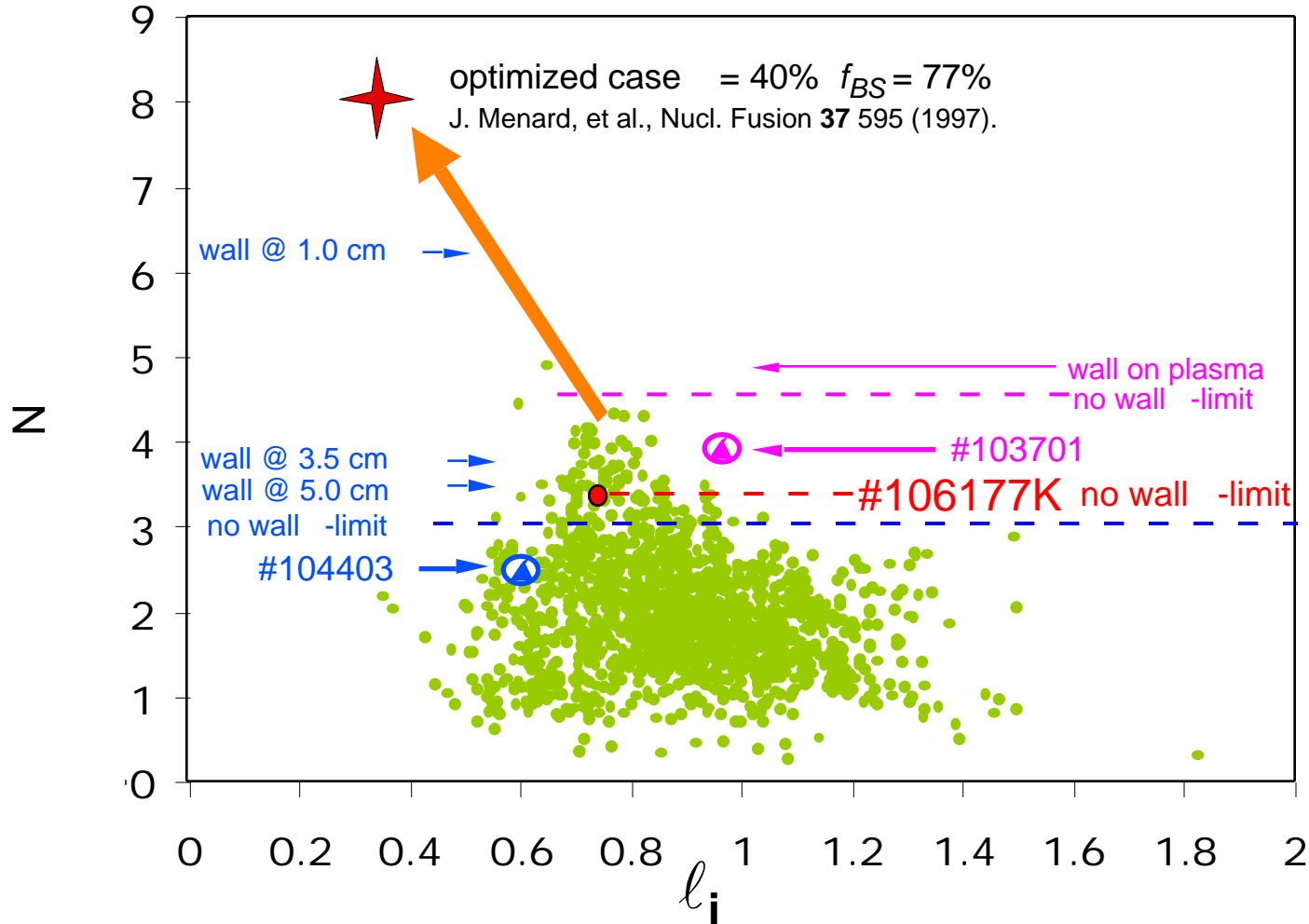
Optimized for high aligned bootstrap fraction ~ 80%



*L. Lao, et al., Nucl. Fusion 25 (1985) 1611
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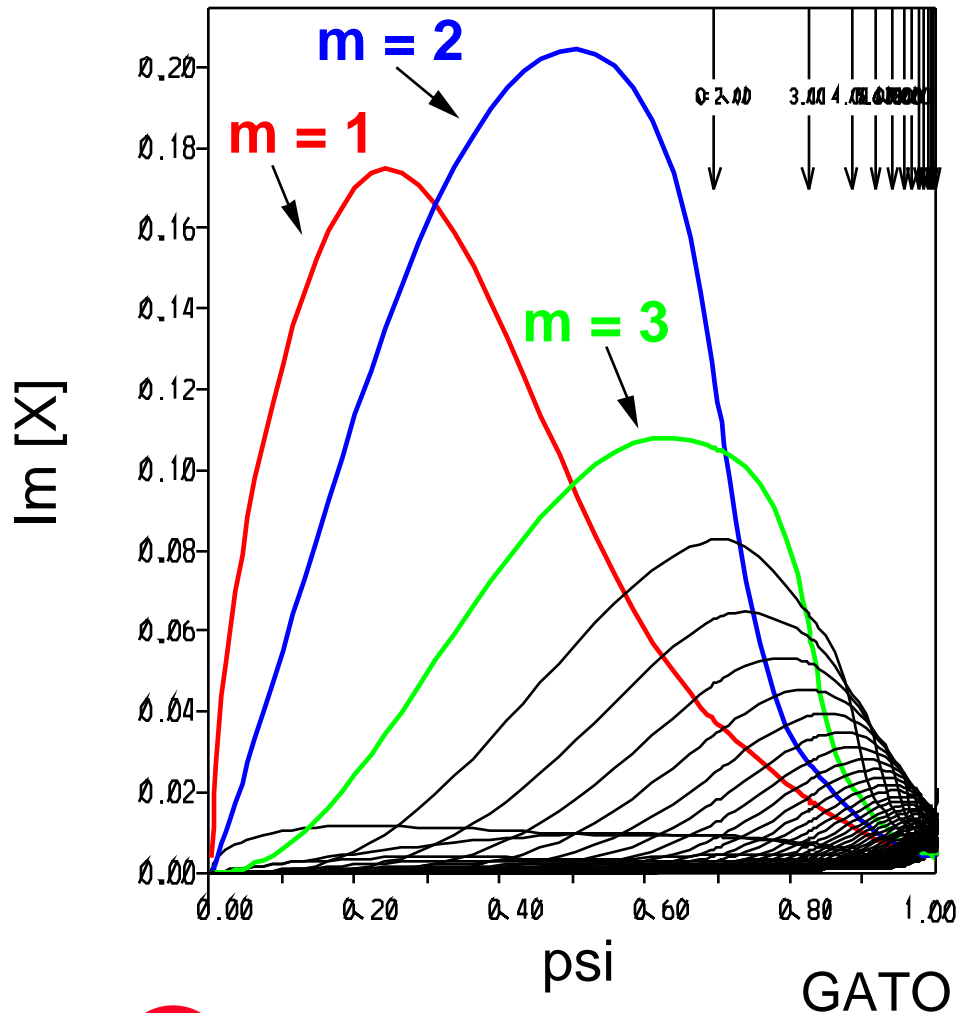
Defining the path to increased performance

Betan vs. l_i (Red = kinetic EFIT)



Global internal mode structure at low ℓ_i and high β_N

sh#:104403 extrapolated to $\beta_N = 6.3$



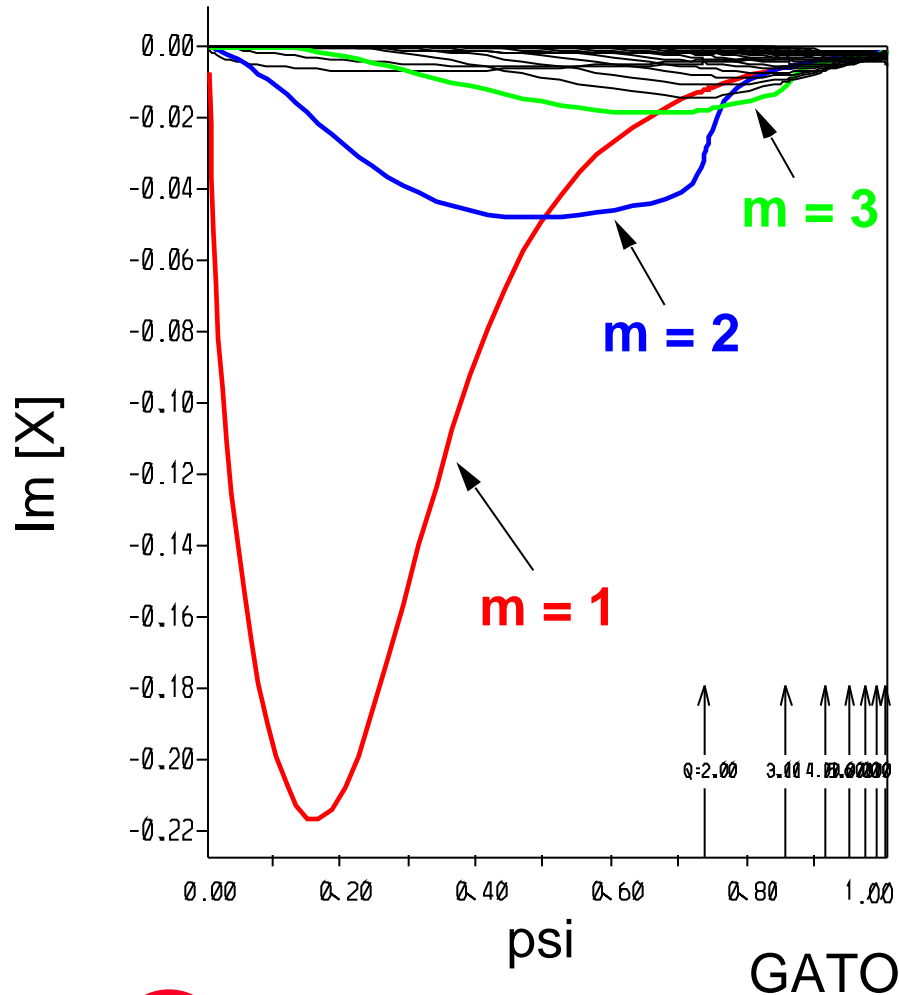
EFIT Magnetics only

$F_p = 2.3$ (pressure peaking)

$\ell_i = 0.56$ (internal inductance)

Centrally localized mode structure at high l_i

sh#:103701 extrapolated to $\beta_N = 4.6$



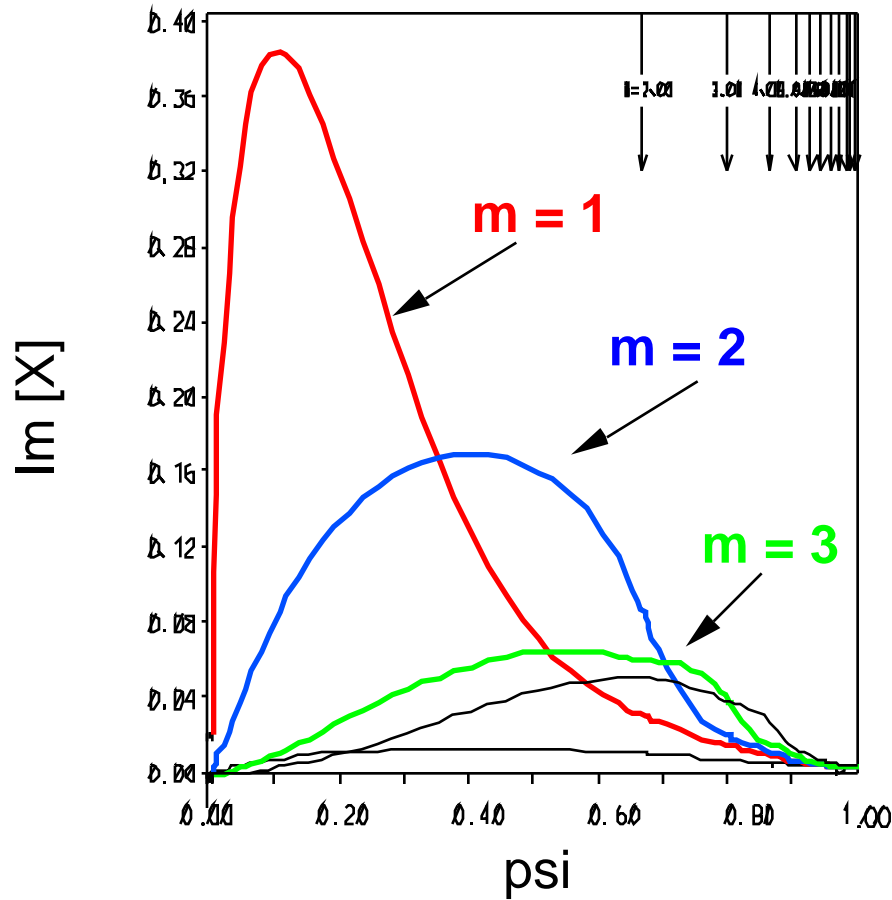
EFIT Magnetics only

$F_p = 2.3$ (pressure peaking)

$l_i = 0.56$ (internal inductance)

Central mode structure at medium l_i and high F_p

sh#:106177 at β -limit $\beta_N = 3.4$



GATO

Kinetic EFIT

$F_p = 3.4$ (pressure peaking)

$l_i = 0.74$ (internal inductance)

The analysis based on kinetic EFITs continues

Comments and Questions



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