



U.S. DEPARTMENT OF
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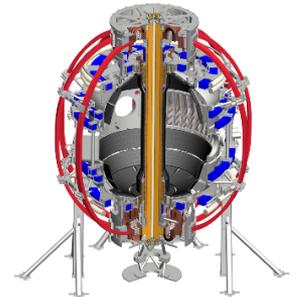


Aspect ratio scaling of tearing stability

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Core Science Group Meeting for National Campaign
10/13/2016

ORAU



'Leapfrog' NSTX-U MSG XP1544

- XP1544 approved but not run
 - “Make contact with NSTX for $n=1$ tearing stability”
- PPPL / GA collaboration on core stability
 - Previously published study

R. J. La Haye, R. J. Buttery, S. P. Gerhardt, S. A. Sabbagh, D. P. Brennan, “Aspect ratio effects on neoclassical tearing modes from comparison between DIII-D and National Spherical Torus Experiment”
PoP **19**, 062506 (2016)

	DIII-D	NSTX-U	NSTX
R/a	3.1	1.7	1.4
Growth rate	!!!	✓	✓
Saturated size	!!!	✓	✓
Marginal point	✓	✗	✓

XP 1544

Comparison of NSTX-U to NSTX physics can be pursued through NSTX-U to DIII-D

- Test aspect ratio dependence of modified Rutherford equation for tearing stability

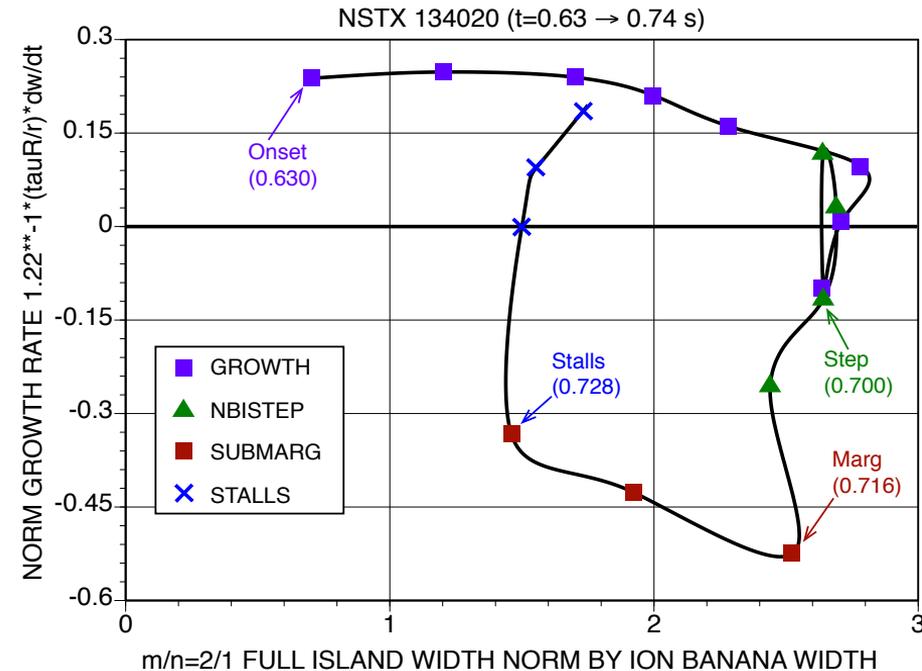
$$1.22^{-1} \frac{\tau_R}{r} \frac{dw}{dt} = \Delta' r + C_R \frac{r D_R}{w}$$

$$+ \left(\epsilon^{1/2} \frac{r L_q}{L_{pe}} \beta_{\theta e} \left[\frac{1}{w} - \frac{w_{small}^2}{3w^3} \right] \right)$$

$\epsilon = r/R_0$

$D_R \propto \epsilon^2 \beta_\theta$

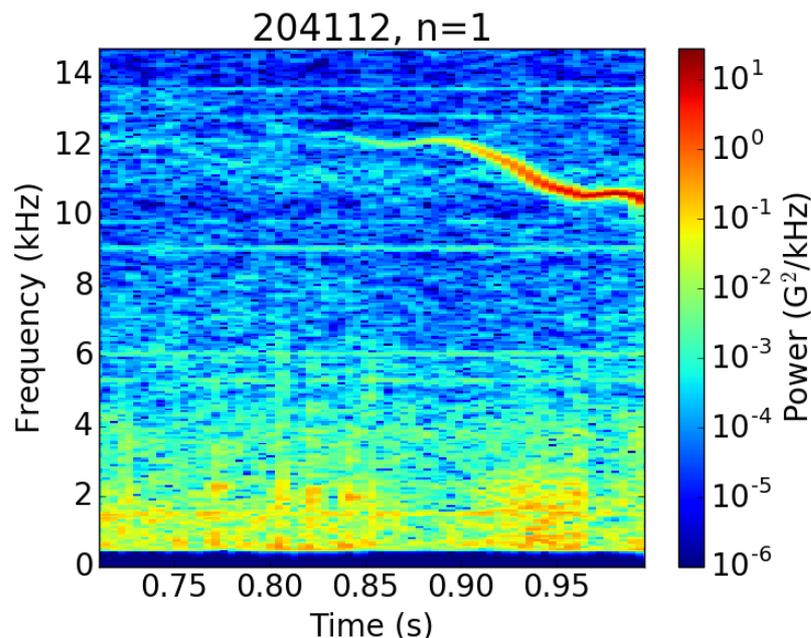
$w_{small}^2 \propto \epsilon ?$



Some useful NSTX-U 2/1 tearing discharges obtained in 2016 run

- Incidental observations

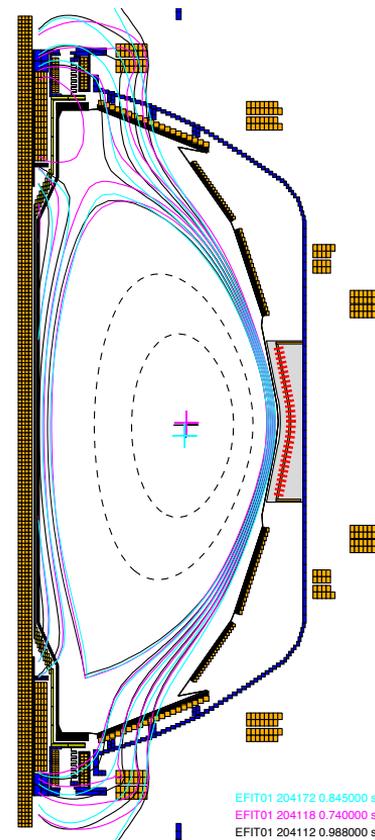
- H-mode shots, Thomson, little/no CER, no MSE



- Interesting shots identified so far:

- 204112
- 204118
- 204172

- All high β_N
- All growing n=1 tearing during flattop
- Islands observable by flat spots on Thomson T_e at q=2



Dedicated DIII-D experiments can match NSTX-U tearing discharges already run

- Match shaping (except R/a), $q_{95} \approx 7$, $I_p \approx 0.9$ MA
 - $B_T \approx 1.44$ T (DIII-D) vs. 0.65 (NSTX-U) for q_{95} matching
- Get onset, growth, saturation
- Tearing stability is high priority topic in MSG
 - Exp's on DIII-D will provide complimentary data for NSTX-U
 - Bonus: marginal point (planned for XP1544)