NSTX-U

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JRT15

J.W. Berkery[1], *S.A. Sabbagh[1], J.-K. Park [2]*

[1]Columbia U., [2]PPPL

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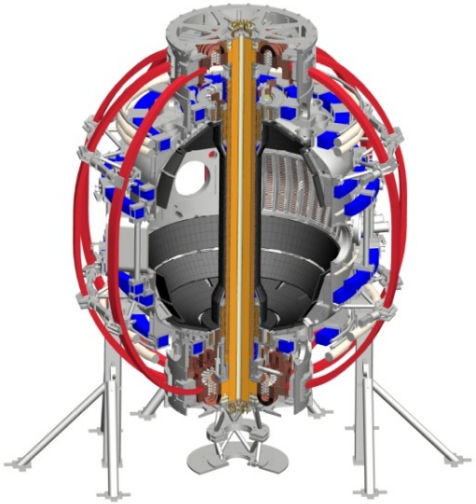

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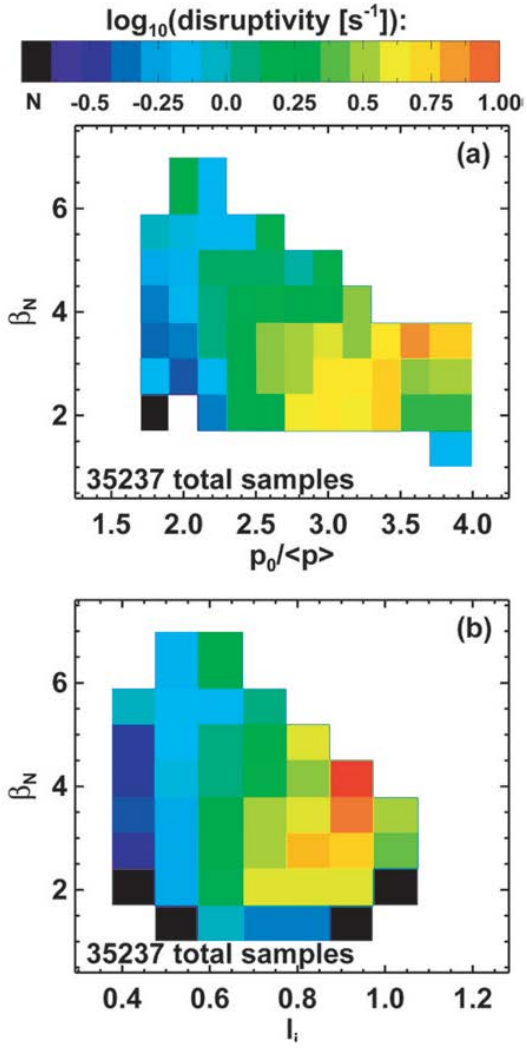
“Broadened pressure profiles generally improve global stability”



NSTX disruptivity

NSTX-U projected ideal stability

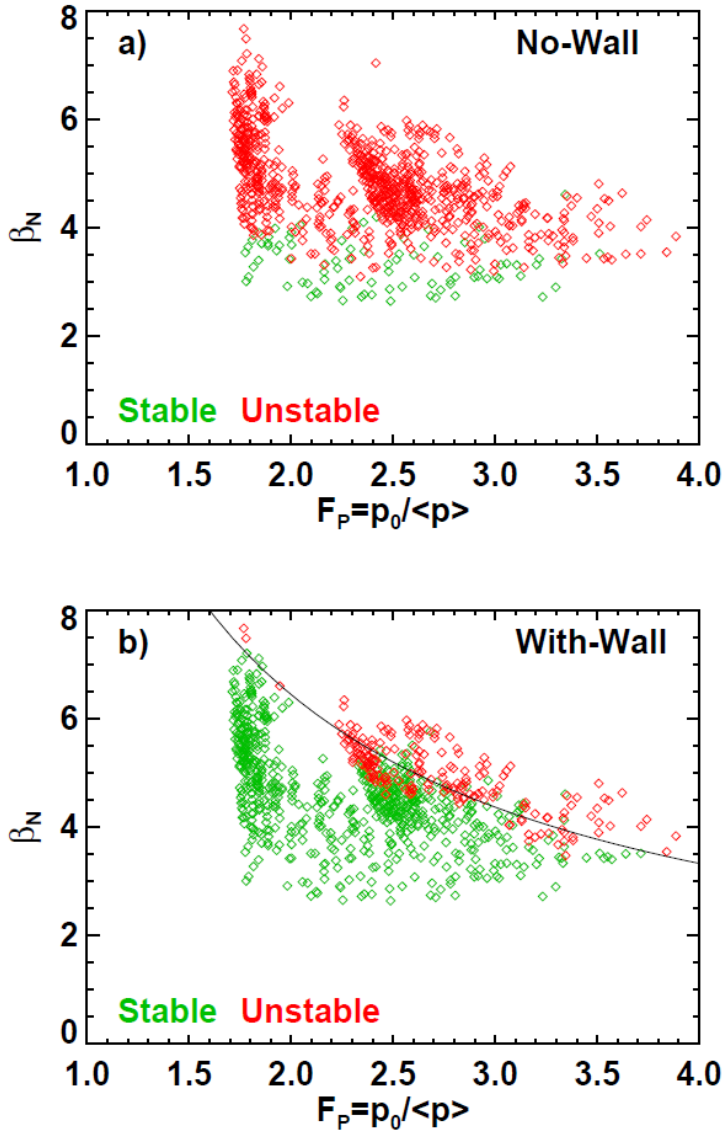


Figure 12. Disruptivity as a function of β_N and (*a*) the pressure peaking factor, or (*b*) the internal inductance.

MS TSG suggestions for the direction of the JRT15

Focus on:

- details of plasma at pressure peaking / current peaking/broadening disruptive limits, and how to avoid such limits (previous slide)
- the impact of broadened current and pressure profiles on stability in plasmas that are close to being fully non-inductive
- pressure peaking / current profile data in light of a plasma under active MHD control
- how these zeroth order parameters can be influenced by more modern hypotheses – e.g. kinetic stabilization
- different dependencies not explicitly stated in the JRT15: the effect of rotation, q, anisotropic EP distribution…

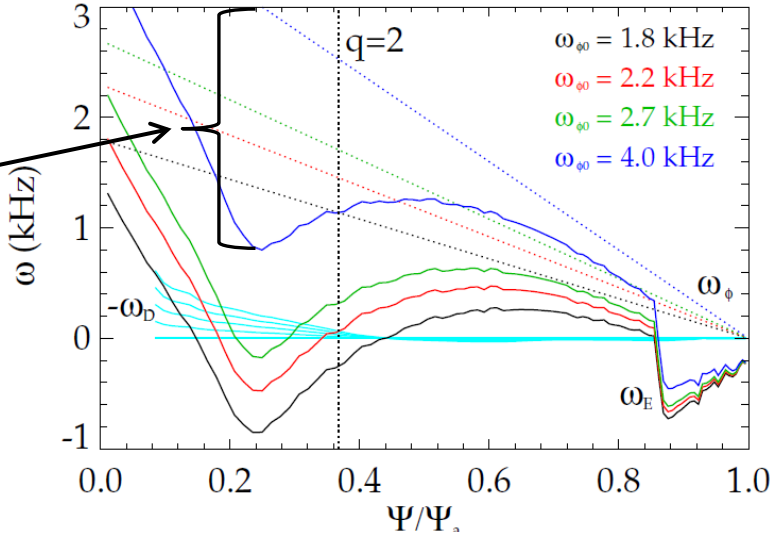
Pressure profile effects kinetic stability by changing the location of mode-particle resonances

Example: ITER case with ITB:

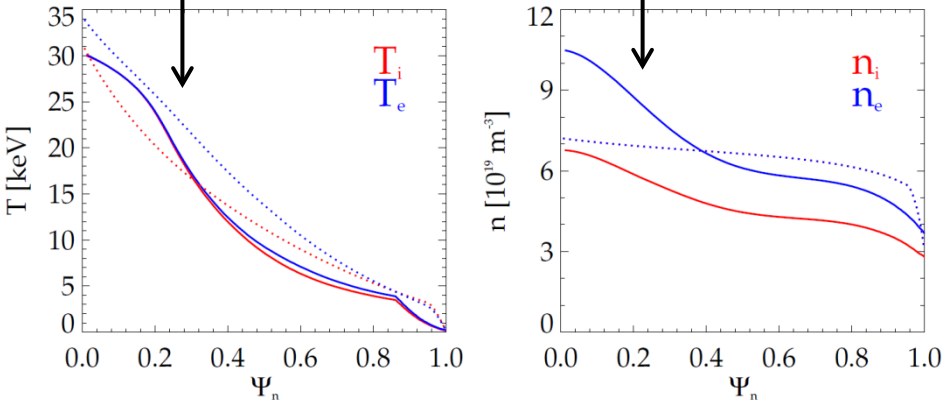
Strong internal gradients create large ω_*

- Cause difference between ω_ϕ and ω_{EXB}.
- Enables resonance with precession drift of trapped thermal ions if ω_ϕ is low.

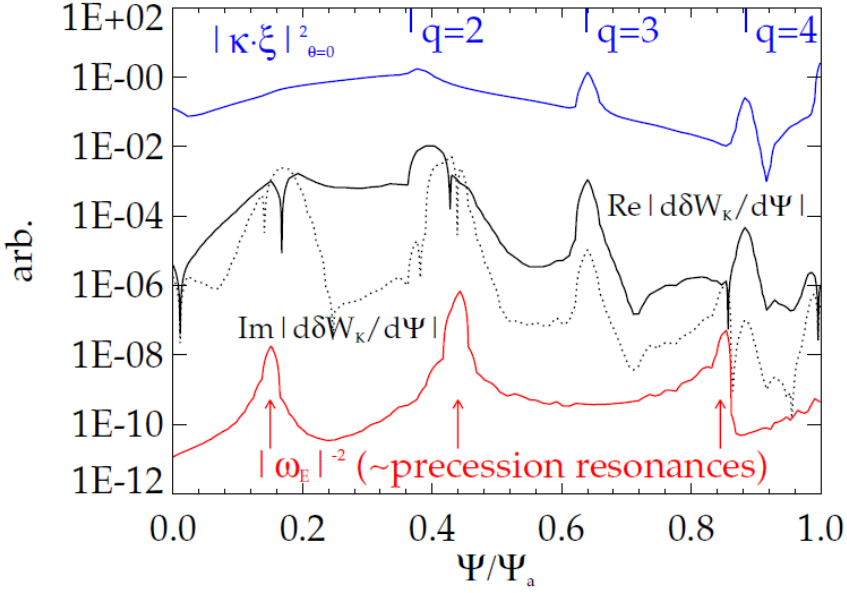
$$\omega_\phi \approx \omega_E + \omega_{*i}$$



Strong gradients

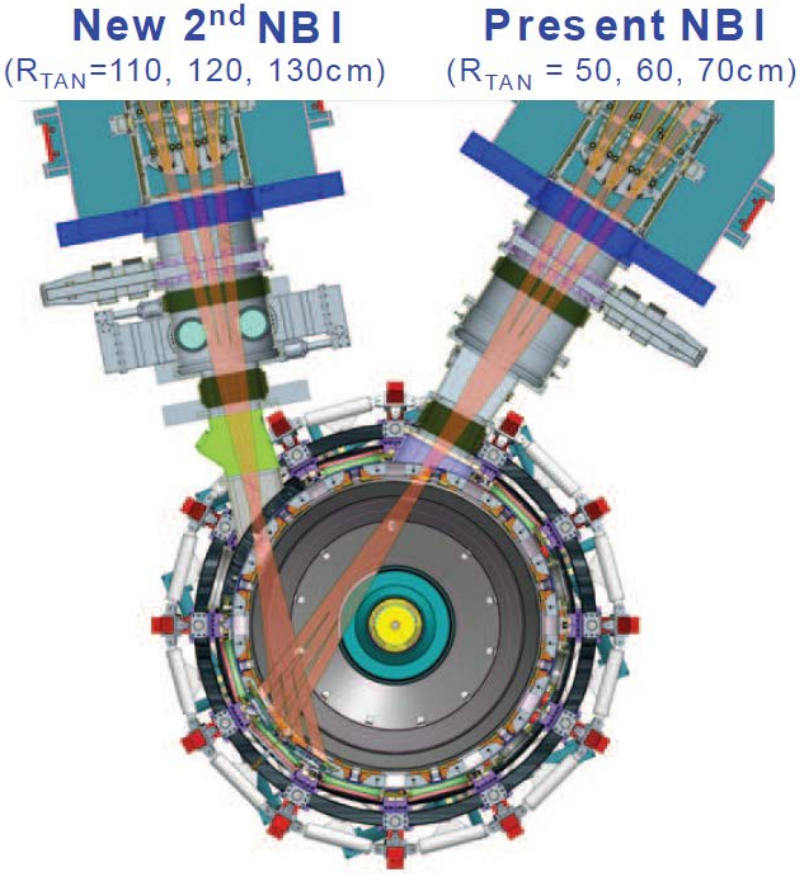


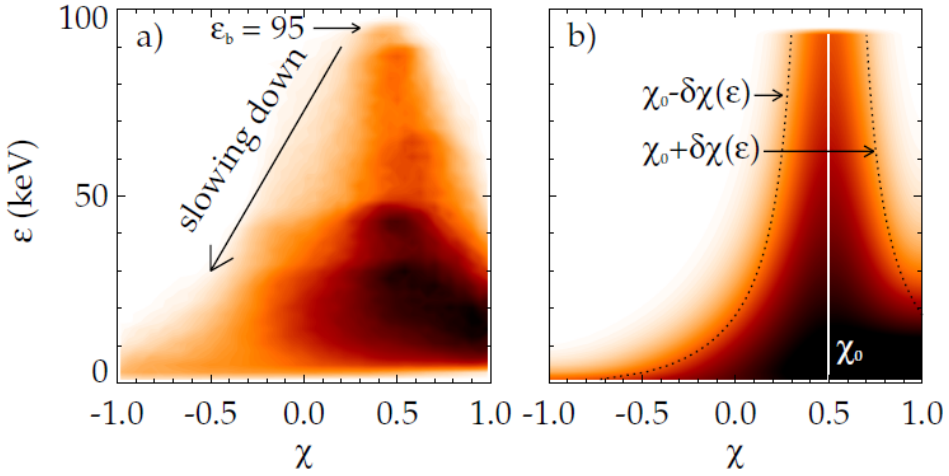
dashed lines = "standard" ITER advanced scenario



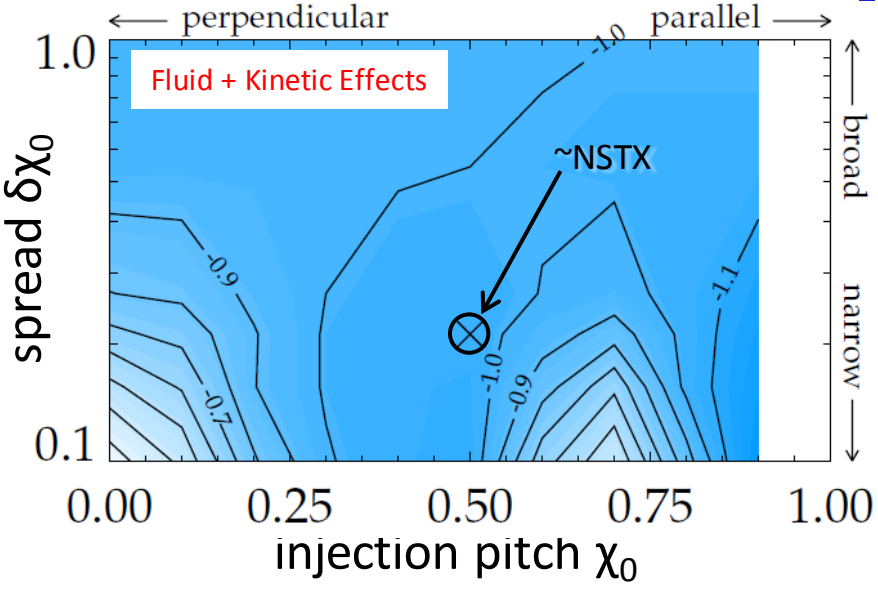
"Validate theoretical models of… global stability response to varied heating and current drive deposition"

Anisotropy of EPs can effect stability and we plan to study this in NSTX-U





Contours of $\gamma\tau_w$ with isotropic thermal particles + anisotropic EPs: fluid correction and δW_K



Study of classical and neoclassical tearing mode stability vs. pressure gradient and q-shear

- Classical and neoclassical tearing modes can be more important in NSTX-U, despite the favorable Glasser and curvature effects, due to high pressure and bootstrap current fraction

- Study on classical tearing mode
  - Can be destabilized by both pressure and current broadening
  - Resistive DCON can be used to more precisely estimate classical tearing mode index Δ' and can be compared with experiments

- Neoclassical tearing mode (NTM)
  - In low aspect ratio, neoclassical and resistive interchange effects can be comparable
  - Depending on (p'/q') and $(p'/q')^2$, respectively, and thus can be further destabilized if current broadening leads to q-shear reduction

- Study can be extended onto rotational-shear stabilization as shown in NSTX

XXX

JRT15

- Conduct experiments and analysis to quantify the impact of broadened current and pressure profiles on tokamak plasma confinement and stability. Broadened pressure profiles generally improve global stability but can also affect transport and confinement, while broadened current profiles can have both beneficial and adverse impacts on confinement and stability. This research will examine a variety of heating and current drive techniques in order to validate theoretical models of both the actuator performance and the transport and global stability response to varied heating and current drive deposition.