

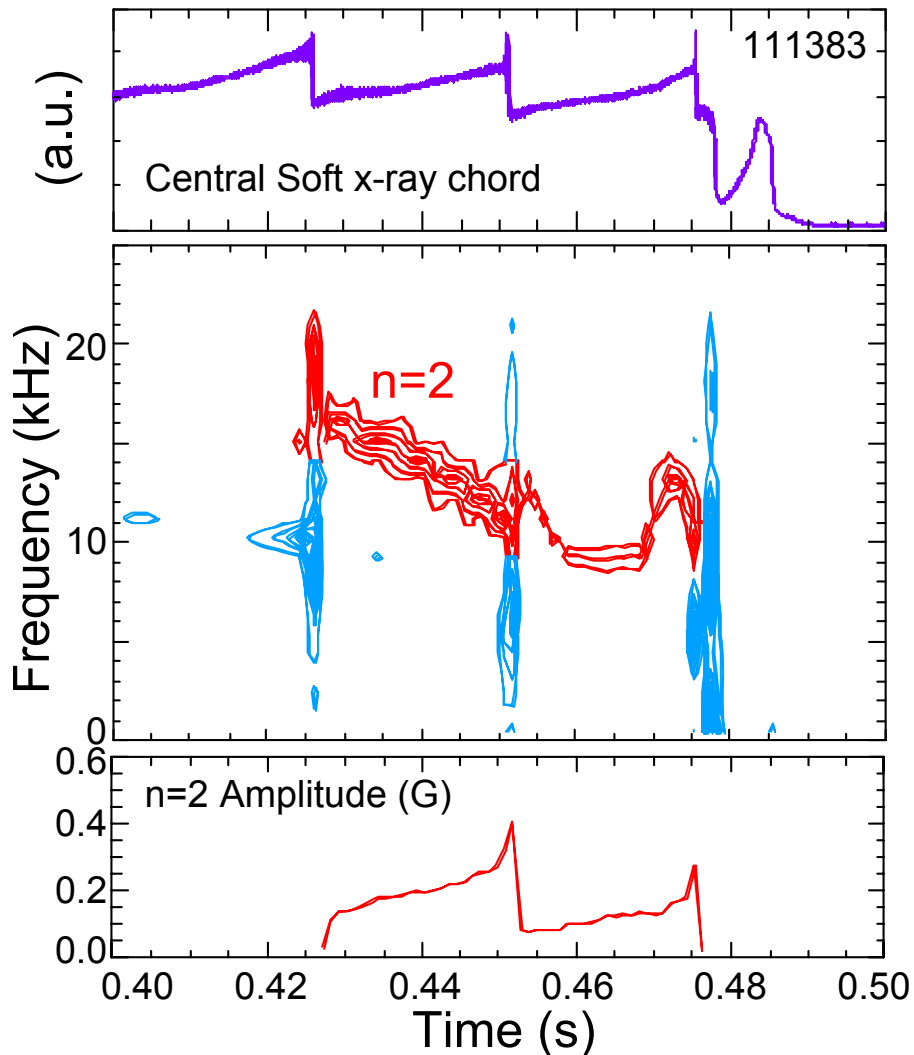
NTM aspect ratio scaling

(NSTX/DIII-D collaboration)



- Scaling of NTM threshold with ρ^* , β_{pol} , other parameters.
 - Previous data indicates reproducible "trigger" amplitude from sawtooth crashes.
 - Use β , other scans in sawtoothed plasmas.
- Island width to be measured internally:
 - on NSTX with soft x-ray cameras, reflectometers.
 - on DIII-D with ECE.
- Modeling with TRANSP and PRIME code

Are "NTMs" really NTMs?

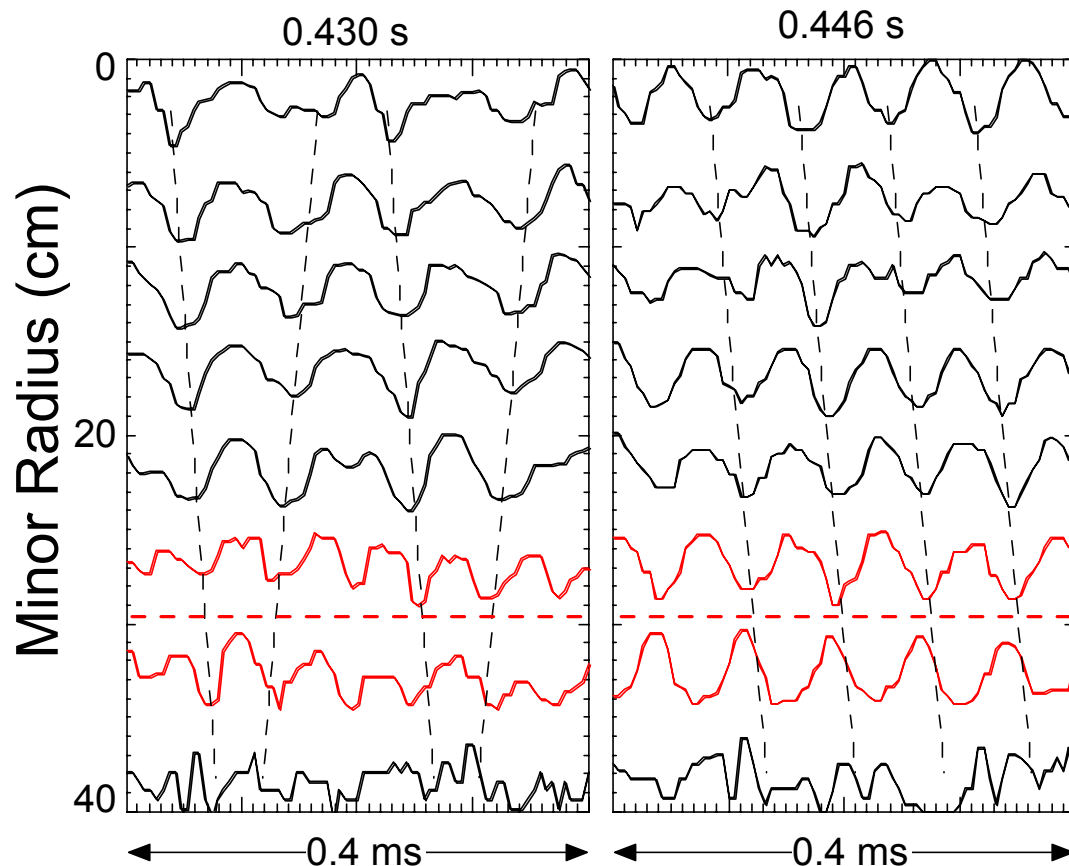


- Toroidal mode number of $n = 2$ suggests NTM, but:
- Strong interaction with sawtooth instability, drop in amplitude at sawtooth - stochastic fields heal island?
- Can amplitude evolution be modeled with extended Rutherford equation?
- "Spontaneous" $n = 2$ modes seen on TFTR - another source of drive?

Early in sawtooth period $n=2$ is kink-like, strong $n=1$ mode



- Weakly phase locked with 3:2 frequency match.
- $n=2$ not triggered through non-linear coupling to $n=1$?
- Are core oscillations a chord-integral effect?
- How does sawtooth crash trigger $n=2$ kink?

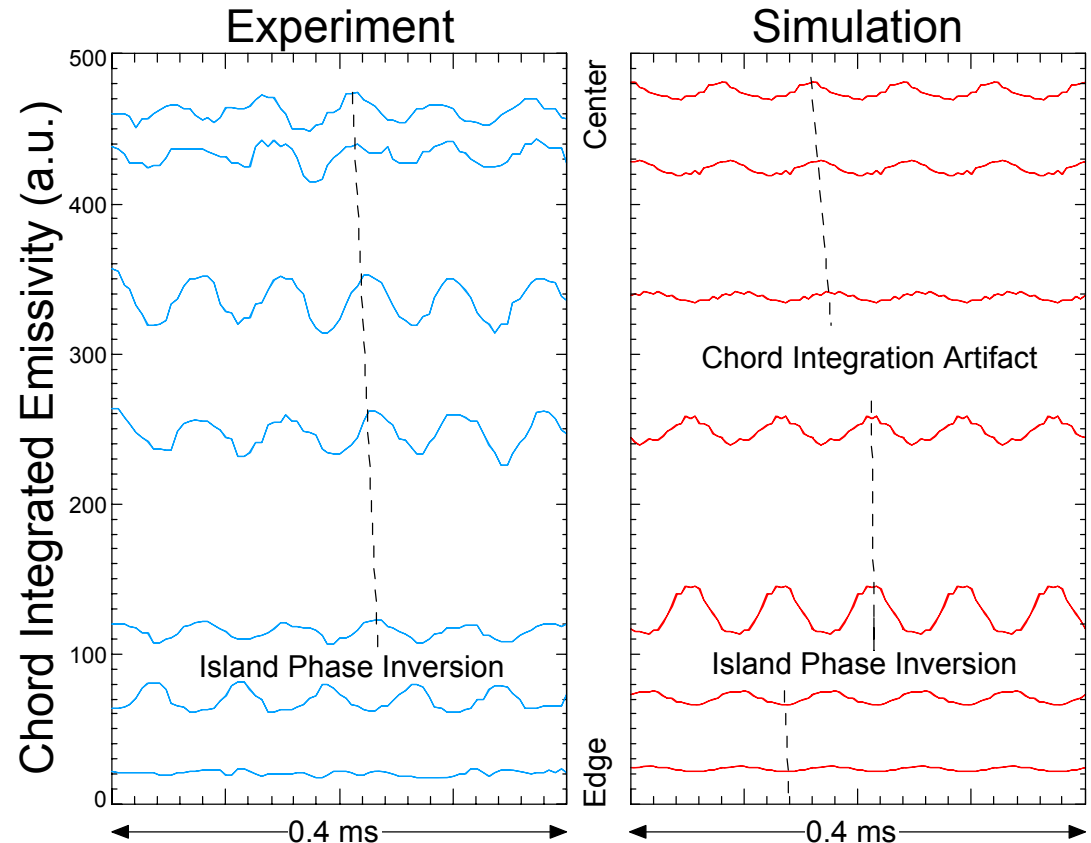


- Insufficient data for tomography, use simulations.

Internal measurements of mode structure, island widths essential



- Some features of sxi data reproduced with simulation.
- Not all $n=2$ are NTMs; $n=2$ kink-like modes seen on NSTX, DIII-D.
- Even when island is present, much of "mode structure" *not* NTM.
- Coupling to $n=2$ probably helps destabilize $3/2$.
- Perhaps time to move beyond NTM paradigm.

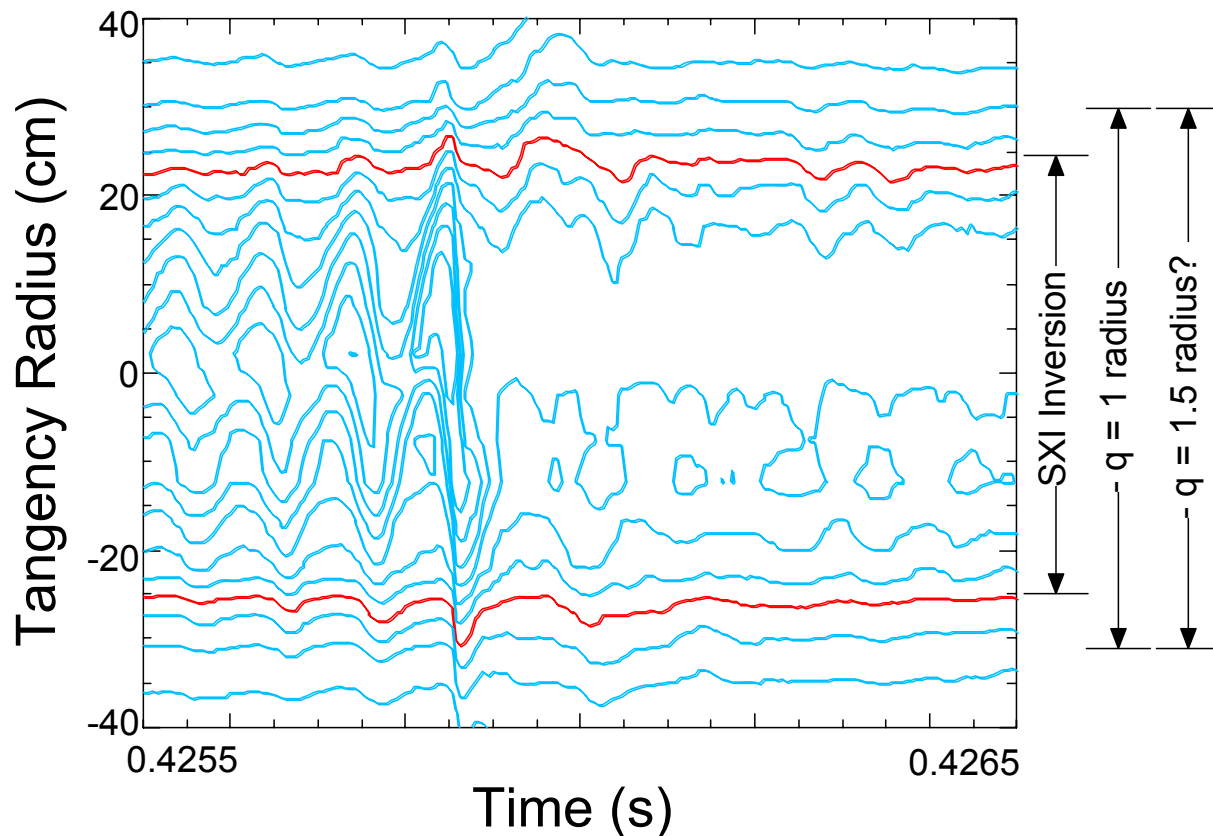


(q profile used for simulation is not measured, adjusted to match phase inversion - 0.45s.)

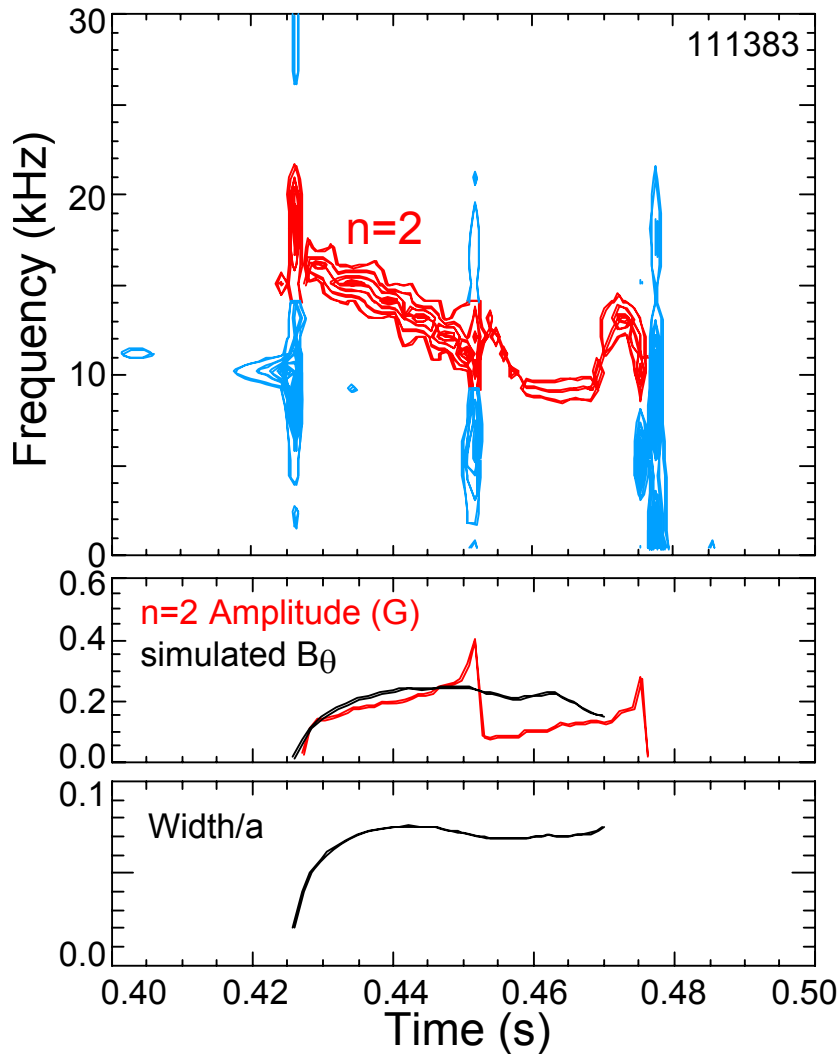
The inferred $q=1$ radius is comparable to the inferred $q=1.5$ radius



- The $q=1.5$ radius was inferred from simulating the island inversion radius.
- Could these $n = 2$ modes be $2/2$ kinks evolving to $2/2$ islands?
- Radius of $q=1$ surface is ≈ 1.2 times the chord integrated inversion radius



Amplitude drop at sawteeth not predicted by Rutherford equation



- Amplitude evolution of 3/2 modeled with Rutherford equation, TRANSP.
- "NTM" coefficients adjusted to match Mirnov amplitude.
- Local parameters not affected by sawtooth crash - island width should evolve on resistive time scale.
- Need internal measurements.

NSTX ready for serious NTM studies



- Diagnostic tools exist for:
 - Internal island width measurements
 - Reliable q-profile evolution
- Growing list of discrepant behavior
 - Interaction with sawteeth
 - Coupling to internal kinks
 - chirps
 - "spontaneous" occurrence
 - Improper scaling
 - $n=2$ kinks

Equilibrium J , q profiles are used to simulate 3/2 tearing mode



- Soft x-ray data Abel inverted on EFIT grid to find local emissivity.
- Emissivity remapped on island flux plot and chord integrated.
- Comparison to fluctuation amplitude in experimental data is used to constrain island size, eigenmode structure.

