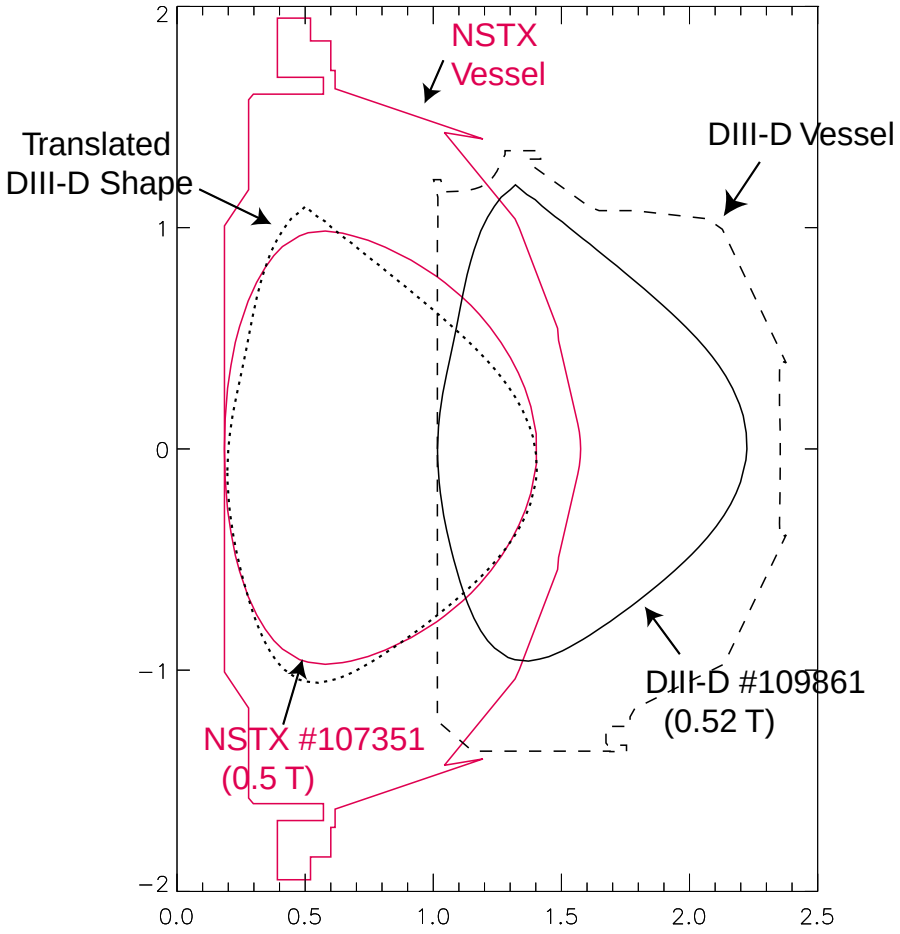
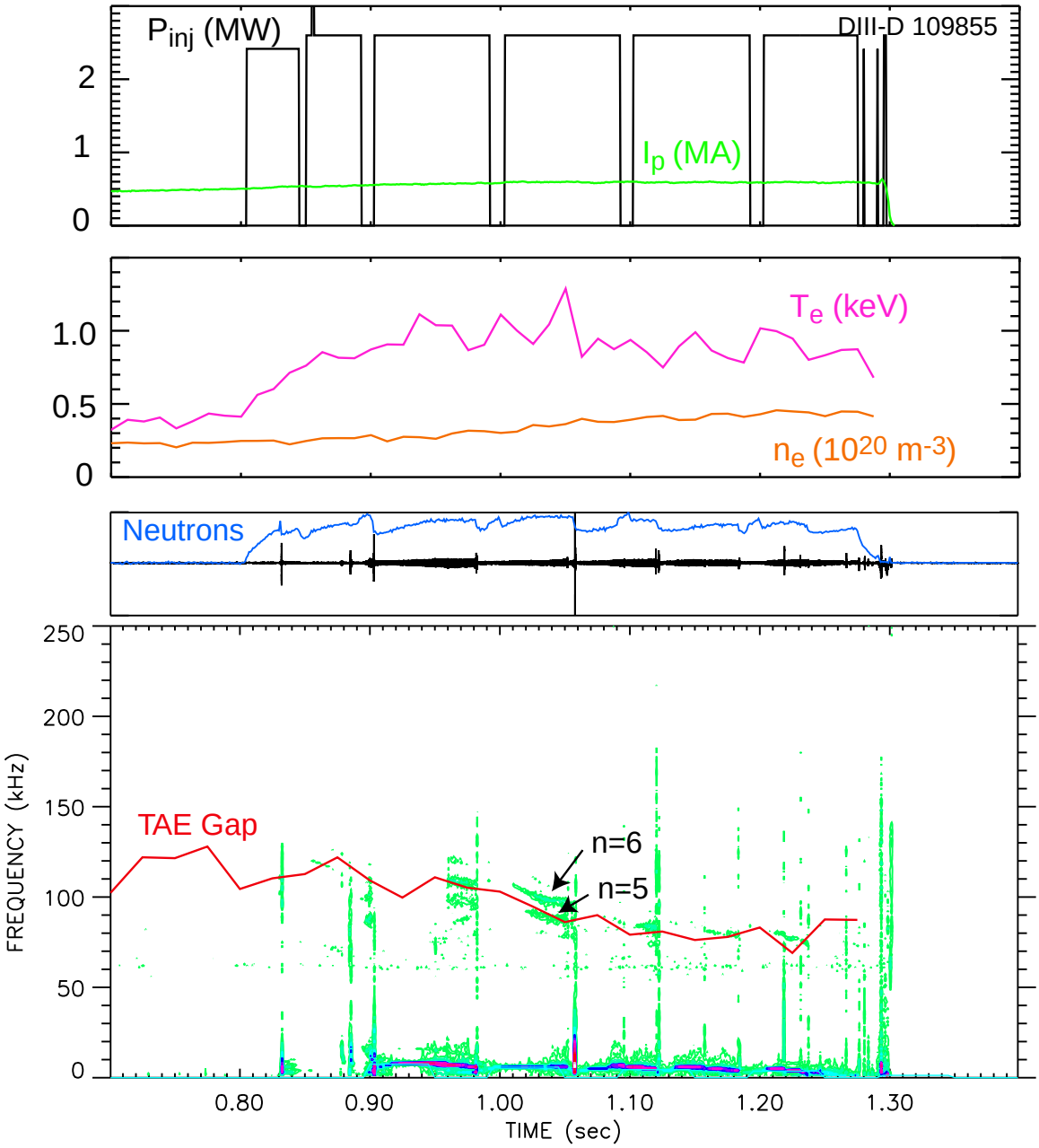
Alfven Mode Similarity Experiment

Goals: Match NSTX field and shape to study R dependence.
(The beams are similar, so this matches v_b/v_A.)
Measure stability threshold.
Measure most unstable toroidal mode number n.

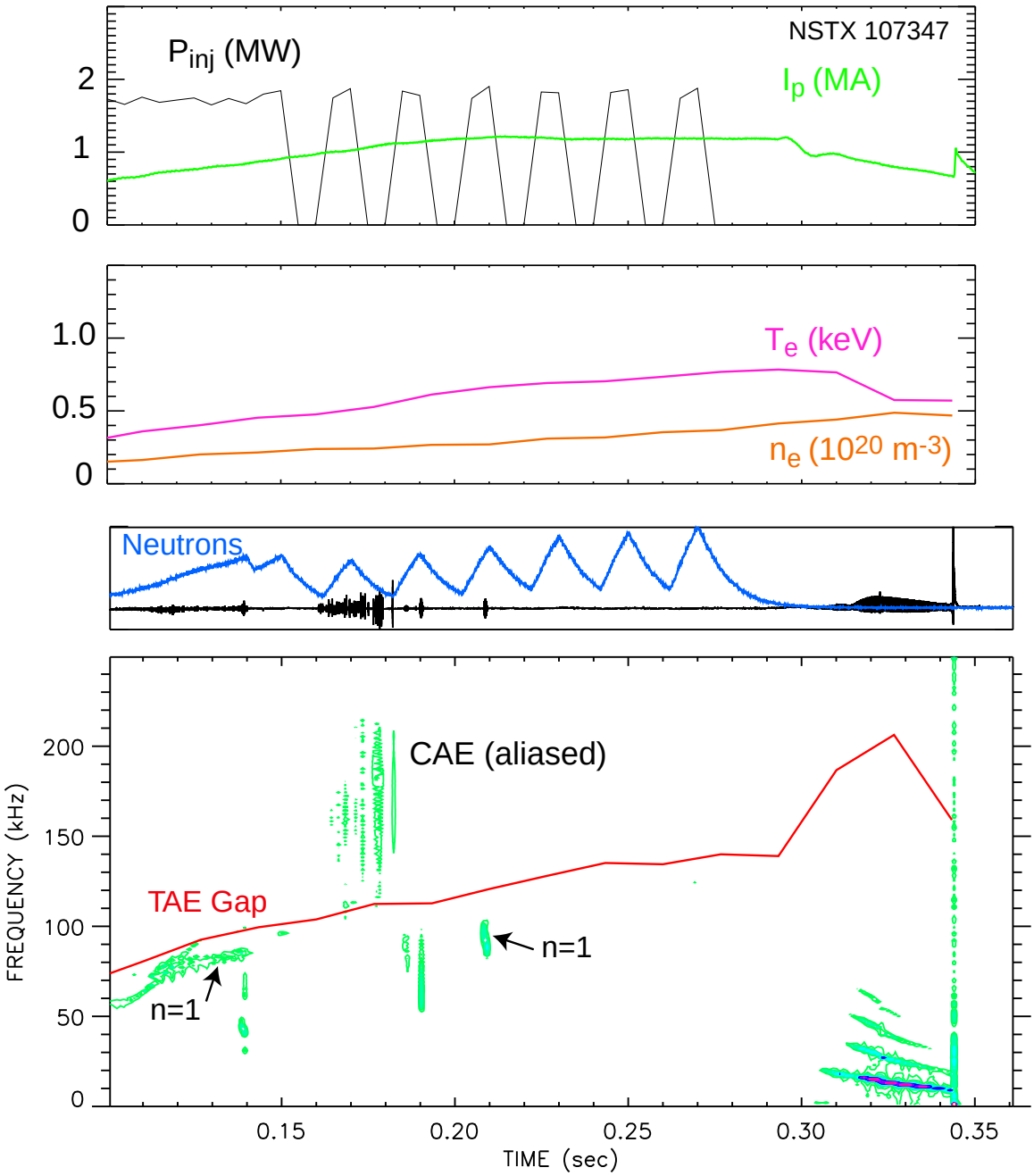


W. Heidbrink, S. Bernabei, E. Fredrickson, G.Y. Fu, N. Gorelenkov, Y. Luo, T. Rhodes; A. Hyatt, D. Mueller, and D. Gates, physics operators.

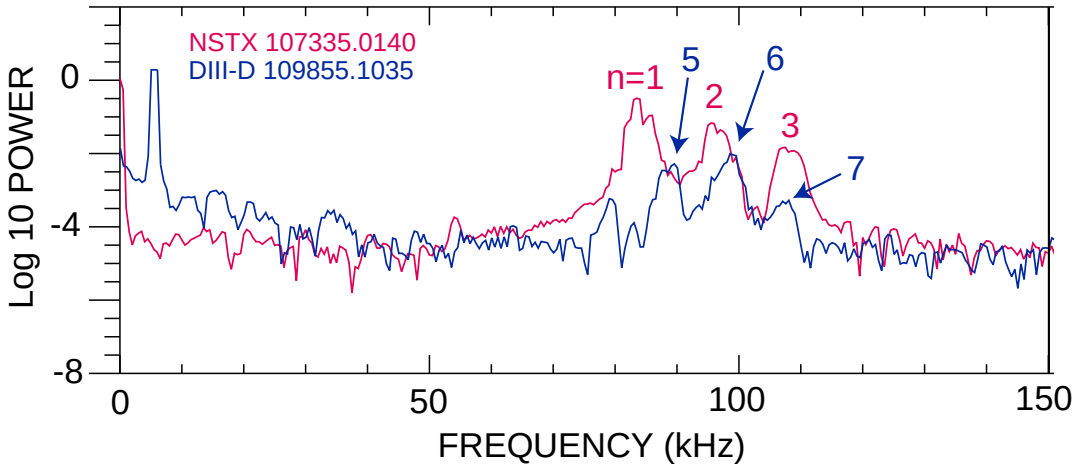
A typical 0.6 T DIII-D Discharge



A typical NSTX Discharge

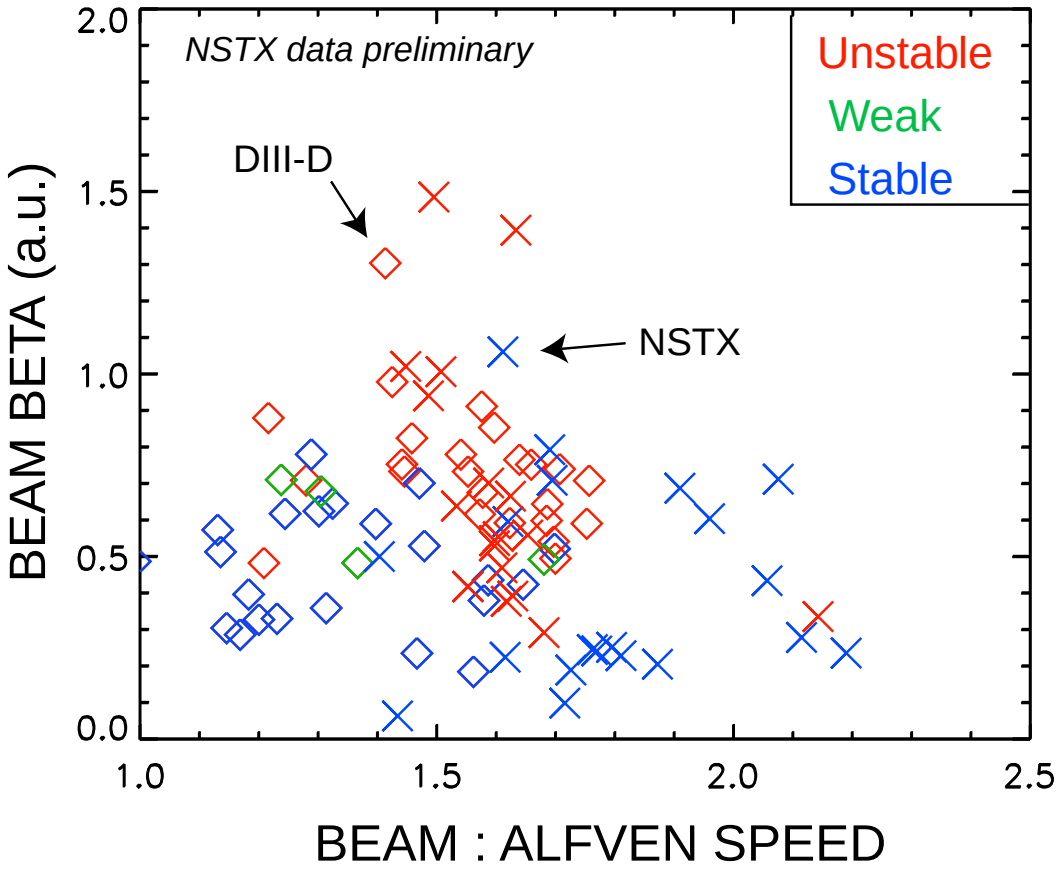


Classic "TAE" Spectral Feature in Both Devices



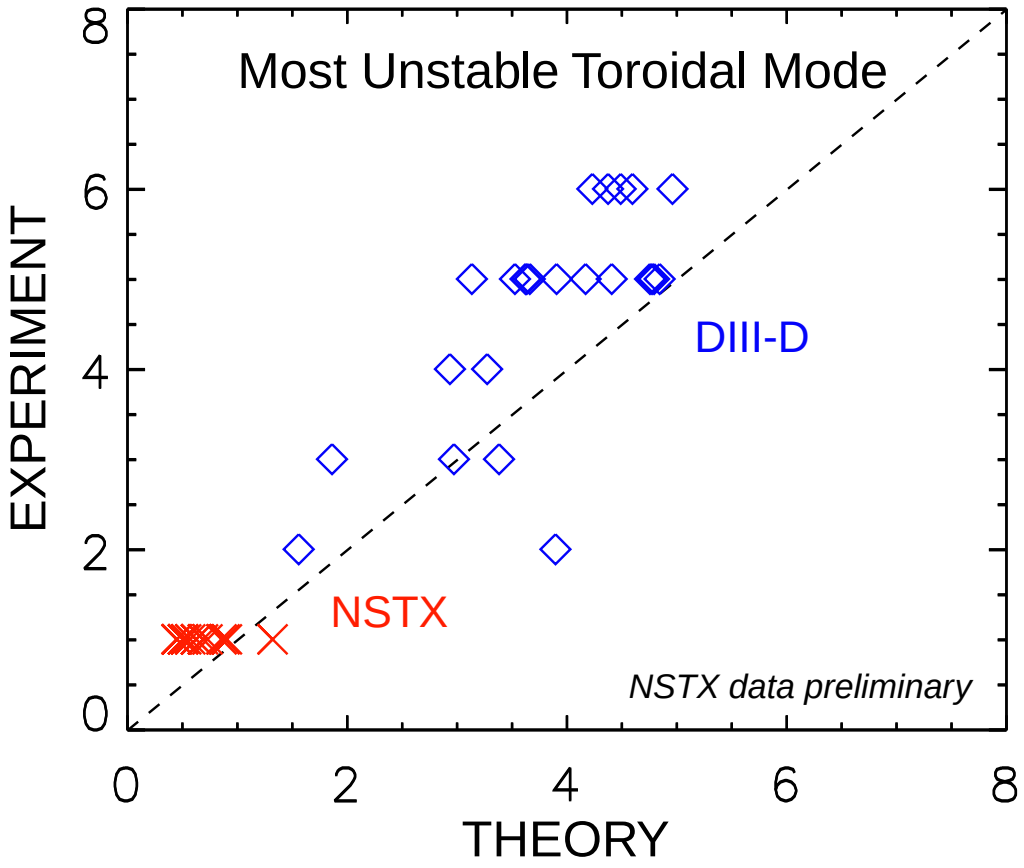
- Many NSTX discharges have a $n = 1$ spectral feature with $f \simeq f_{TAE}$ that is ~ 10 kHz wide–possibly a bounce-resonance fishbone.
- Use narrow line & coexistence of other n numbers as TAE signature.
- For DIII-D, inferred frequency in plasma frame $\sim 80\%$ of nominal TAE frequency.
- Classic "chirping modes" ($f \simeq \frac{1}{2} f_{TAE}$, $\Delta f/f \sim 50\%$, ~ 1 ms bursts, $n = 1$, 2 or 3) also occur on most NSTX discharges.

Similar TAE Thresholds



- One steady 80 keV beam is usually unstable in both devices.
- $\beta_{beam} \propto (Neutrons)/(density * volume * B^2)$.

TAE Mode Number Scales as Expected



- Gorelenkov *et al.* predict most unstable n scales as $\sqrt{n_e}/q^2$ with no explicit dependence on R.
- An earlier expression by Berk *et al.* with an explicit R dependence disagrees with the data.

Conclusions

1) Made 0.52 T discharge on DIII-D &
~ matched shapes.
Future similarity experiments will be easier.

2) Chirping modes common on NSTX but not observed on DIII-D.
Why? Larger shear? Larger gap?

3) Empirical TAE thresholds comparable.
Will calculate theoretical stability.

4) TAE n number larger in DIII-D as expected.
Scaling law works; will compare w/ full theory.

5) Observed CAE activity on DIII-D.
Need to repeat for quantitative conclusions.

Miscellaneous Remarks:

1) DIII-D H-mode threshold was low as expected.
2) Electron profiles looked similar. Learned how to avoid Alfven modes for a confinement similarity experiment.