

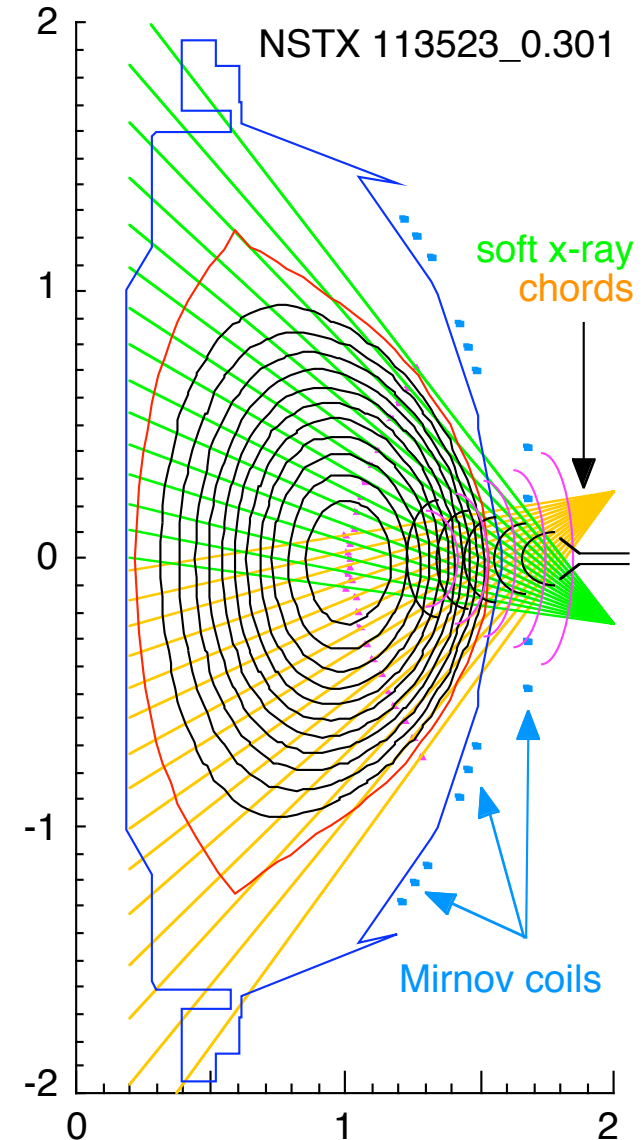
Diagnostic capabilities for fast ion driven modes

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PPPL, Feb 9, 2007

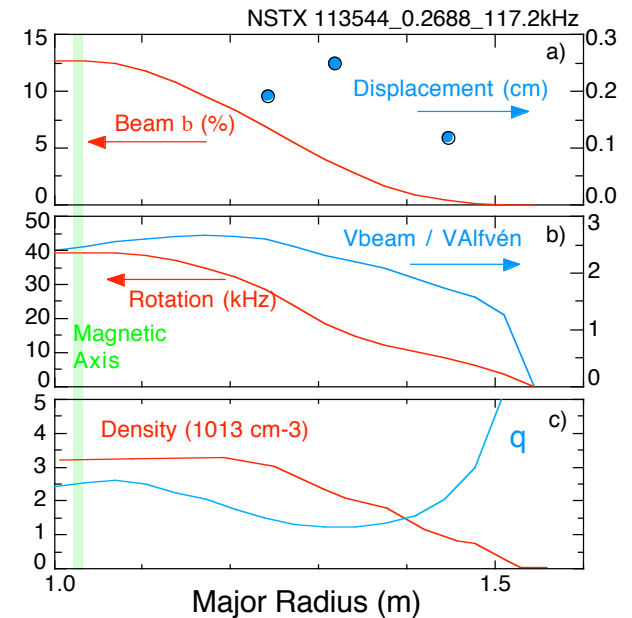
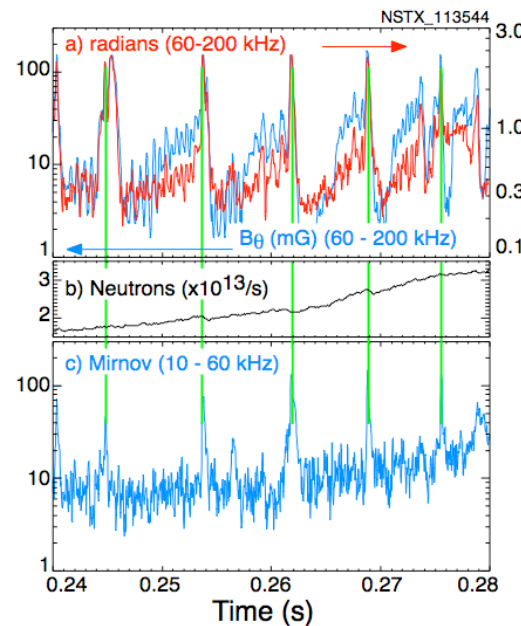
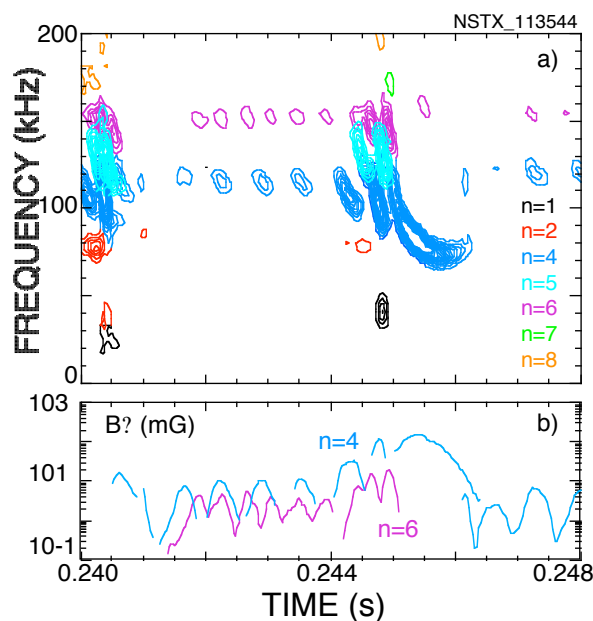
Diagnostics to measure the structure of fast ion modes

- Mirnov coils give frequency, toroidal wavelength, limited poloidal wavelength and some information on amplitude.
- **Internal measurements generally not available in H-mode.**
- Soft x-ray cameras give chord-integrated measurements, frequencies less than ≈ 100 kHz.
- Reflectometer may give data at up to six radial points; also requires interpretation (4 MHz).
- Scanning reflectometers give high resolution eigenmode structure (up to 3×10^{13} , < 50 kHz)
- Interferometers give chordal averages (250 kHz).



TAE "avalanches" example of multiple mode enhanced fast ion transport

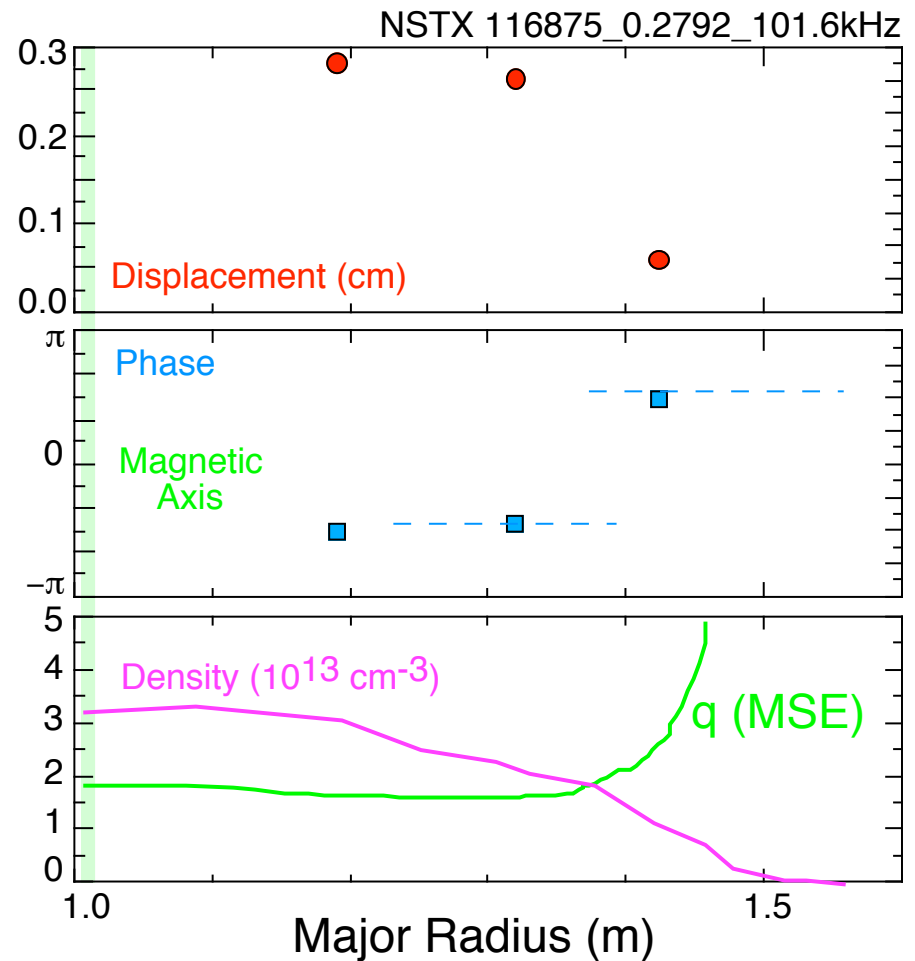
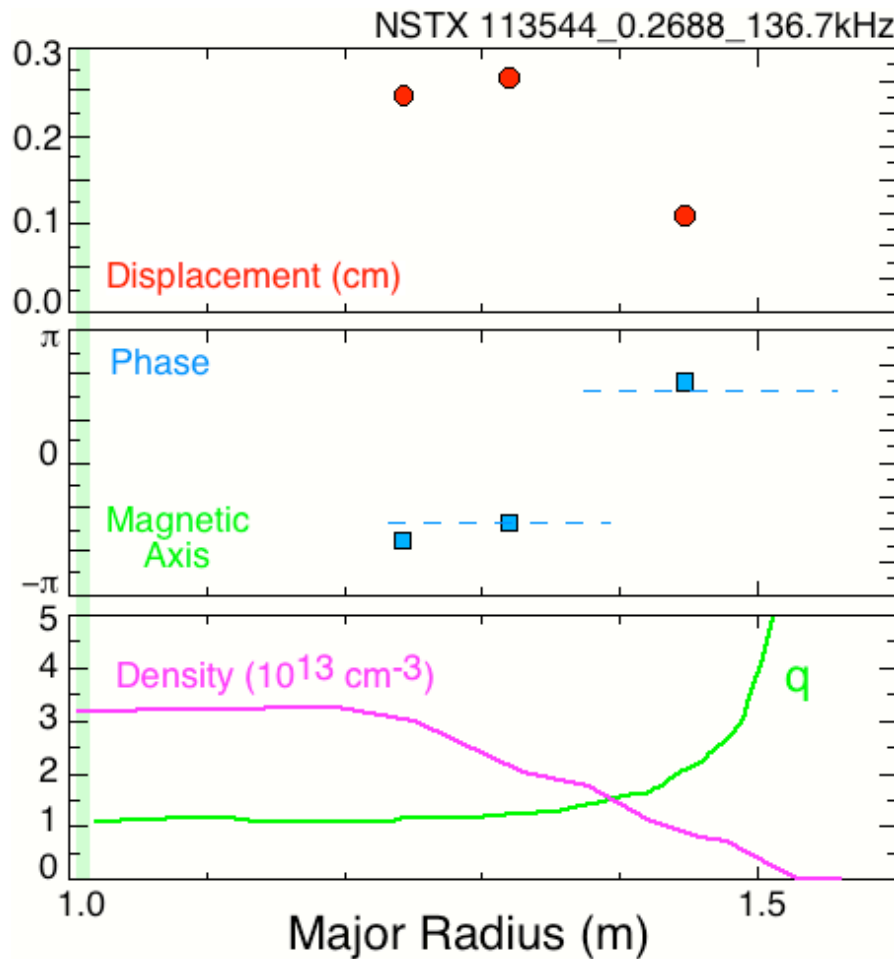
- Phase-space island overlap of multiple modes leads to big fast ion losses.
- Overlap triggers "avalanche" where multiple modes are destabilized.
- Relevant to small ρ^* regime



Additional data needed:

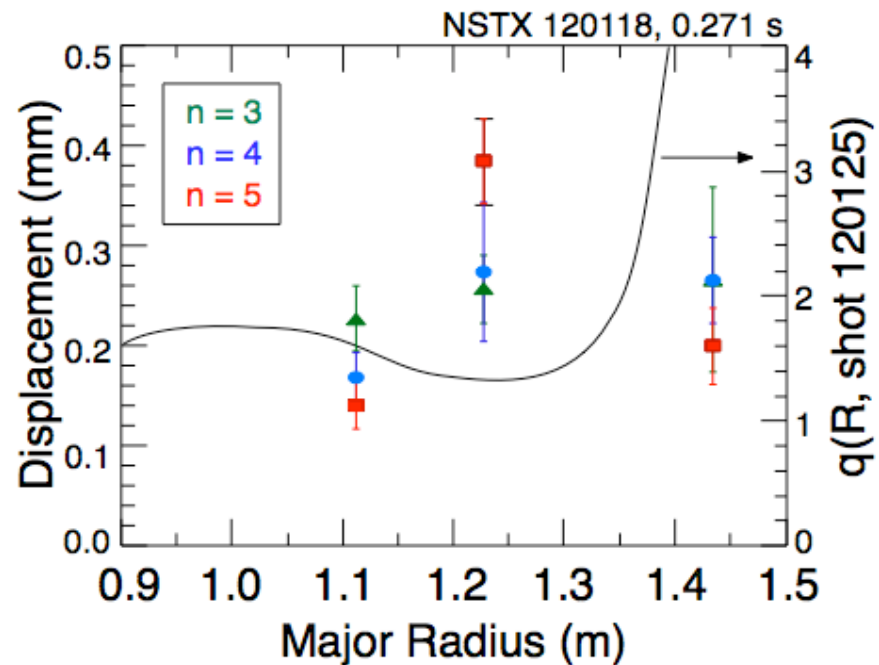
- Higher resolution documentation of modes' structure, amplitudes
- NPA/FLIP measurements of affect on fast ion transport.
- Power-scaling of onset, MSE-constrained q -profile

Difference in fast ion losses not due to different mode structure



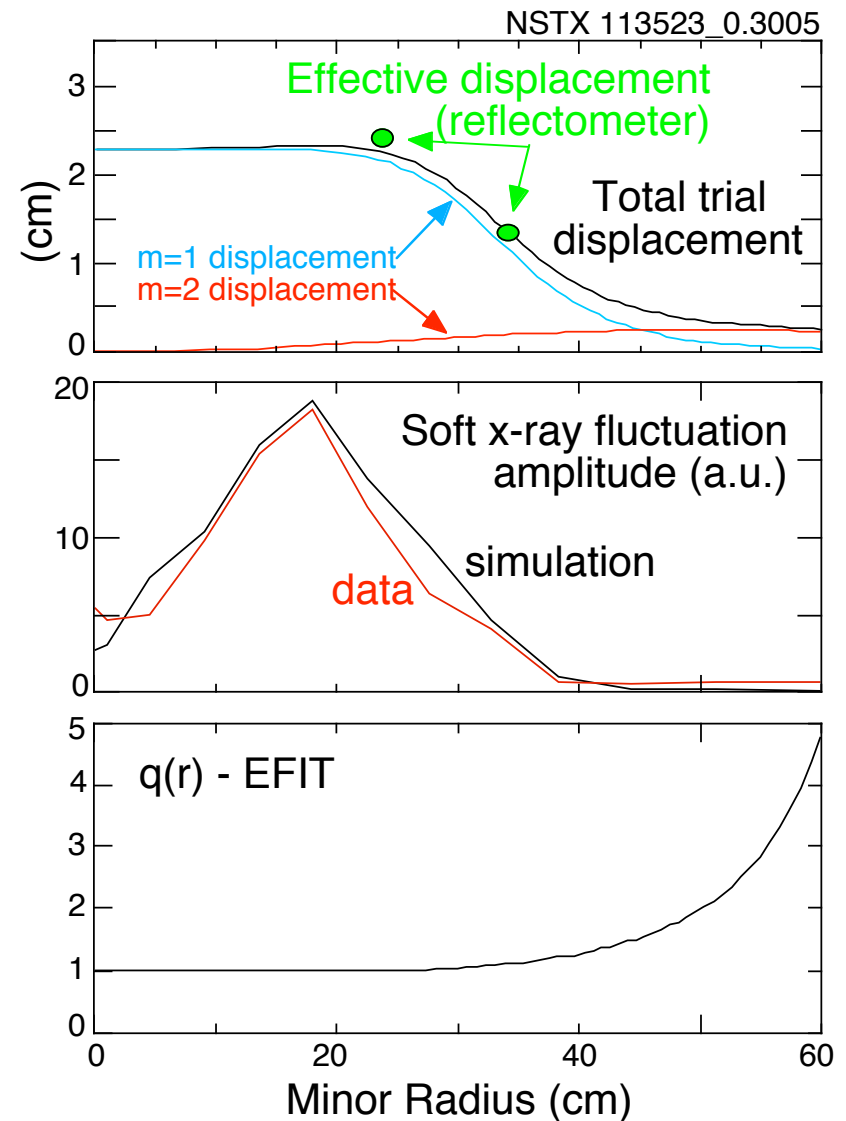
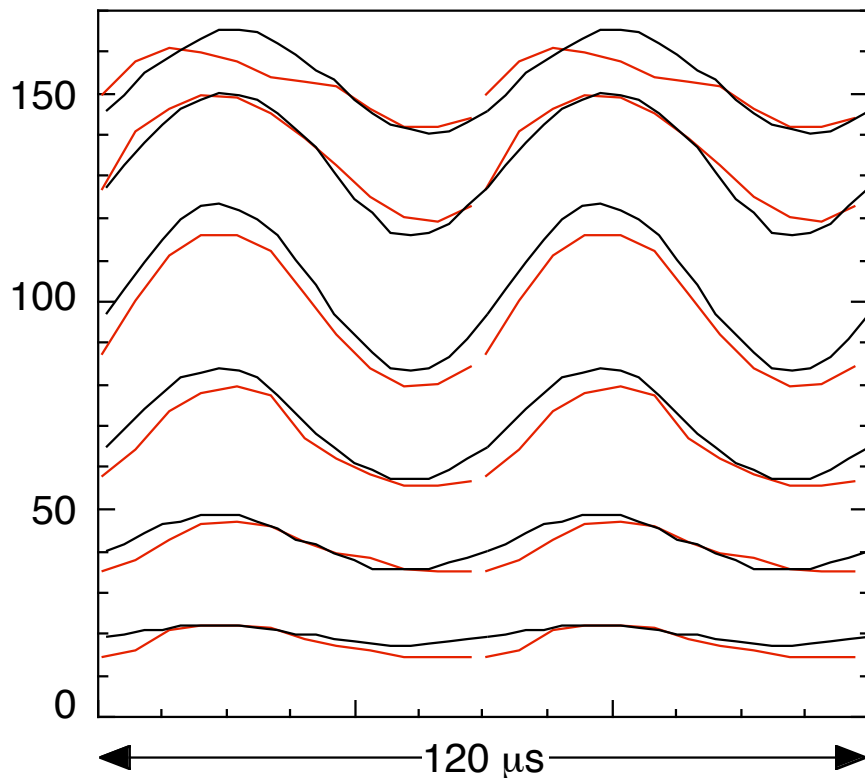
Variation in mode structure seen for Cascade Modes

- Higher n (higher m) modes more strongly localized.
- Lower n modes extend to plasma edge.



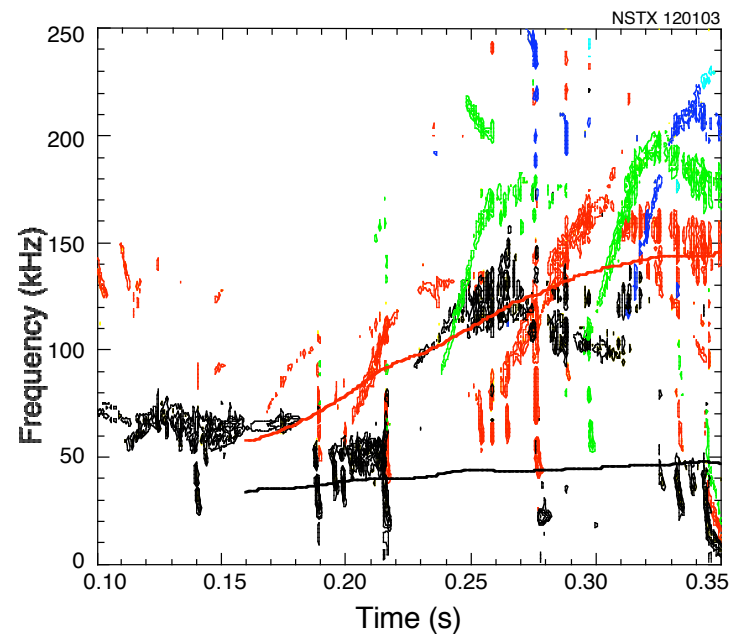
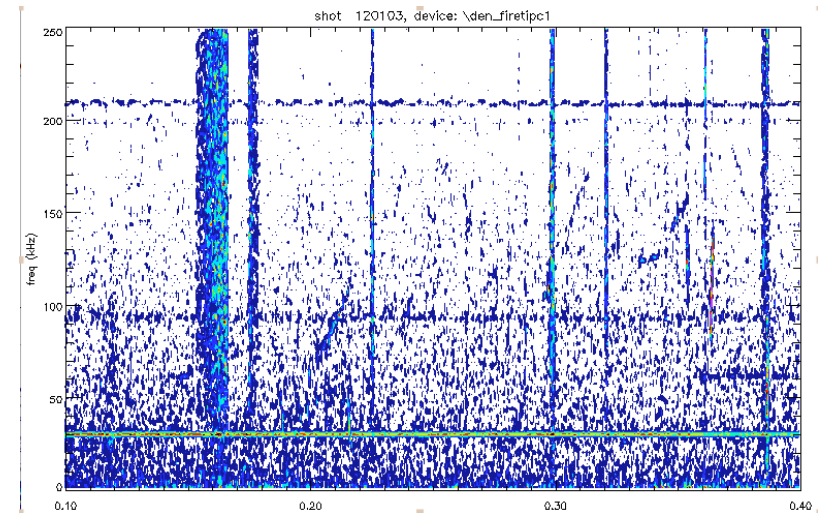
SXI works for large, low frequency modes

- Multi-parameter model of mode, using inverted SX emission profile and EFIT equilibrium, used to simulate the soft x-ray data.



Interferometers can also provide internal amplitude data

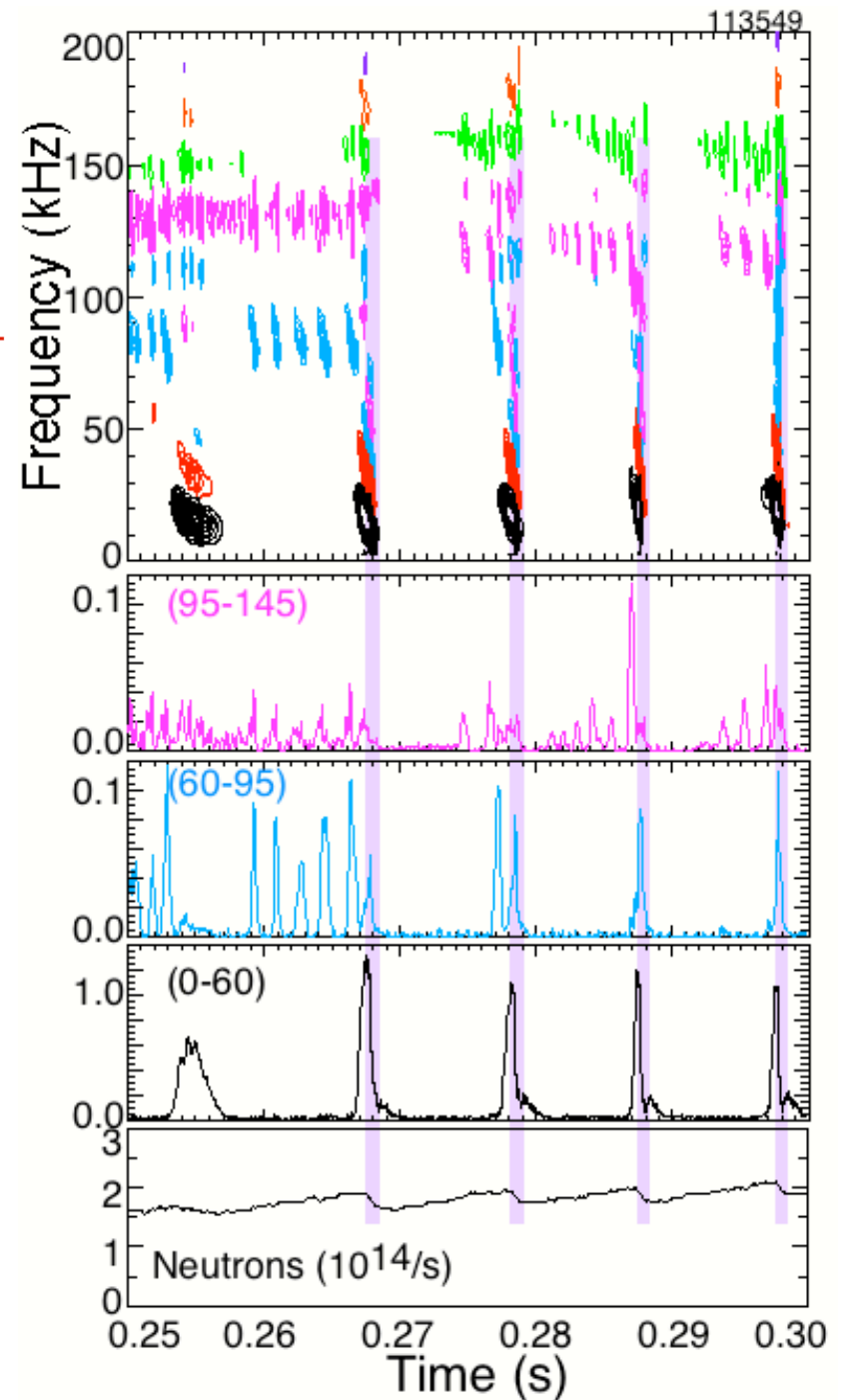
- Chord integrated measurement requires codes to interpret.
- Signal-to-noise is an issue
- Bandwidth presently limited to <500 kHz.



EPMs and TAE strongly interact



- Instability of EPM triggered by TAE?
- Neutron drops better correlated with EPM bursts
- Chirping of TAE indicates non-linear event
- Interaction of TAE & EPM also non-linear



CAE/GAE may also be involved



- Here, strong burst of CAE/GAE precede each EPM.
- No other strong evidence for fast ion losses from CAE/GAE, but modes might modify fast ion distribution.

