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xp705: Multimode ion transport: TAE avalanches

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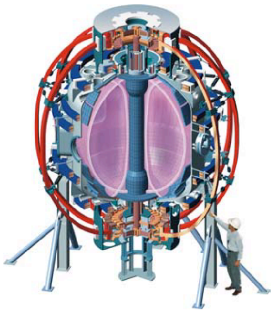
NSTX Results Review

July 23-24, 2007, PPPL



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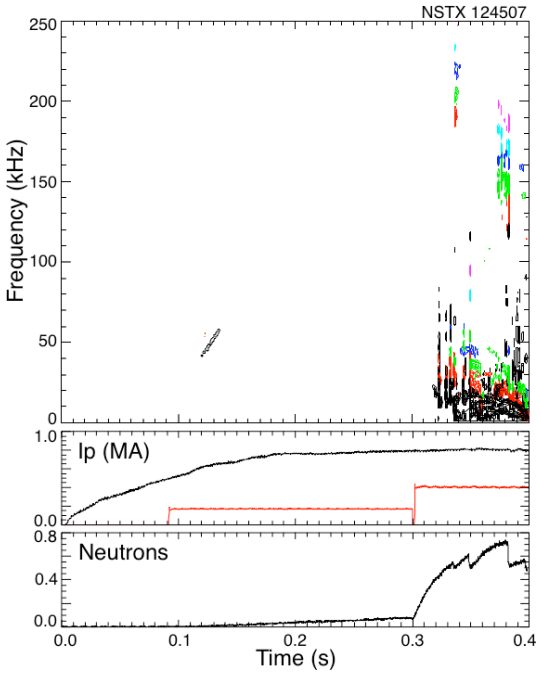
Goals for this XP:

- Higher resolution documentation of modes' structure, amplitudes
  - Goal is to estimate EP phase-space island sizes, develop capability to predict amplitude at which avalanche is triggered
- NPA/FLIP measurements of affect on fast ion transport.
  - Particularly the fast NPA data to look for transport on TAE burst timescales
- Power-scaling of onset
  - Start from quiescent regime, increase fast ion beta until TAE onset, then until TAE avalanches
- MSE-constrained q-profile (best documented avalanche cases pre-date MSE)

- mostly complete, - partially completed, - very limited data

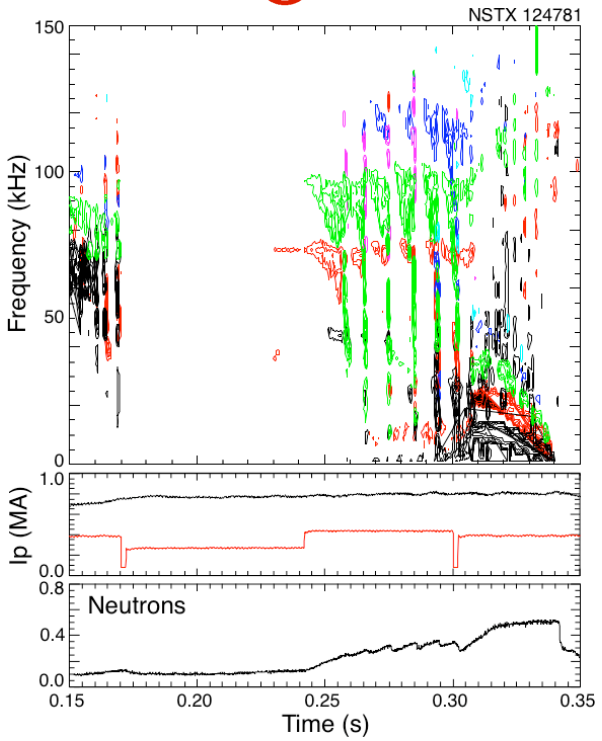
Reproducible, quiescent, beam heated plasma condition found

- One source, ≈ 62 kV is just below threshold for TAE.
- Very weak CAE/GAE modes still present.
- f.b.s occur shortly after on time of source A, suggesting q_{min}≈1 by this time.
- q-profile measured both before and after quiescent period - current profile evolution will be modeled between these times.
- NPA scan completed.



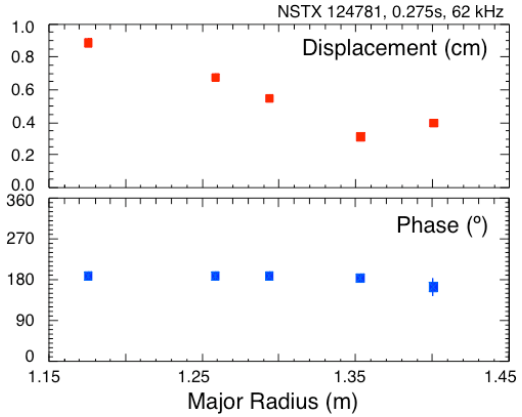
Power scan up to Avalanche threshold

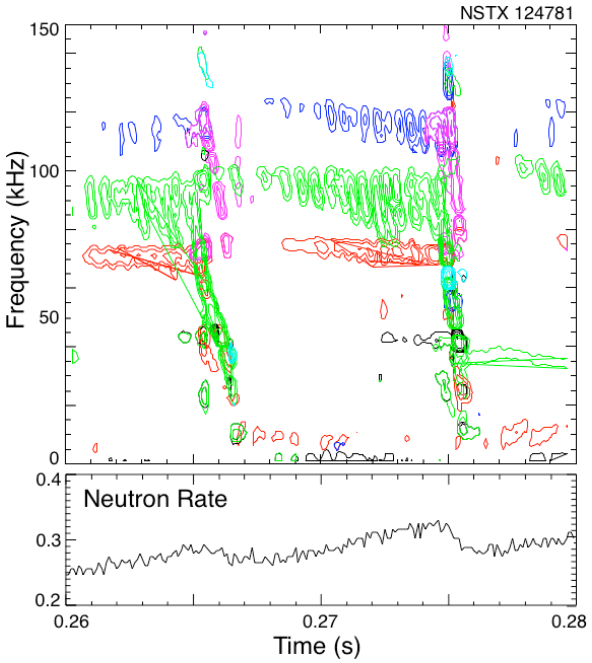
- As power is raised, first see TAE, then chirping TAE, and then Avalanches and multi-mode transport.
- Avalanches are strong bursts of multiple TAE modes ($2 \leq n \leq 6$), with weak or no n=1 f.b.s, correlated with neutron drops.
- Source A timing scan used to document q-profile evolution.



TAE evolution is avalanche-like

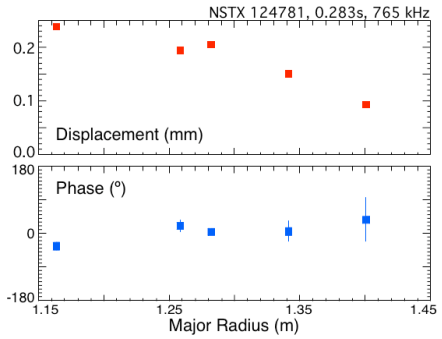
- Sequence of bursting, chirping TAE culminates in strong multimode burst.
- Drops in neutron rate coincide with multimode bursts.
- Amplitudes measured with reflectometer array

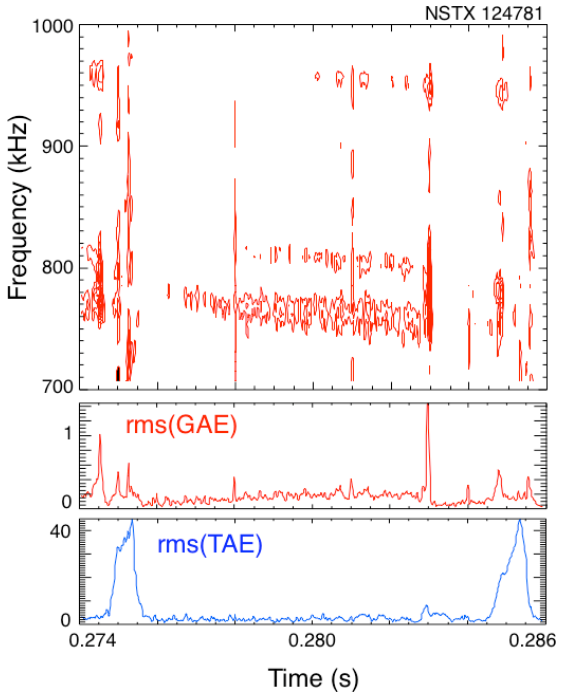




GAE also show avalanches?

- Mode amplitude peaks towards axis - GAE and not CAE?
  - Reflectometer mapped with TS
- Sequence of small bursts, followed by large burst.
- Precedes TAE avalanche - plays role in trigger?





Further work needed

- Goal is to model fast ion losses with Nova and Orbit and possibly M3D-K.
- Mode amplitudes measured with reflectometers can benchmark linear Nova calculations.
- These can be used as input to Orbit:
  - Can Orbit model island overlap condition?
- Need to analyze NPA, FLIP and possibly FIDA data.
- q-profile analysis hasn't started
- Questions about Thomson scattering data
  - Can reflectometers contribute here?