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Study of TAEs and TAE-induced fast ion transport in L-mode, center-stack limited deuterium plasmas

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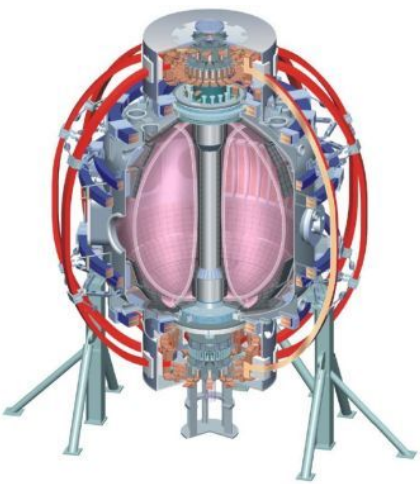
and NSTX team

NSTX Results Review,
Sep. 15-16, 2009



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Study of TAEs and induced fast ion transport successfully extended to Deuterium L-mode plasmas

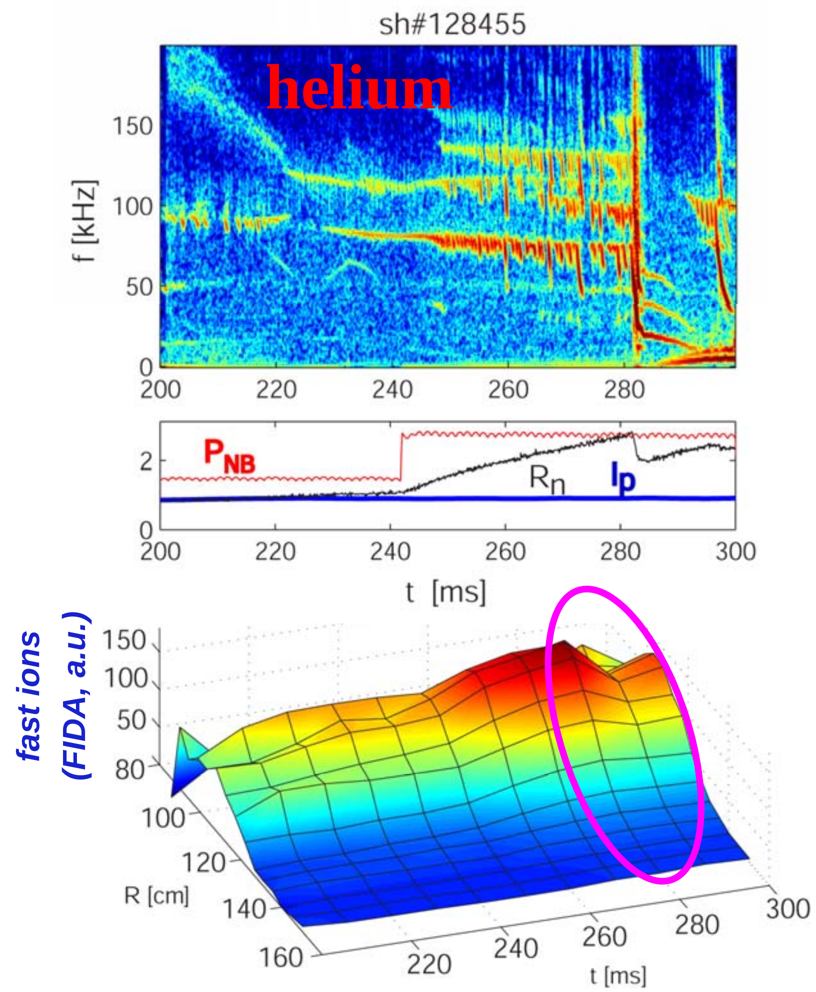
- 2^+ days XP, large dataset now available on TAE dynamics in deuterium plasmas
  - Expand dataset from helium plasma

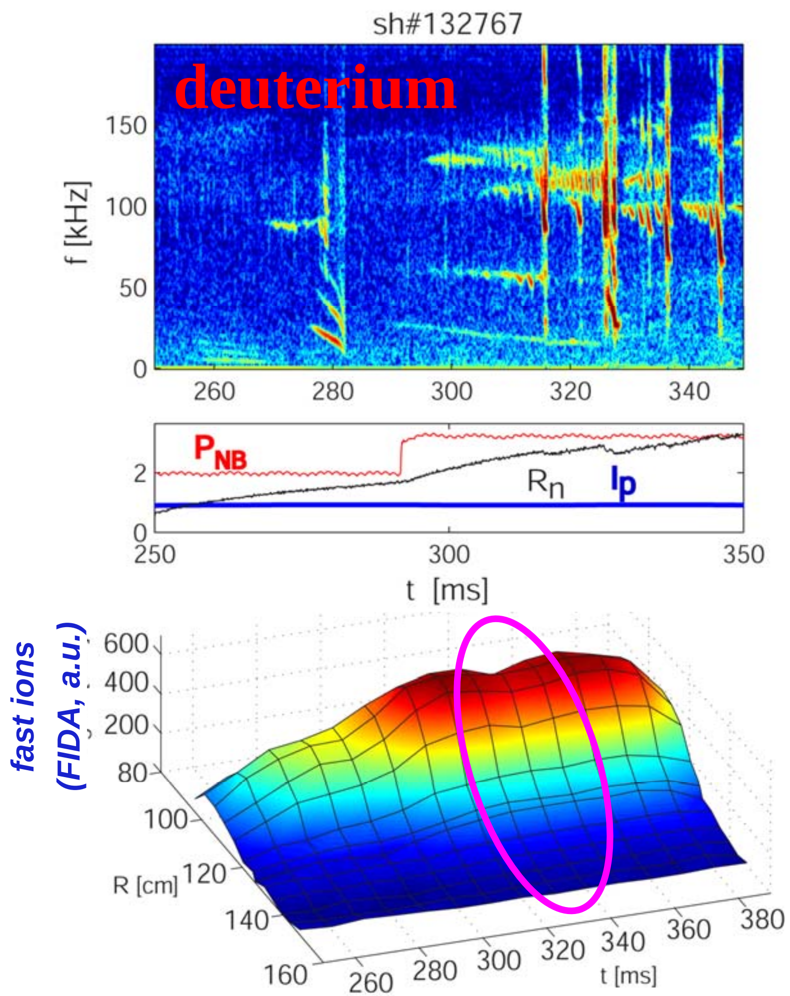
- Main goals of XP achieved:
  - Scan of NB power, plasma density, RF power done
  - Good conditions for comparison with numerical codes achieved
  - Other “scans” (e.g. q_0, T_e, …) obtained from shot-to-shot variations

- Extensive diagnostic coverage
  - Profiles (MPTS, CHERS)
  - Magnetics, reflectometer (6 channels available)
  - Neutrons, sFLIP, NPA/ssNPA, FIDA, …

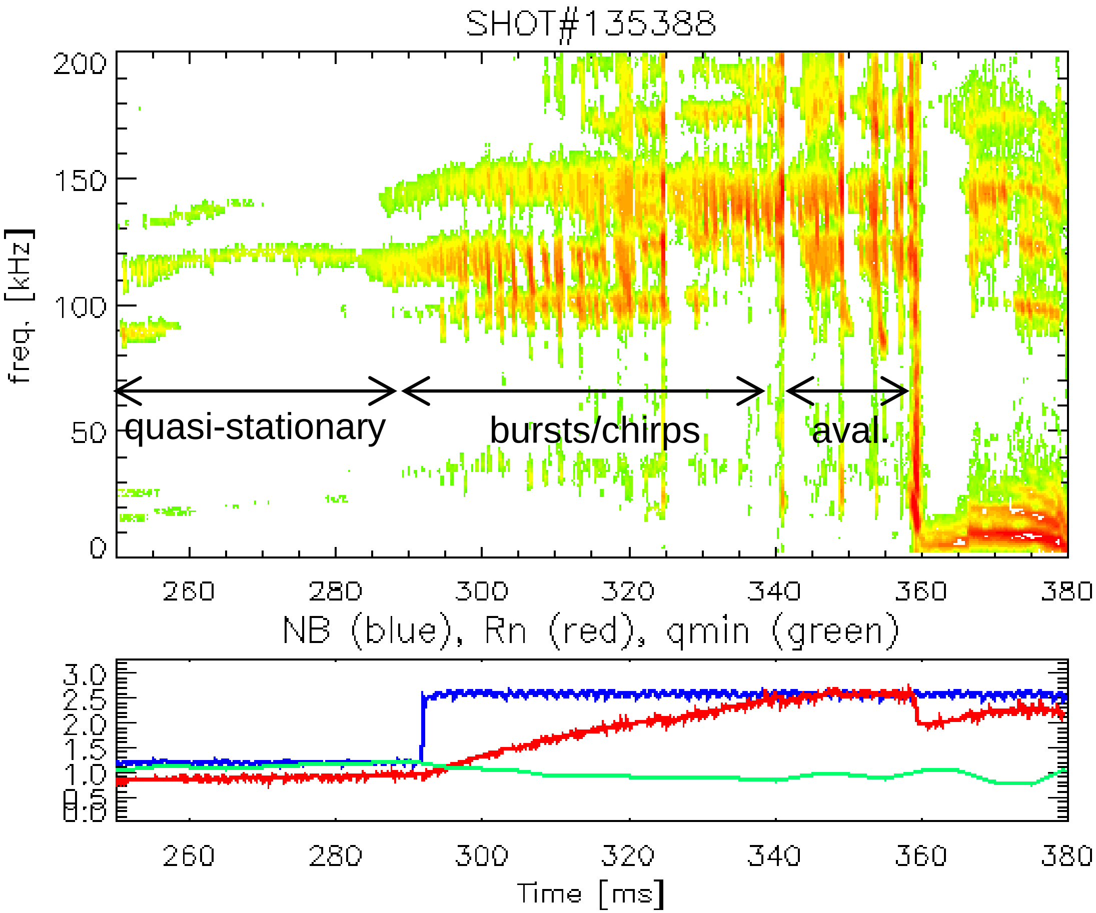
Similar TAE and TAE avalanches' behavior observed in He and D plasmas

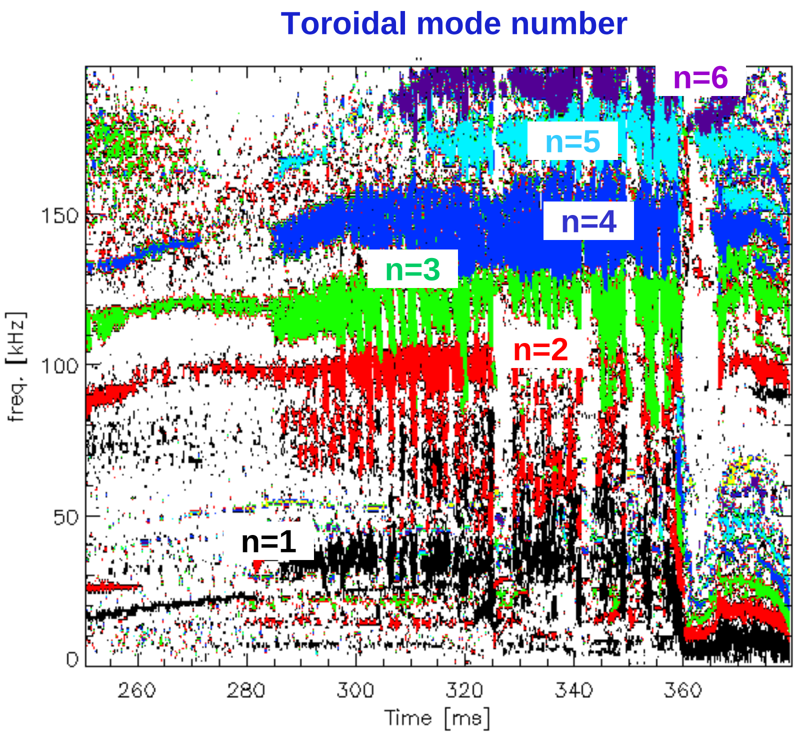
- Low-*n*, quasi-stationary TAEs evolve into bursty behavior & *avalanches*
- Fast ion losses ≤30% observed (e.g. FIDA, neutrons) during avalanches
- Similar $n_{e,i}$, $T_{e,i}$, I_p, B_{tor}, P_{NB} (but different plasma shape: LSN *vs* limiter)





Good set of data allows comparison with predictions of numerical codes

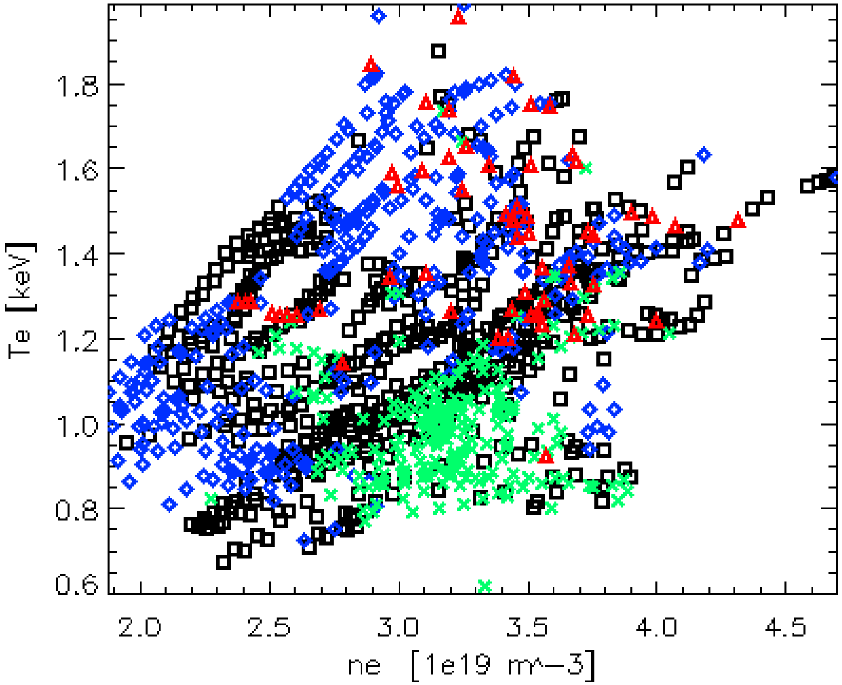


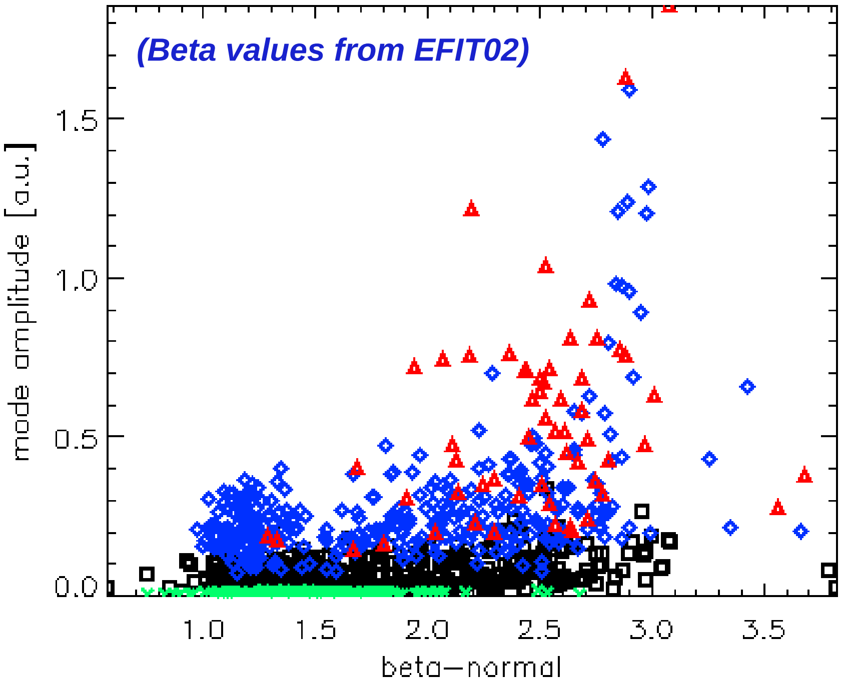


- All three "phases" of *AEs successfully documented
  - Quasi-stationary, bursting/chirping, avalanches

Searching for correlations between mode behavior and plasma parameters…

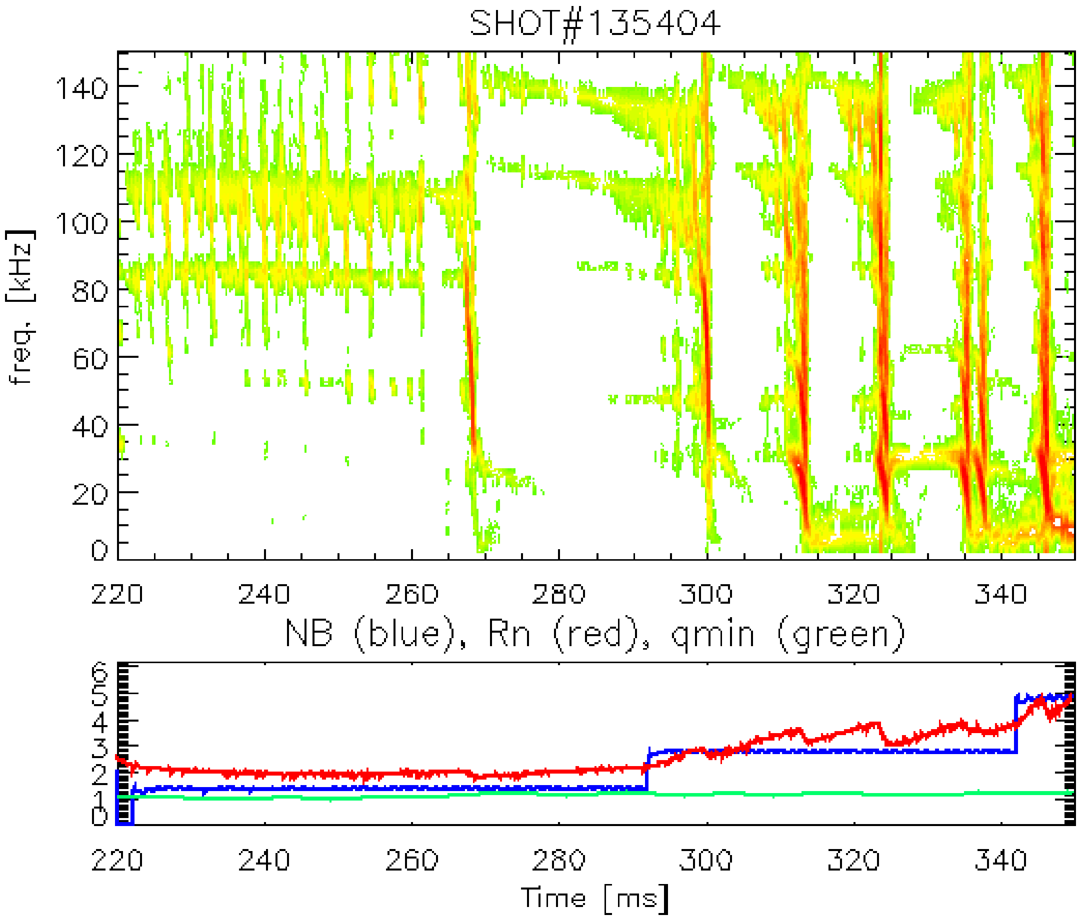
- Most of parameters evolve in time with similar trends
  - Need careful analysis to isolate dependence on single parameters
- Statistically significant results can be obtained from extensive dataset
- Data from ~30 shots, focus on t=200→380ms, time-bin of 5ms
  - Characterize mode behavior depending on amplitude, frequency chirps, …
  - Color code: **no modes**, **quasi-stationary**, **bursting/chirping**, **avalanches**

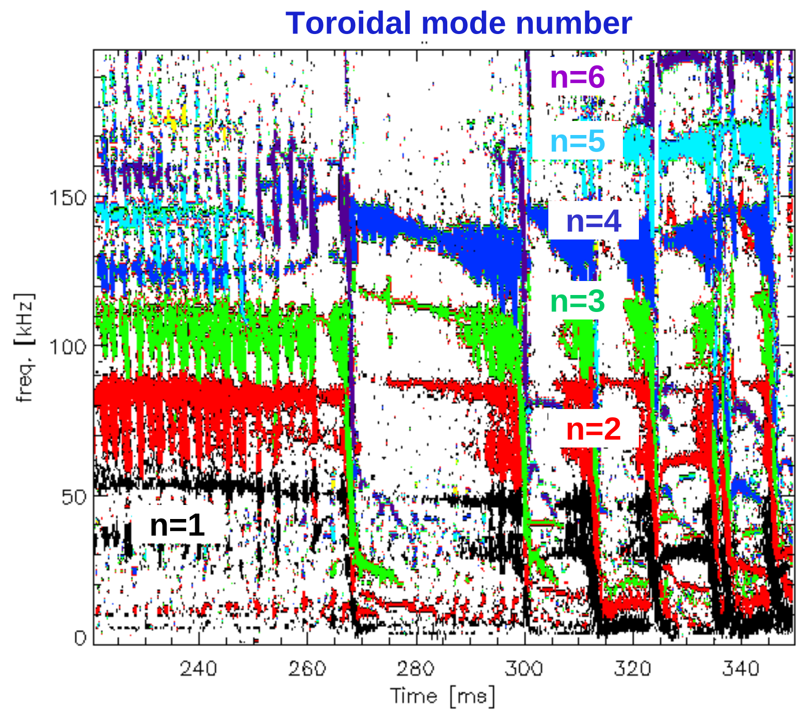




Backup viewgraphs

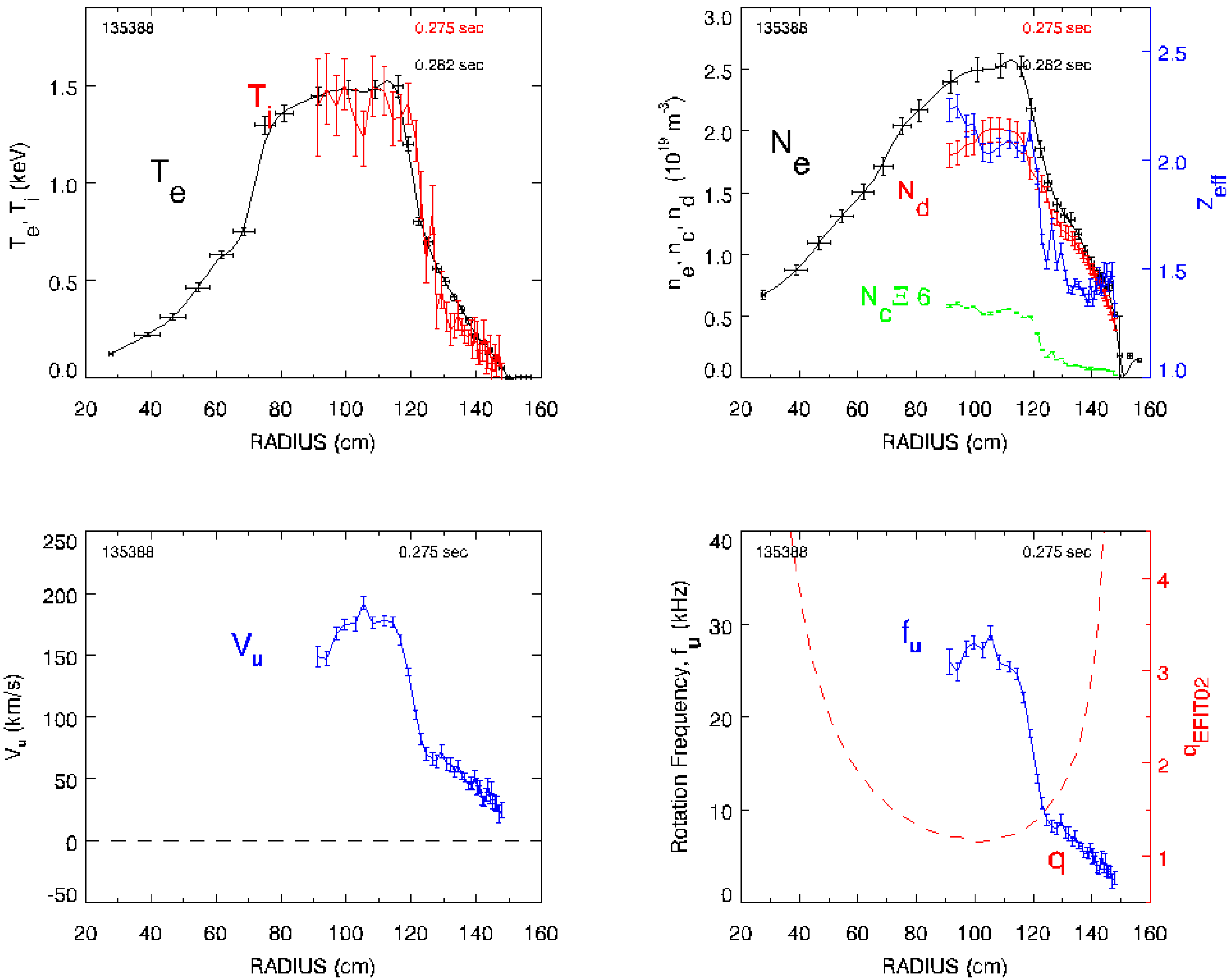
Small variations of background parameters have significant impact on mode dynamics





- Density higher than in reference shot ($4x10^{19}m^{-3}$ *vs.* $2.5x10^{19}m^{-3}$ @t=275ms)
  - More frequent avalanches, even at low NB power (t=268ms, P_{NB}~1.2MW)

Background plasma profiles (shot 135388)



- *CHERS and MPTS data from R.Bell, B.LeBlanc*

Correlation between mode behavior and plasma parameters

- Most of parameters evolve in time with similar trends
  - Need careful analysis to isolate dependence on single parameters
- Example: beta-dependence reflects distribution in time
  - Color code:
    - **no modes**, **quasi-stationary**, **bursting/chirping**, **avalanches**