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"Controlling" MHD During the Plasma Start-Up

S.P. Gerhardt,…

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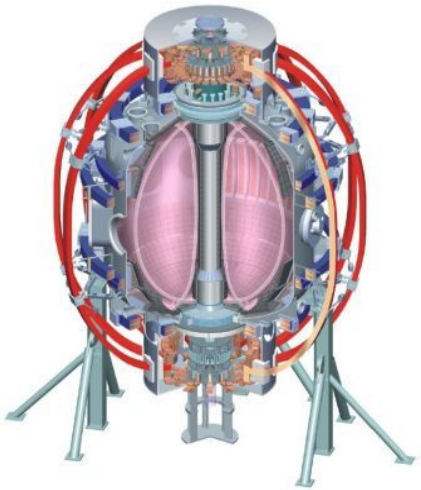
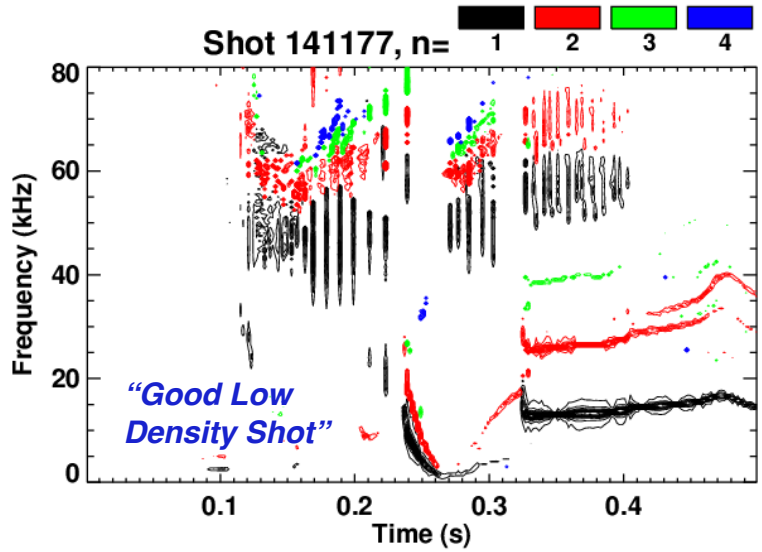
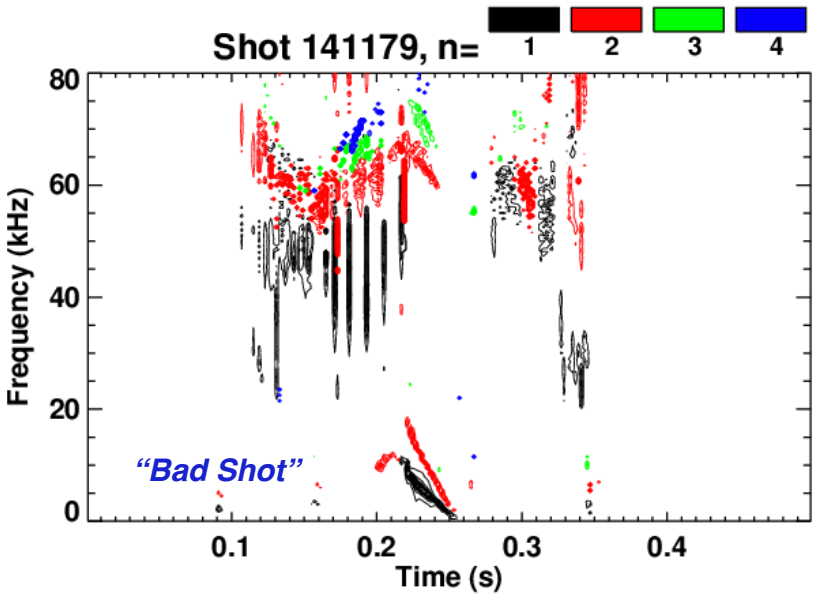


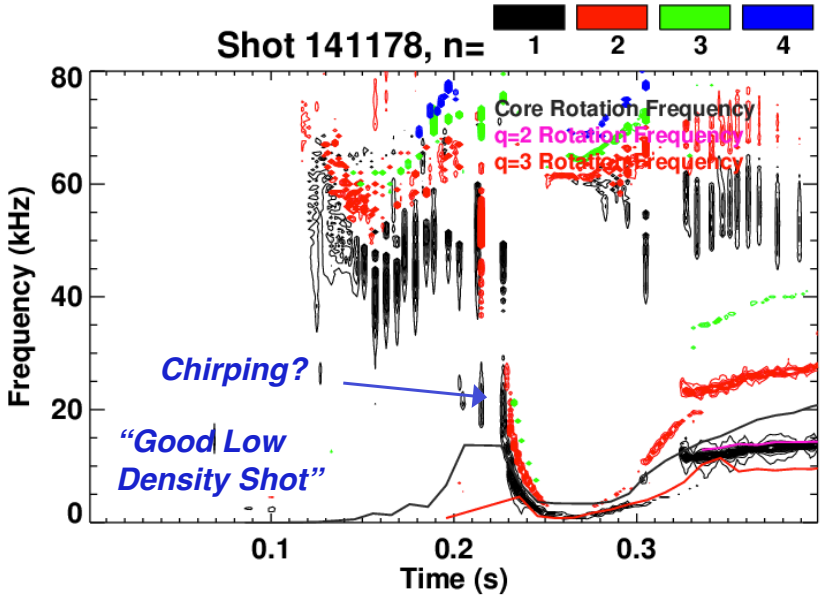
Overview

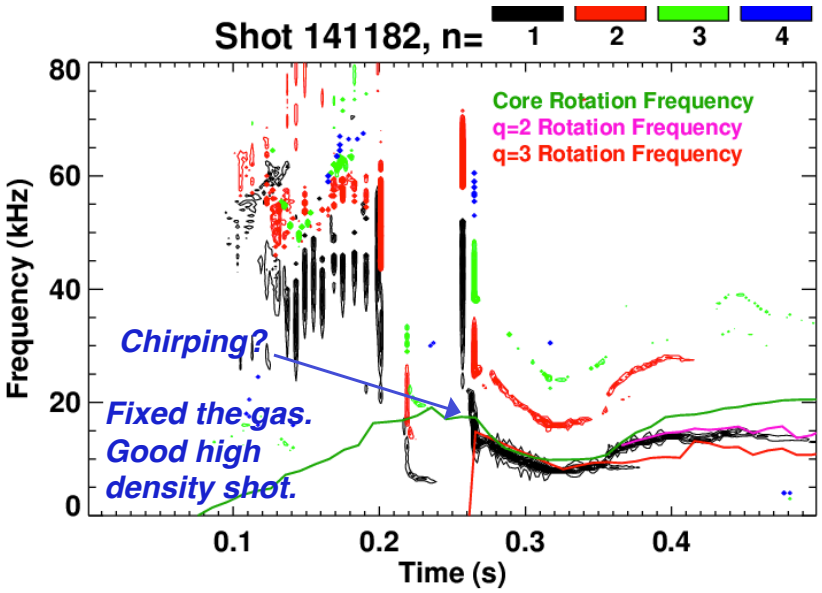
- "Low-density startup" should include surviving the entrance of q=2 into the plasma…typically some few hundred msec. after SOFT.
- Tearing/mhd associated with those surfaces often locks to the wall, leading to large β collapse or disruption.
- I (we?) think that any of the current profile, plasma β, rotation, or rotation shear may impact the amplitude locking of these modes.
  - Also all the early EPM/TAE activity.
- Propose to optimize these parameters to ride through early modes:
  - β: Feed forward or feedback control of NB heating.
  - Current profile: heating timing, ramp rate.
  - Rotation: H-mode timing.
- Early EFC is not a focus of the XP, but will be used as available.

S. Sabbagh's Low n_e Shots Failed When Rotating Modes Started to Lock

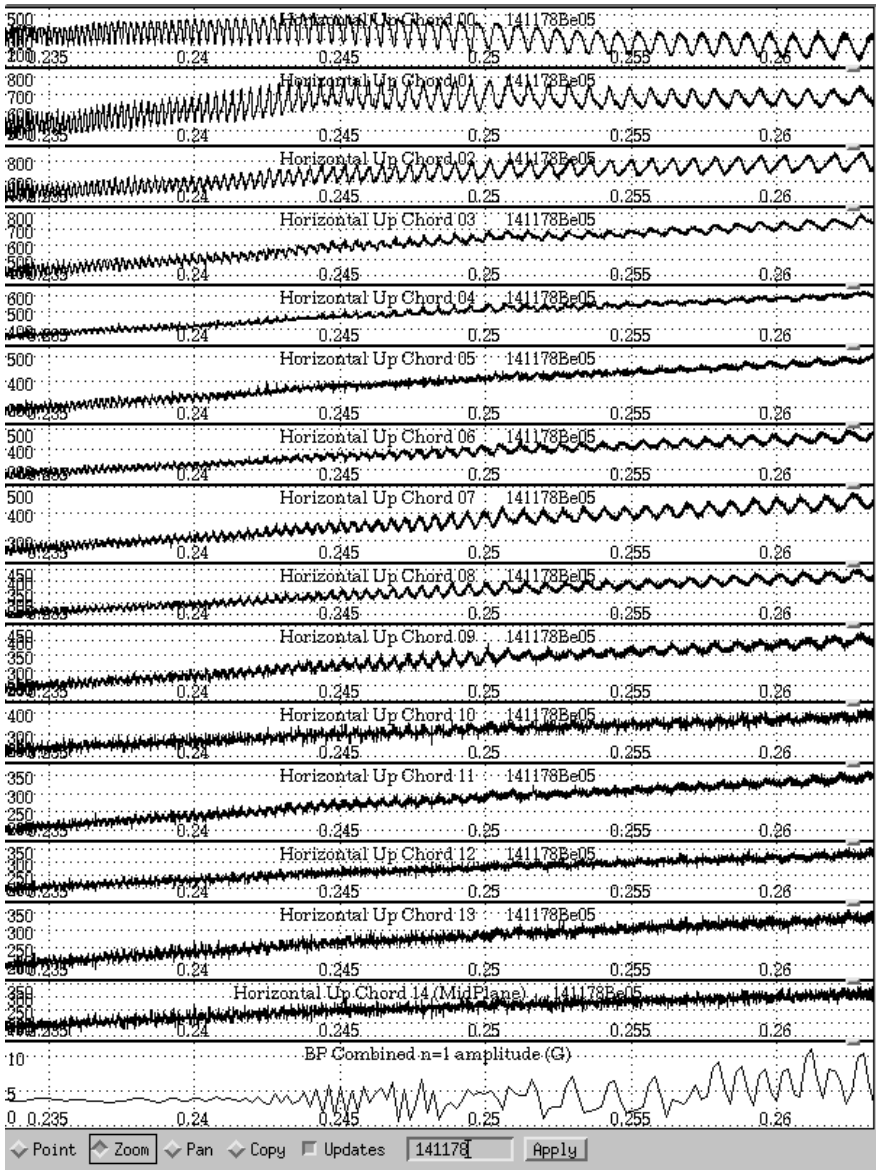




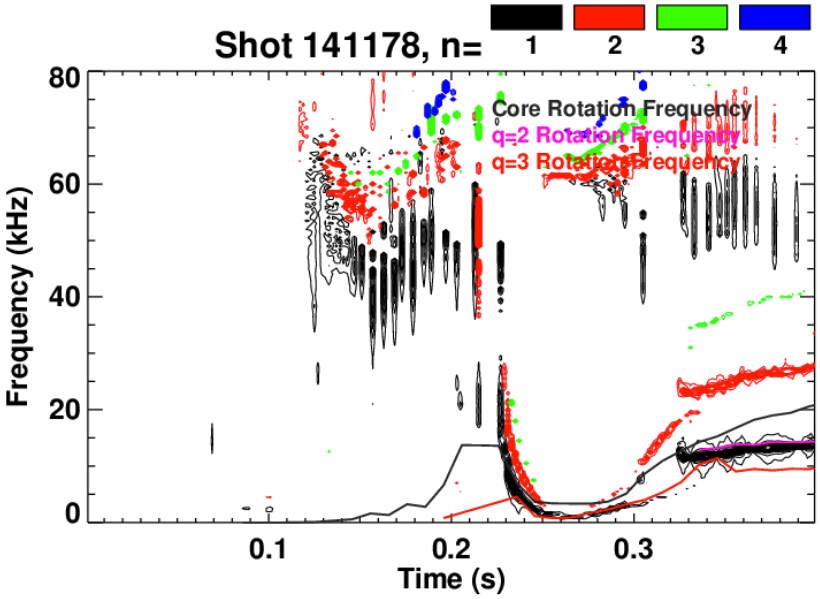




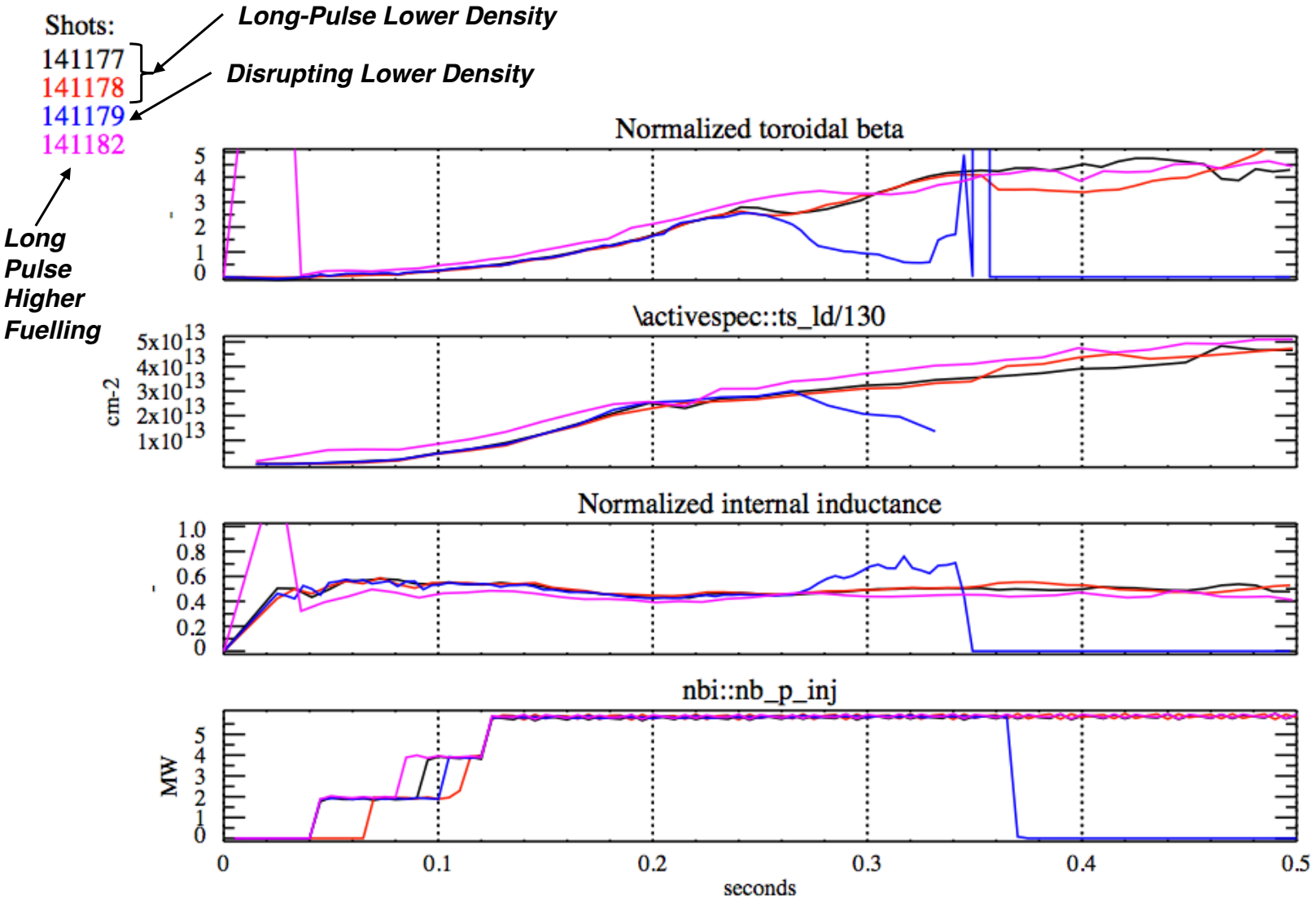
Chirping q=3 Mode Settles With Inversion Radius In the Outer Plasma



- Mode chirps down.
- Inversion layer near the edge develops.
  - q=3 island?…need bit more analysis.
- ME-USXR may be quite useful analyzing this data.

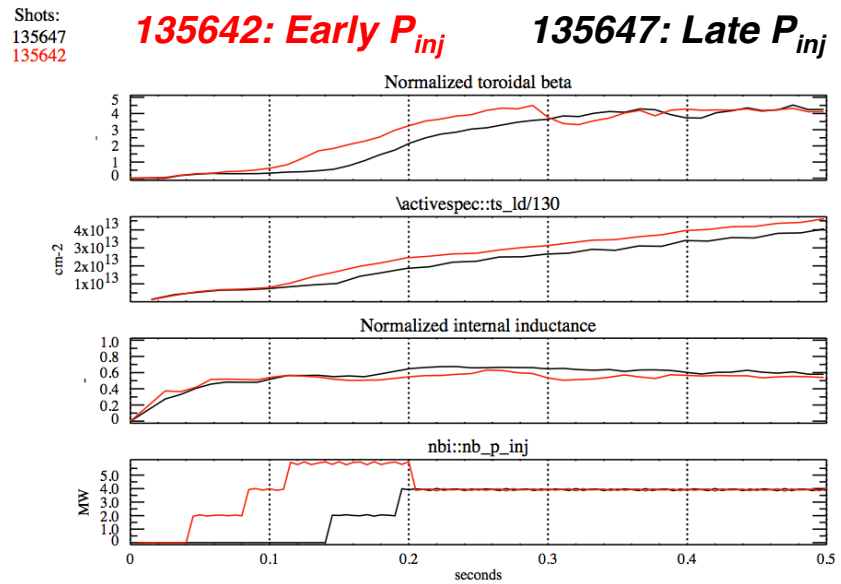


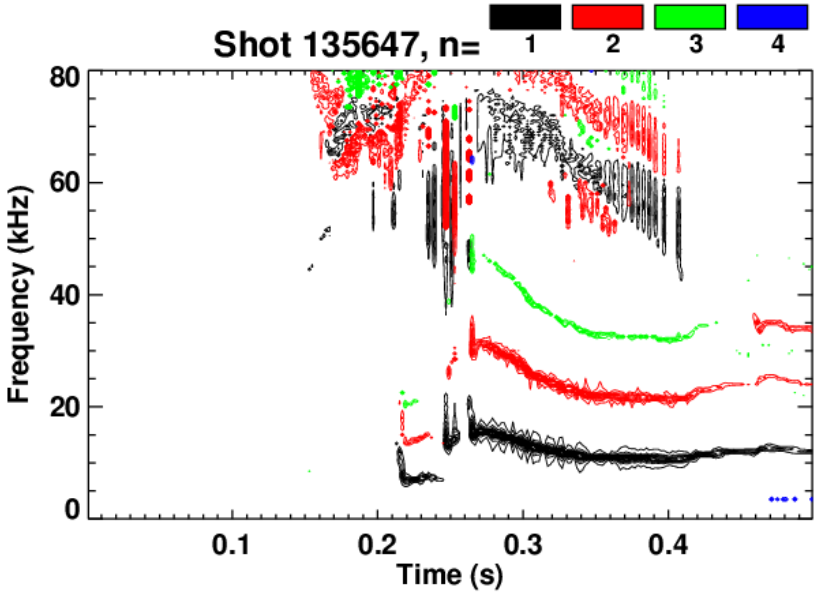
Not Easy To Find Difference Between Shots Using 0D Parameters

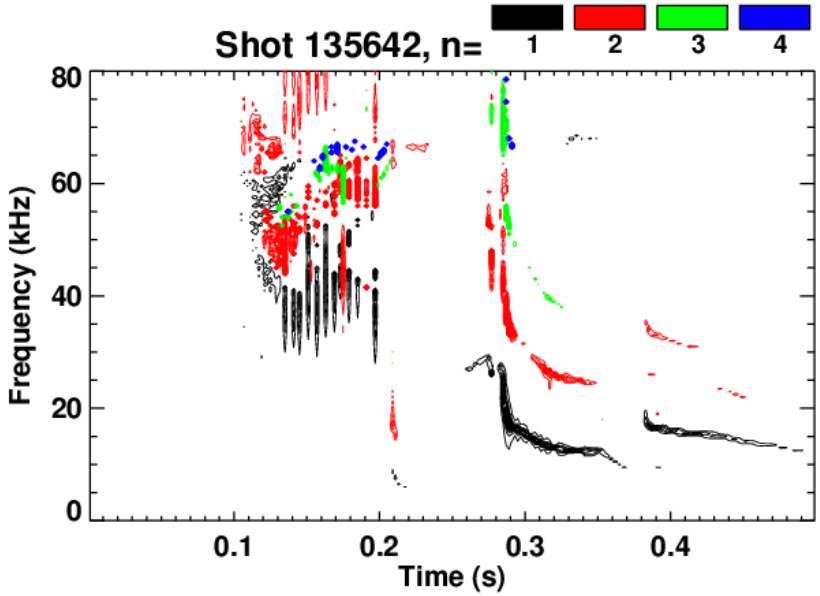


We Have Evidence That Changing the Heating Profile Can Impact the Evolution of These Modes.

- Tried early and late heating.
  - Delay of H-mode as well.
  - Substantial changes in EP/TAE
- Rotating n=1 mode amplitudes are modified.
  - Need to look more carefully and m identification.







XP Plan: Needs refinement, but basics are…

- Reload a scenario such as 141178 (S. Sabbagh's reduced density target).
- Study the space of rotation, β, and n_e vs. mode dynamics.
  - Test low power early, delayed H-mode.
    - Reduced β and density with single source will allow surfaces in quickly, should have strong rotation.
    - Elimination of EPMs may be important…lower voltage pre-heating beam?
  - Study timing of β (P_{inj}) ramp.
    - When is the earliest time that we can ramp β without EPMs and large modes.
    - Can we prevent too-rapid J evolution if we only heat strongly after q=2 enters?
  - Vary the ramp rate:
    - If we slow the ramp rate, can we prevent some unstable current profiles?
    - And eliminate some irreproducibility of the modes?
    - Target the q=2 & 3 surfaces entering just after the I_{OH} zero crossings?
  - What is the impact of reduced input power?
    - Onset of "IREs" will be unacceptable.
    - Unsustainably high l_i will be unacceptable.
    - Earlier onset of RWMs or the "late" rotating MHD is OK…
      - not in scope of XP
- Diagnostic considerations.
  - Need source A for important MSE measurements.
    - MSE-LIF might be OK…?
  - Need USXR measurements, BES (?) for MHD identification.

Typical q and $J_{||}$ profile during time of q=2 & 3 entering