



U.S. DEPARTMENT OF  
**ENERGY**

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Science



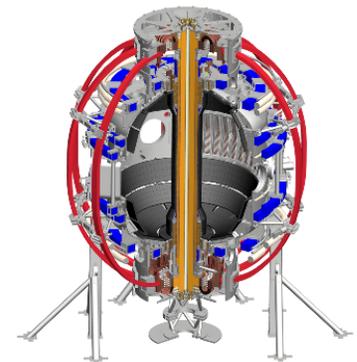
# Observations of MHD in NSTX-U

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MS TSG Meeting

PPPL

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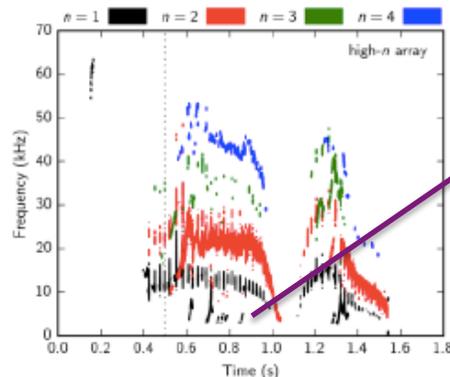
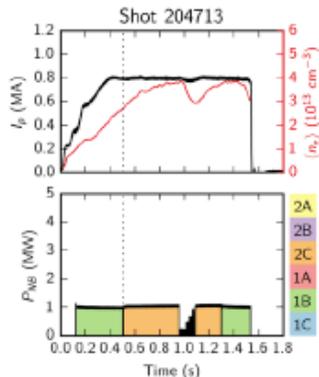


# Observations

- L-modes on NSTX-U almost always have locked 2/1 mode
  - L-modes with NB1 always have locked 2/1 (all shots at all times)
  - L-modes with NB2 sometimes are not locked (based on spectrogram data)
- H-modes on NSTX-U do not have locked 2/1 mode
  - 2/1 unlocks shortly after L-H transition
- Many L-modes have rotating 1/1 mode (i.e. helical core) simultaneously with locked 2/1 mode
  - Appears to be influenced by gas fuelling rate
- EFC study casts doubt on PF5 being main source of error field (Myers, Park)
- Locking of core (inside  $q < 2$ ) seems to be responsible for disruptions
  - Complicates interpretation of EFC study
- Strong 3/2 mode is often seen. Brakes rotation, but is usually(?) benign

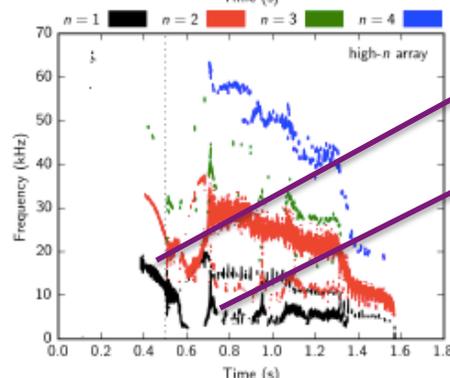
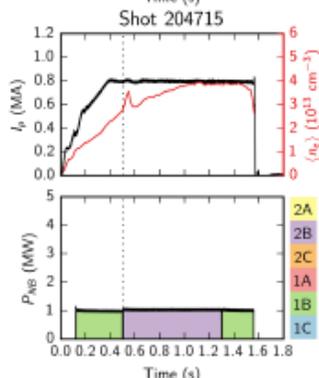
# Spectrograms tell story when CHERS is not available

1B→2C



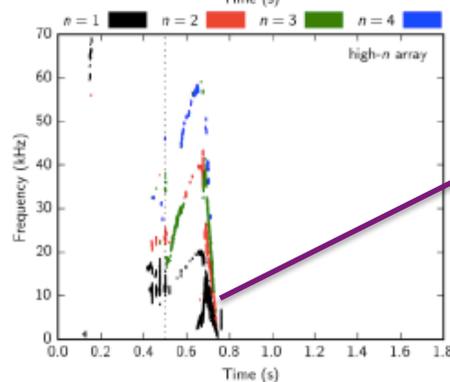
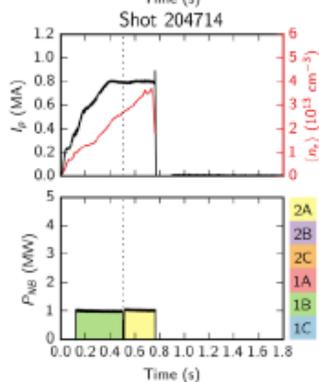
- Sawteeth start at t=0.4
- Brief 2/1 unlockings
- Strong 3/2 mode

1B→2B



- 1/1 core starts at t=0.4
- 2/1 unlocks and sawteeth start at t=0.65

1B→2A



- Sawteeth start at t=0.4
- 2/1 unlocks at t=0.65; disruption shortly after

# Questions & Opportunities for MS TSG

- What is main source of error field, and how do we model this?
  - My naive guess: NB ports in vacuum vessel (hard to model)
  - Other possibilities: tilt in TF coils; bus tower
- How can we better diagnose the locked modes?
  - Can we rotate the mode with  $n=1$  RWM coils?
- How do eliminate the locked modes?
  - RWM coils in  $n=1$  configuration seem insufficient. In EFC studies, 1/1 locks before 2/1 unlocks
    - Would powering single coil work better? This would imply  $n>1$  modes contribute significantly.
    - Would we expect NCC coils to work better? What would the ideal EFC coil look like?
- Frequency-locking of different  $n$  modes precedes disruptions.
  - Mode can only grow large enough to disrupt in absence of sheared rotation?
  - What is the mechanism of frequency-locking? Tobias/Fitzpatrick?