NSTX

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High Frequency CAE & Fast-Ion Redistribution (XP 1170)

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WEP TSG XP review
LSB 252
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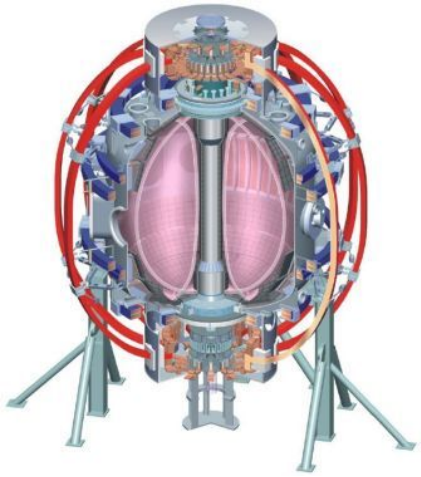

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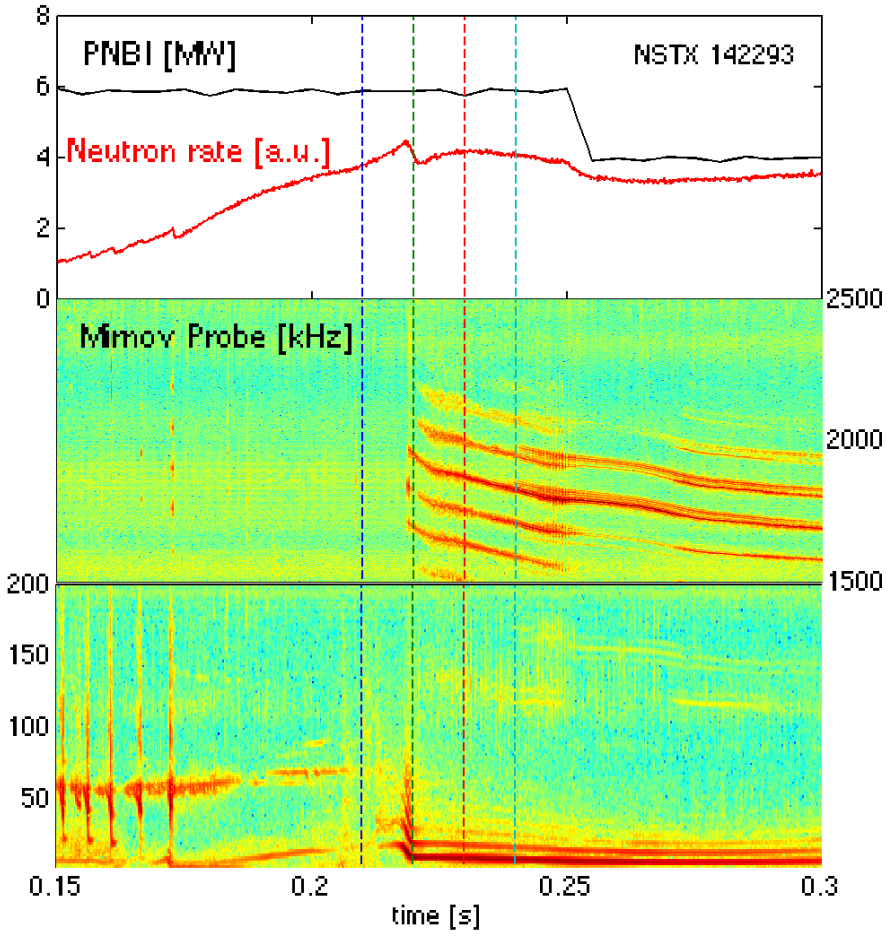
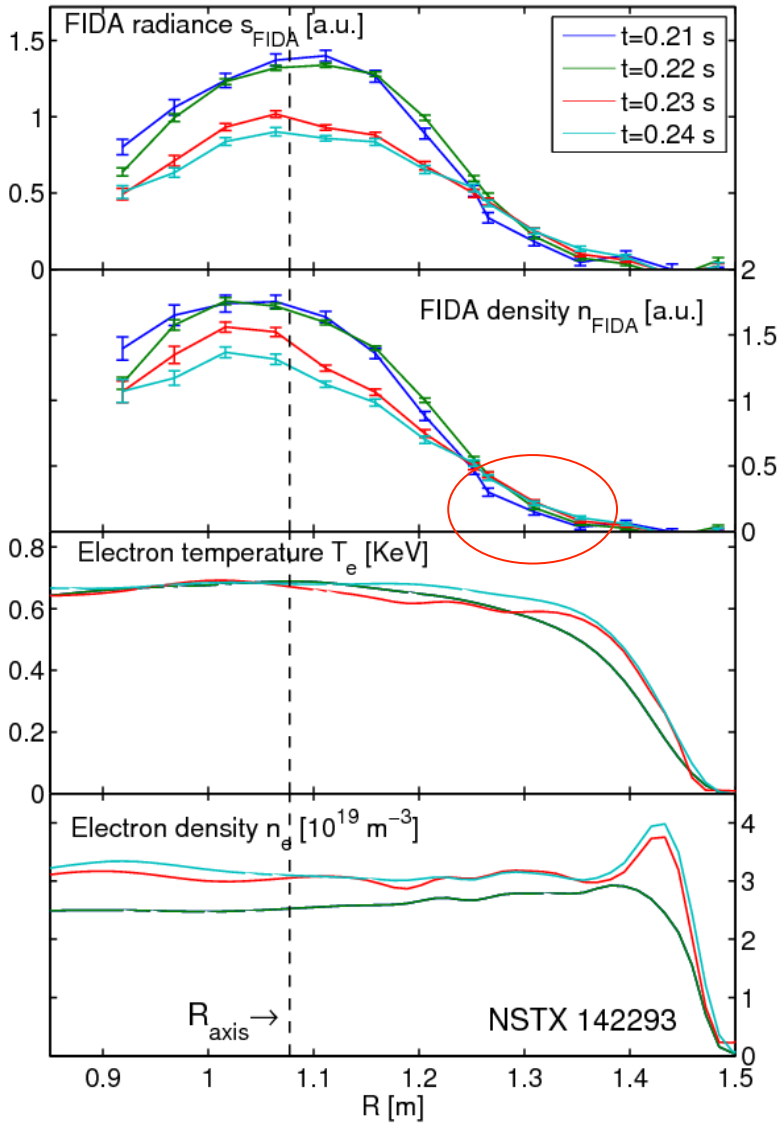
High Frequency CAE often seen on NSTX



- Continuous modes at 1-2MHz appear frequently in H-mode, P≥4MW
- Appear in the early phase of discharge t=200-300 ms
- Propagate co-parallel to beams $8 \leq n \leq 13$.
- Frequency spacing, mode numbers consistent with CAE
- Often destabilized in combination with n=1 kink mode, possibly as a result of fast ion redistribution

Fast Ion Redistribution Associated with LF MHD



- Depletion of Fast Ion density at the mode onset
- Increase in the peripheral region
- Could the redistribution of Fast Ion destabilize CAE modes?

- Electron density flat in the core
- Is this a necessary condition?
- 'Bat' ear in the pedestal region
  - Reflectometer coverage limited to the edge
  - Challenging inversion of SXR line integrated data

XP goals and objectives

XP Goal: Characterize the hf-CAE and understand the interaction between CAE, kink modes and fast ion population

Objectives

- To measure the radial structure of the High Frequency and Low Frequency MHD
- To measure the redistribution of Fast-Ions (real and phase space) associated with the LF MHD
- Test the dependence of CAE/Kink activity on plasma parameters (e.g. q_{95} , beam ion distribution function)

Allocated time

- 0.5 days FY11 priority 1 (target scenario and objectives 1, 2)
- 0.5 days FY12 priority 2 (complements and extension)

Primary importance diagnostics

Fast-Ion profile and Losses

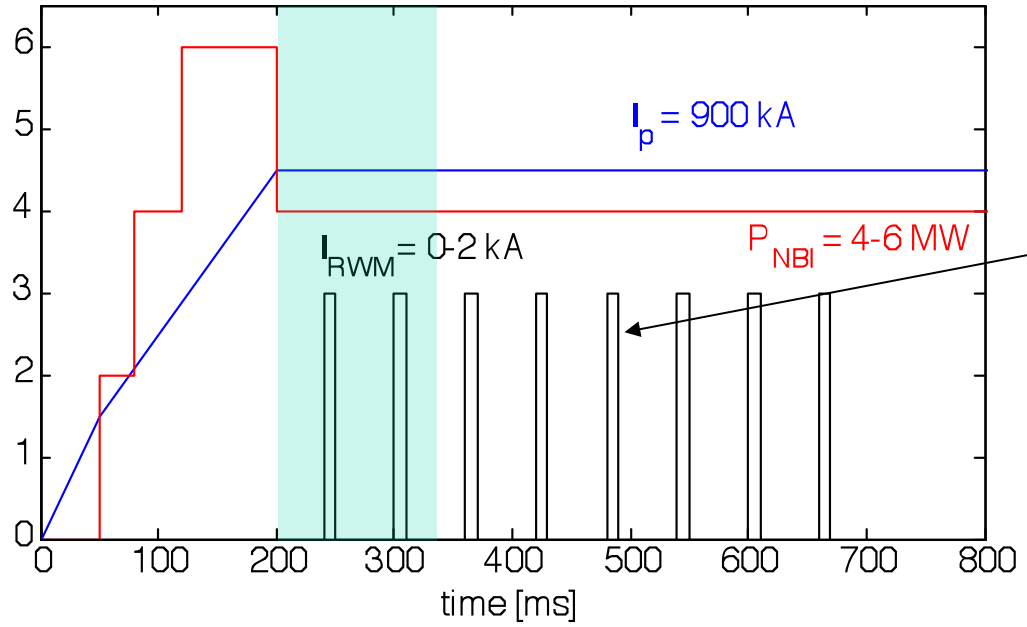
1. FIDAs
2. NPA, ssNPA
3. sFLIP

Mode structure

1. BES
2. USXR, MESXR
3. Reflectometer
4. Fast Tangential Camera (LF kink or island)
5. Interferometer FIRETIP

Reference experimental scenario

- Fiducial like H-mode, high power to reliably obtain HF modes activity
- Li ~50-100 mg, to obtain ELM free plasmas (beneficial to FIDA)
- Large Li rates may imply high pedestal and density ear: detrimental for the measurement
  - Optimize discharge for monotonic n_e profile at mode onset
  - Induce pedestal relaxation by triggering ELMs with n=3 pulses. Measure in the inter ELM phase



- n=3 pulses introduced in the last part of the session

Session plan

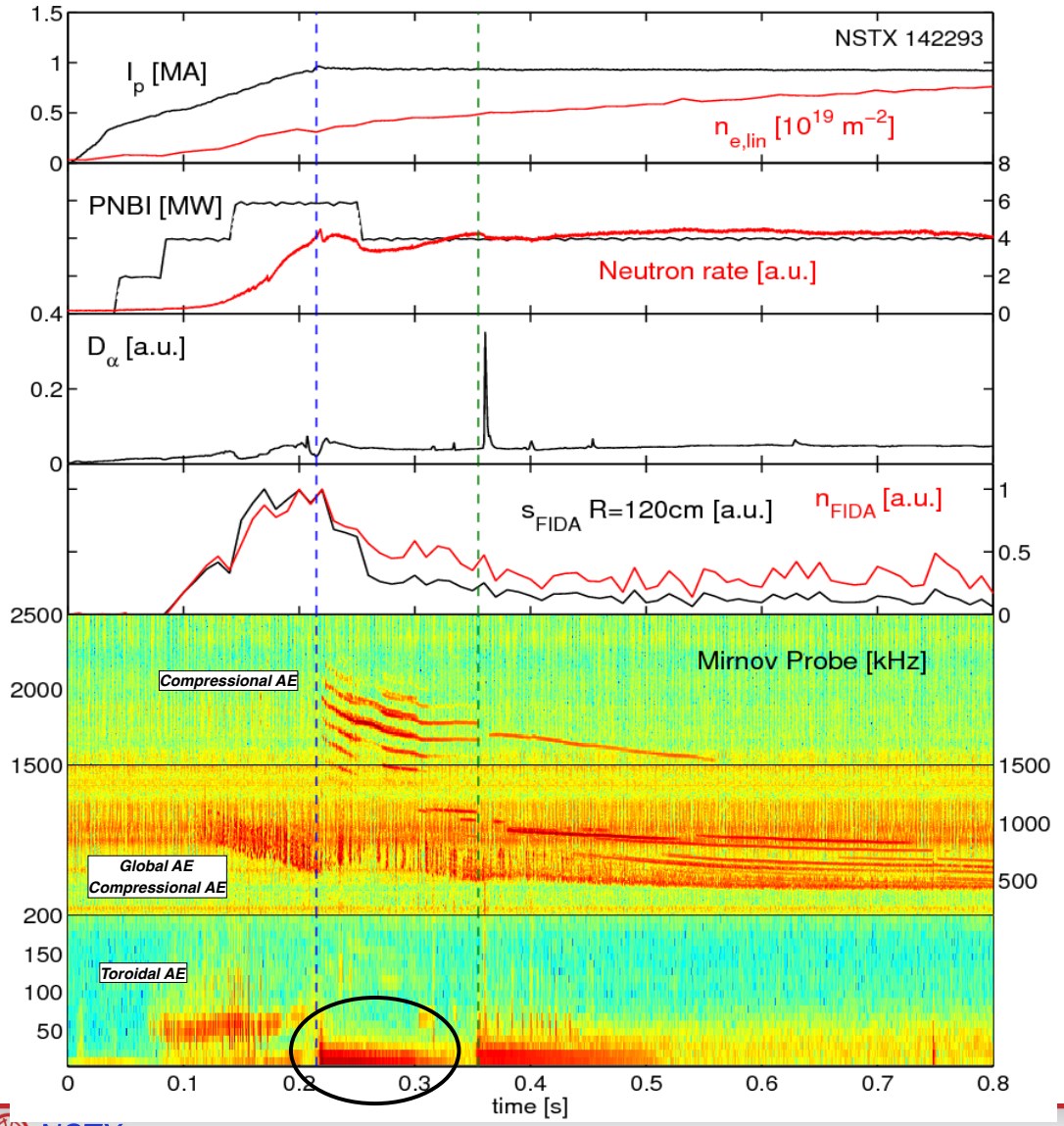
A. Repeat reference discharge (sources A,B)
   - adjust q evolution to get 50 ms MHD quiescent phase after flat top [2 shots]

B. Optimize density profile for measurements of mode structure and FIDA
   - Adjust startup parameters, early NB waveforms [2 shots]
   - Vary dr_{sep}, I_p [5 shots]

C. [if good measurements are obtained] Test plasma parameters dependences
   - Scan q_{95} [3 shots]
   - Repeat Ref with sources B, C [3 shots]

D. Trig ELM with n=3 pulses (last part of 1st session)
   - Repeat Ref with 1.5 kA pulses (10 ms on 60 ms period) [5 shots]
   - Optimize I_{coil} and timing to measure after the ELM and before pedestal recovers

Low Frequency MHD Example of time traces



- NSTX H-mode scenario
- MHD activity at different frequencies:
  - Toroidal AE (bursting)
  - Global/Compressional AE (bursting/continous)
- Fast ions determine stability of different AE modes
- Low frequency MHD affect the fast ion content (n_{FIDA})
- ***High frequency modes (CAE) appear in combination with LF MHD***
- CAE are destabilized after the LF onset