

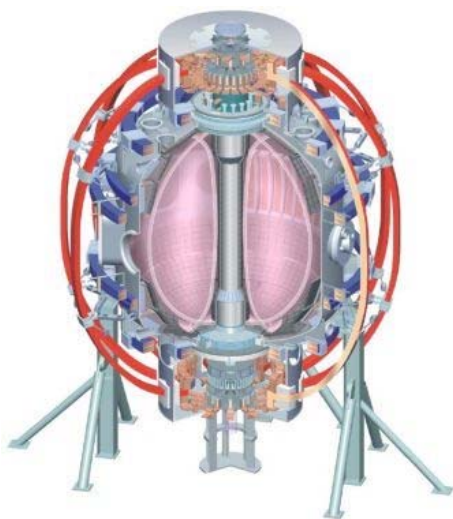
# Initial density fluctuation measurements from the NSTX Beam Emission Spectroscopy diagnostic system

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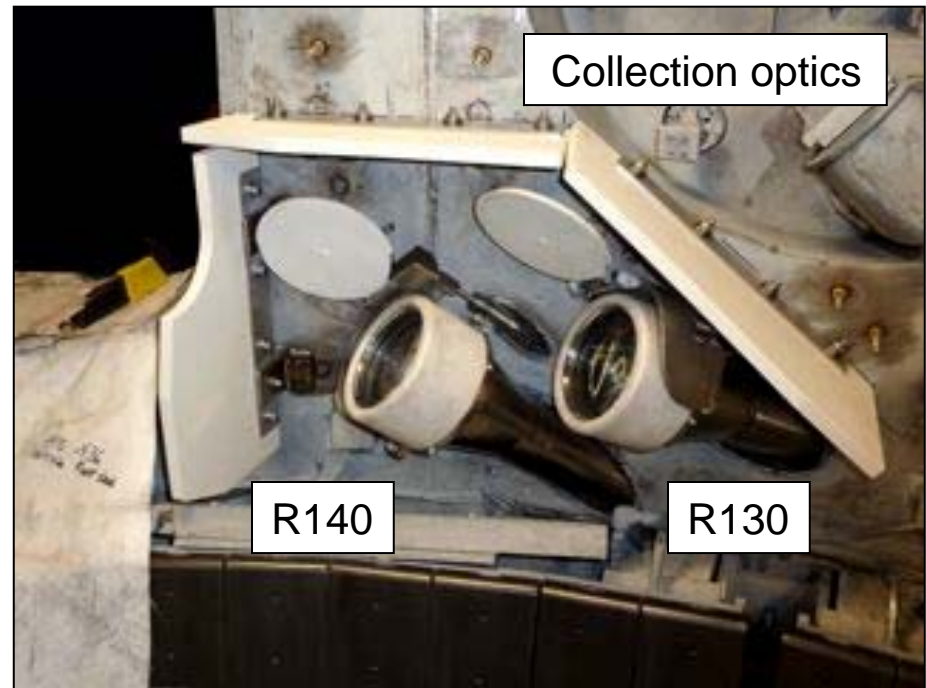
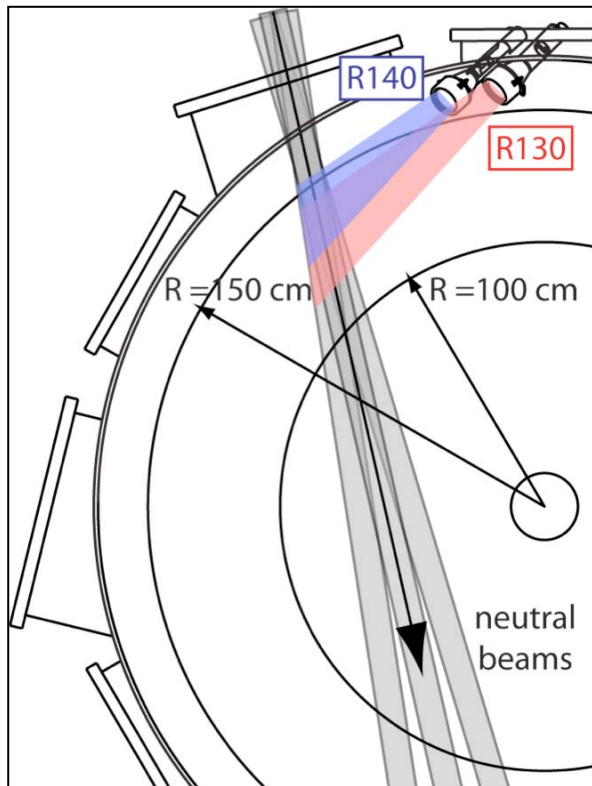
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# Overview

- A **beam emission spectroscopy** (BES) system has been commissioned on NSTX to study **long wavelength ( $kp_i < 1$ ) fluctuations**
  - Measures Doppler-shifted  $D_\alpha$  emission from deuterium neutral beams
  - Up to 24 detection channels were employed in FY10
    - 32 channels planned for FY11
- Initial measurements show...
  - Edge fluctuations decrease at LH transition
  - Broadband fluctuations exist in many discharges
  - Fluctuations increase during large ELMs
  - Inter-ELM harmonic features around 100 kHz
  - Radial extent of TAE and GAE modes

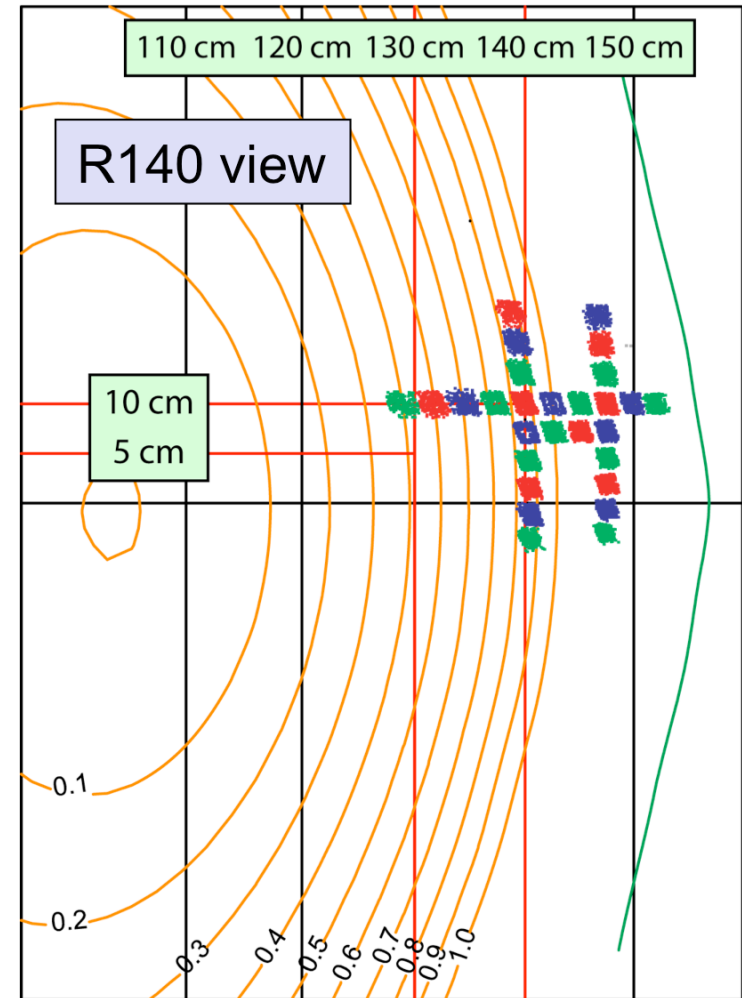
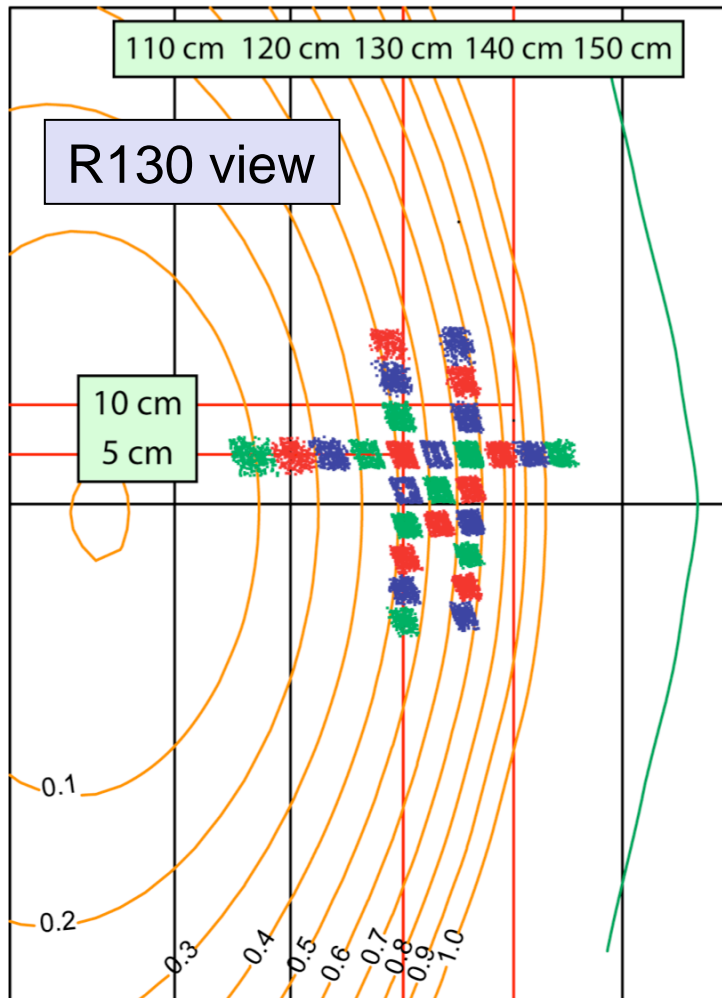
# A BES system commissioned on NSTX in June 2010 will study long wavelength ( $kp_i < 1$ ) fluctuations

- Doppler shift isolates **NB  $D_\alpha$  emission** from thermal  $D_\alpha$
- Two optical views centered at  $r/a \sim 0.4$  and  $r/a \sim 0.85$
- Optical views are aligned to **steep NSTX pitch angles**
- Up to 24 channels employed in FY10
- 32 channels planned for FY11
- DAQ sampling with 1 MHz Nyquist
- Digital filter eliminates e-noise  $> 1$  MHz
- Refrigerant cooling at  $-20^\circ\text{C}$
- D. R. Smith et al, RSI 2010;  
N. L. Schoenbeck et al, RSI 2010





# Two optical views with 56 fiber bundles provide radial coverage from $r/a \approx 0.1$ to SOL with 2-3 spot sizes

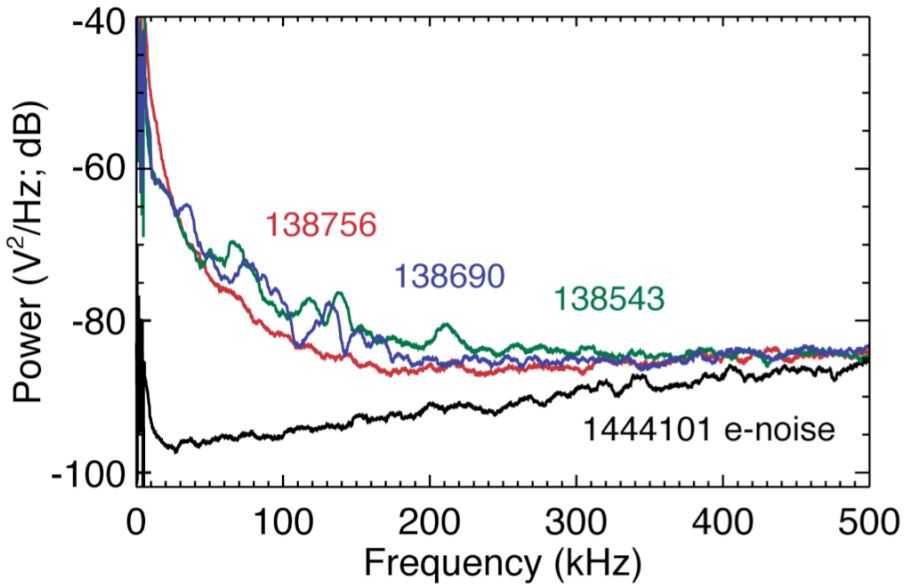


Channel layout will provide radial and poloidal correlation lengths and k-spectra

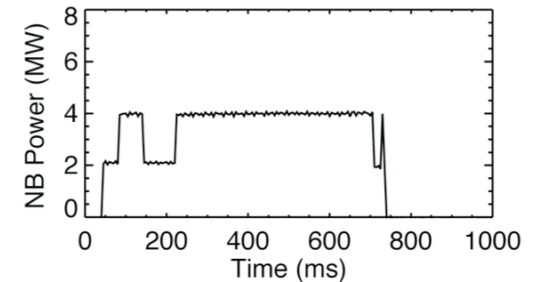
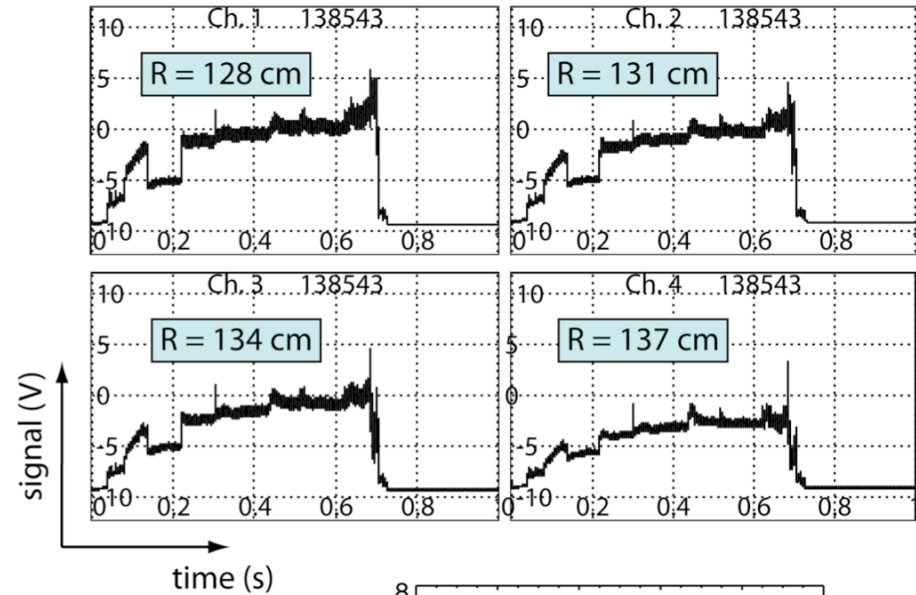


# Measured spectra exceed e-noise and signal amplitudes correspond to NB power

Measured spectra exceed e-noise

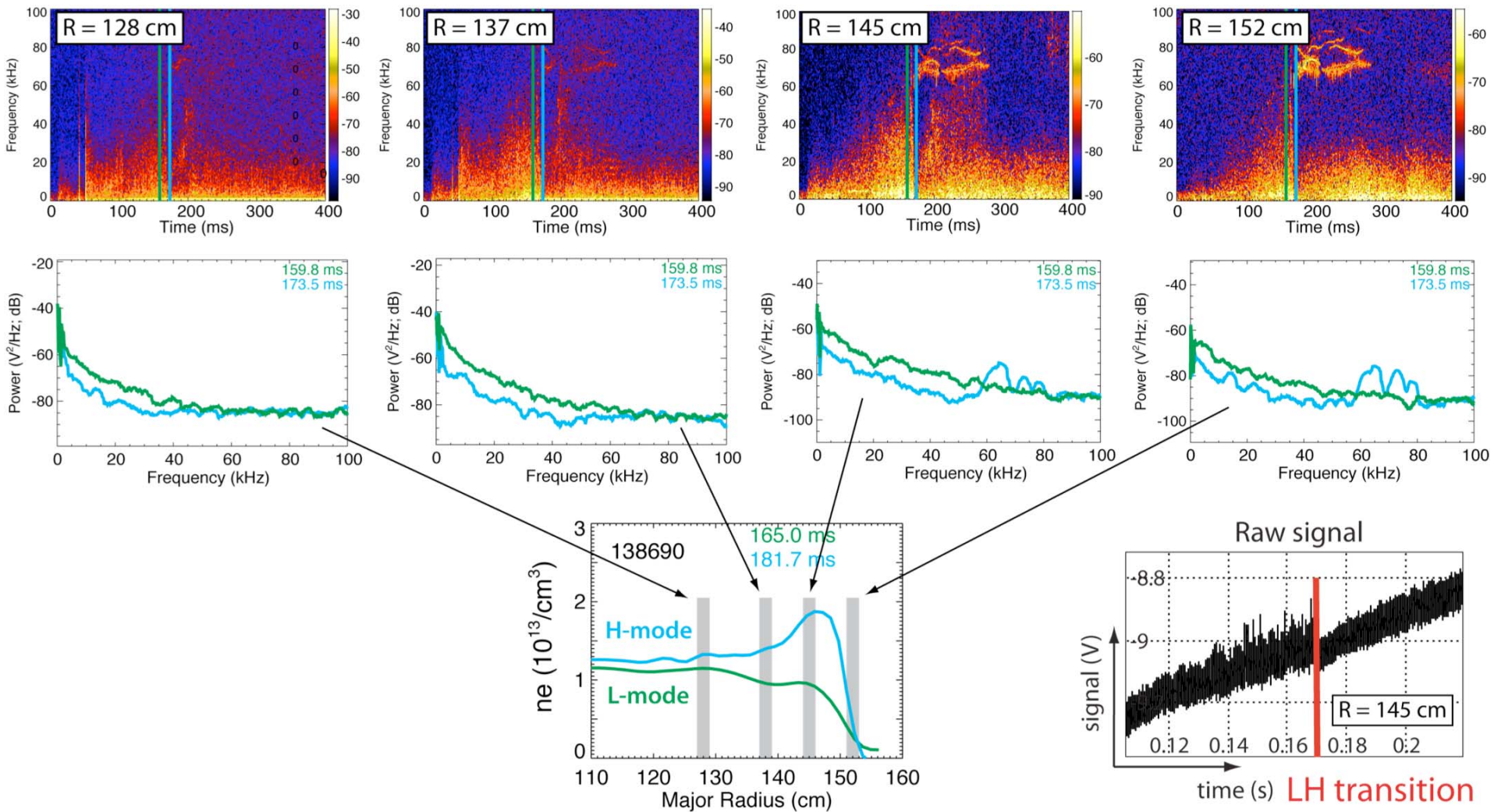


Signals correspond to NB power



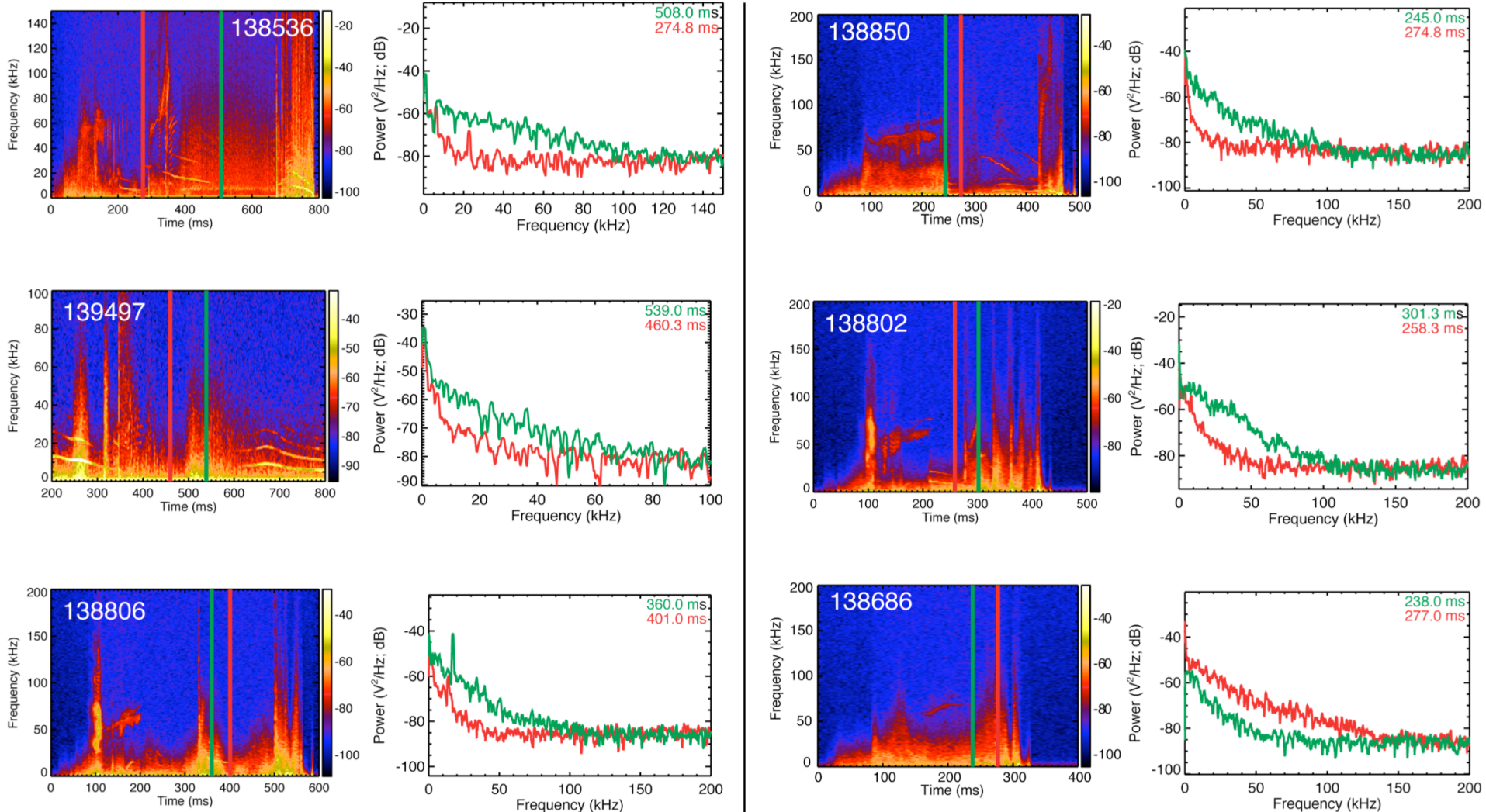
**E-noise and photon noise** must be removed from measured spectra to isolate **plasma fluctuation spectra**

# Decrease in fluctuations at LH transition observed from edge to core regions



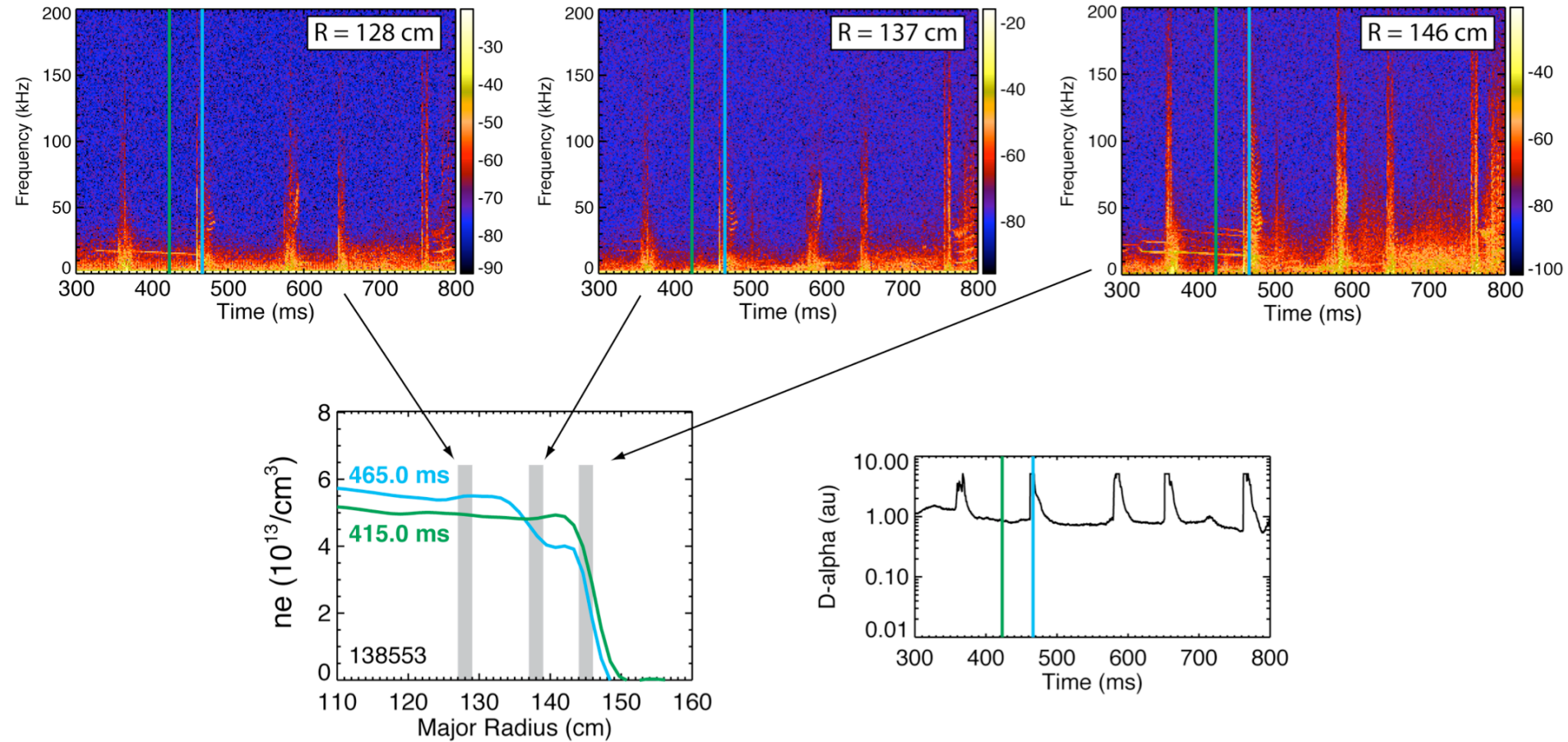
Similar increase in fluctuations observed at HL back-transitions

# Broadband fluctuations observed in many discharges

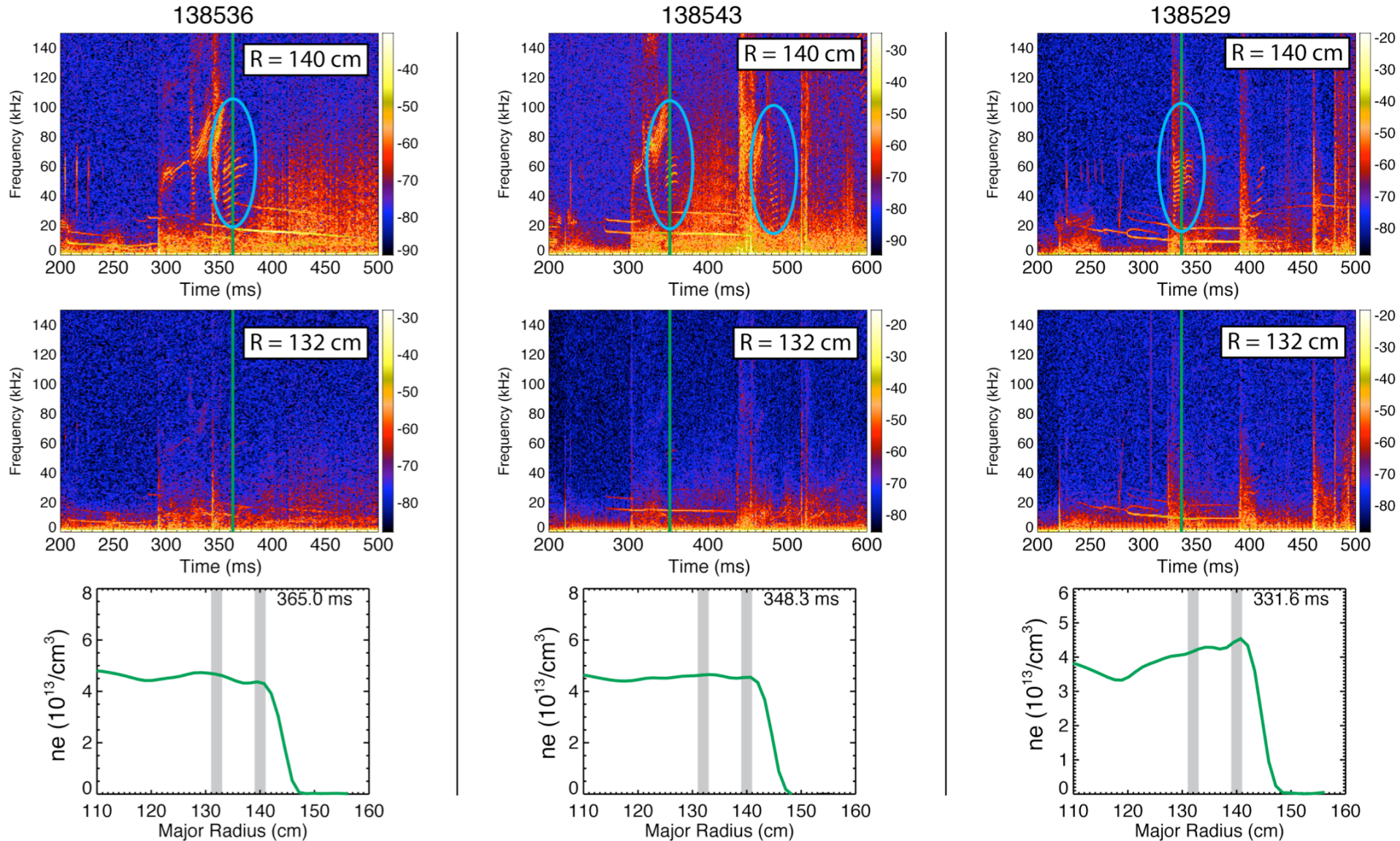




# Fluctuations increase during large ELMs

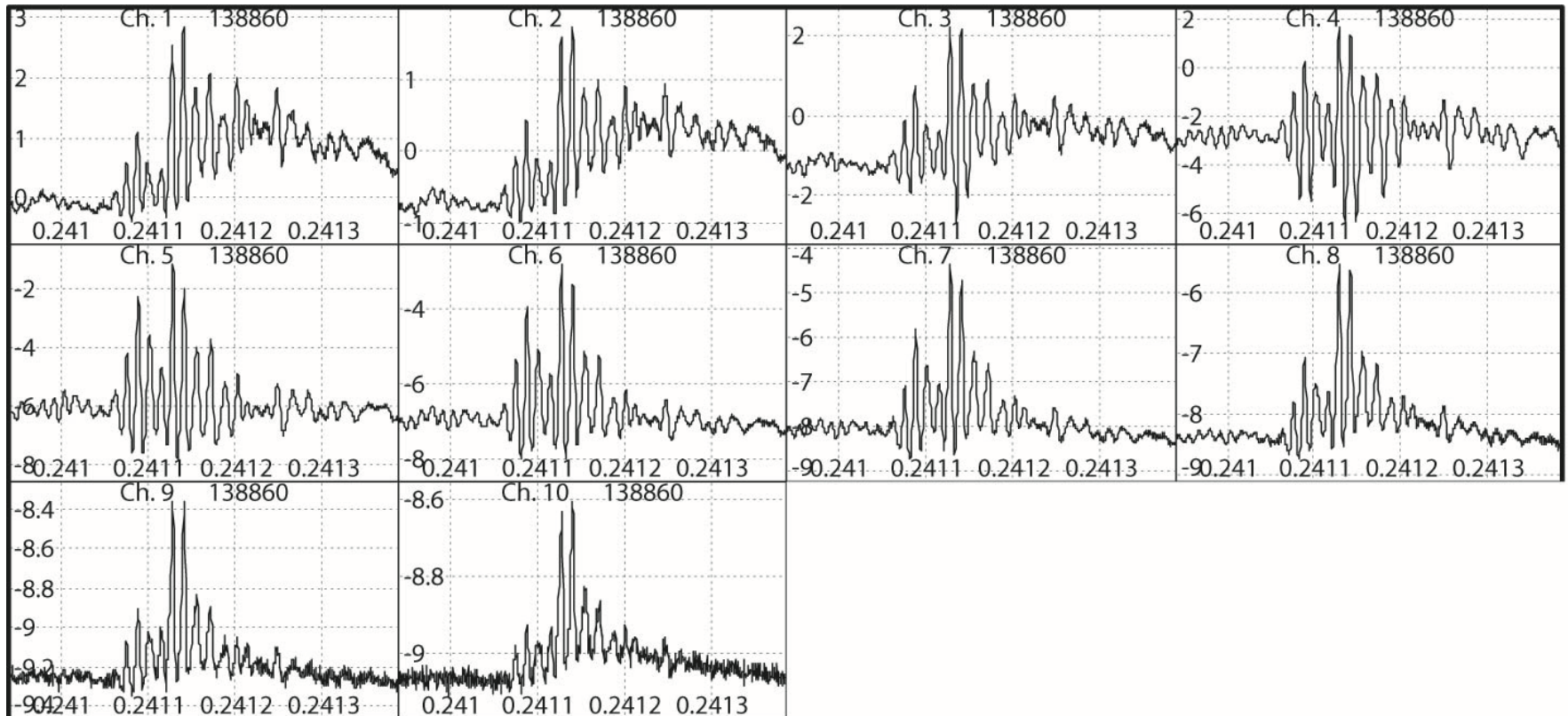


# Inter-ELM harmonic features around 100 kHz are localized near the edge





# TAEs and GAEs have been observed in extended radial regions





# Summary

- A BES system has been commissioned on NSTX
  - Radial coverage from  $r/a \sim 0.1$  to SOL with 2-3 cm spot sizes
  - Up to 24 detection channels were employed in FY10
  - Measured spectra exceed e-noise spectra
  - 32 detection channels expect in FY11
- Initial measurements show...
  - Change in fluctuations at LH and HL transitions
  - Broadband fluctuations
  - Inter-ELM harmonic features localized near pedestal
  - TAE and GAE radial structures
- Future work
  - Assess radial and poloidal correlation lengths
  - Calculate spatial transfer function to assess spatial and k-space measurement characteristics