

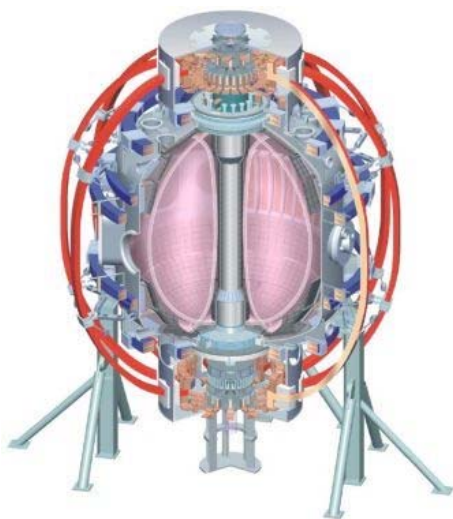
Initial density fluctuation measurements from the NSTX Beam Emission Spectroscopy diagnostic system

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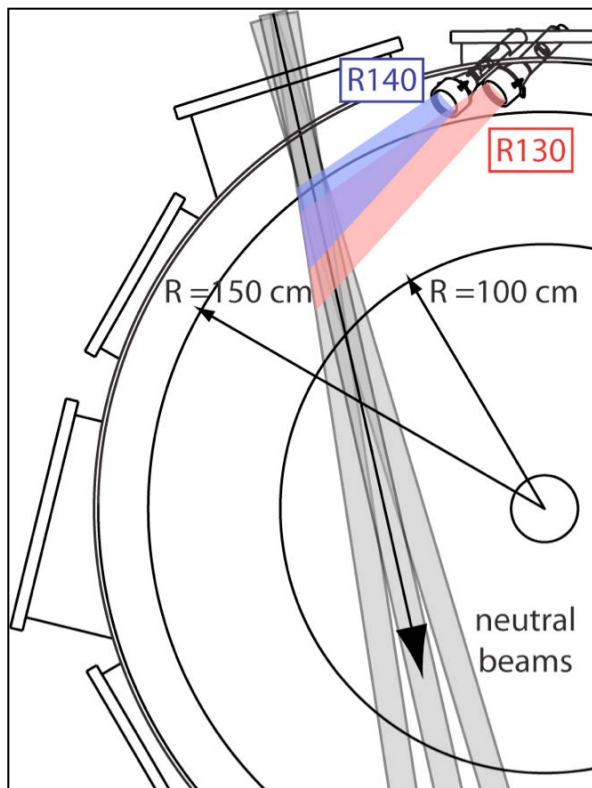
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Overview

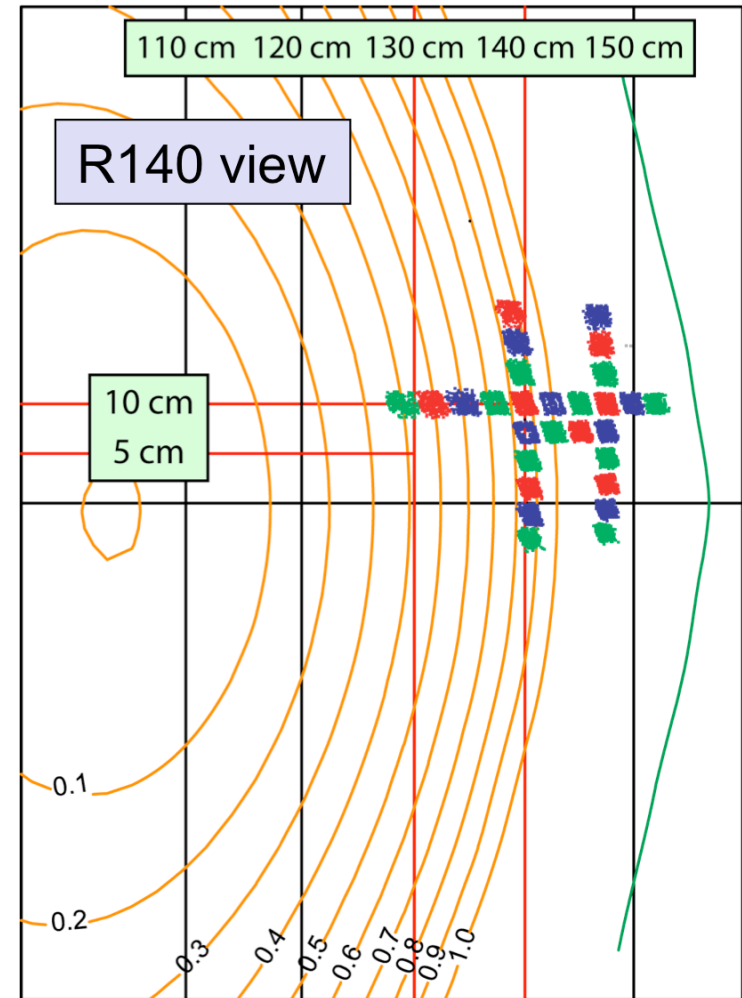
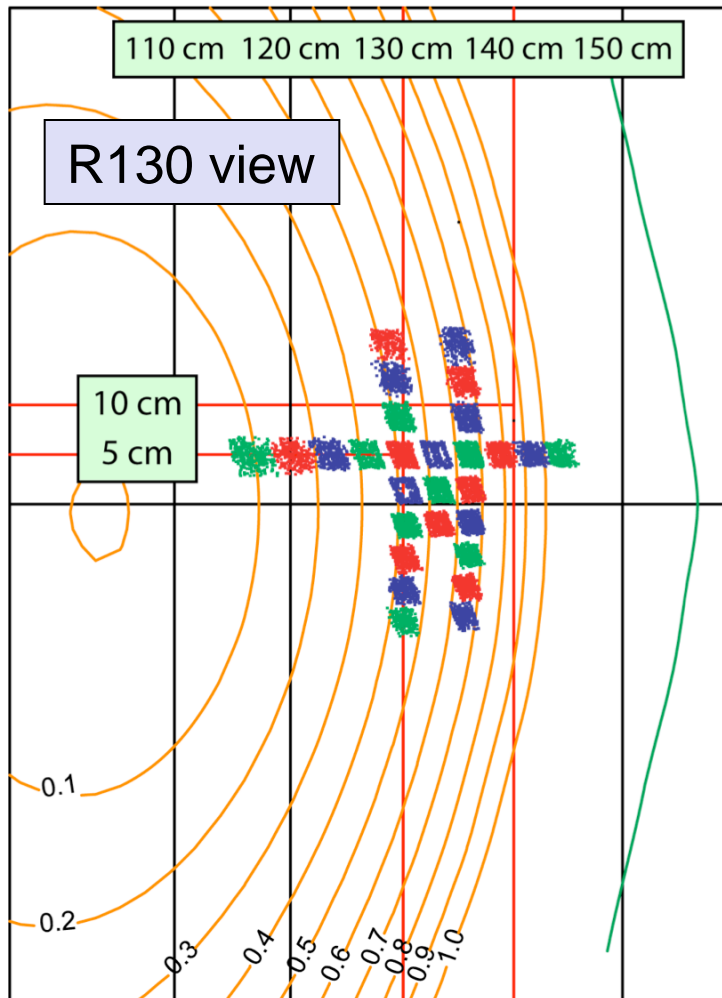
- A **beam emission spectroscopy** (BES) system has been commissioned on NSTX to study **long wavelength ($kp_i < 1$) fluctuations**
 - Measures Doppler-shifted D_α emission from deuterium neutral beams
 - Up to 24 detection channels were employed in FY10
 - **32 channels planned for FY11**
- Initial 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 structure 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_α emission from thermal D_α
- 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°C
- D. R. Smith et al, RSI 2010;
N. L. Schoenbeck et al, RSI 2010
- N. L. Schoenbeck, BP9



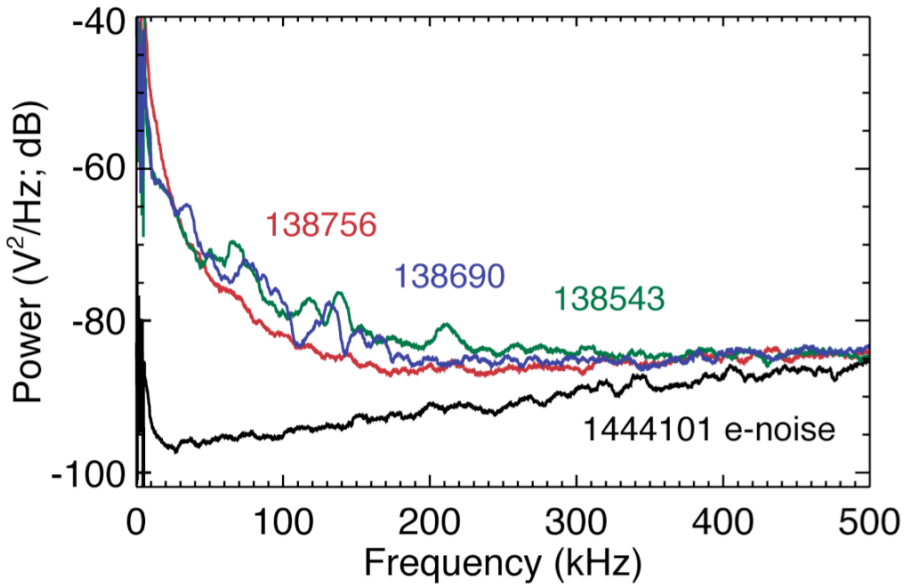
Two optical views with 56 fiber bundles provide radial coverage from $r/a \approx 0.1$ to SOL with 2-3 spot sizes



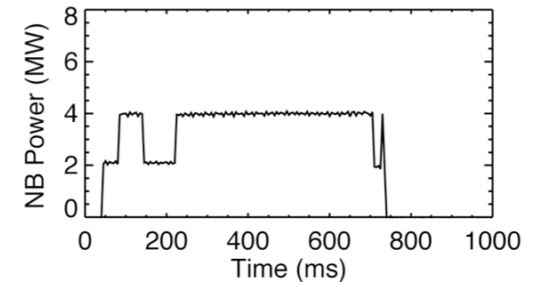
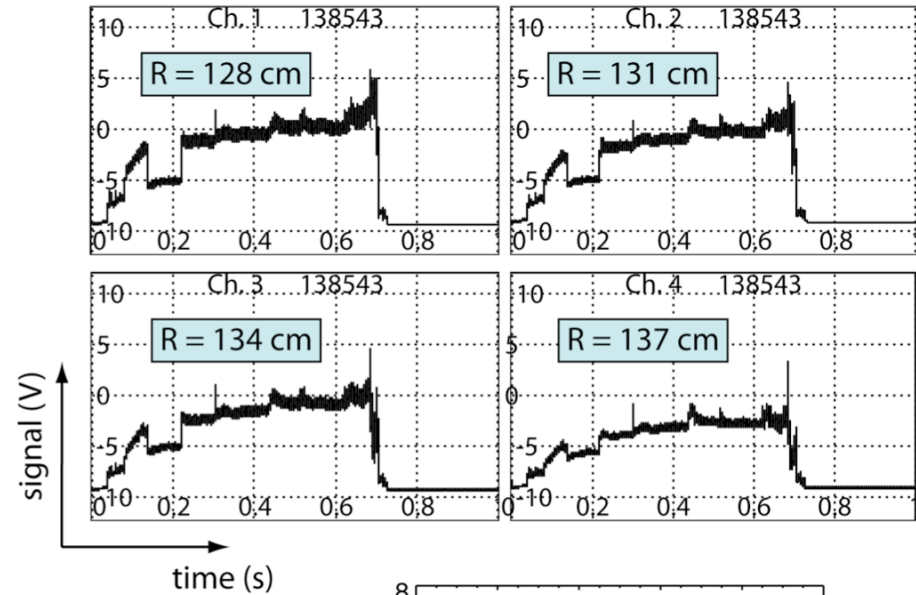
Channel layout provides radial and poloidal correlation lengths and k-spectra

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

Measured spectra exceed e-noise

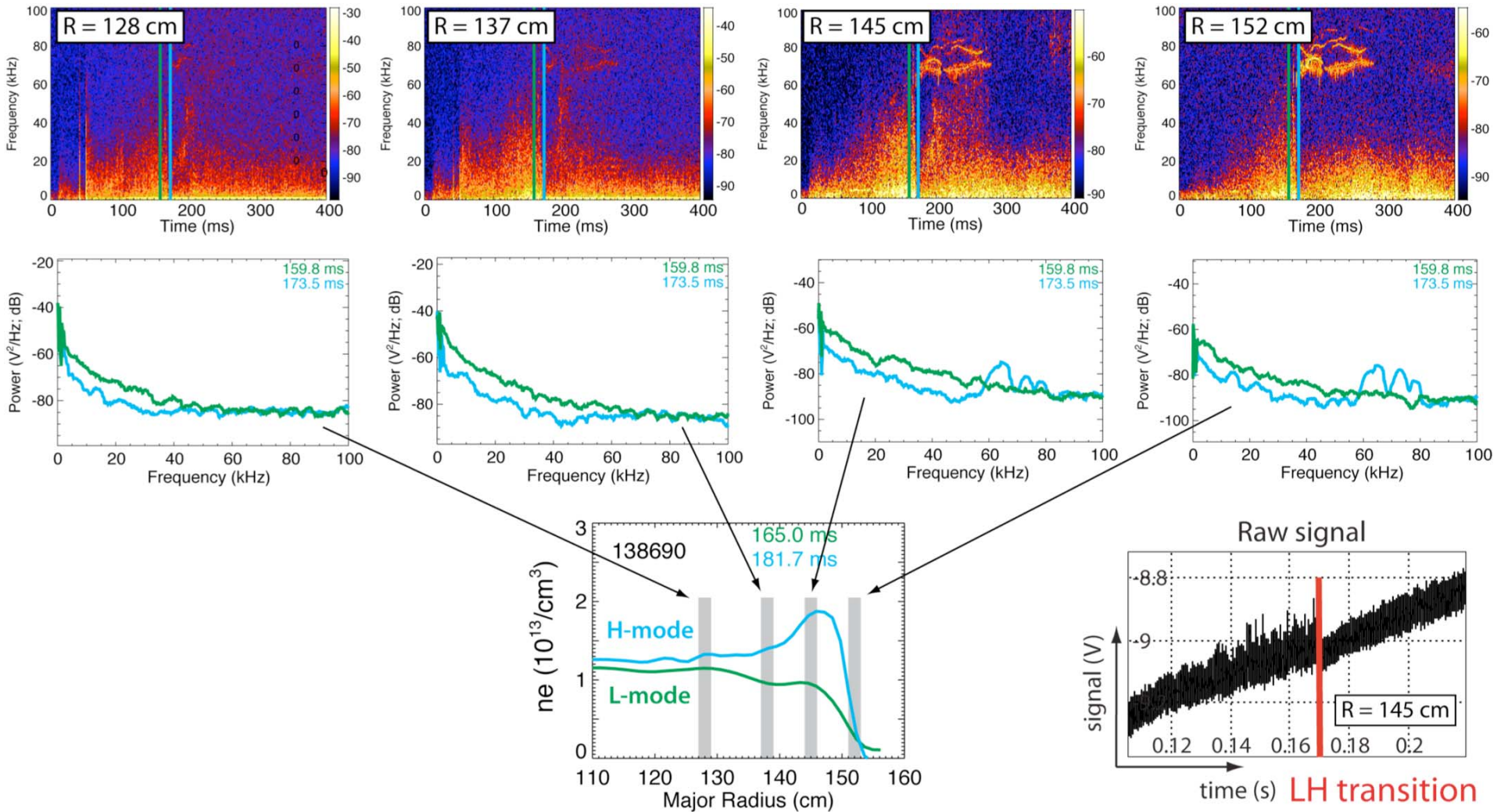


Signals correspond to NB power



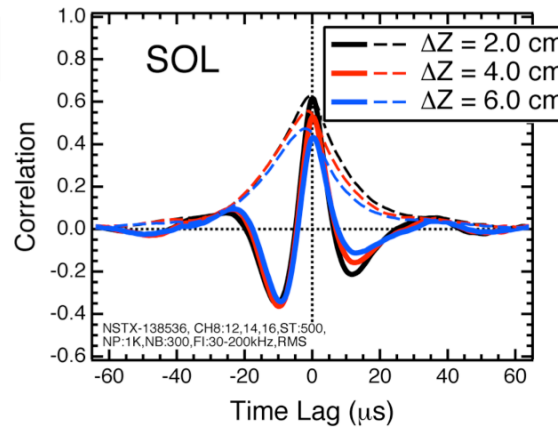
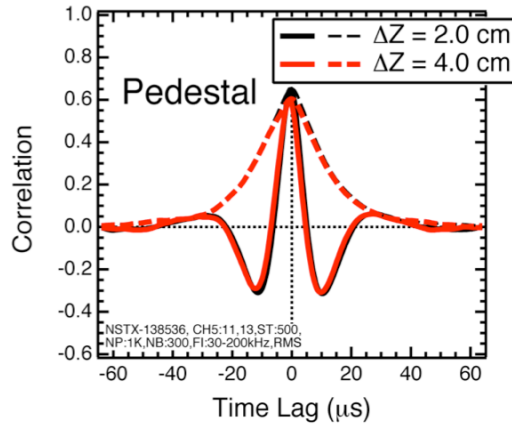
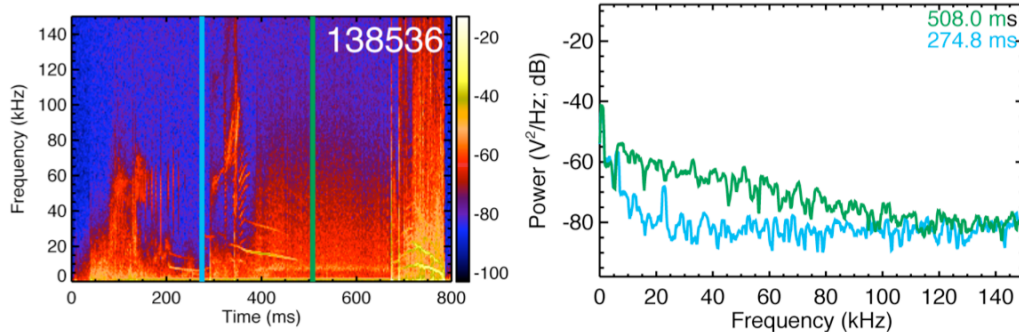
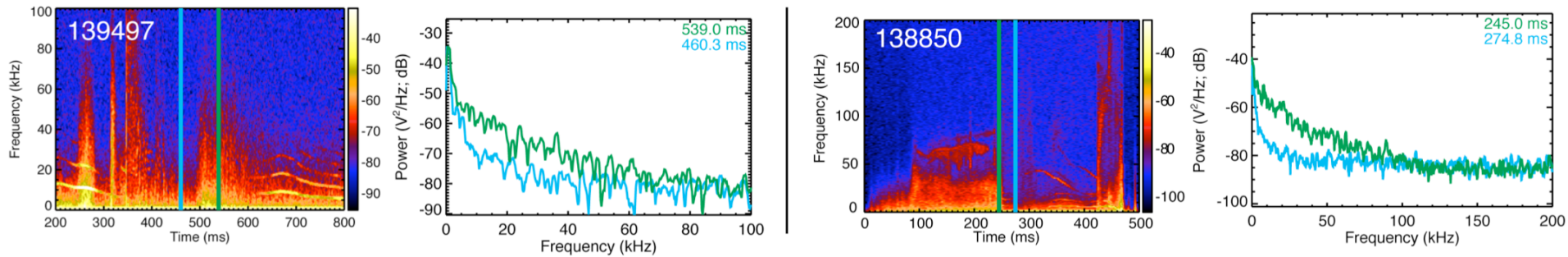
E-noise and photon noise must be removed from measured spectra to isolate **plasma fluctuation spectra**

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



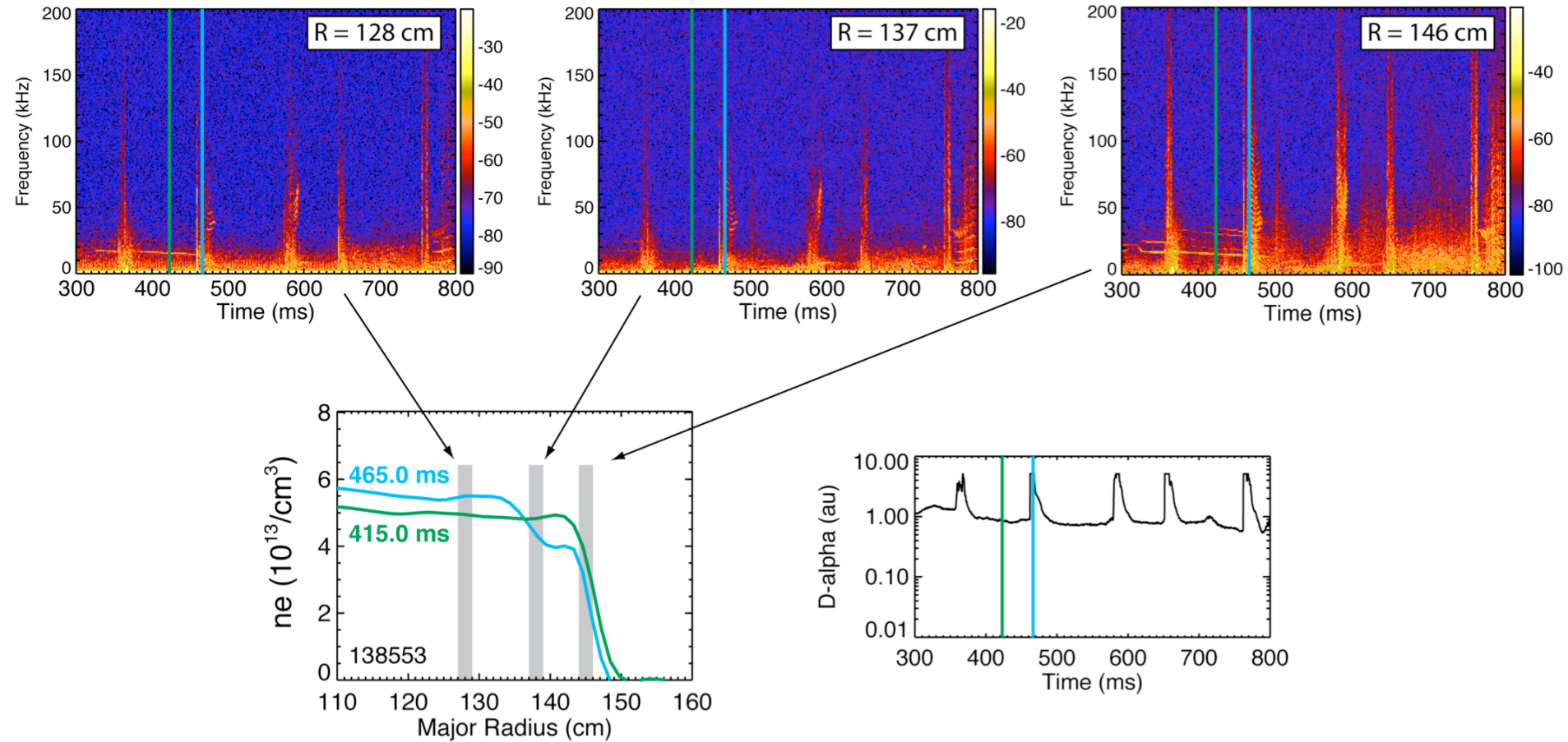
Similar increase in fluctuations observed at HL back-transitions

Broadband fluctuations have been observed in many discharges

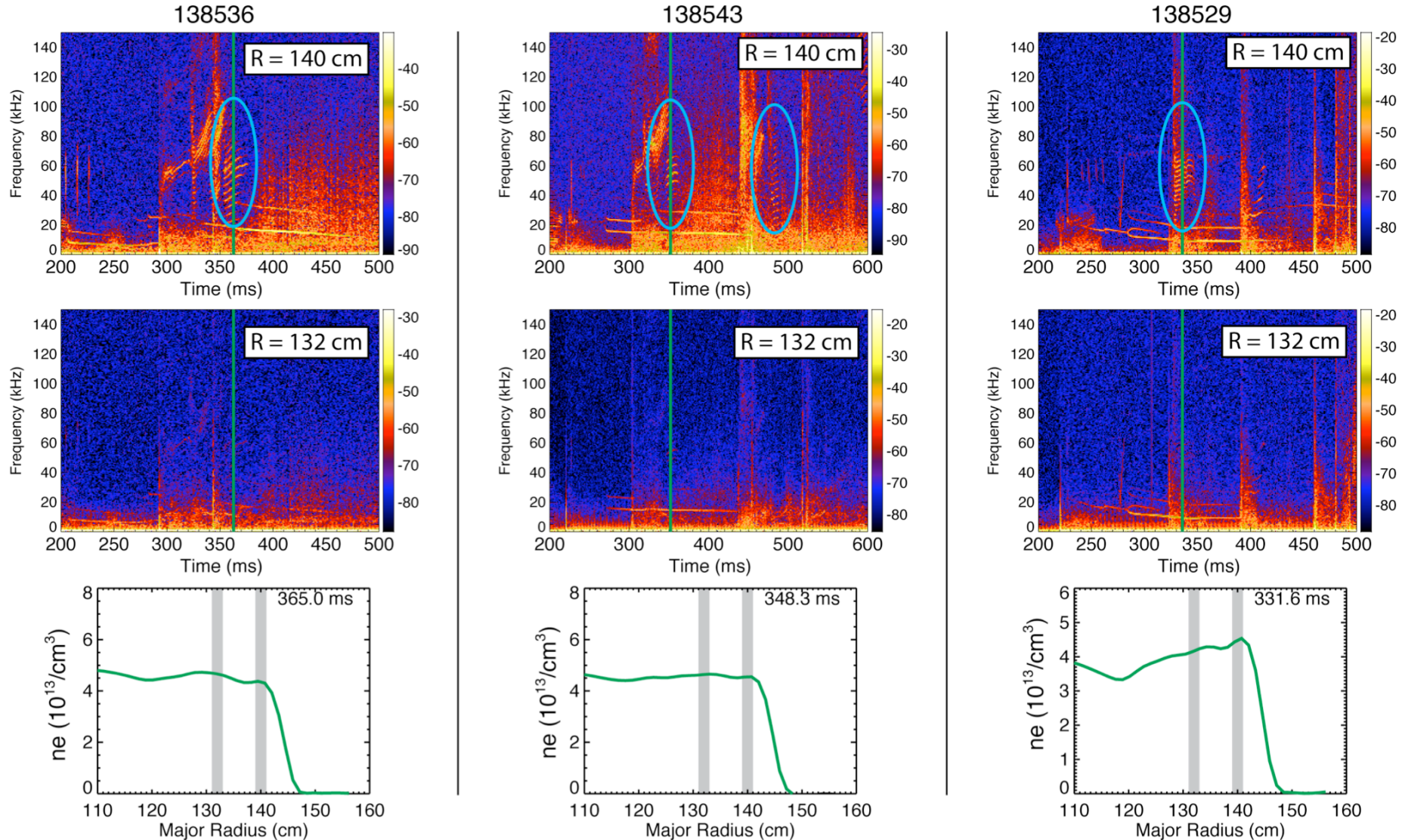


- Preliminary poloidal correlation measurements
 - Not corrected for photon and e-noise, but SNR is large
- Rapid poloidal advection
 - ~ 10 - 20 km/s in SOL
 - Greater in pedestal
- SOL correlation shows dispersion
- Decay indicates correlation lengths ~ 10 cm

Fluctuations increase during large ELMs



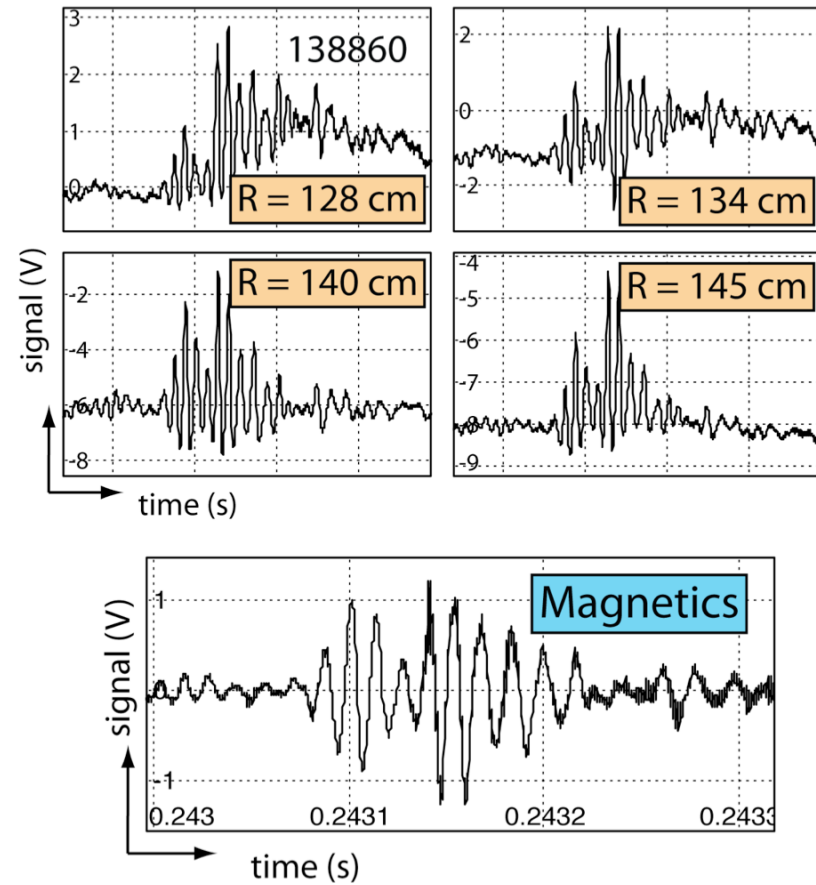
Inter-ELM harmonic features around 100 kHz are localized near the edge



Z. Yan, GI2

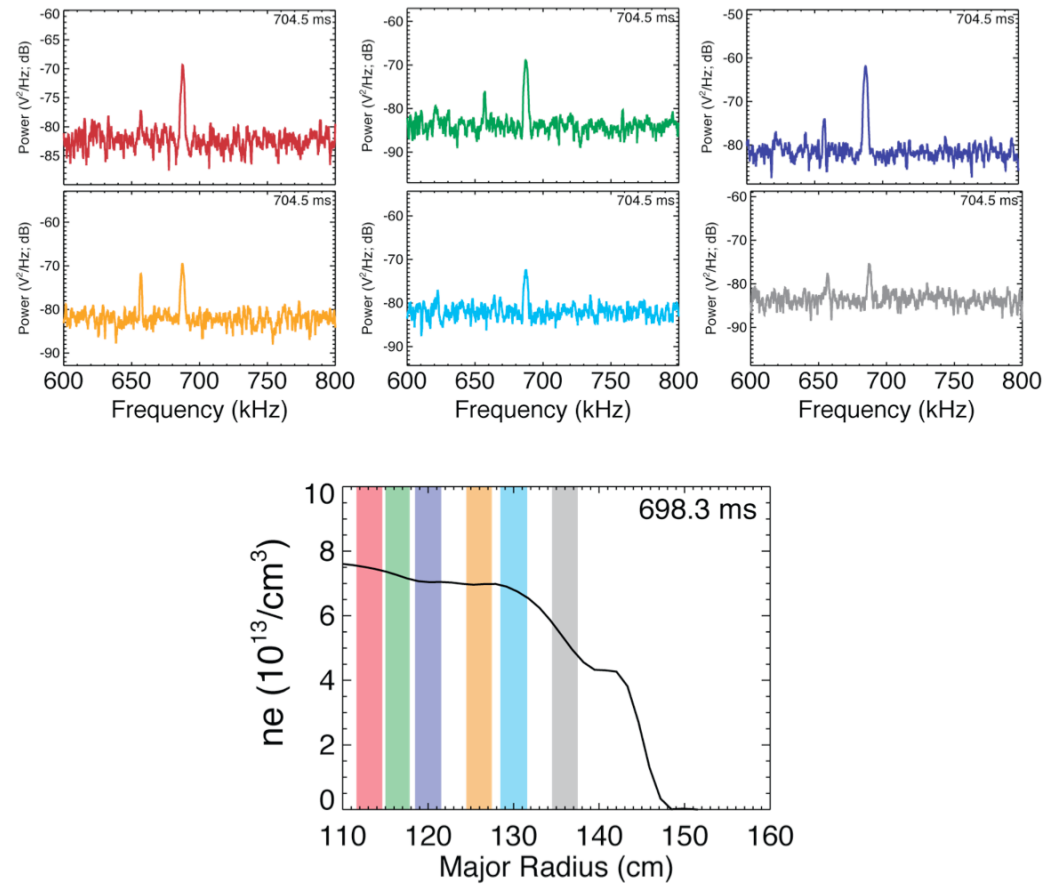
TAEs and GAEs have been observed in extended radial regions

TAE burst



Heidbrink, CO4

GAE mode



Tritz, PI2

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
 - Measured spectra exceed e-noise spectra
 - Up to 24 detection channels were employed in FY10
 - 32 detection channels expected 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