Driving EHOs in NSTX

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Houston, We have a Problem

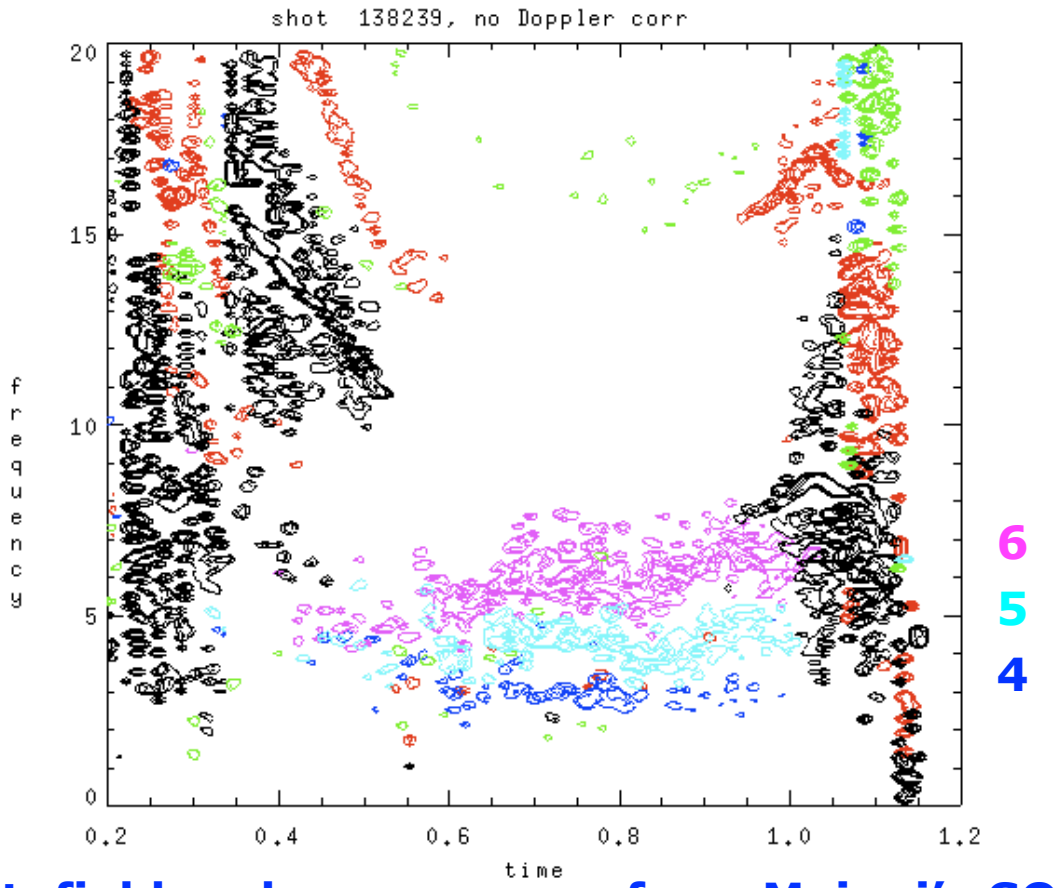
- **Lithium is effective at holding the deuterium density constant.**
- **But the carbon density keeps rising.**
- **Core radiation rises.**
- **This is not good, but it is not because the lithium is not pumping deuterium.**
- **In the absence of ELMs the plasma does not unload impurities.**

Are EHOs the Answer?

- DIII-D has found QH modes with strongly rotating co-injected plasmas, as predicted by Snyder.
- High edge rotational shear is required.
- The density does not rise in these plasmas, despite absence of ELMs.
- DIII-D believes that the Edge Harmonic Oscillations (EHO's) are the reason, both for counter and co-injected cases.

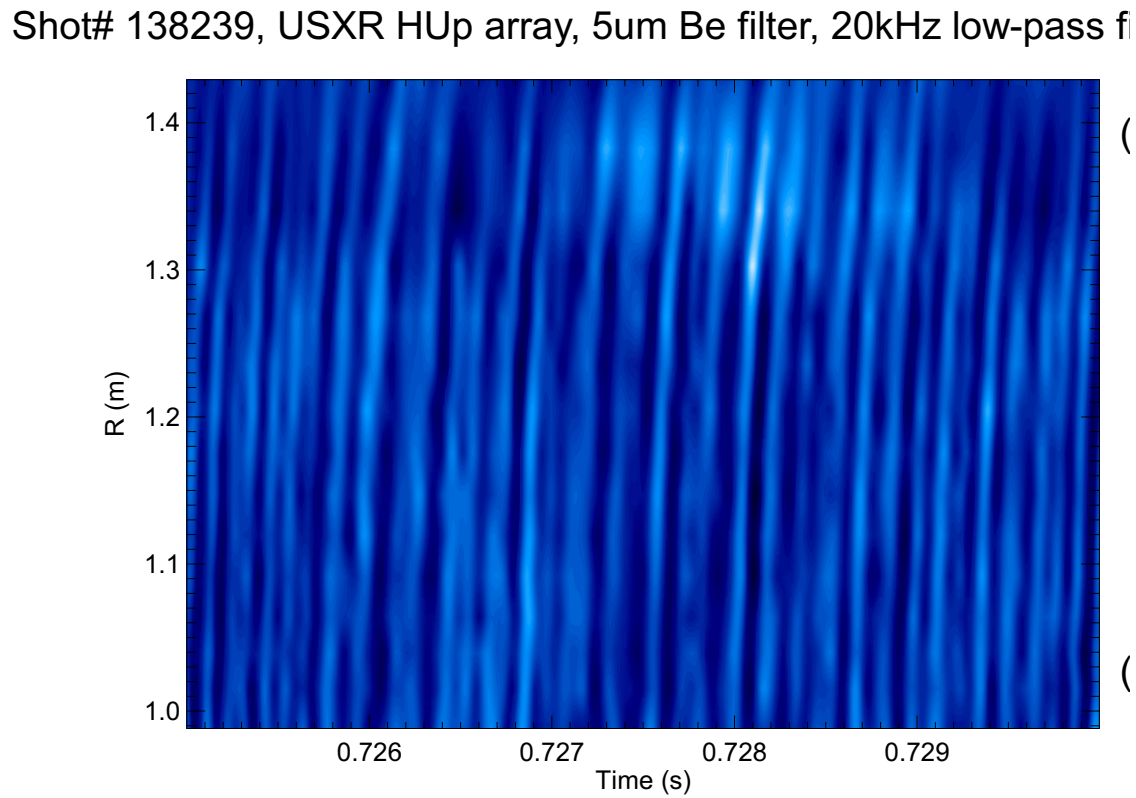
EHOs Seen on NSTX Mirnov Coils

- **Eric Fredrickson's MODE code**
- **Tuned for low frequency (long samples)**
- **Tuned for low amplitude (measures dB/dt)**



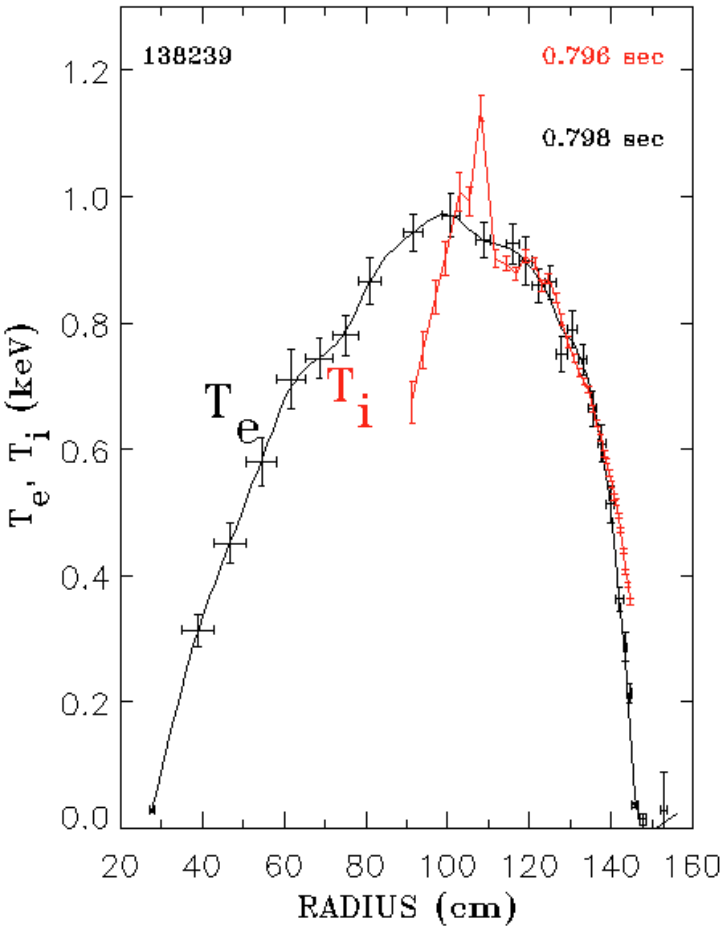
- **Studied current, field and power scans from Maingi's SOL study**
  - ELM-free, lithiated, steady density rise
- **Clearest EHO cases are 4 MW, 800 kA, 4.5 kG**
  - Fairly quiescent 1 MA, 6MW high-δ plasmas did not show EHOs
  - Need a time window with very, very low n = 1 modes
- **EHOs do not obviously reduce density rise in NSTX**

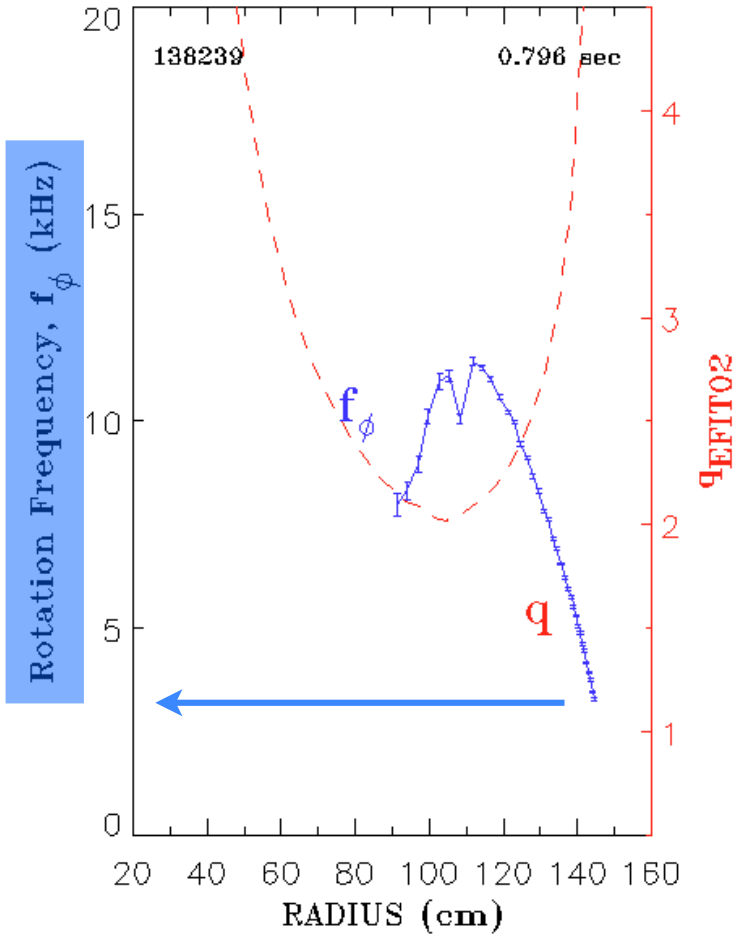
EHOs are Seen on USXR



- **Kevin Tritz / Johns Hopkins**
- **Such clear USXR signals not seen on shots without EHOs on Mirnov signals**
- **FFT by eye gives ~6 kHz**

NSTX has Strong Edge Rotation Shear





The shear at 1 kHz must be pretty impressive.

Driving EHOs Using Modulated HHFW

- **Easy to amplitude modulate HHFW**
- **HHFW couples to the edge plasma in ways we don't completely understand**
- **Maybe we can use it to drive EHOs and even control impurity influx.**
  - Evidence of coupling would motivate theory.
  - Theory would allow optimization of experiments. For example what wave numbers should we use?
  - How about beating straps against each other?
- **C-MOD has a Mini-Proposal to use modulated ICRF to drive their QCMs, at much higher f.**
  - QCMs seem to be ~ coherent, nonlinearly stable drift waves.
  - EHO's seem to be ~ coherent, nonlinearly stable kink-peeling modes.

Driving EHOs Using HHFW Coils with Audio Frequency Currents

- **Looking into technical possibility of hooking up SPAs to coils - electrical issues associated with feeds, grounding.**
- **Far from coil mechanical resonances, probably OK to drive ~ kAs in these coils at audio frequencies (!).**
- **Physics of drive should be similar in most respects to RWM interactions - but in rotating frame.**
  - Being examined by J-K Park and A. Boozer
  - More thoughts very welcome
- **Much harder experimentally, easier to understand theoretically. Trying modulated RF first.**
- **CONTROL OVER PEDESTAL HEIGHT USING ICRF-LIKE COILS WOULD BE A VERY USEFUL TOOL FOR ITER.**