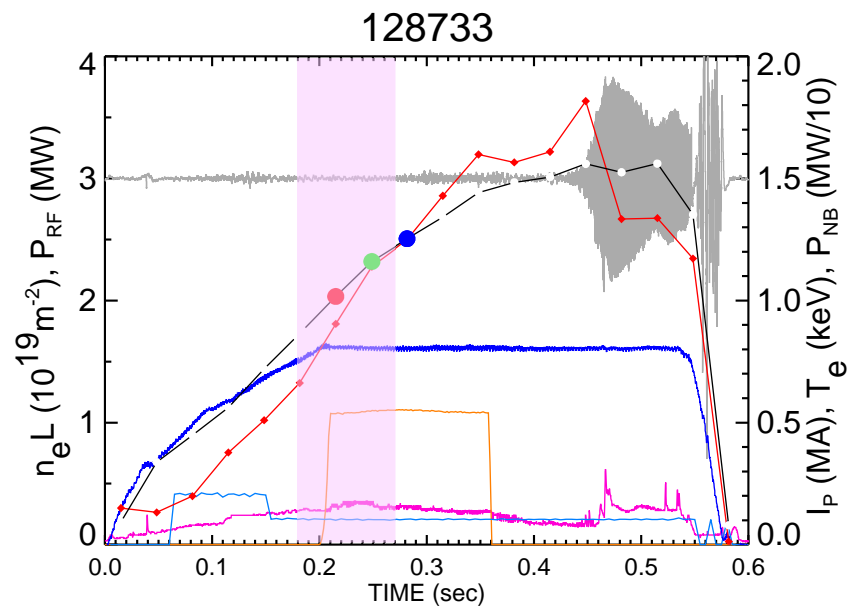
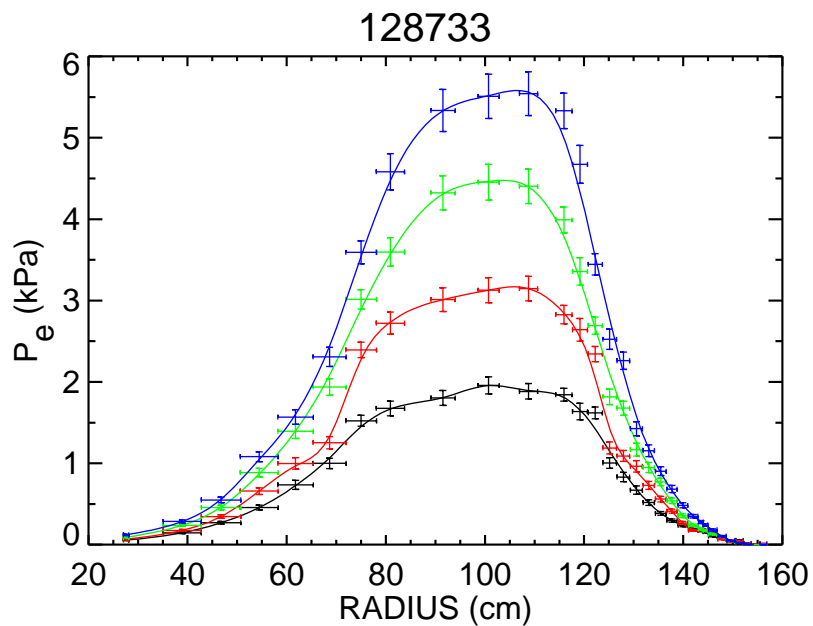
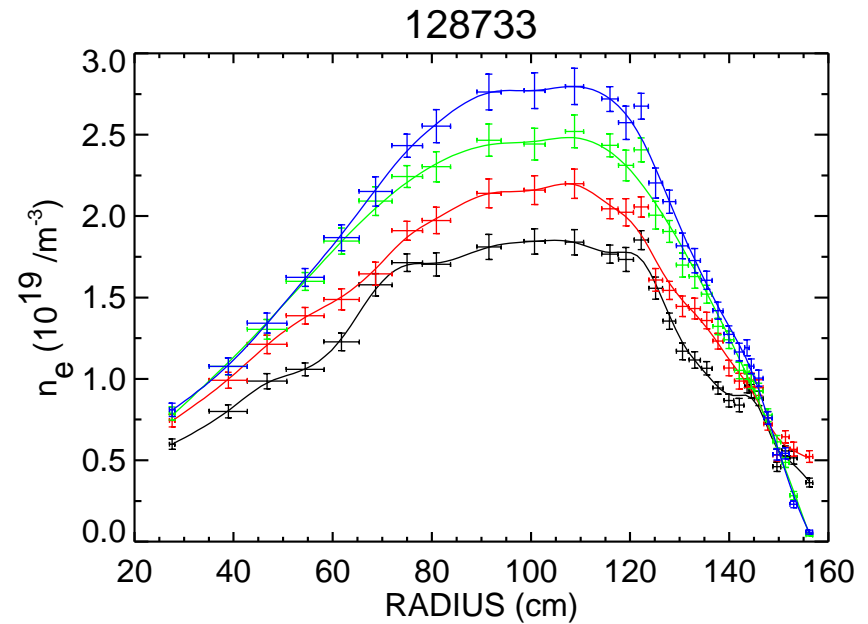
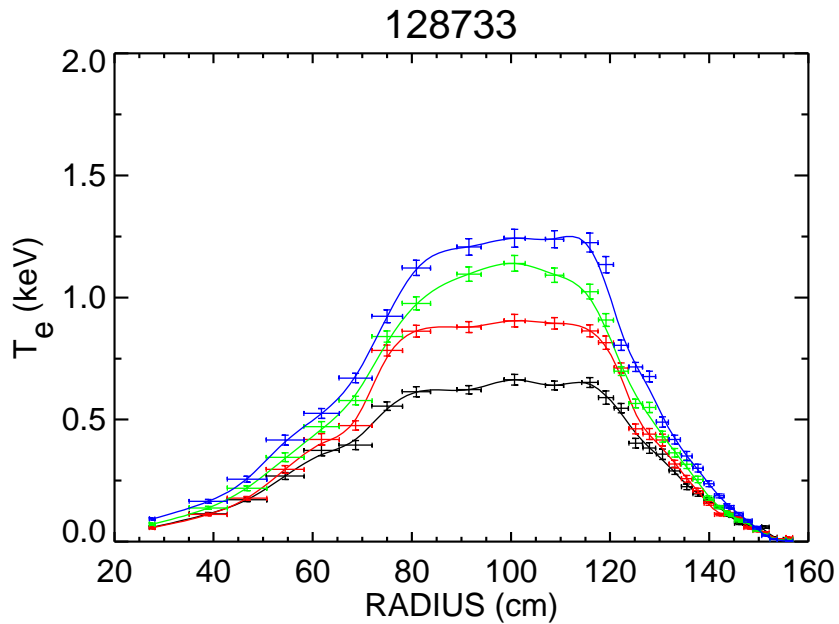


# Measurements of $\delta n(r)$ (and $\delta E(r)$ ) Due to HHFW Using FMCW Reflectometry - S. Kubota



- **Background:**
  - Previously used fixed-frequency 42 GHz heterodyne reflectometer to look at density fluctuations associated with the HHFW in the plasma core.
  - This system is unavailable this run (converted to dedicated heterodyne quadrature system to support AE measurements).
- **Capabilities of new FMCW reflectometers:**
  - 18- $\rightarrow$ 8  $\mu$ s sweep duration, 20- $\rightarrow$ 10  $\mu$ s repetition interval.
  - IF in the range of 10-25 MHz. Uses wider band amplifiers ( $f_{-3dB}$ =35 MHz) and 100 MSa/s acquisition.
  - Primary use is for turbulence measurements (density profiles, correlation length, fluctuation level).
  - Can also see modulation of electron density due to HHFW.
  - Covers entire plasma ( $f$ =13.5-53 GHz) for typical HHFW discharge.
- **Previous measurements of RF waves using reflectometry:**
  - DIII-D (Lee et al.), scannable fixed-frequency heterodyne.
  - NSTX (Wilgen et al.), edge FMCW, swept and fixed.
  - TST-2 (Ejiri et al.), fixed-frequency quadrature and FMCW.

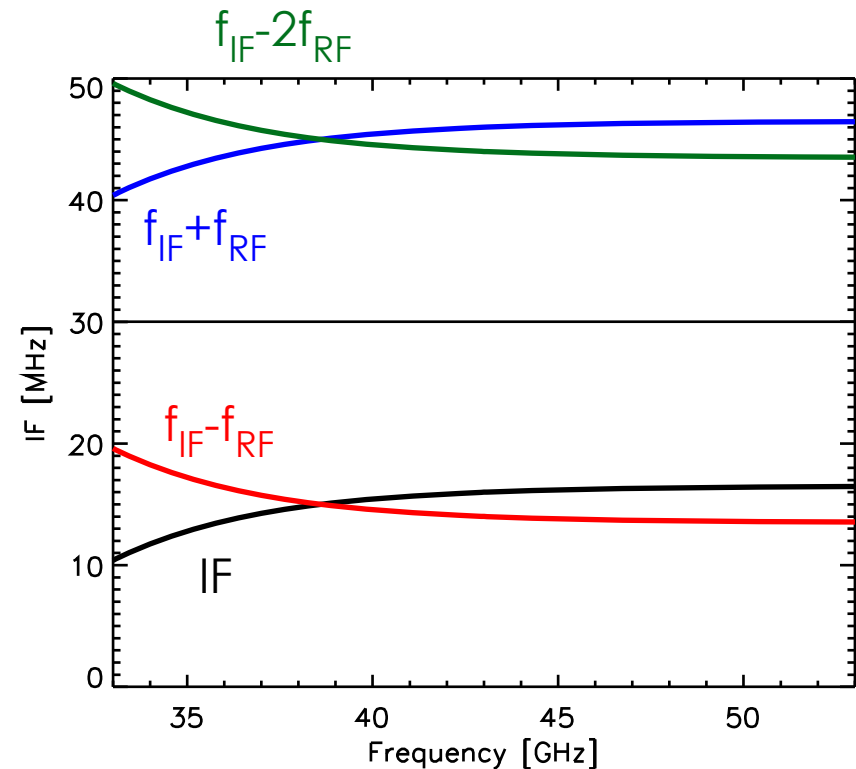
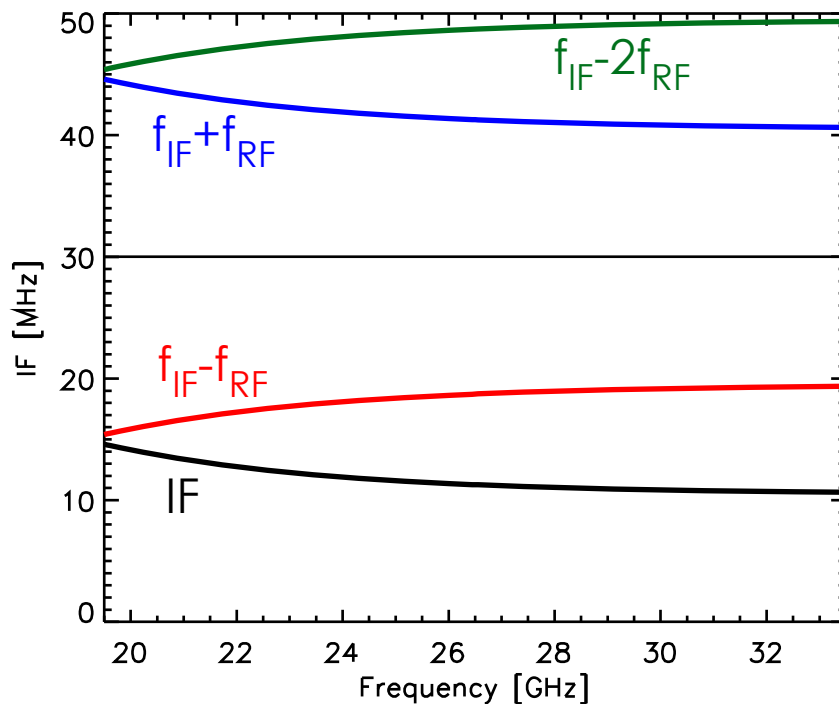
# Measurements Made Between $t=0.180$ and $0.272$ s



# Examples of the IF Modulated by the HHFW



- **Examples of IF versus probe frequency:**
  - 128733\_1.mov (13.5-20 GHz), 128733\_4.mov (20-32 GHz), 128733\_3.mov (33-53 GHz)
  - $t=0.180$  to  $0.273$  s,  $10 \mu\text{s}$  interval between sweeps.
- **Identification of main peaks in spectrum:**
  - $t=0.180$  to  $0.273$  s,  $10 \mu\text{s}$  interval between sweeps.



# Future Work



- **Noise check is necessary:**

- Direct pickup coupled through IF amplifier input - appears at RF frequency of 30 MHz.
- FM noise coupled through VCO tuning voltage - appears at the same frequencies as phase modulation sidebands (potential problem!).
- 1 mm interferometer (operated as a fixed-frequency homodyne interferometer) also sees a signal at 30 MHz.
- XMP needed to do a noise check to evaluate noise level of these systems.

- **Other work and issues:**

- Can we compare with simulation work?
- If this measurement is requested, will have to coordinate with turbulence measurements. Fastest repetition rate (total coverage of 92 ms of discharge) is desirable for turbulence measurements. Can cover more of discharge with slower repetition rate.