New Reflectometry Measurements on NSTX

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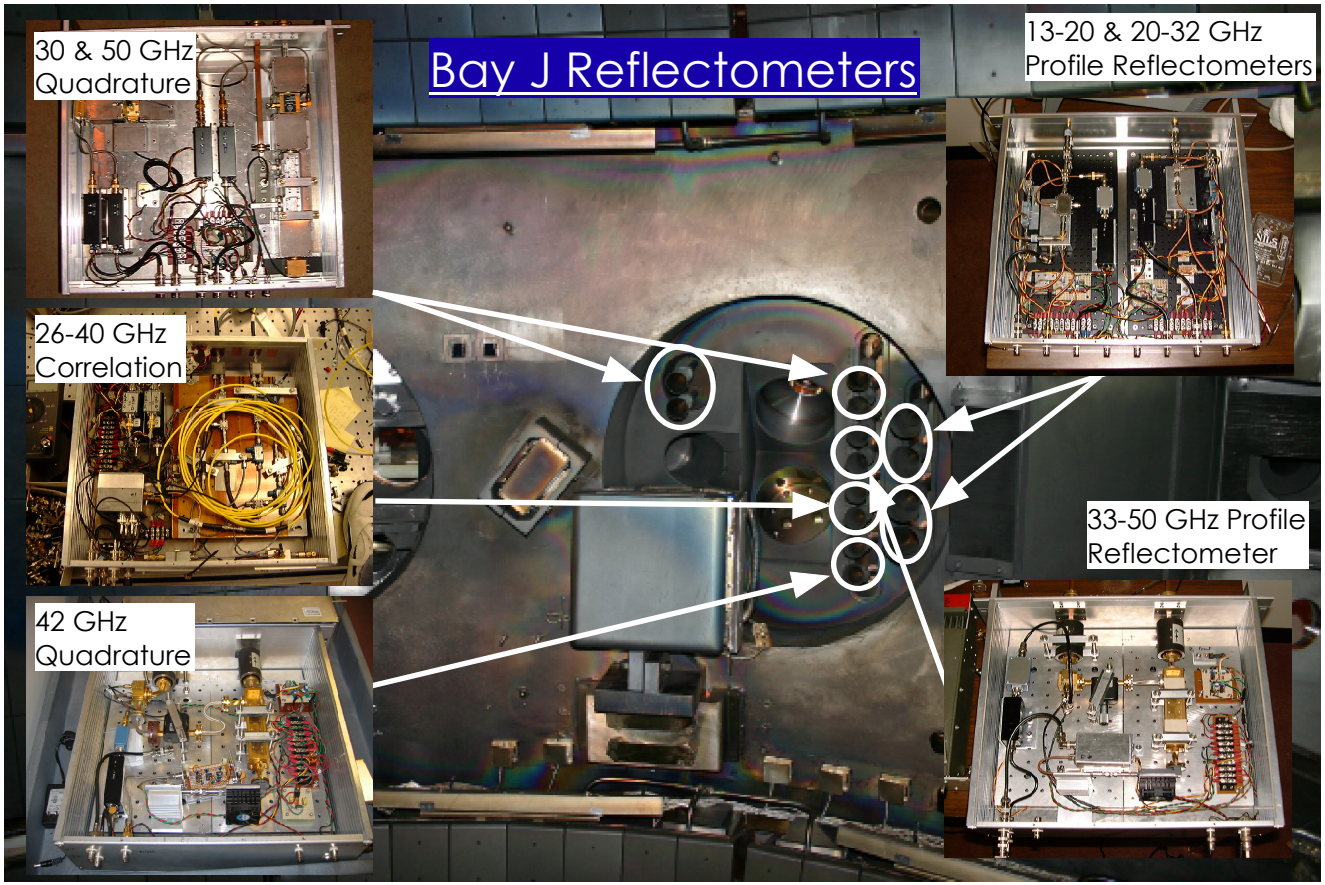
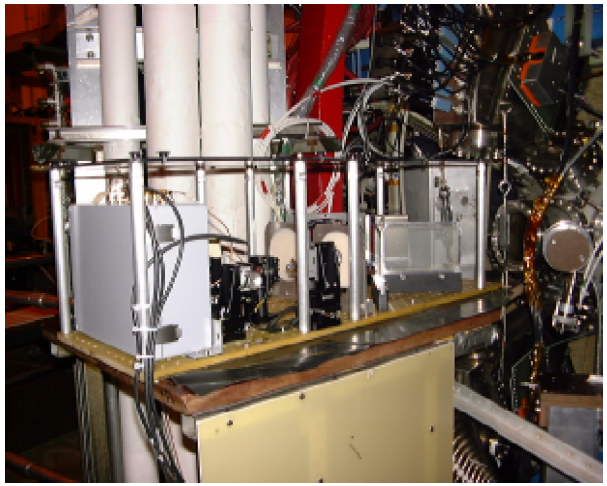
E.D. Fredrickson, J.C. Hosea, J.R. Wilson, M. Ono & the NSTX Team**



Bay G Interferometer



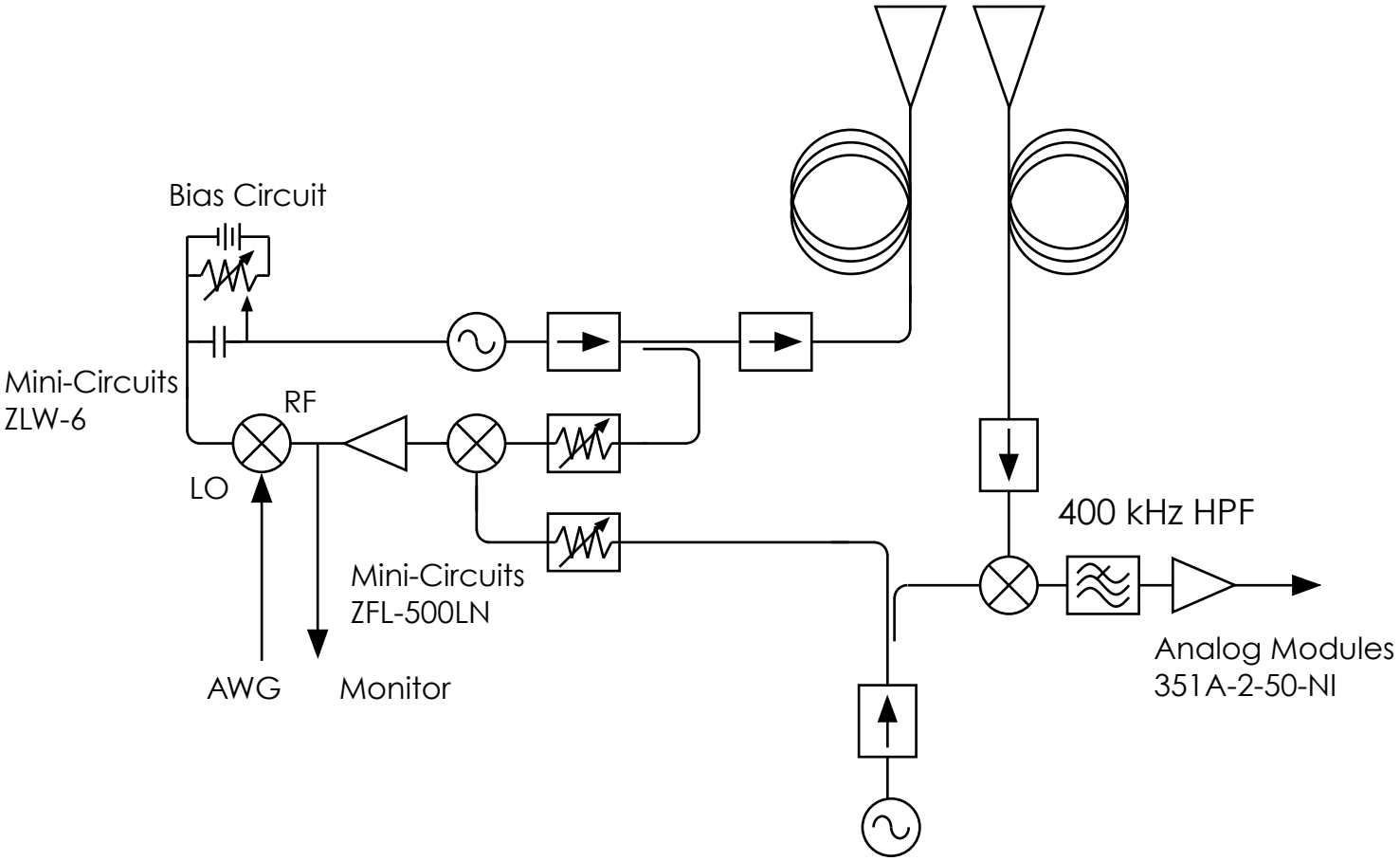
- **42 GHz reflectometer system for detecting 30 MHz fast wave.**
- **Fast FM-CW (profile) reflectometry for EPM measurements.**
- **Polidal/correlation reflectometry with quadrature detection.**

Introduction

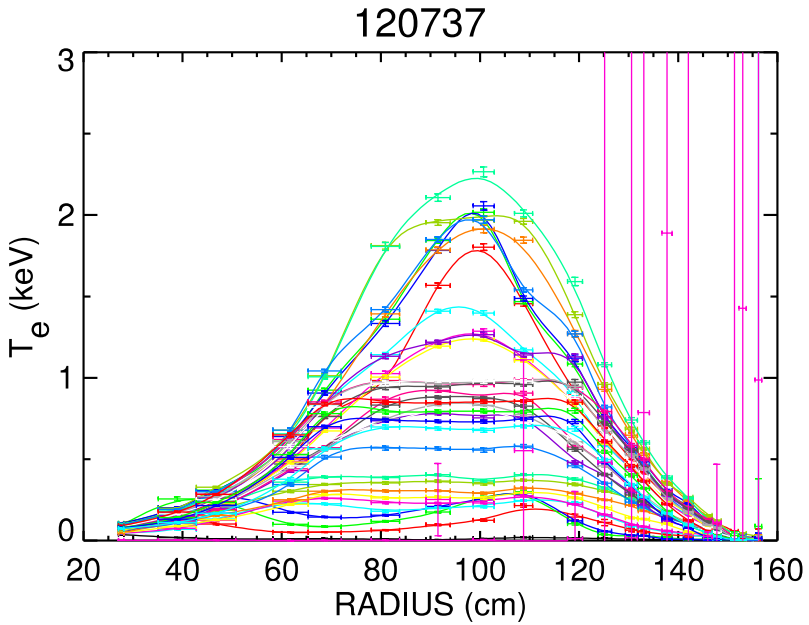
- **Measurement of externally launched waves (30 MHz HHFW):**
  - Directionality of launch, magnitude of wave electric field ($\delta\varphi \propto E$).
  - Radial correlation for estimate of radial wavelength.
  - Contribute to understanding of HHFW propagation and interaction in core. Compliments edge ORNL reflectometer at HHFW antennas.
  - **For FY06, converted 42 GHz fixed-frequency homodyne quadrature channel to heterodyne reflectometer with Δf=27-32 MHz. ($f_{probe}<f_{lo}$). PoP measurements for core plasma.**
- **Radial density profile measurement of EPM's:**
  - Radial profile of plasma displacement can yield estimate of δB.
  - Magnitude, localization, radial structure, etc.
  - **Begun converting profile reflectometer for 10 μs repetition rate. Difficulty finding suitable IF amplifiers. Otherwise, OK for measurements down to $\delta n/n$~0.5%.**
- **Correlation reflectometry:**
  - Radial and poloidal correlations ($\delta n/n$, k spectrum, Lc, velocity).
  - All of this made possible by converting to quadrature detection.
  - **System ready in late March, but not installed until June.**

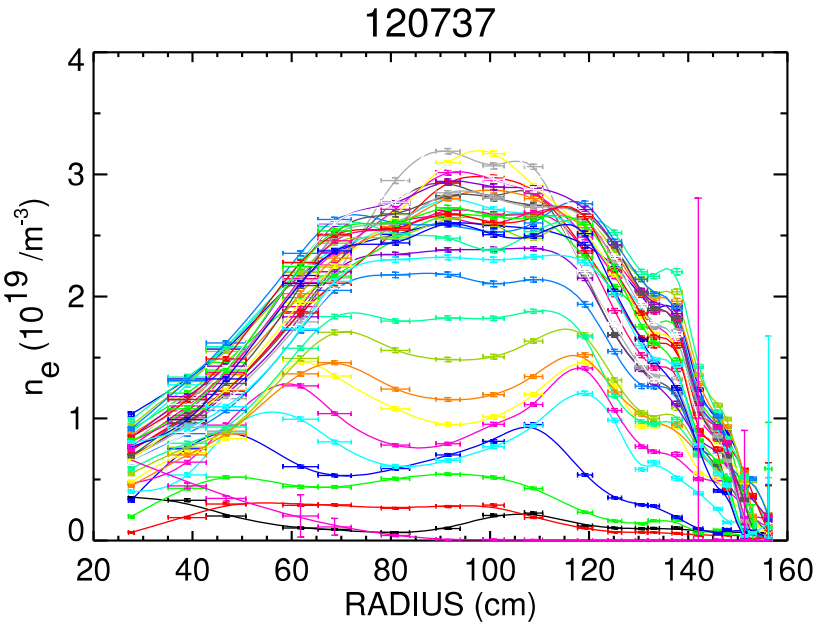
1. Reflectometer Modified for HHFW Measurements

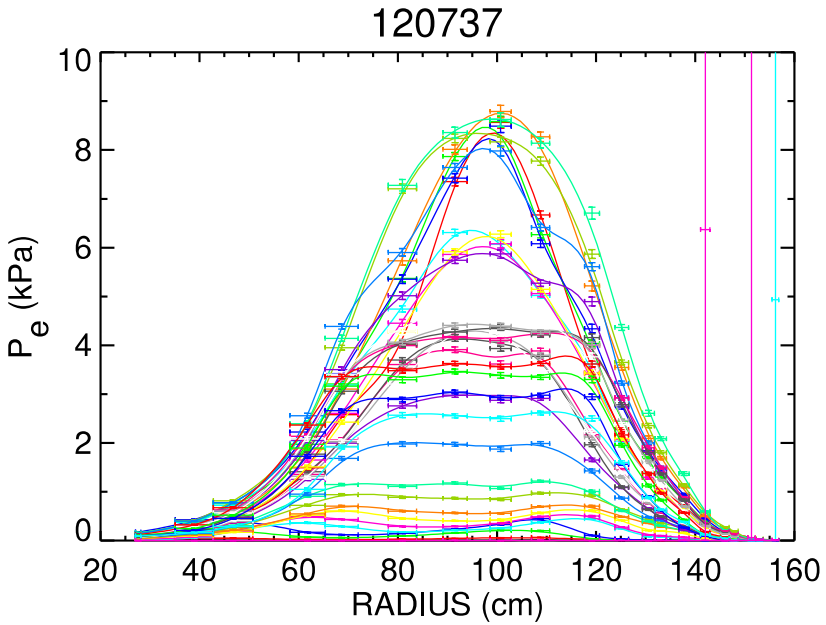
- **Heterodyne reflectometer with Δf=27-32 MHz around RF frequency of 30 MHz. $f_{probe} < f_{lo}$.**
  - Digitizer sampling rate of 8MSa/s.
  - LPF at 5 MHz, IF amplifier cutoff (6.5 MHz), digitizer cutoff 9 MHz.

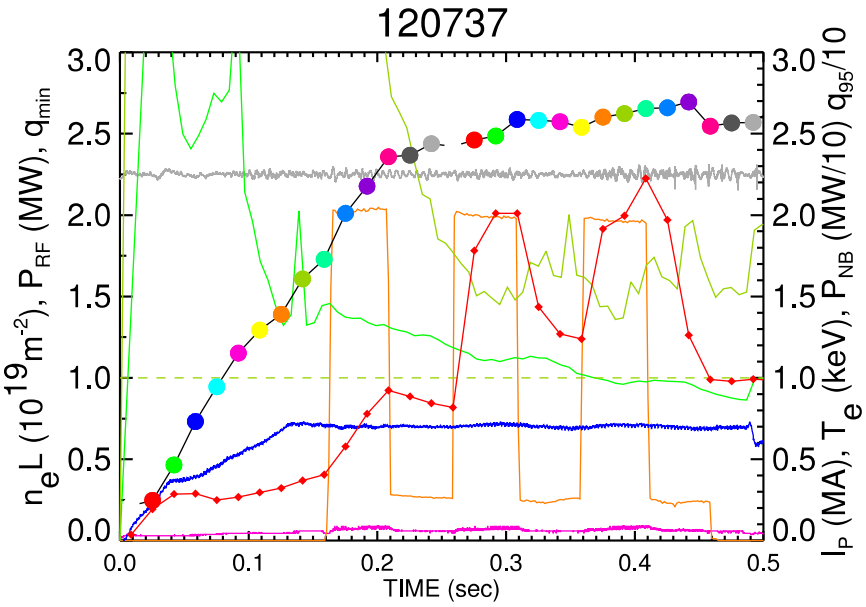


Initial Measurements During XP-617

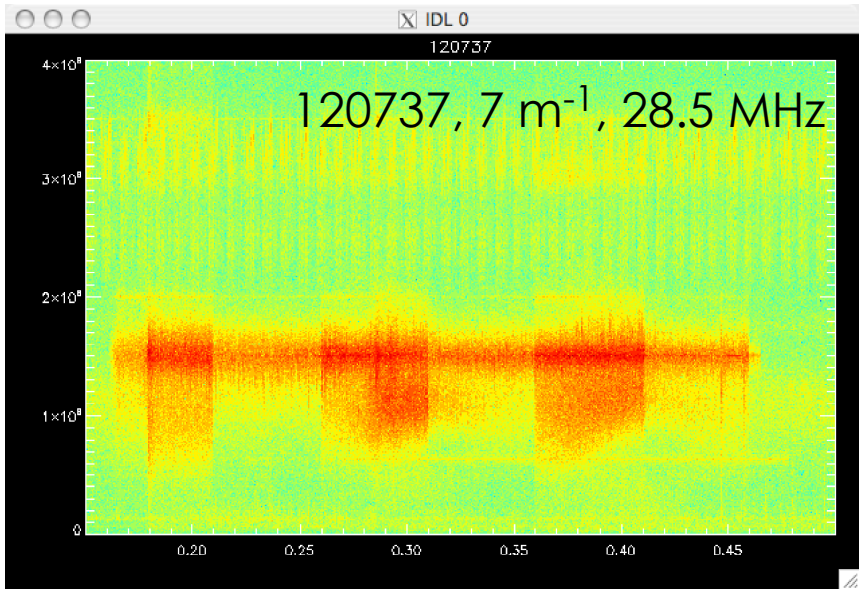


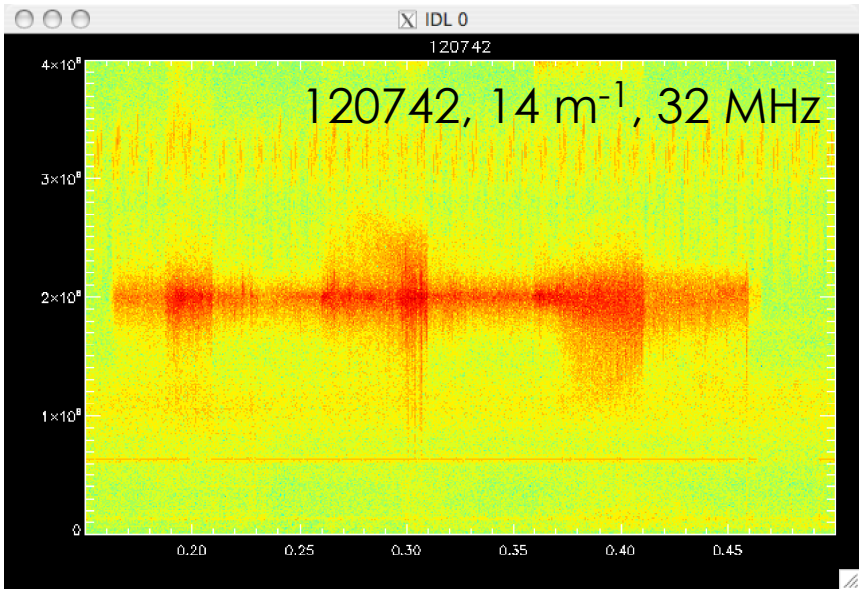


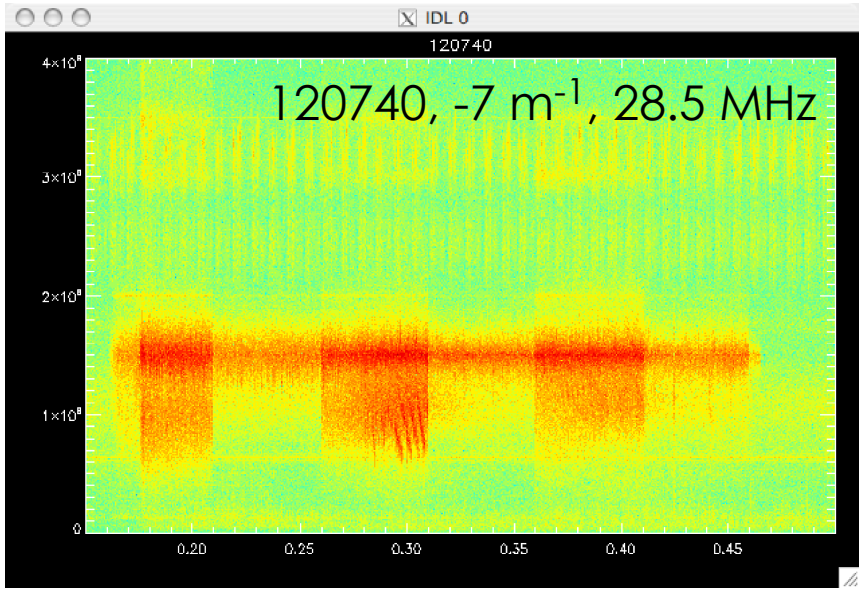


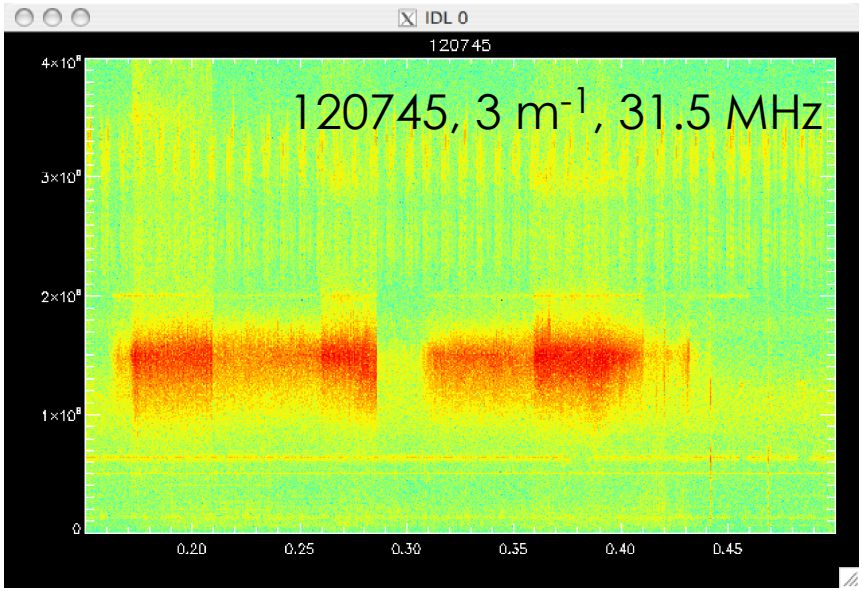


Signal Spectra, 5.5 kG

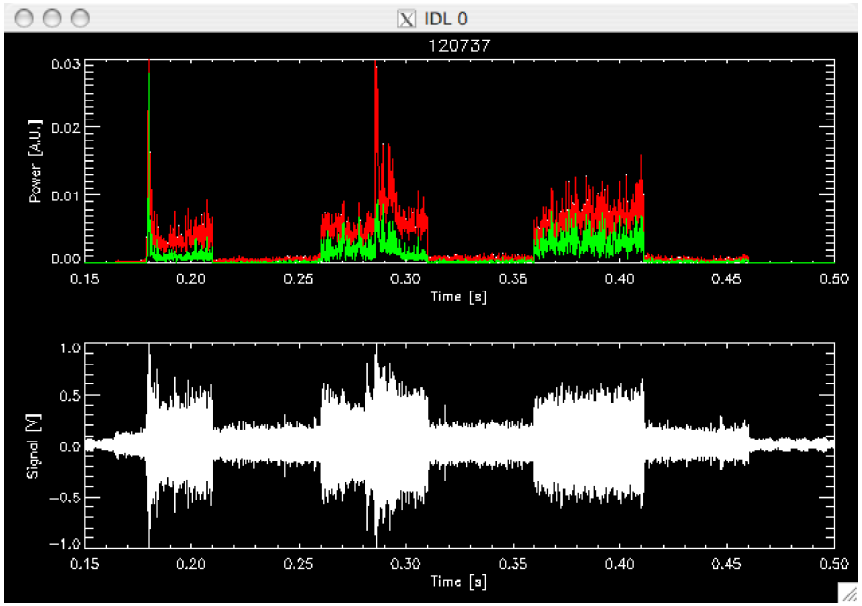


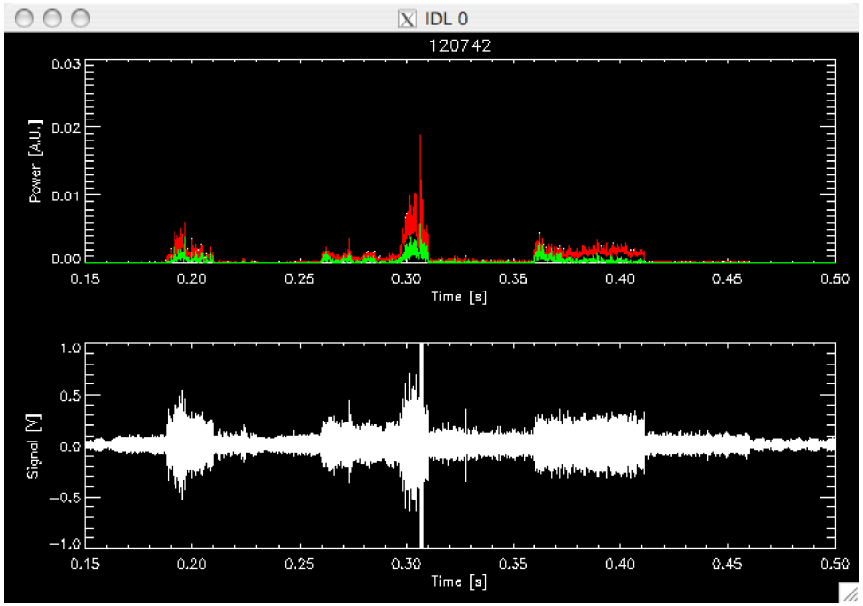


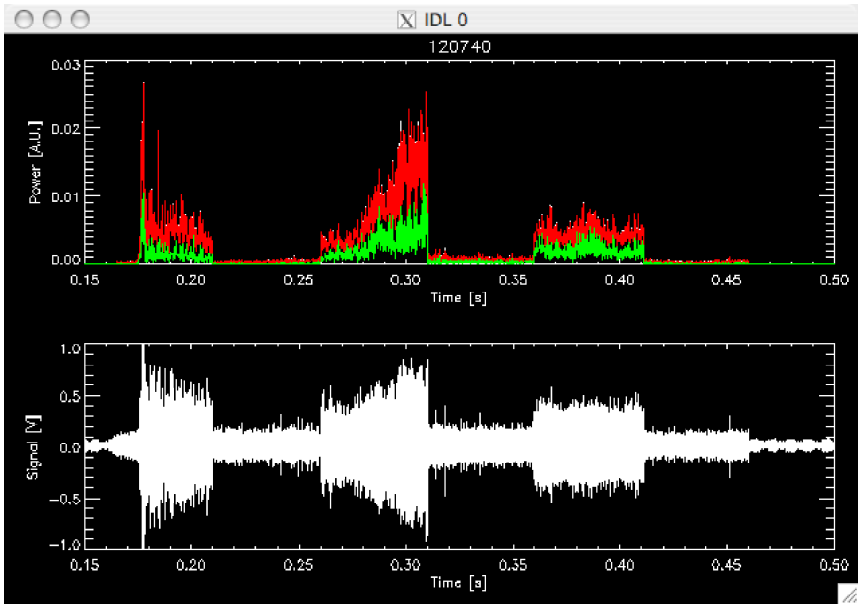


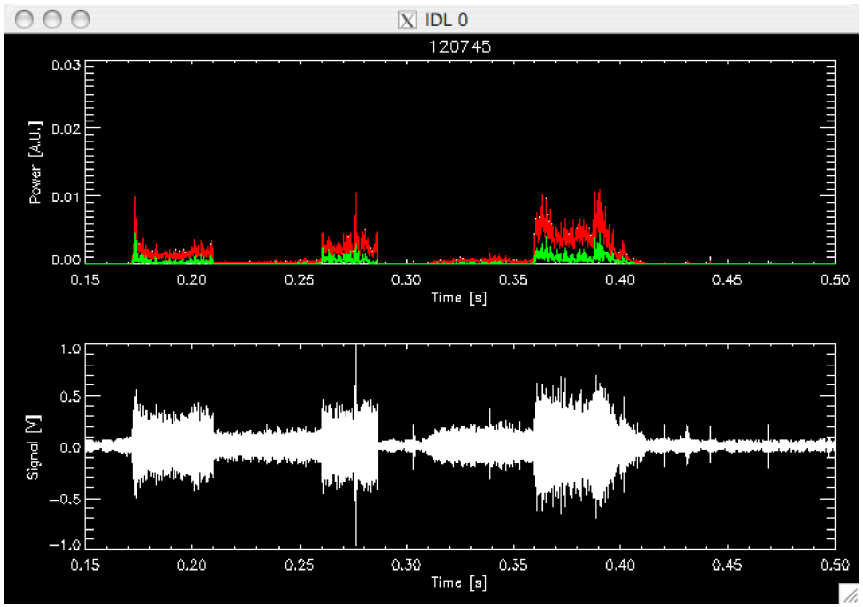


Signal and Power



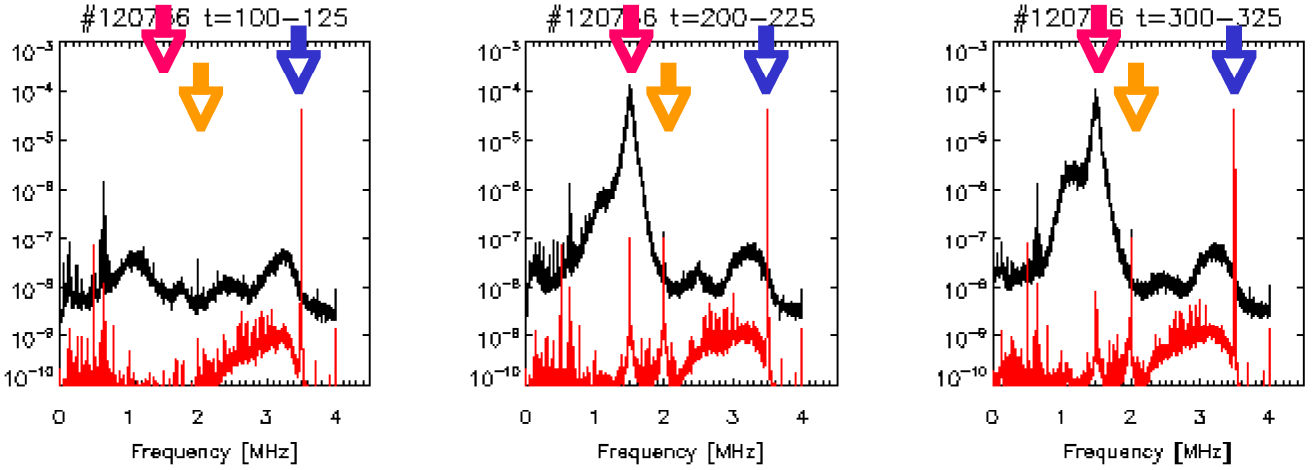






Noise/Pickup (A. Ejiri)

f_{IF}=28.5MH



3.5MHz:Aliased IF(28.5MHz)

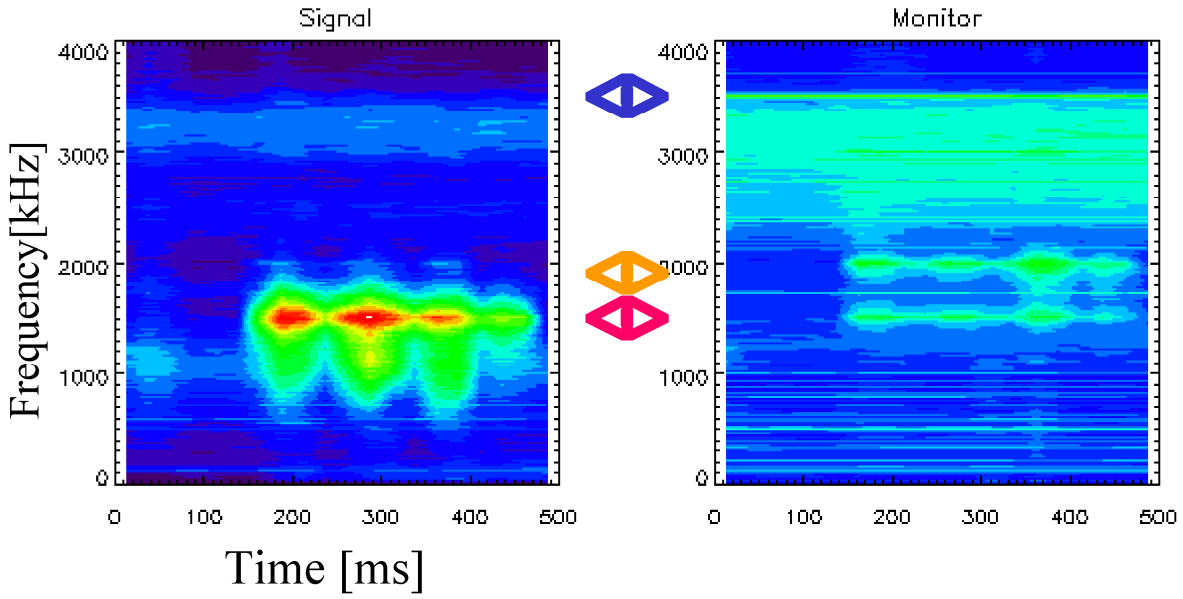
It is strong in 'mon', but also in 'signal'. Very narrow spectrum.

2MHz:Aliased 30MHz

Direct RF pickup. Narrow, but some broadening

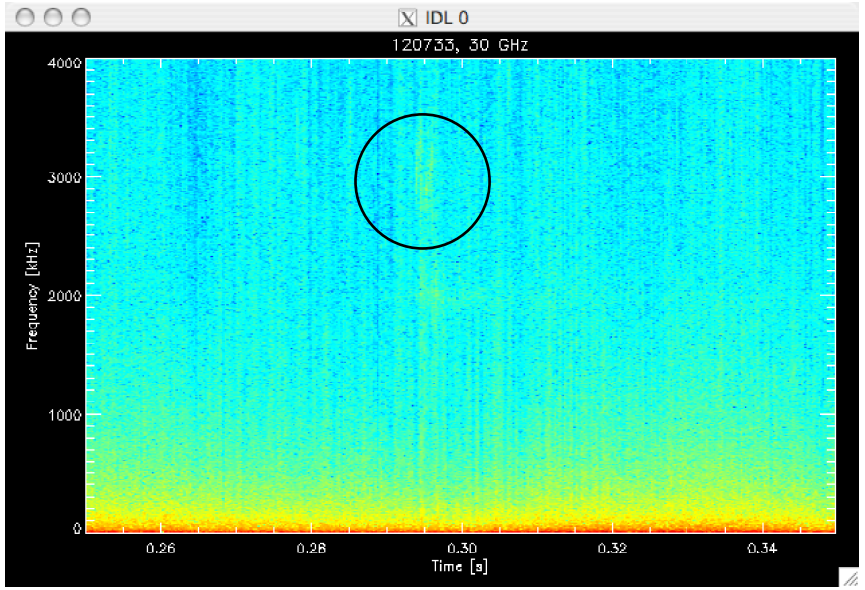
1.5MHz:Target RF

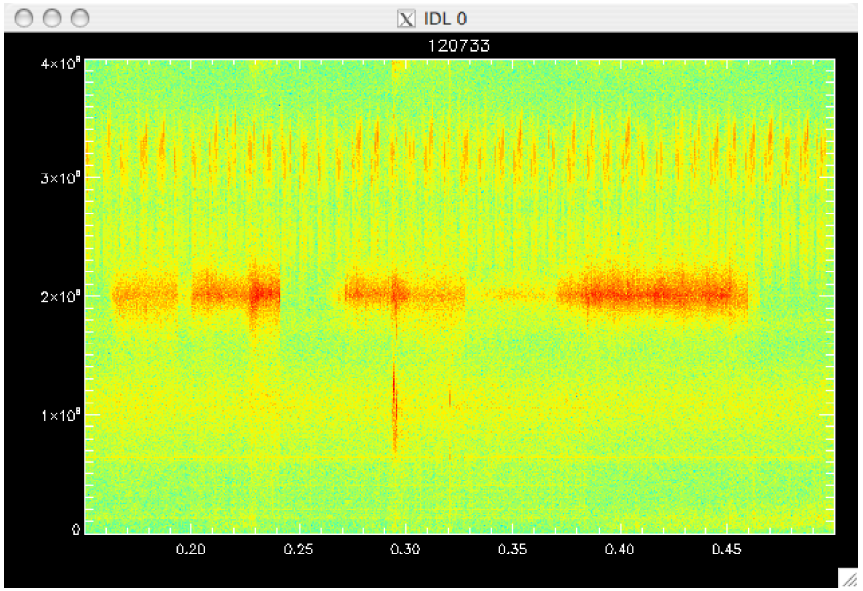
It also appears in 'mon', which means source modulation or contamination of 'signal' into 'mon' via unexpected microwave path.

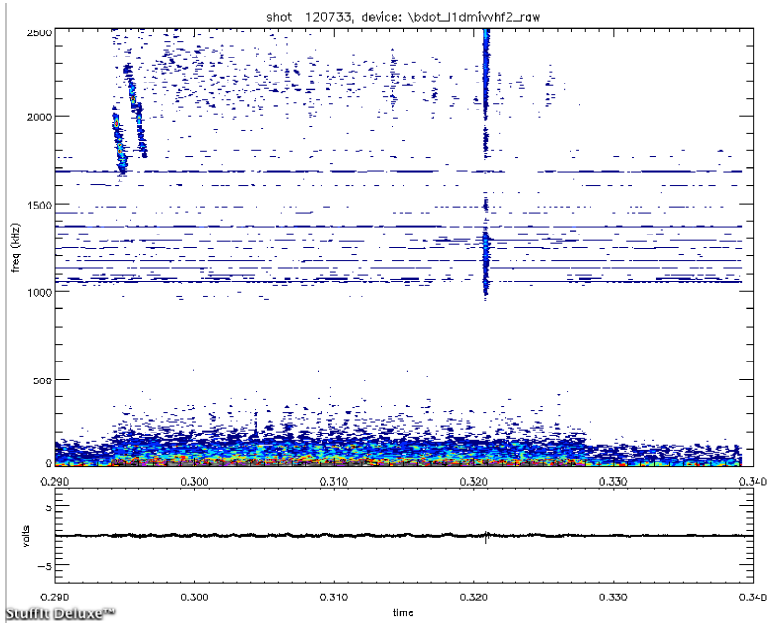


Summary and Future Work

- **Signal characteristics:**
  - Broad turbulence spectrum.
  - Typically asymmetric.
  - Broad offset sidebands.
  - Coherent chirps.
- **Future work:**
  - Modifications to estimate $\delta\varphi$.
  - Multiple channels?
  - Further noise checks.
  - Scattering of HHFW by fluctuations.







2. Fast Profile Reflectometry & 3. Correlation Reflectometry

- **For FY06 and onward:**
  - Time-resolved poloidal and radial correlation measurement capability. **Radial propagation, poloidal correlation lengths, dn/n and flows.**
  - Quantitative estimates of **radial structure and amplitude** of Alfven eigen-modes. Combination of multiple quadrature systems to use single pair of midplane horns. Boost repetition rate of profile reflectometers.
  - Improved time response for 1 mm interferometer (use of heterodyne).
- **Correlation measurements:**
  - Asked to forgo installation during early April maintenance week.
  - In mid-May asked to install system.
  - Essentially no data this run year. (~3 days). Diagnostic check.
  - Signals look excellent.
  - XP-439, XP-506, etc. incomplete.
  - Diagnostics, code, manpower was in place to make substantial progress.