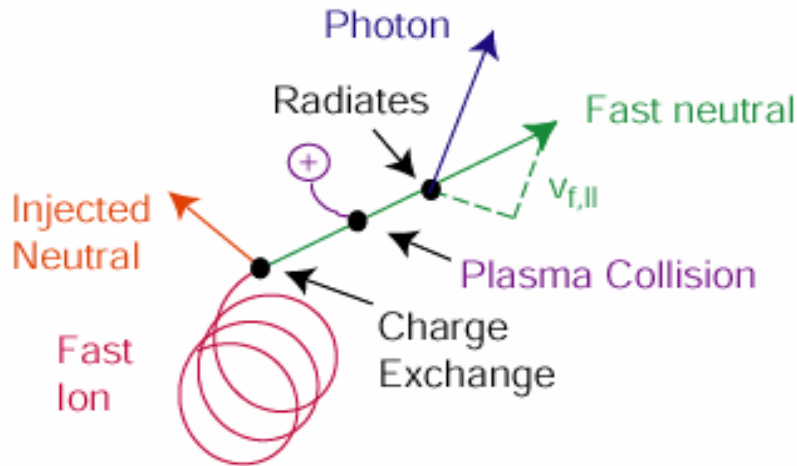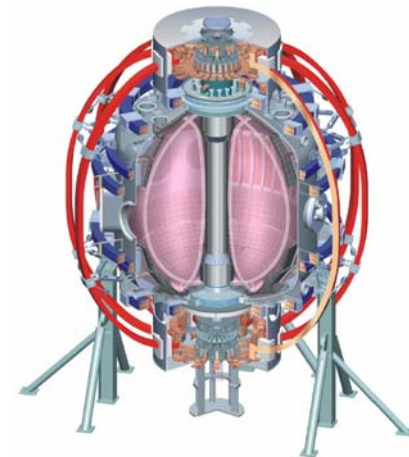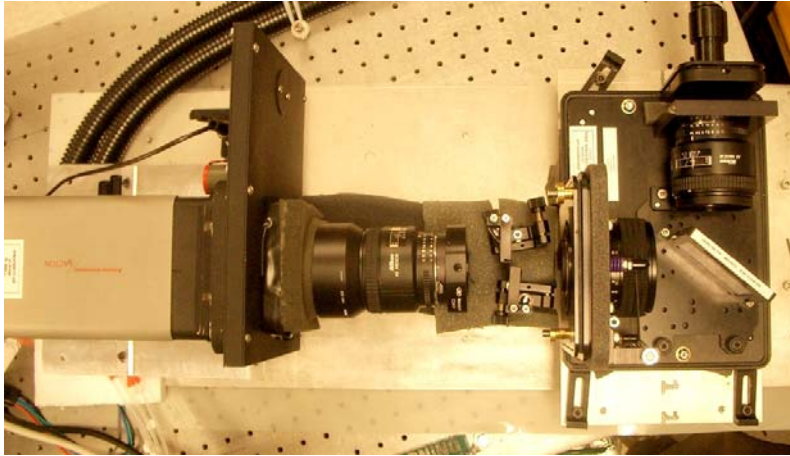# FIDA Diagnostic Checkout (XMP-54)

W. Heidbrink, R. Bell, R. Feder,
D. Liu, M. Podestá, E. Ruskov

Goal: Make MHD-quiescent discharges with beam modulation to confirm the validity of the new fast-ion D-alpha (FIDA) diagnostics.

PPPL
PRINCETON PLASMA
PHYSICS LABORATORY

UCIrvine
University of California, Irvine

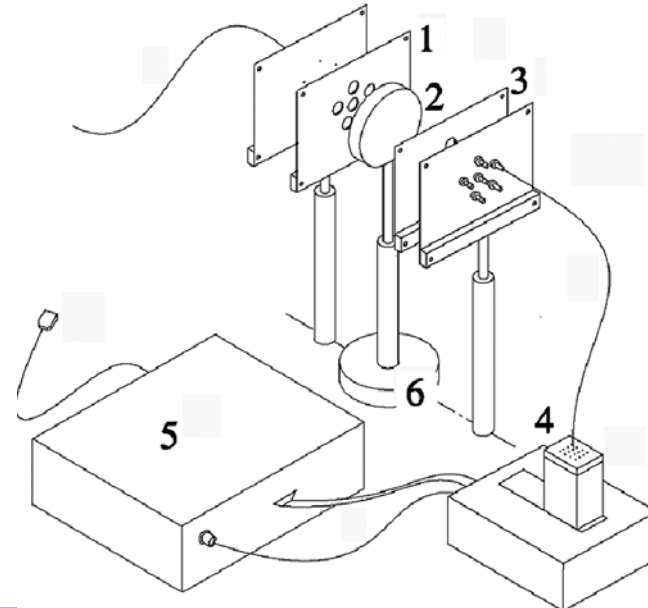# FIDA Instruments: s-FIDA (spectra) & f-FIDA (bandpass)

s-FIDA

- 16 spatial channels
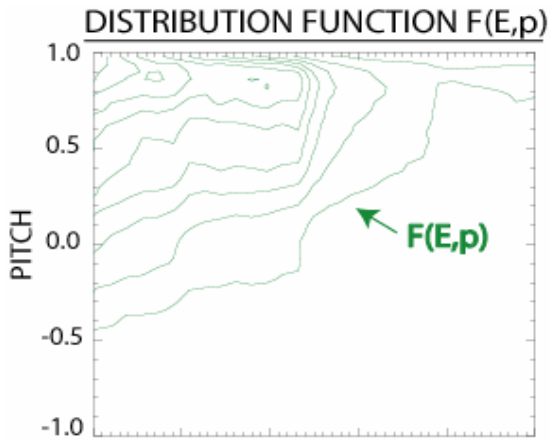- 10-ms temporal resolution
- Spectrometer & CCD camera

f-FIDA

- 3 spatial channels
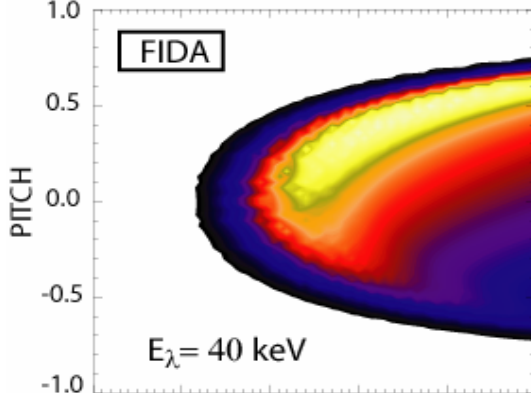- ~0.1-ms temporal resolution
- Bandpass filter & PMT

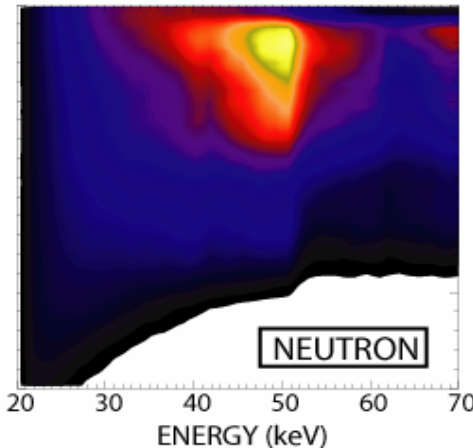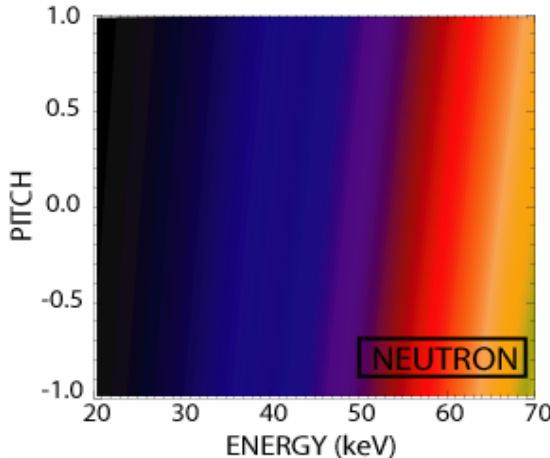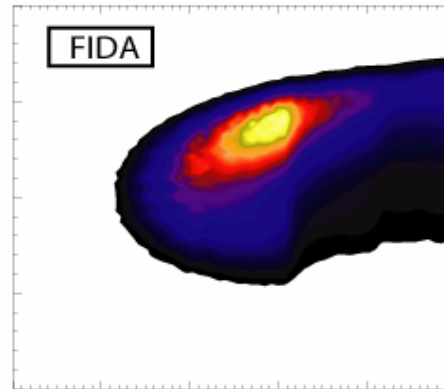Both instruments have active (Bay A) and passive (Bay B) vertical views.

The FIDA signal is a weighted average in velocity space

DISTRIBUTION FUNCTION F(E,p)

WEIGHT FUNCTION W(E,p)

FIDA

$E_\lambda = 40$ keV

NEUTRON

CONVOLUTION W*F

FIDA
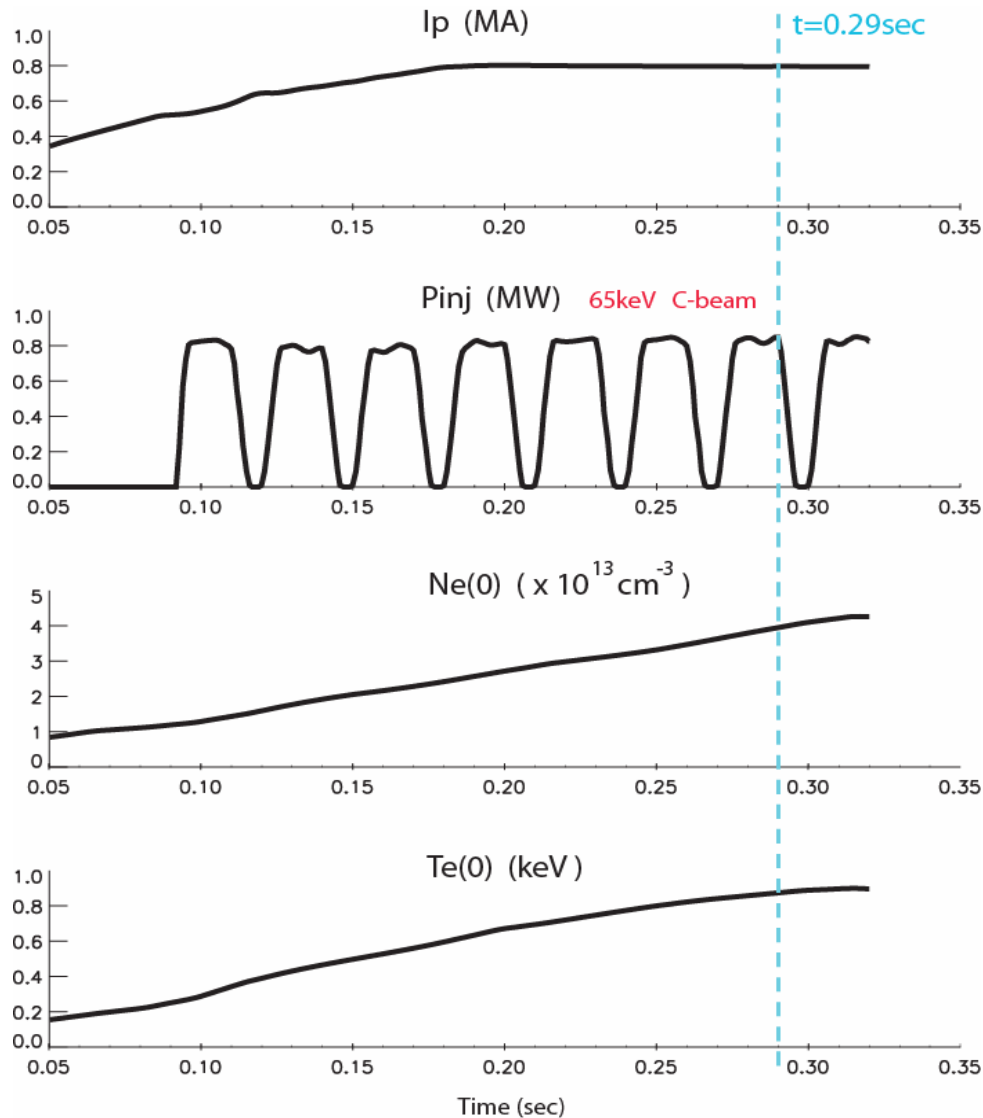
NEUTRON

- Only one component of the velocity causes the Doppler shift

- A particular Doppler shift is associated with a weight function in velocity space

- Call "E_λ" the Doppler shift of a neutral that heads straight toward the fiber

Most XMP shots used modulated, derated NBI

t=0.29sec

Ip (MA)

Pinj (MW)   65keV C-beam

Ne(0) (x 10^{13} cm^{-3})

Te(0) (keV)

Time (sec)

- Two forms of background subtraction: active - passive vs. "beam-on" - "beam-off"

- 65 keV to avoid MHD → compare with TRANSP fast-ion distribution function

Measured Spectra Make Sense
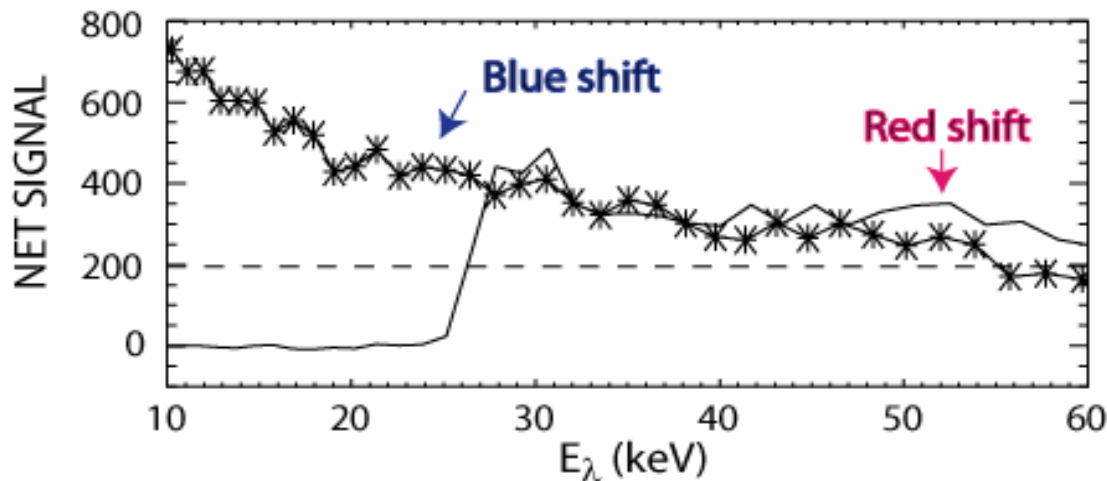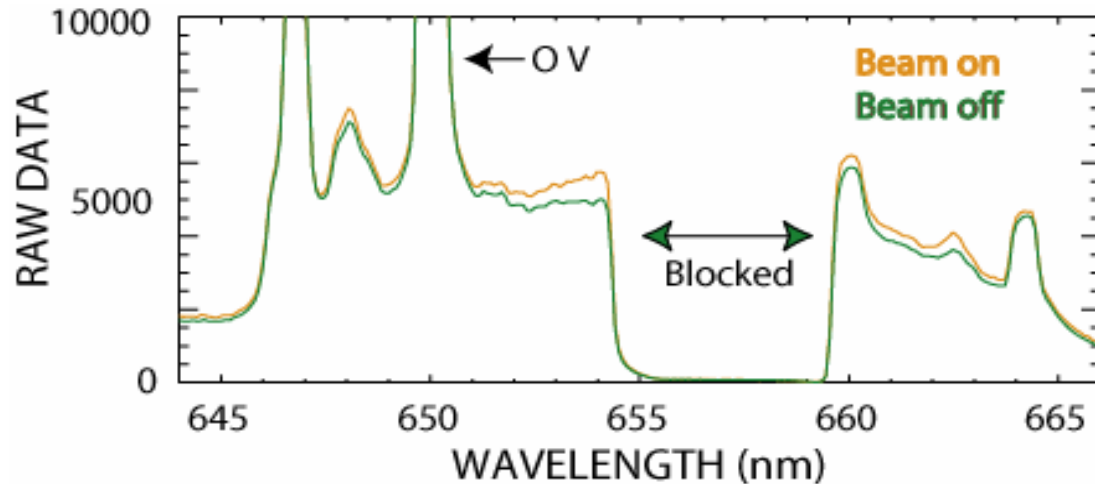
- Background of impurity lines, visible bremsstrahlung, and scattered cold & injected neutral light

- Net signal appears at the expected wavelenths

- As expected for vertical views, the blue-shifted and red-shifted spectra are similar.

# Bandpass-filtered Difference Signals Are Reasonable
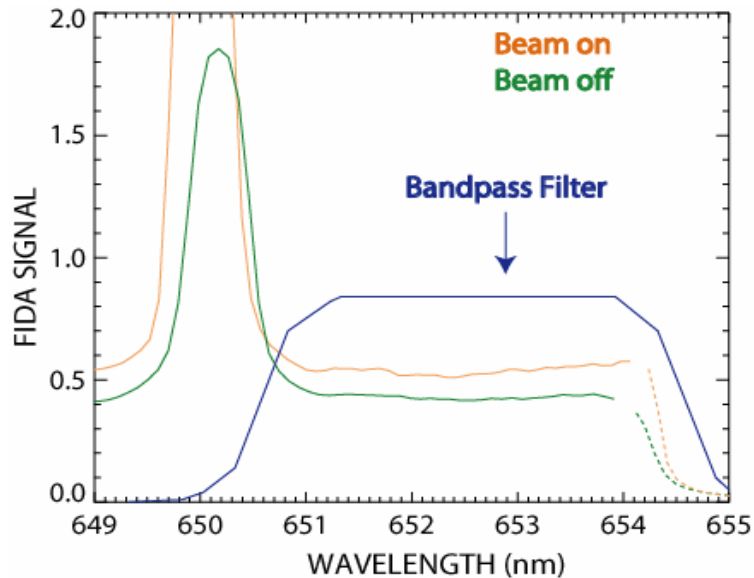
- The spectral measurements show that the bandpass filter is well positioned to measure the FIDA light

- Backgrounds are a significant fraction of the signal

- The net signal modulates with the neutral beam.
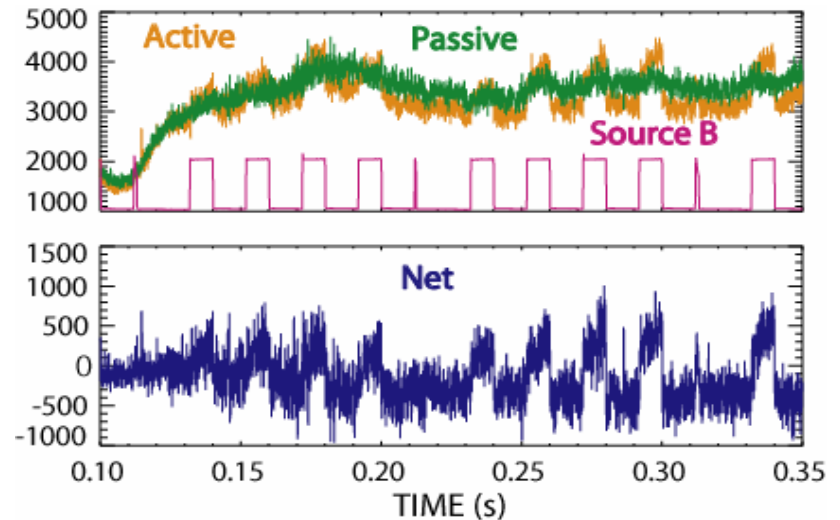
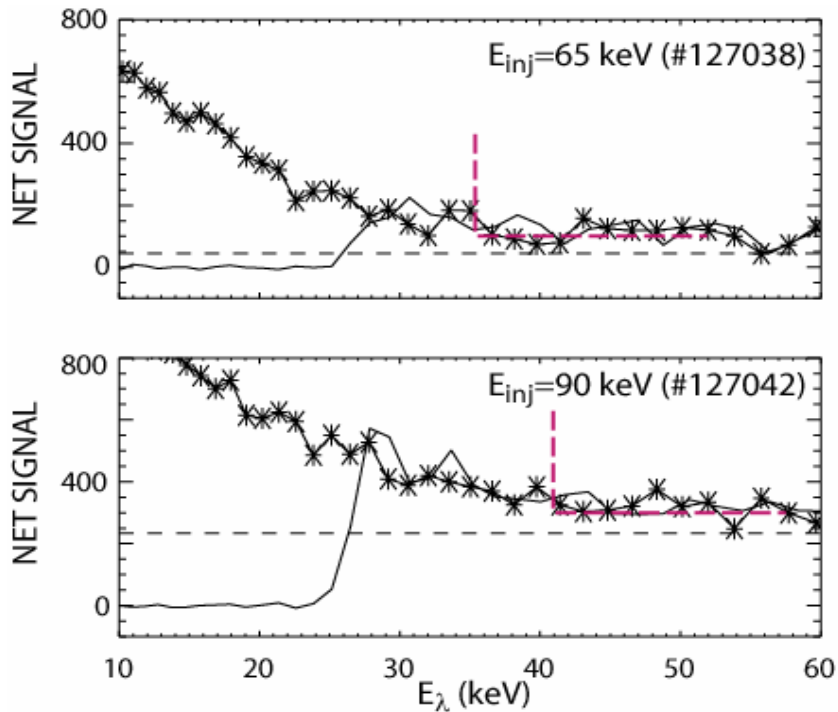# Two background subtraction methods fairly consistent

(a) sh#127038

(b)
- active, beam ON
- active, beam OFF
- passive views
- CII line

(c)

(d)
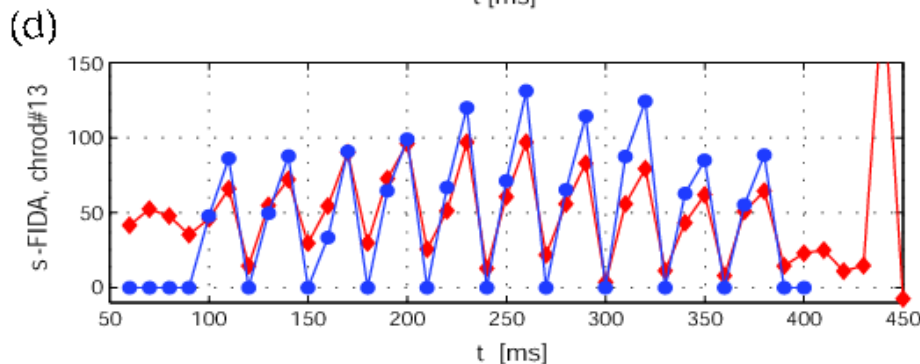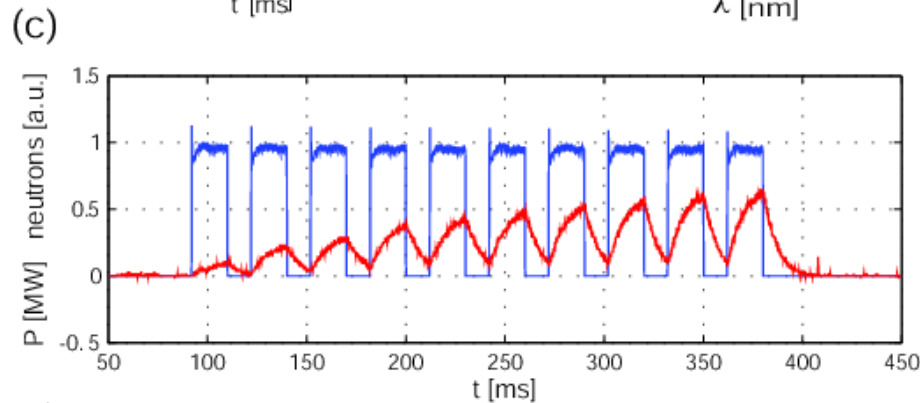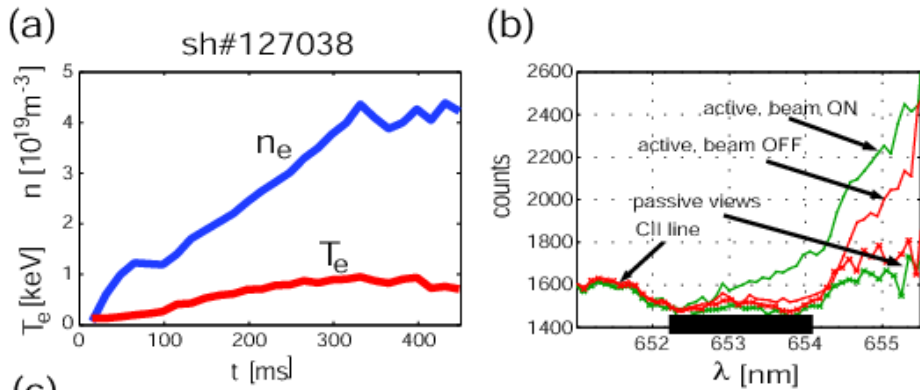
- **Red from passive (Bay B) view**
- **Blue from beam modulation**
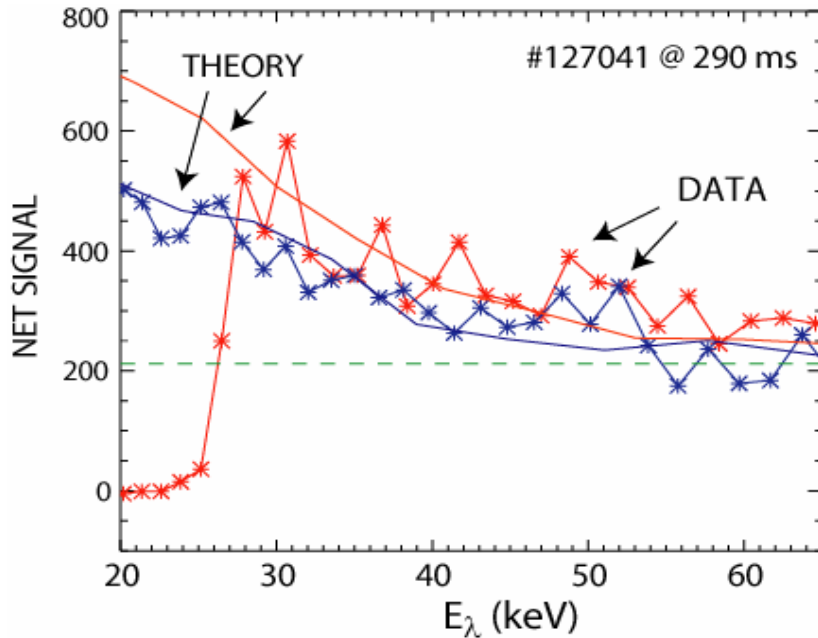- BUT…some offsets are still poorly understood

The Doppler shift increases with increasing injection energy

- Changed voltage on sources between shots

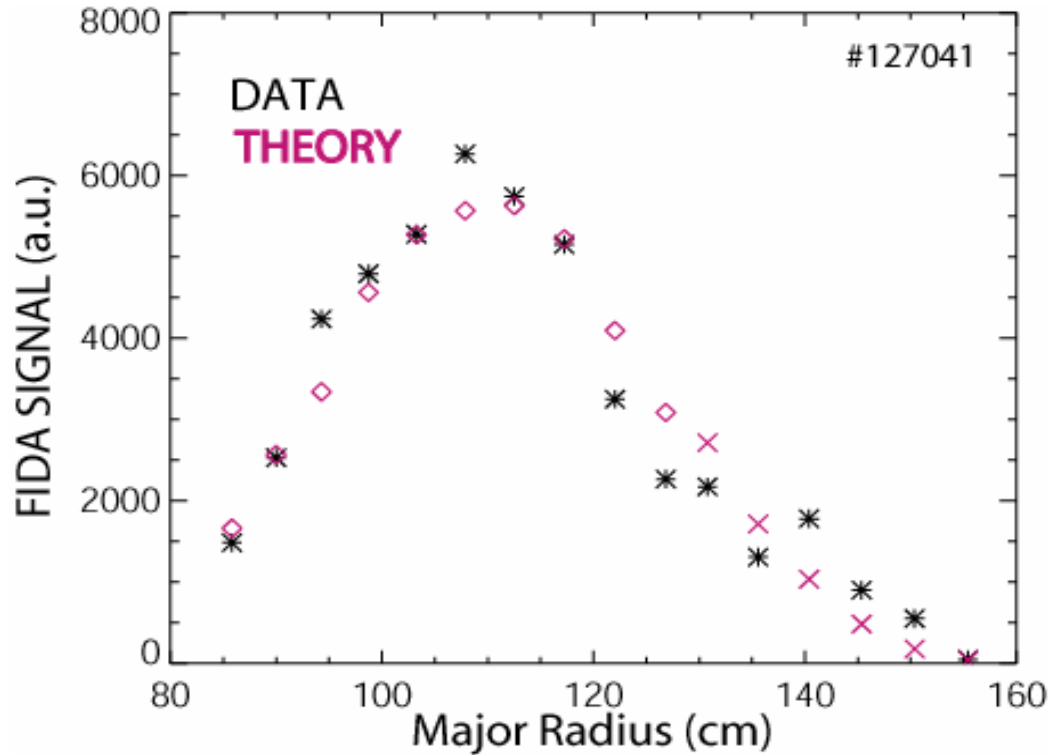- Source A comparison shown here

Initial Comparison with FIDA simulation code: Spectral shape OK

- Modified FIDA simulation code for use at NSTX (& elsewhere)

- Measured spectral shape appears consistent with theory

Initial Comparison with FIDA simulation code: Spatial Profile OK?

- Graph looks great but …

- No intensity calibration of data yet (this week)

- Theory has an unexplained jump (that I normalized away) between diamonds and crosses

Conclusions

- Spectra, spatial profile, time evolution, and background subtraction are generally reasonable.

- XMP was extremely valuable.

- Overall, for first year, both instruments worked great.

- But…we still have plenty to sort out by APS.