Fast Ion Absorption of the High Harmonic Fast Wave in NSTX

NSTX Results Review

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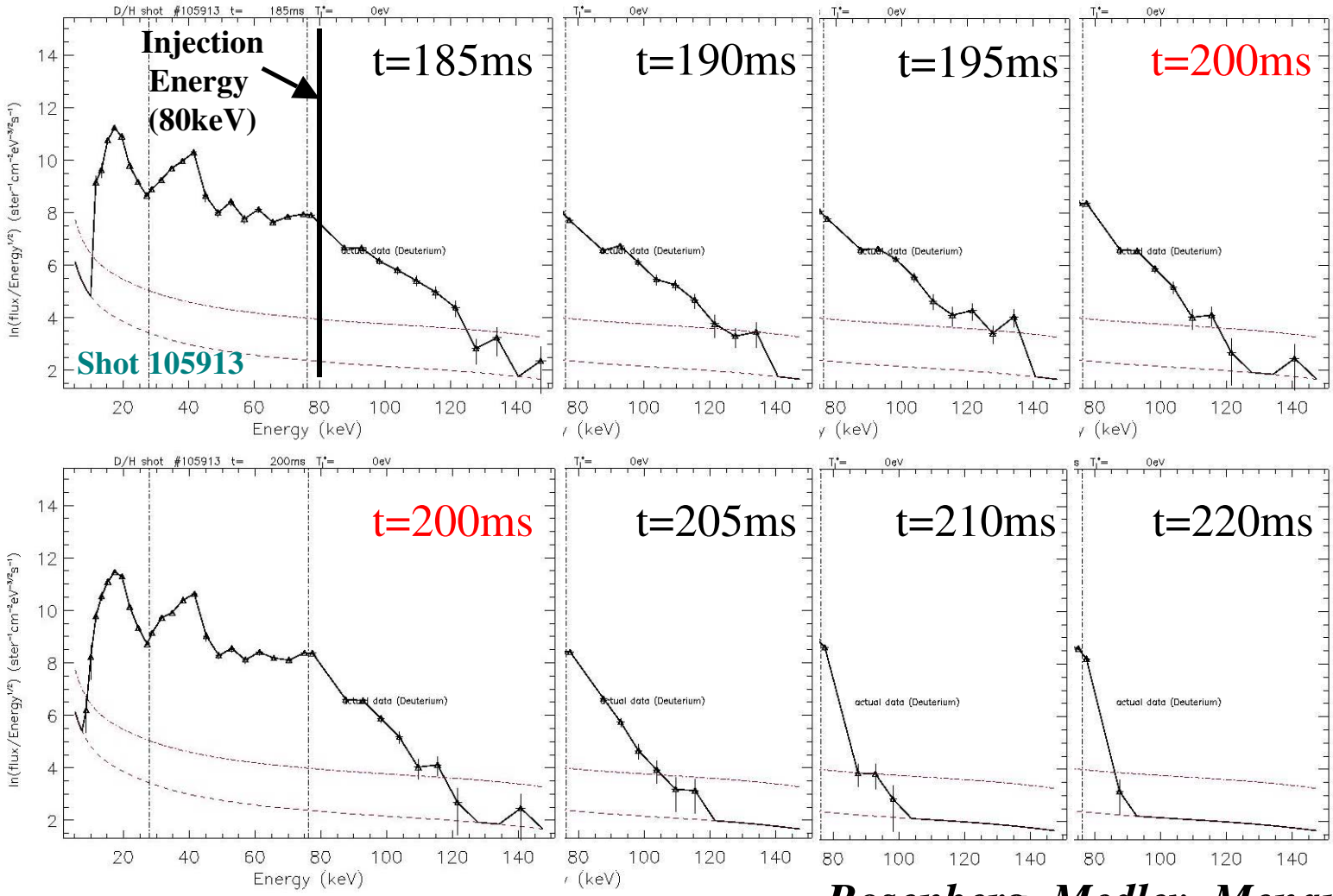
NPA shows fast ion tail build-up and decay

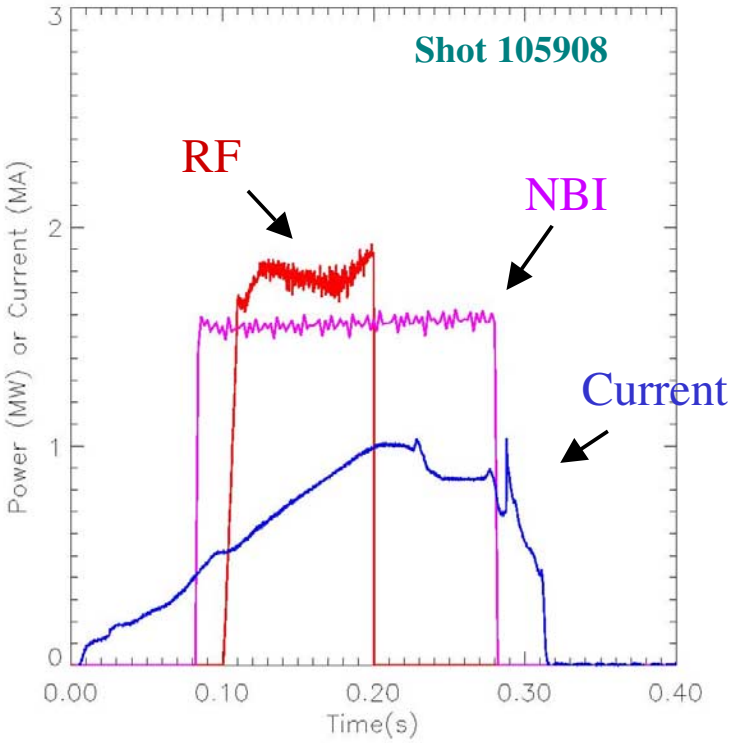
- HHFW turns off at t=200ms
- NBI Source A on throughout

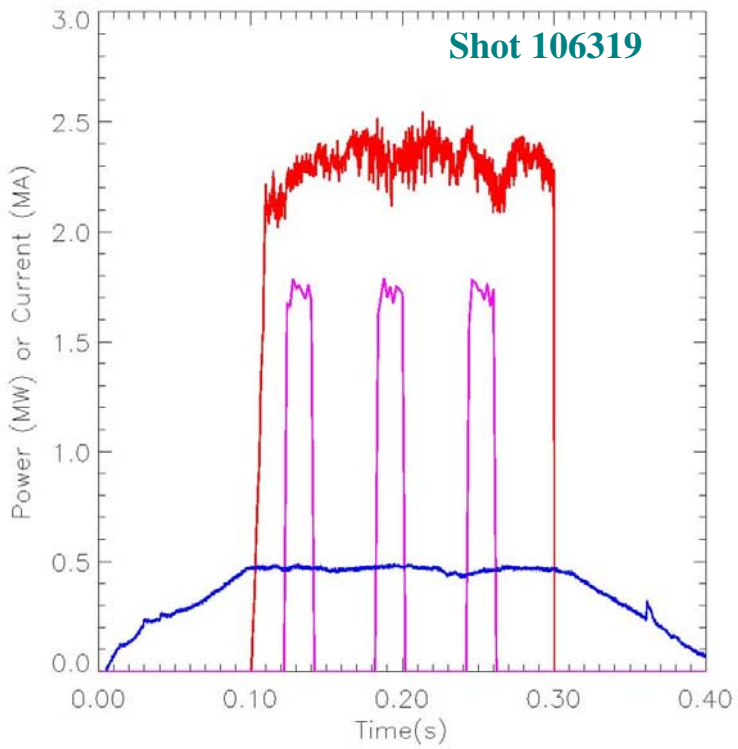
- D^+ tail extends to 140keV
- Tail saturates in time during HHFW



Rosenberg, Medley, Menard

Current, RF, and NBI Power Traces

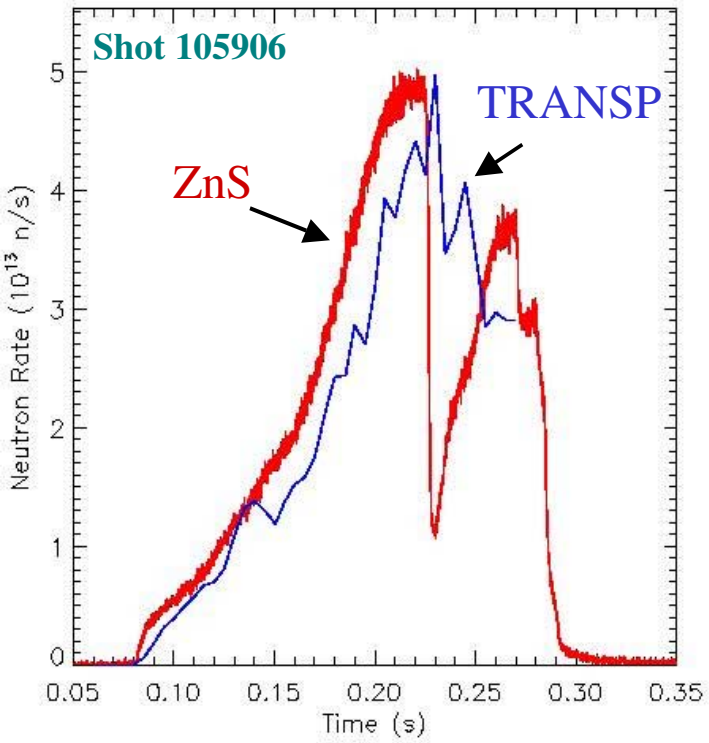




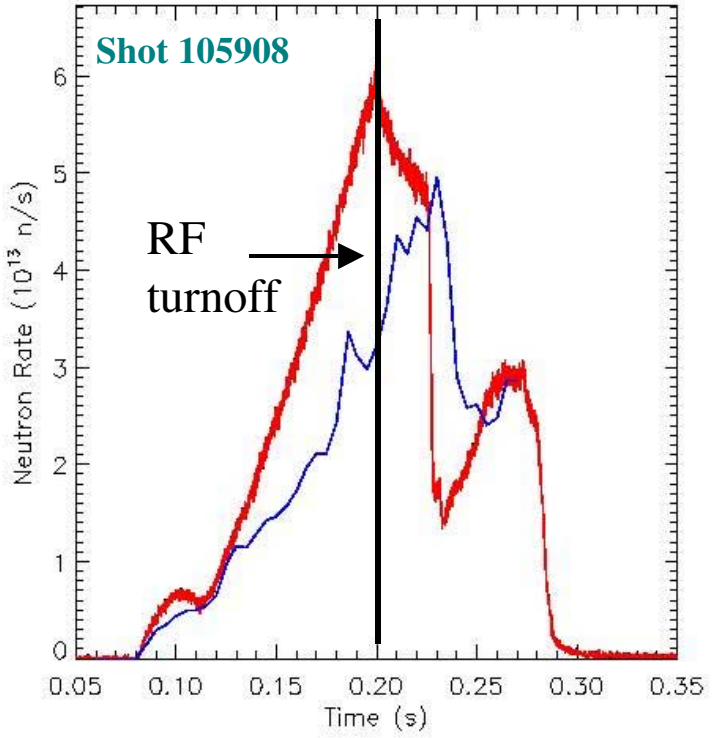
- Two sets of shots investigated
- $B_T(0) \approx .45T$, $\beta_t < 7\%$ while RF on

Measured vs. Predicted Neutron Rate

No RF



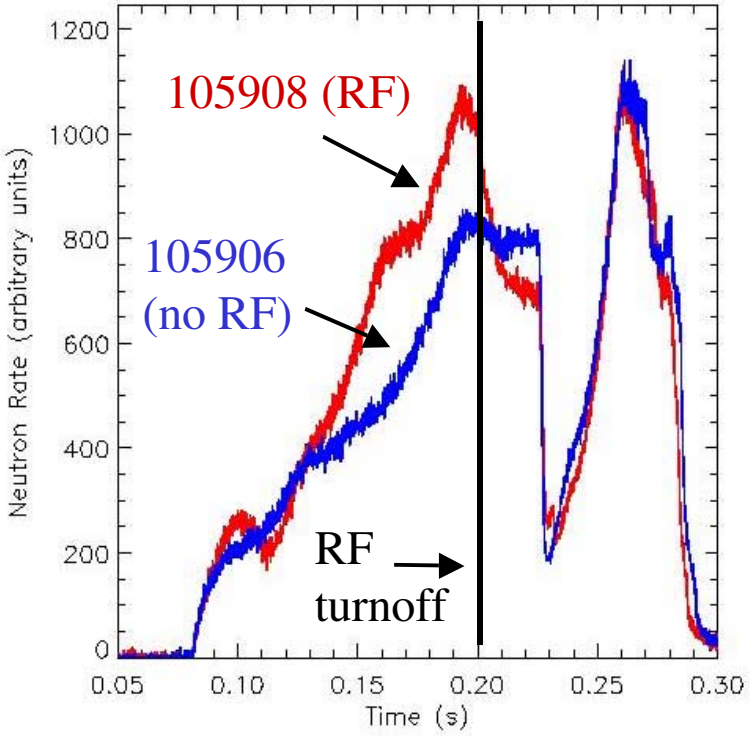
RF



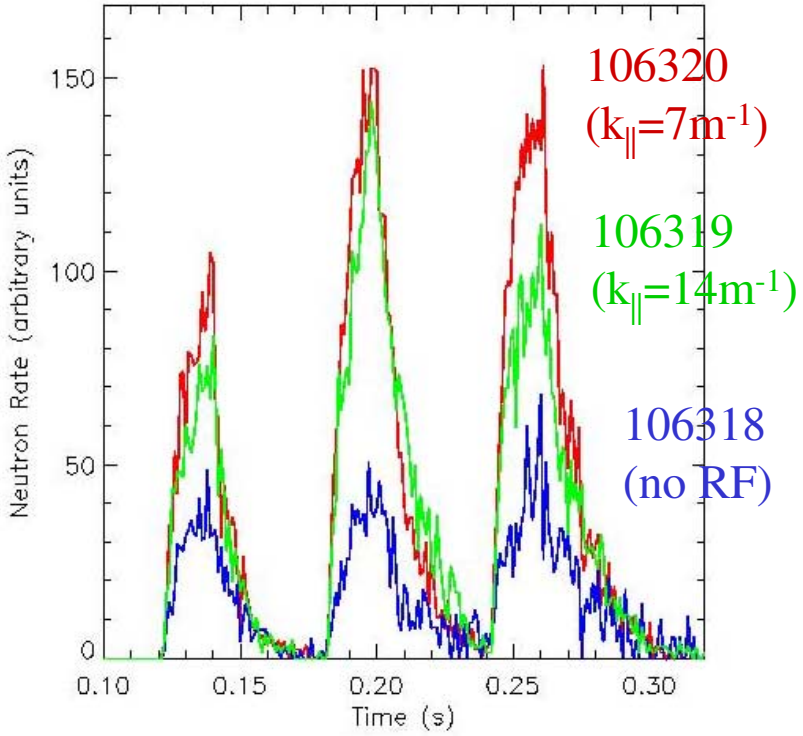
- TRANSP neutron rate predictions without RF input fall shorter than measured rate for RF shot
- After RF turnoff, rate decays to predicted value

Comparison of Density Normalized Neutron Rates

Zeff, Central e⁻ Density Normalized

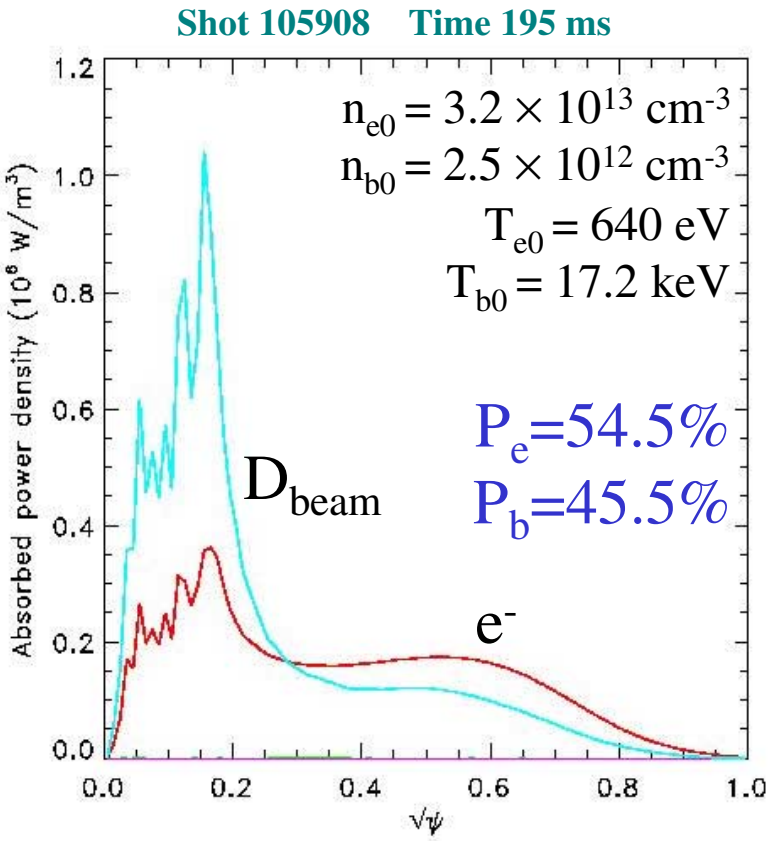


Central e⁻ Density Normalized



- Central e⁻ density determined from interpolation of Thomson data
- After RF turnoff, rate decays close to no RF value
- Enhanced neutron rate with RF on, lower $k_{||}$

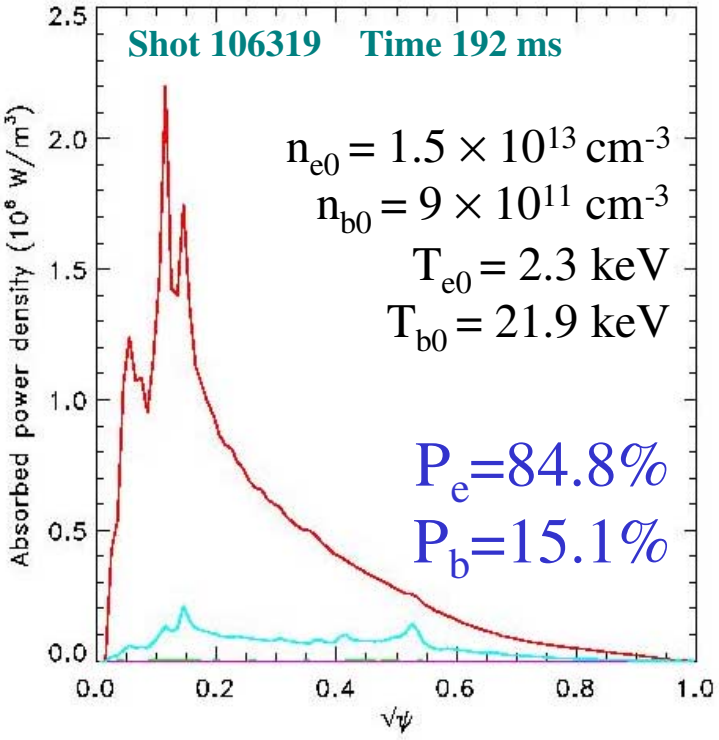
Ray Tracing Predicts Significant Fast Ion Absorption



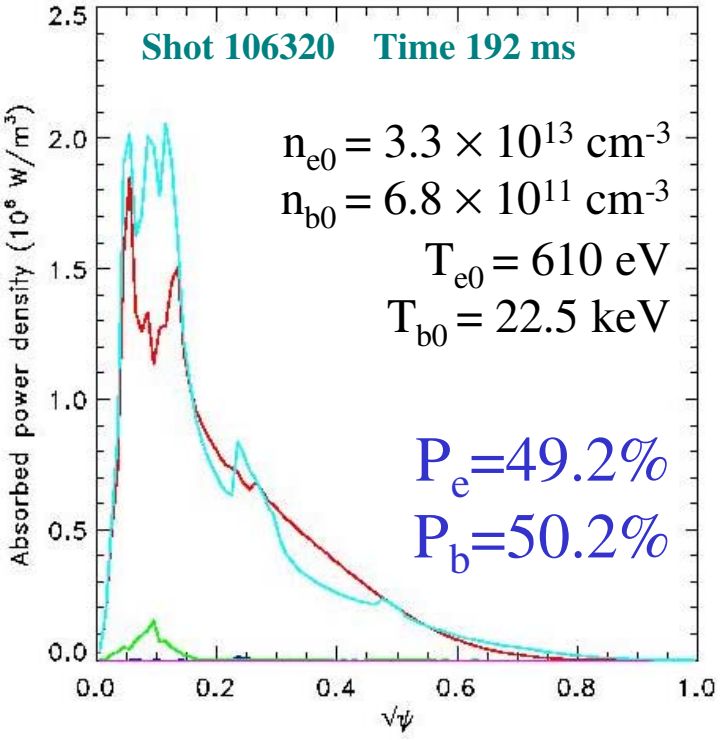
- HPRT computes hot plasma absorption over cold ion/hot electron ray path
- 25 rays used
- TRANSP output used as input for fast ion temp and density distribution
- Total power evenly split
- Fast ions dominate central absorption
- Electrons dominate further off-axis

Power Absorption vs. Antenna Phasing

$k_{\|} = 14\ m^{-1}$

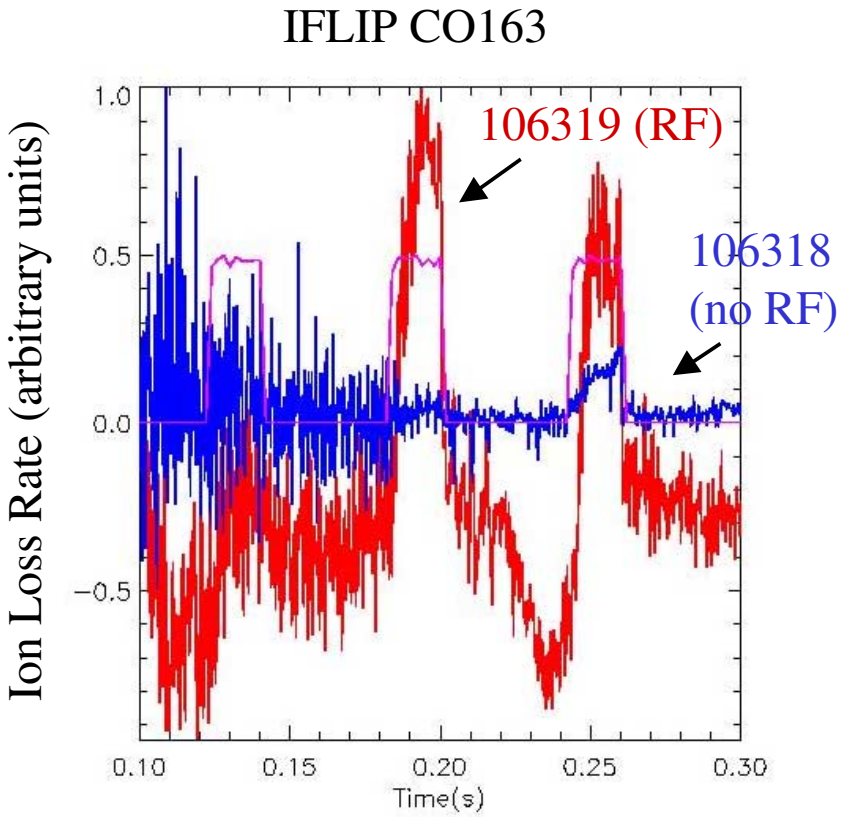


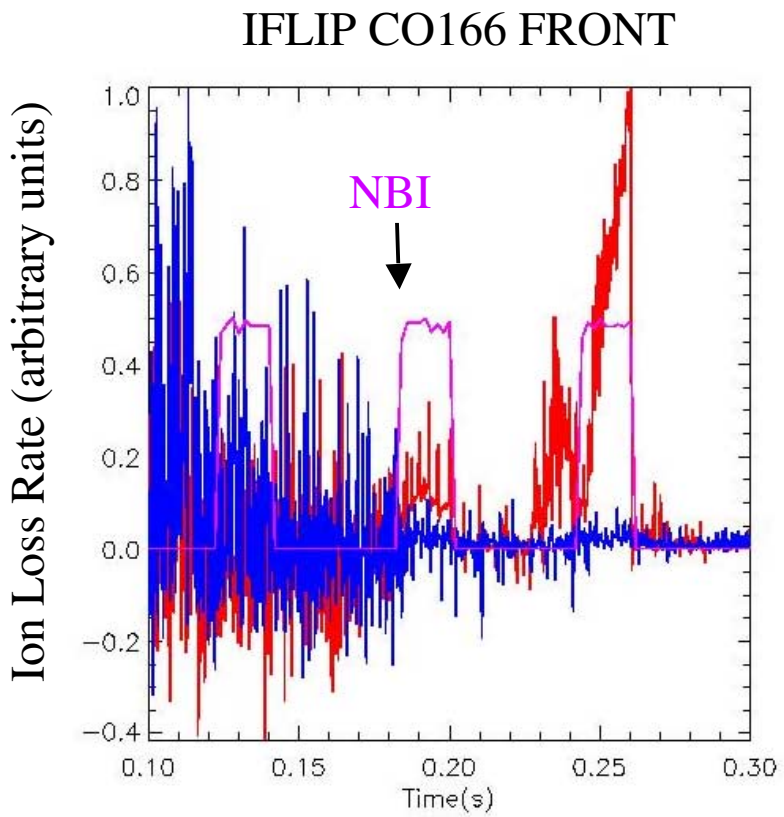
$k_{\|} = 7\ m^{-1}$



- n_{b0}/n_{e0} 3 times lower for low $k_{\|}$ shot, yet beam ion absorption and neutron rate higher

Fast Lost Ion Probe (IFLIP) Measurements





- Greater ion loss signal observed for last two beam blip with RF on
- CO163 at R = 163 cm

Summary

- NPA sees enhanced fast ion tail at 140 keV that drops down to beam energy at expected rate upon RF turnoff
- Measured neutron rates vs. predicted higher with RF on
- Normalized similar RF vs. no RF shots indicate significant enhancement with RF
- Ray tracing predicts heavy fast ion absorption with neutral beams on
- Fast Lost Ion Probe signal increased with RF on