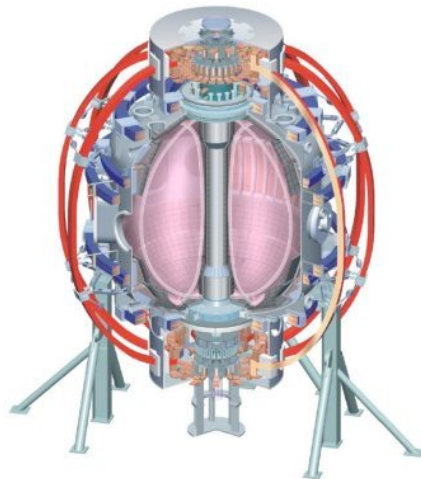


Observation of an ‘Anomalous’ High-Energy Feature on Energetic Ion Spectra in NSTX using the E||B Neutral Particle Analyzer

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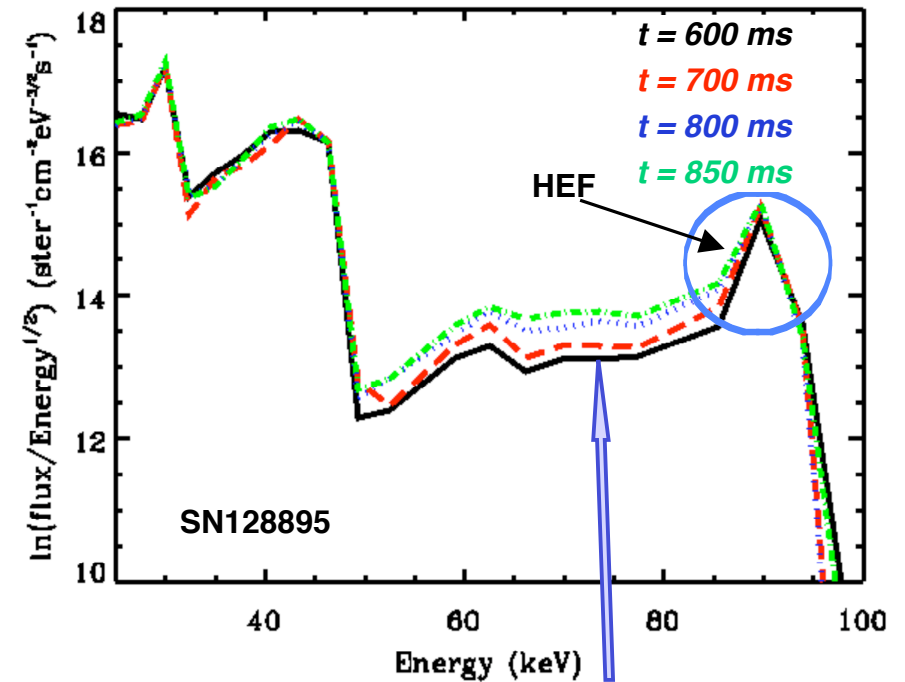
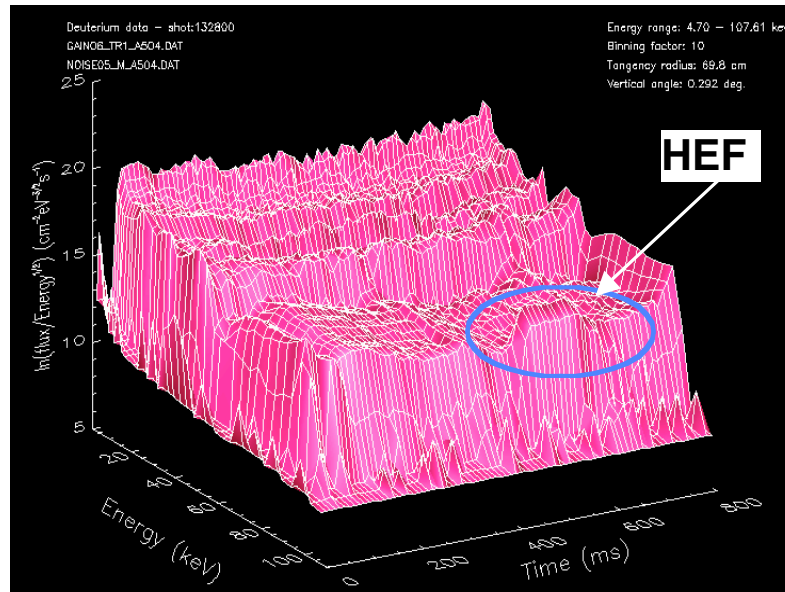
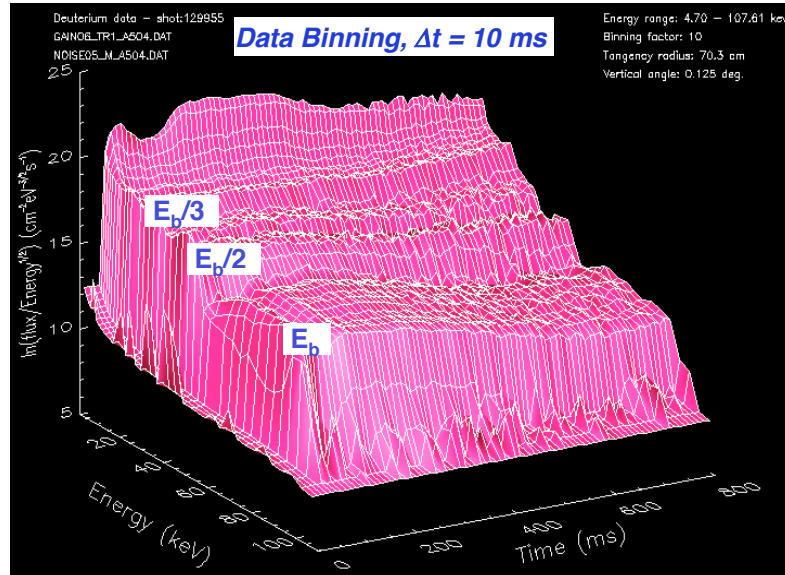


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Illustration of the High-Energy Feature (HEF)

H-modes: $I_p = 0.9$ MA, $B_T = 4.5$ kG, AB&C @ 90 keV, $P_{NB} = 6$ MW, $n_e L \sim 6.6 \times 10^{13}$ cm⁻²



- A **strong slowing down spectrum** of fast ions evolves from the HEF energy region.

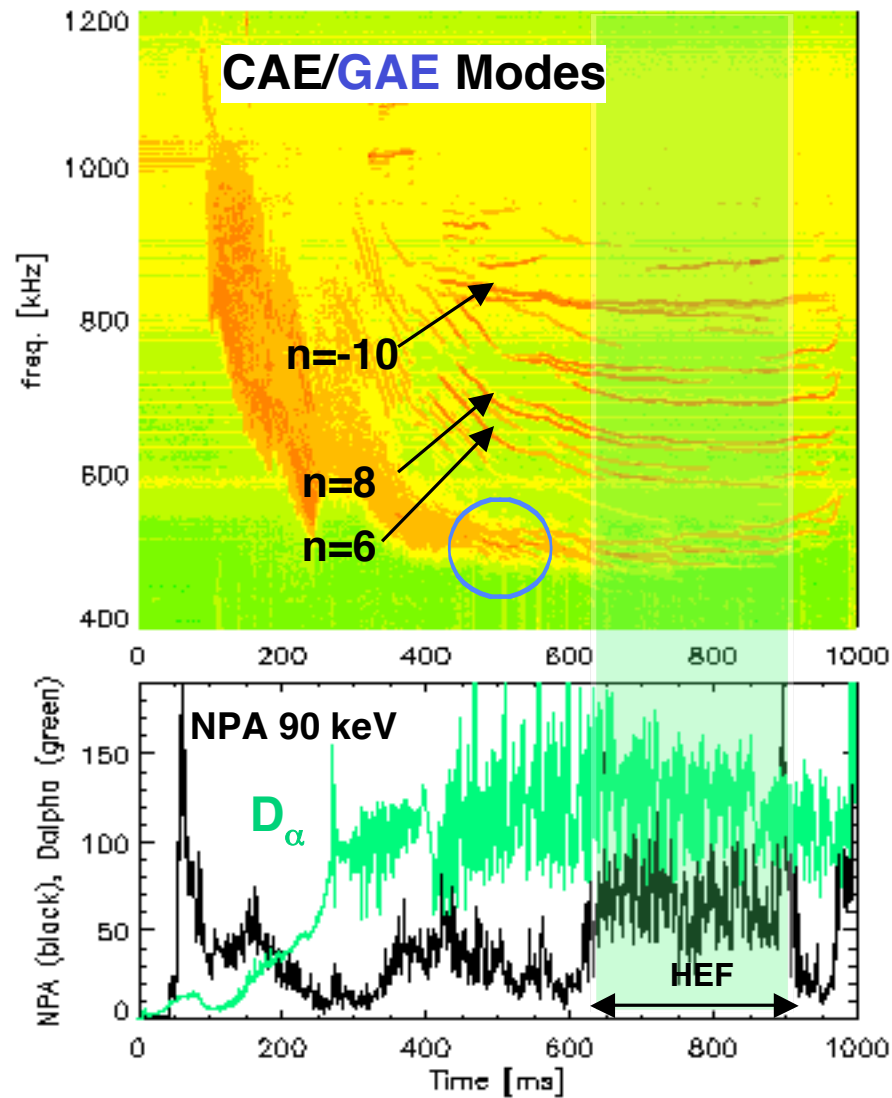
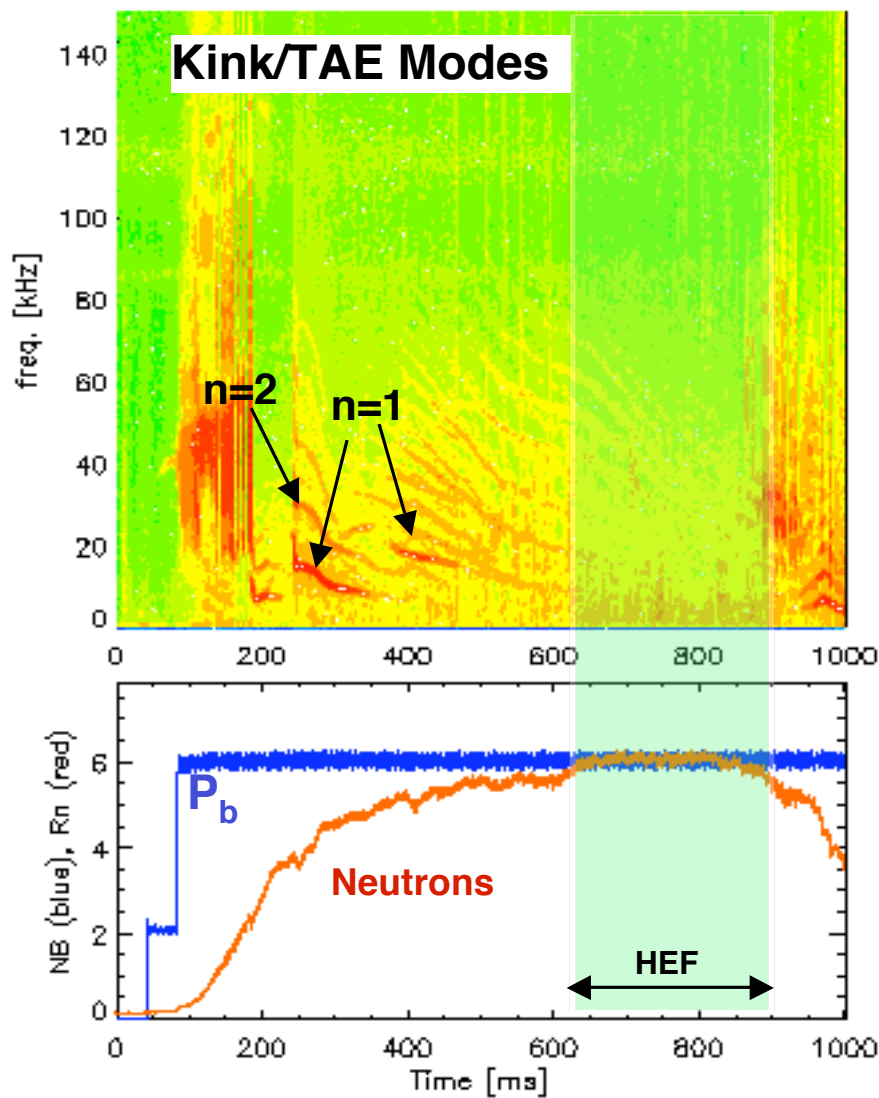
- HEFs observed for mid-plane NPA $R_{tan} \sim 55$ - 86 cm corresponding to $v_{||}/v \sim 0.7$ - 0.9 (but no horizontal/vertical scan data exist).

- HEFs are not a NPA instrumental effect.

HEF Existence Requires Feeble Kink/TAE MHD Activity

- no MHD 'chirping' is observed on Mirnov signals during HEF interval

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Some 'Factoids' Related to Observation of HEFs

- Only observed during H-mode discharges (never in L-modes).
- Not observed in the presence of n=1 kink modes and/or robust ($\delta B_{\text{rms}} > 75$ mGauss) TAE activity.
- HEFs can 'turn-on' and 'turn-off' multiple times during a discharge, in 'counter-sync' with occurrence of < 140 kHz MHD activity.
- Onset of the HEF is not 'abrupt' but exhibits a growth time of $\sim 20 - 60$ ms.
- Not observed for $P_b < 4$ MW (even during brief P_b notches to lower power).
- The magnitude of the HEF flux is modulated by strong bursting MHD EPM activity or "avalanches", just like the normal slowing down ion distribution.
- HEFs are suppressed by robust LITER operation (e.g. $> 50-100$ mg/shot).

Future Work

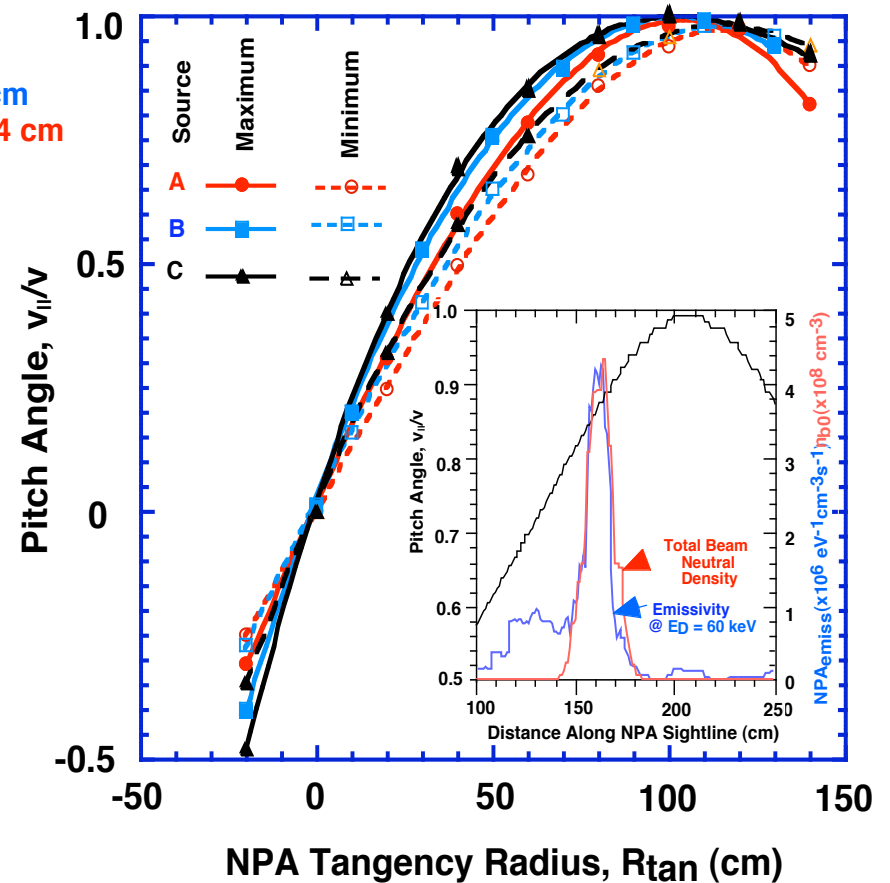
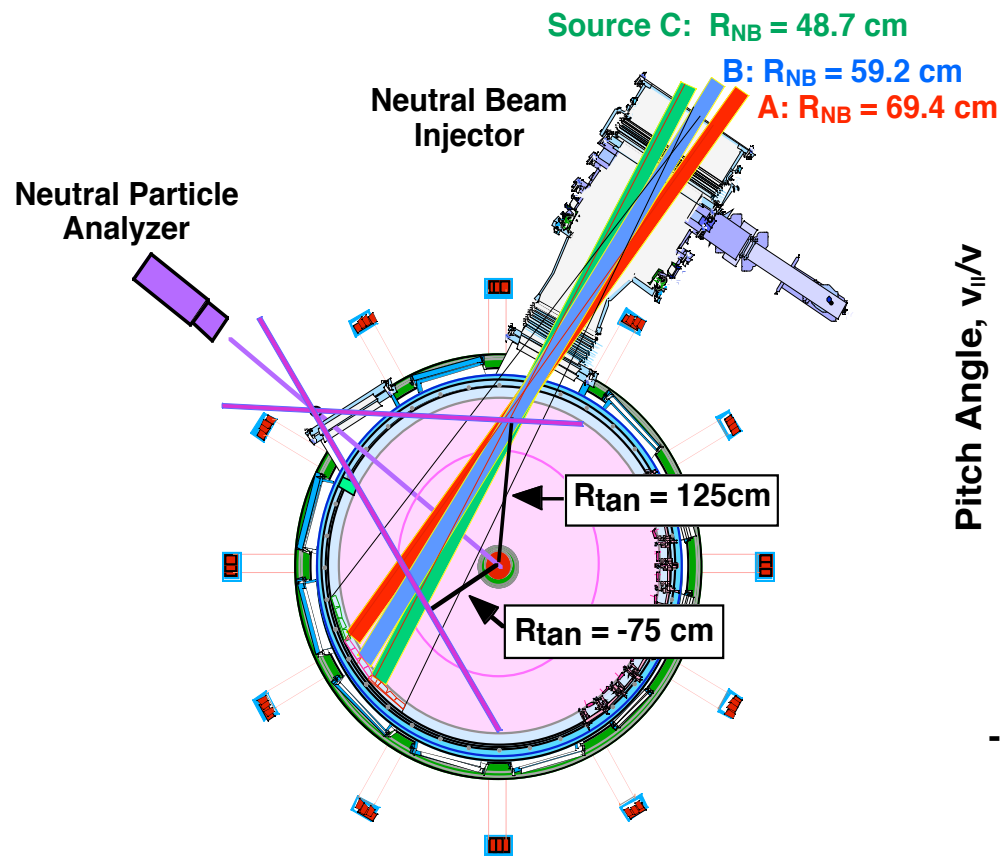
Dedicated XP for Exploration of the High-Energy Feature(HEF): Total ~ 34 Shots

- **Does the HEF depend on NB energy, E_b ?**
 - E_b scan with ABC @ 100, 90, 80, 70 keV
(Fiducial + 3 shots...Lithium free)
- **Does the HEF depend on NB sources?**
 - Select E_b from above scan: run with AB, AC BC (need $P_b > 4$ MW)
(3 shots)
- **Does the HEF occur with NB sources @ mixed E_b ?**
 - For example, A @ 100 keV, B@ 90 keV, C@80 keV (3 shots for permutations)
- **Horizontal and vertical NPA scans with all NBs at a selected E_b**
 - Hscan requires ~ 12 shots and Vscan ~ 8 shots (20 shots)
- **Does Lithium suppress HEFs?...use a robust scenario from above**
 - LITER deposition @ 50, 100, 150, 200 mg/shot (4 shots)



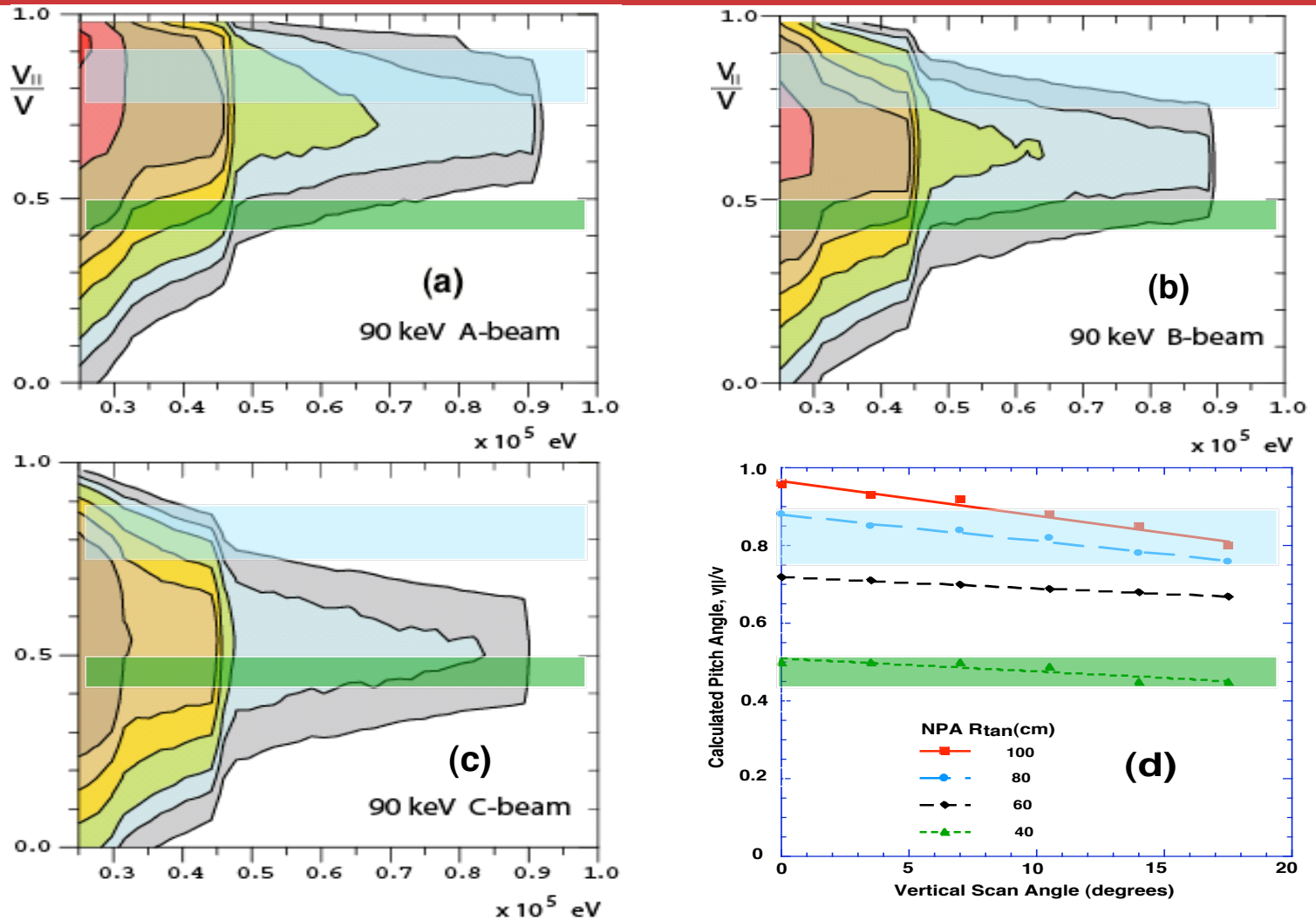
Backup

The Neutral Particle Analyzer (NPA) on NSTX Scans Horizontally Over a Wide Range of Tangency Angles on a Shot-to-Shot Basis



- Intersection of the NPA sightline with beam neutrals (primary and halo) localizes the charge exchange flux measurement in space and field pitch, $v_{||}/v$.

The Field Pitch, $v_{||}/v$, Viewed by the NPA Depends on Both the Horizontal and Vertical Sightline Setting



- For 'standard' values of the NPA $R_{tan} \sim 70 - 80$ cm, $v_{||}/v \sim 0.80 \pm 0.1$ (blue bar).