FIDA Blue/Red Shift XMP

Motivation: Resolve discrepancy between FIDA & FIDA simulation code in special quiet plasmas so we trust it for instability studies

Goal:

Validate predicted differences between red-shift & blue-shift

Approach: Use low voltage to avoid fast-ion instabilities; modest density (3-4 e13), vary field-line pitch and TF to alter theoretical red:blue ratio; deuterium fill gas

Field Line Helicity Asymmetry

Geometry: B_T is clockwise; I_p is counter-clockwise; FIDA views vertically downward

Beam Population: Nearly all in co-direction

At large major radius, co-going ions come up towards lens → blue shift larger than red-shift

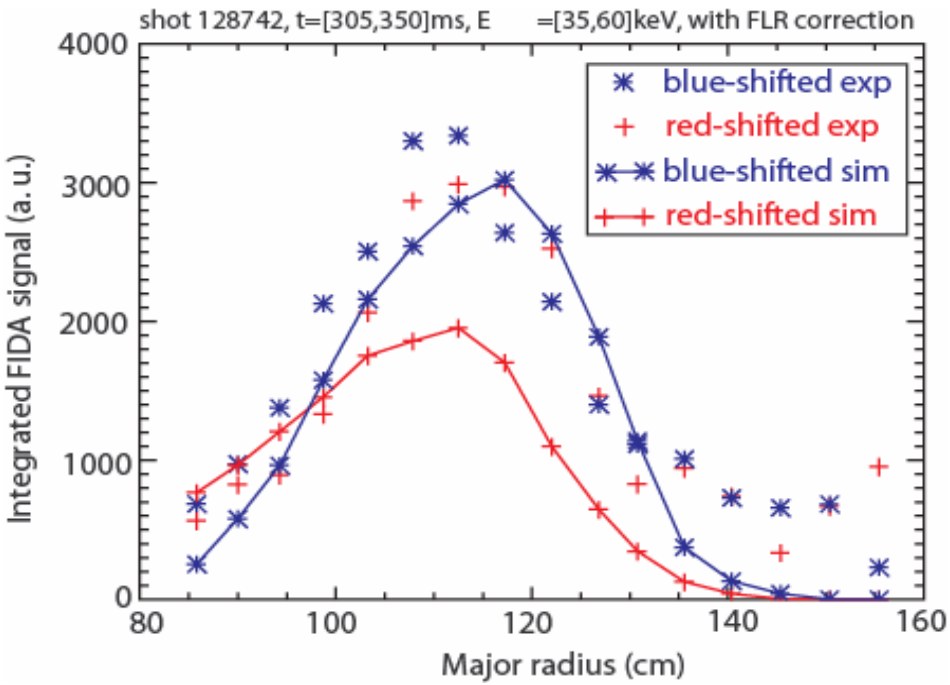
Finite Larmor-radius Effect

Consider a spatially peaked guiding center distribution.

For clockwise B_T, fast ions gyrate downward at large major radius, upward at small major radius

→ red-shifted profile shifts outward (relative to guiding center); red-shifted profile shifts inward

Poor agreement in this comparison



- Predicted blue larger than red (pitch effect)
- Predicted FLR effect opposes pitch effect
- Little difference in experimental red & blue profiles but data quality is poor

Experimental Plan

1. **Baseline Condition** Source B @ 60 keV & 50% duty cycle; I_p=0.8 MA; 5.5 kG, deuterium, 3-4e13 (2 shots); Source A at end for MSE
2. **Toroidal Field Scan** 4.5 kG, 3.0 kG (2 shots)
3. **Plasma Current Scan** 0.5 MA, 1.1 MA (2 shots)
4. **Source C** Substitute for Source B in condition with largest observed red/blue asymmetry (1 shot)
5. **Filter Scan** Scan angle of f-FIDA bandbass filter in favorite condition (3 shots)