FIDA measurements of the fast-ion distribution function

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The fast-ion D-alpha (FIDA) diagnostic uses the large Doppler shift of Balmer-alpha light emitted by neutralized fast ions to diagnose the fast-ion distribution function. Radial profiles with ~ 2 cm spatial resolution are obtained. Spectra from multiple views of the same spatial volume provide information on the distribution of fast-ion velocities. With the distribution function as input, the synthetic diagnostic code FIDASIM predicts signals for comparisons with the data. FIDASIM also computes "weight functions" (diagnostic sensitivities) that provide the basis for tomographic inference of the distribution function from the data. Injected neutral beams produce "active" FIDA signals, while cold edge neutrals produce "passive" signals. Recent experiments confirm the feasibility of active measurements with negative-ion based neutral beams. The main technical challenges are background subtraction and scattered light from the cold Balmer-alpha line. FIDA diagnostics are in operation at tokamaks, stellarators, and FRCs worldwide. This invited talk emphasizes developments since the 2010 review [1].

References

[1]   W.W. Heidbrink, *Rev. Sci. Instrum.* **81** (2010) 10D727.