On velocity-space sensitivity of fast-ion D-alpha spectroscopy

The velocity-space observation regions and sensitivities in fast-ion Dα (FIDA) spectroscopy measurements are often described by so-called weight functions. Here we derive expressions for FIDA weight functions accounting for the Doppler shift, Stark splitting, and the charge-exchange reaction and electron transition probabilities. Our approach yields an efficient way to calculate correctly scaled FIDA weight functions and implies simple analytic expressions for their boundaries that separate the triangular observable regions in (v‖, v⊥)-space from the unobservable regions. These boundaries are determined by the Doppler shift and Stark splitting and could until now only be found by numeric simulation.

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