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3.2 Inferring the distribution function from diagnostic measurements

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All the information about a plasma species is encoded in its distribution function (DF). While it would be helpful to measure the DF directly it is only possible to measure its moments. If the form of DF is not known a priori it can be difficult to interpret diagnostic signals. This is particularly true in fast-ion physics where, due to the complicated nature of the fast-ion DF, velocity-space weight functions were developed to interpret experimental data. Weight functions also allow for the inference of an approximate, spatially localized fast-ion DF i.e. Velocity-space Tomography. However, the technique is restricted, both by its accuracy and the availability of spatially overlapping diagnostics. In this work we overcome these limitations by extending velocity-space weight functions to a 3D orbit-space without loss of generality. We show how orbit weight functions can be used to infer the entire fast-ion DF from experimental data, i.e. Orbit Tomography. Using Fast-ion D-α (FIDA) data taken during a sawtooth crash at ASDEX-Upgrade, we show how Orbit Tomography can be used to do a first of its kind direct comparison between theoretical predictions and experimental measurements.This work was supported by the U.S. Department of Energy under DE-AC02-09CH11466 and DE-FC02-04ER54698

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