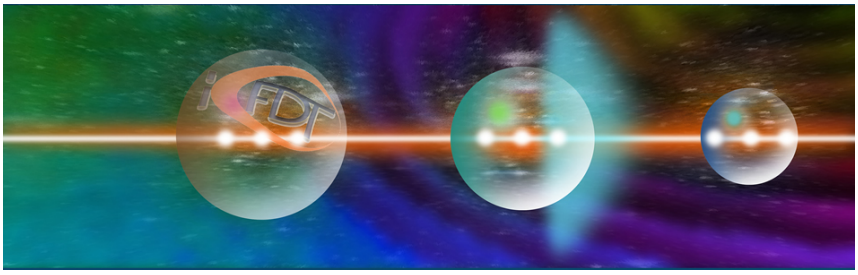

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Diagnostic of fast-ion energy spectra and densities in magnetized plasmas

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The measurement of the energy spectra and densities of alpha-particles and other fast ions are part of the ITER measurement requirements, highlighting the importance of energy-resolved energetic-particle diagnostic for the mission of ITER. However, it has been found in recent years that the velocity-space interrogation regions of the foreseen energetic-particle diagnostics do not allow these measurements directly. We will demonstrate this for gamma-ray spectroscopy, collective Thomson scattering, neutron emission spectroscopy and fast-ion D-alpha spectroscopy by invoking just energy and momentum conservation. The consequences of these conservation laws highlight analogies and differences between the velocity-space sensitivities of the diagnostics. Nevertheless, alpha-particle energy spectra and densities can be inferred at ITER for energies larger than 1.7 MeV through integrated data analysis of CTS and GRS by velocity-space tomography. Further, assuming isotropy their energy spectra can also be inferred by 1D inversion of spectral single-detector measurements, allowing the recovery of alpha-particle energy spectra and densities down to about 300 keV by CTS. Examples of these inversion formalisms will be given.

Summary

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