Bi-Maxwellian, slowing-down, and ring velocity distributions of fast ions in magnetized plasmas - DTU Orbit (09/04/2019)

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We discuss analytical fast-ion velocity distribution functions which are useful for basic plasma modelling as illustrated for the tokamak ITER. The Maxwellian is by far the most widespread model for ions and electrons in tokamaks and stellarators. The bi-Maxwellian and the drifting (bi-)Maxwellian are extensions allowing for anisotropy and bulk plasma flow, respectively. For example, fast ions generated by wave heating in the ion cyclotron range of frequencies are often described by bi-Maxwellians or so-called tail temperatures. The ring distribution can serve as a basic building block for arbitrary distributions or as a bump-on-tail in stability studies. The isotropic slowing-down distribution is a good model for fusion α-particles. The anisotropic slowing-down distribution occurs for anisotropic particle sources as is typical for neutral beam injection. We physically motivate these distribution functions and present analytical models in various coordinate systems commonly used by theorists and experimentalists. We further calculate 1D projections of the distribution functions onto a diagnostic line-of-sight to gain insight into measurements relying on the Doppler shift.

General information
Publication status: Published
Organisations: Department of Physics, Max-Planck-Institut fur Plasmaphysik
Contributors: Moseev, D., Salewski, M.
Number of pages: 16
Publication date: 2019
Peer-reviewed: Yes

Publication information
Journal: Physics of Plasmas
Volume: 26
Issue number: 2
ISSN (Print): 1070-664X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
Original language: English
DOIs:
10.1063/1.5085429

Research output: Contribution to journal › Journal article – Annual report year: 2019 › Research › peer-review