Simulations of neutral beam injection in TJ-II stellarator using the Monte Carlo code ASCOT

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Neutral beam injection (NBI) is one of the main sources of fast ions in magnetically confined plasmas. Fast ions generated by NBI are used for heating, to produce non-inductive current and to investigate the excitation of MHD instabilities. The detailed study of fast-ion orbits is also important since particle losses can damage the inner components of the device. The work described in this contribution is motivated by the need to progress in the understanding of fast ion physics in non-axisymmetric configurations. With this aim, TJ-II stellarator and its NBI system have been implemented in the Monte Carlo orbit-following code ASCOT [1]. The device is equipped with two 34 keV H_0 neutral beams (co and counter injection), each one delivering up to 700 kW of power [2]. To simulate the effect of both neutral beams, their injection geometry and the device vessel have been introduced into ASCOT, which has been executed in the supercomputing facility MARCONI. Fast-ion birth profiles and shine through power have been modelled using ASCOT's module Beamlet-Based Neutral-Beam Injection (BBNBI). TJ-II VMEC equilibrium and kinetic plasma profiles, calculated with the transport code ASTRA at different times of a simulated discharge, have been introduced in ASCOT to consistently determine the beam power deposition profiles, the fast ion distribution function (fig. 1) and the neutral-beam current drive (NBCD) profile, this latter being essential for MHD simulations when non-balanced power injection is used. These results and a comparison between full orbit and guiding-center simulations will be presented.

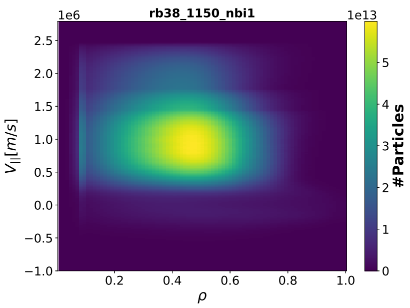

Figure 1: *2D parallel-velocity distribution-function of the co-injected beam (NBI 1)*

References

[1] J. Varje et al., Submitted to Comput. Phys. Commun. (2019) (arXiv:1908.02482v1)

[2] M. Liniers et al.,Fusion Engineering and Design 123 (2017) 259-262