Fas Ion Simulations in LHD

A. Bustos, F. Castejón, L. A. Fernandez [a], V. Martin-Mayor [a], M. Osakabe [b], J.L. Velasco [c].

Asociación Euratom/CIEMAT para Fusión, 28040, Madrid, Spain.
[a] *Universidad Complutense, Madrid, Spain.*
[b] *National Institute for Fusion Science,322-6 Oroshi-cho, Toki 509-5292, Japan*
[c] *Insitute for Biocomputation and Physics of the Complex Systems, Zaragoza University, Spain.*

andres.debustos@ciemat.es

NBI heating plays a crucial role in the Physics of most fusion devices, since it is a valuable method for ion heating and plasma fuelling. The understanding of the transport of these fast ions is important since the NBI heating efficiency depends strongly on their confinement and they carry a significant fraction of the total energy. In this work, the orbit code ISDEP [1] is used to perform simulations of fast ion transport in the Large Helical Device. ISDEP is a linear code that solves the guiding center equations of motion in 5D phase space (2D for velocity space and 3D in real space) taking into account i-i and i-e collisions with the background plasma, and finite Larmor radius effects, which can be mandatory for high energy ions. ISDEP is a global MC code, therefore it avoids approximations on the size of the orbits and on the diffusive nature of transport. ISDEP uses cartesian coordinates, overcoming the limitations of the magnetic coordinates, thus allowing the inclusion of geometries with magnetic islands or ergodic zones. As a consequence, the properties of ion transport in the scrape-off-layer can be studied as well as the hit points on the vacuum chamber of the device [2]

The fast ions are considered as a perturbation to the background plasma. The small perturbation in the distribution function is obtained, measuring transport magnitudes like radial fluxes, escape points and cumulants of the velocity distribution. Important time scales like fast ion confinement time and slowing down time can be also investigated with this code.

A preliminary comparison with the LHD experimental data[3] is carried out. The first simulations are performed without considering the electric field, whose effect on confinement depends on the ion energy.

[1] Castejón F. *et al.* Plasma. Phys. Control. Fusion **49** 753 (2007).
[2] Castejón F. *et al.*, Nucl. Fusion **49**, (2009).
[3] Osakabe M. *et al.*, Rev. Sci. Instrum. **79**, 10E519 (2008).