Gyrokinetic modelling of light impurity transport in JET H-mode and hybrid discharges

P. Manas[1], Y. Camenen[1], S. Benkadda[1], C. Angioni [2], F. J. Casson [3]

[1] *Aix-Marseille Université, CNRS, PIIM UMR7345, 13397 Marseille, France*

[2] *Max-Planck-Institut für Plasmaphysik, IPP-EURATOM Association, D-85748 Garching bei München, Germany*

[3] *CCFE, Culham Science Centre, Abingdon, Oxfordshire, UK*

The understanding and modelling of impurity transport in core tokamak plasmas is essential to achieve controlled fusion. The accumulation of impurities in the core is detrimental and is driven by the competition between a diffusion and a convection term in the particle flux. Many theoretical studies have been carried out to characterize this turbulent diffusion/convection mechanism (see e.g. [1]), underlining the importance of the dominant micro-instabilities, progating either in the ion diamagnetic direction (Ion Temperature Gradient) or in the electron diamagnetic direction (Trapped Electron Mode), on the sign and magnitude of the different convection terms, i.e pure convection, thermo-diffusion and roto-diffusion.

Previous results [2] of simulations performed for ASDEX Upgrade discharges at mid-radius underlined the importance of roto-diffusion to reproduce hollow experimental profiles. In the continuity of this study, gyrokinetic simulations of core micro-turbulence ($r/a = 0.3 - 0.8$) of JET H-mode and hybrid discharges with dominant NBI heating, hence strongly rotating plasmas, are performed with the Gyrokinetic code GKW [3]. In these discharges, ITG is shown to be the main instability on the whole radial range. The neoclassical contribution to the total Carbon flux is computed with the code NEO and compared to the contribution from turbulence. In these gyrokinetic simulations where the trace limit validity has been checked, the logarithmic density gradient of Carbon is calculated from linear simulations using a quasi-linear rule [4] and the result is compared to the experimental values measured with charge exchanged recombination spectroscopy with a special emphasis on the effect of roto-diffusion. Finally, this quasi-linear study is complemented with a few nonlinear simulations.

References

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