

# Collisional Simulations with the Global Gyrokinetic $\delta f$ Particle-in-Cell Code ORB5

T. Vernay<sup>1</sup>, S. Brunner<sup>1</sup>, L. Villard<sup>1</sup>, B. F. McMillan<sup>2</sup>, S. Jolliet<sup>1</sup>, A. Bottino<sup>3</sup>

<sup>1</sup> *Centre de Recherches en Physique des Plasmas, Ecole Polytechnique Fédérale de Lausanne, Association EURATOM – Confédération Suisse, CH-1015 Lausanne, Switzerland*

<sup>2</sup> *Centre for Fusion, Space and Astrophysics, Department of Physics, University of Warwick, Coventry CV4 7AL, United Kingdom*

<sup>3</sup> *Max-Planck-Institut für Plasmaphysik, Boltzmannstrasse 2, EURATOM Association, D-85748 Garching, Germany*

Global gyrokinetic simulations provide a powerful tool for studying microturbulence underlying the anomalous transport in tokamak plasmas. The  $\delta f$  Particle-In-Cell (PIC) code ORB5 [1] has been recently upgraded with linearized collision operators [2] and a solver for electromagnetic perturbations [3]. Results from global simulations of electrostatic ITG turbulence with a linearized ion-ion collision operator are presented, featuring heat sources maintaining constant temperature gradients, both above the non-linear stability threshold as well as below, in the so-called Dimits shift region above the linear stability threshold. The effects of a finite collisionality on the turbulent transport level, through its action on zonal flows [4], are emphasized. Numerical issues are addressed as well through a coarse graining procedure [5, 6] applied on the weights, which is shown to have a positive effect on the numerical noise level. Furthermore, a new numerical scheme for the  $\delta f$  approach is presented, switching between a canonical Maxwellian background and a local Maxwellian background for carrying out the collisionless and the collisional dynamics respectively [2].

Presentation type: Poster

## References

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