Effects of anistropic slowing-down energetic particle distribution function in ITER-like regime

Didier GOSSARD[1], Alessandro BIANCALANI[2], Alberto BOTTINO[3], Thomas HAYWARD-SCHNEIDER[3], Philipp LAUBER[3], Alexey MISHCHENKO[4], Juvert N. SAMA[5], Laurent VILLARD[6]

[1] De Vinci Higher Education, Paris , France
[2] De Vinci Higher Education, De Vinci Research Center, Paris, France
[3] Max Planck Institute for Plasma Physics, 85748 Garching, Germany
[4] Max Planck Institute for Plasma Physics, 17491 Greifswald, Germany
[5] Institut Jean Lamour UMR 7198, Université de Lorraine-CNRS, Nancy 54011, France
[6] École Polytechnique Fédérale de Lausanne, Swiss Plasma Center, CH-1015 Lausanne, Switzerland
didier.gossard@devinci.fr

The dynamics of zonal flows (ZFs) plays a crucial role in tokamak fusion plasma physics research, as flow shear can suppress drift-type turbulence that deteriorates plasma confinement performance. ZFs are electrostatic perturbations with a spatial structure that exhibits both toroidal and poloidal symmetry. ZFs can be classified into 2 distinct branches: the low-frequency branch (with the frequency $\omega \sim 0$) [1] and the high-frequency branch ($\omega \sim c_s/R_0$ where c_s is the sound speed and R_0 is the major radius of the torus). The high-frequency branch is also known as the geodesic acoustic mode (GAM) [2]. Due to inverse Landau damping, energetic particles (EPs) can excite a new GAM-like mode, taking the name of EP-driven GAM (EGAM) [3].

In this work, we have studied the dynamics of zonal flows in the presence of EPs with the gyrokinetic particle-in-cell code ORB5 [4]. The ITER pre-fusion-power-operation plasma scenario [5], [6] is considered for these numerical simulations. The effects of anisotropic slowing-down EP distribution function on the nonlinear saturation will be investigated. The anisotropic slowing-down EP distribution function is used here because it describes in a more realistic way, population of EPs injected by heating systems in different directions.

References

1. A. Hasegawa, C. G. Maclennan, and Y. Kodama, *Phys. Fluids* **22**, 2122 (1979)
2. N. Winsor et al. *Phys. Fluids* **11**, 2448, (1968)
3. Fu, G.Y. *Phys. Rev. Lett.* **101**, 185002, (2008)
4. E. Lanti, et al, *Comp. Phys. Commun.* **251**, 107072 (2020)
5. T. Hayward-Schneider, et al. *Nucl. Fusion* **62**, 112007 (2022)
6. Polevoi A.R. et al. *Nucl. Fusion* **61**, 076008 (2021)