17th European Fusion Theory Conference
9 - 12 October 2017, Athens - Greece
EFTC 2017

Full-F gyrofluid modelling of blob-impurity interaction in the tokamak scrape-off layer

E. Reiter[1], M. Wiesenberger[2], M. Held[1], and A. Kendl[1]

[1]*Universität Innsbruck, Innsbruck, 6020, Austria*
[2]*Technical University of Denmark, Kongens Lyngby, 2800, Denmark*

In two-dimensional gyrofluid simulations of filament evolution in the tokamak scrape-off layer show a slowdown of radial blob propagation, dependent on concentration, mass and charge of impurity ions present.

A better understanding of non-trace non-fuel ion effects on edge turbulent transport is of uttermost relevance for reactor operations because of two partially interlinked issues. First, the distribution of impurities, originating from plasma-wall interaction or deliberate seeding, throughout the reaction volume determines positive and negative effects on confinement alike; Heat mitigation at the divertor or plasma dilution and increased radiation losses at the core, respectively [1]. With the plasma edge as a natural boundary between plasma volume and impurity sources, transport processes at the SOL significantly influence impurity penetration deeper into and impurity distribution in the plasma.

The assessment of a parameter-scan on cold isothermal seeded blob evolution with constant impurity background focuses on the second aspect of importance. Between the last closed flux surface and the first wall propagating filaments dominate particle and heat transport. Quantification is provided by the maximum center of mass velocity of a blob. This parameter is computationally accessible and results are comparable to a suitable linearised analytical scaling law.

Derived in the full-F gyrofluid model [2], the presented equation set self-consistently evolves multiple ion species while making no distinction between background and fluctuations which are known to be of comparable amplitude at the scrape-off layer [3]. Calculations remain far less computationally expensive than operating kinetic codes used for similar purposes [4].

This work was partly supported by the Austrian science fund (FWF) Y398. The computational results presented have been achieved in part using the Vienna Science Cluster (VSC2/3).

References

[1] C. Angioni et al., Phys. Plasmas 14, 055905 (2007)
[2] J. Madsen, Physics of Plasmas 20, 072301 (2013)
[3] S. Zweben et al., Nucl. Fusion 55, 093035 (2015)
[4] H. Hasegawa and S. Ishiguro, Nucl. Fusion, at press: doi.org/10.1088/1741-4326/aa7700 (2017)