From injection to deposition – capturing the drift of ablated pellet material in a tokamak

O. Vallhagen[1], I. Pusztai[1], P. Helander[2], L. Antonsson[1], S. Newton[3], T. Fülöp[1]

[1]Department of Physics, Chalmers University of Technology, Gothenburg, SE-41296, Sweden
[2] Max-Planck Institute for Plasma Physics, Greifswald, Germany
[3]CCFE, Culham Science Centre, Abingdon, Oxon OX14 3DB, UK

Email: vaoskar@chalmers.se

Pellet injection is an important means to fuel and control discharges and mitigate disruptions in reactor-scale fusion devices, and it is foreseen in ITER. To be able to assess the efficacy of these applications, prediction of the profiles of material deposition from pellets is an essential requisite providing input to further workflows. For this, predicting the drift of ablated pellet material is a key ingredient. While complex modeling tools exist to this end, there is a need for reduced, but still sufficiently accurate models that can be implemented in numerical frameworks.

Here we present a derivation of an equation governing the drift motion of ablation clouds in a slab geometry, from first principles, taking into account both the Alfvén and ohmic currents which short-circuit the charge separation responsible for the $E \times B$-drift [1]. We then employ an approximate model for the cloud expansion parallel to the magnetic field, allowing for a semi-analytical solution for the total drift displacement. Finally, we demonstrate the possibility to use our model to improve the physics fidelity of disruption mitigation modeling by including it in simulations performed with the numerical tool DREAM [2].

References

[1] O. Vallhagen *et al*, *J. Plasma Phys.* **89** 905890306 (2023).

[2] M. Hoppe *et al*, *Comp. Phys. Comm.* **268** 108098 (2021).