Gyrofluid Simulations of Tokamak Edge Plasmas

A. Dempsey[1], H. Leggate[1], M. M. Turner[1]

[1] *Dublin City University, Dublin 9, Ireland*

Filaments are field aligned structures that are known to form in the scrape-off-layer (SOL) in tokamaks. These structures are composed of hot electrons and ions. They can constitute a non-negligible thermal and particle flux on the first wall. As such the propagation of these structures to the first wall is problematic. All unnecessary heat loading of structural components must be avoided to prolong the lifetime of a fusion device. In order to arrive at an optimal design for a next-generation machine it is advantageous to predict wall fluxes so that thermal loading and tritium retention can be modelled. One approach to predicting such fluxes in plasmas is to rely on simulation. However depending on which kinetic equation, closure and approximations are used some physics can be lost. For instance, finite Larmor radius effects are often lost.

The approach described herein is to use a gyrofluid model. Gyrofluid models incorporate higher order finite Larmor radius effects more naturally that other fluid models. The gyrofluid model used in this study is briefly introduced [1] and initial progress towards solving it using BOUT++ [2] is presented. The focus of this simulation is on filament dynamics as modified by finite Larmor radius (FLR) effects. Of particular interest are filament-background interactions and filament propagation near the SOL.

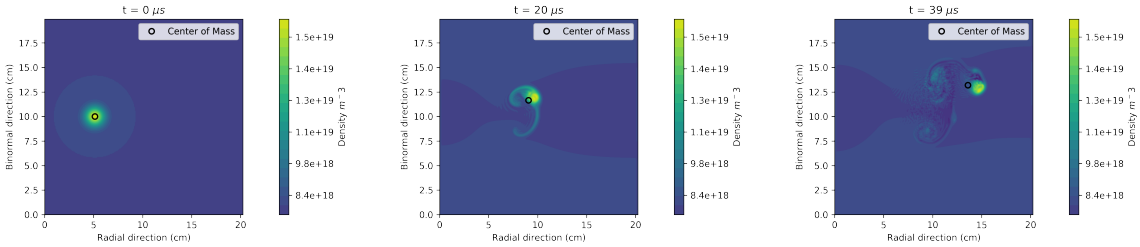

Figure 1: Filament density plots exhibiting typical radial propagation.

References

[1] Bruce Scott and Juri Smirnov, "Energetic consistency and momentum conservation in the gyrokinetic description of tokamak plasmas", *Physics of Plasmas*, vol. 17, no. 11, aug 2010.

[2] B. D. Dudson, M. V. Umansky, X. Q. Xu, P. B. Snyder, and H. R. Wilson, "BOUT++: A framework for parallel plasma fluid simulations", *Computer Physics Communications*, vol. 180, no. 9, pp. 1467–1480, 2009.

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