Technical University of Denmark

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Full-n gyrofluid blob dynamics in the tokamak scrape-off-layer

M. Wiesenberger[1], J. Madsen[2], A. Kendl[1]

[1] Institute for Ion Physics and Applied Physics, University of Innsbruck, Technikerstr. 25, A-6020 Innsbruck, Austria

[2] Association EURATOM-DTU, Technical Universtiy of Denmark, Department of Physics, DK-2800 Kgs. Lynby, Denmark

Radially propagating density filaments elongated along magnetic field lines constitute a major form of cross-field transport in the scrape off layer (SOL) of tokamaks. These filaments are generally known as blobs and convect plasma radially outwards by the interchange mechanism. The maximum density amplitude of such structures compared to the background plasma density in the SOL can be well above unity, since blobs are assumed to be born in or near the more dense closed-flux-surface edge plasma. We present simulations and analyses of seeded blobs for far SOL conditions where the ion-temperature within the blob can be assumed constant. Our 2-dimensional simulations are based on an isothermal full-n gyrofluid model derived from the full-f gyrokinetic equations, including finite Larmor radius effects. We are thus able to model large amplitude blobs, where the low amplitude approximation is not valid. One aim of our analysis is thus to compare our model to existing local models based on delta-n gyrofluid equations.

Our code solves the generalized Poisson problem for various boundary conditions. We employ discontinuous Galerkin methods to discretize spatial derivatives. These methods are flexible and easily parallelizable, which we exploit in an implementation for GPUs.

We further apply the code on driven turbulence simulations, where drift wave vortices are generated in the closed-flux surface edge plasma by the Hasegawa-Wakatani mechanism and further propagate into the SOL as blobs. We discuss how turbulent drift wave structures, blob generation, frequency and shape are altered by the nonlinearity in the polarization equation in the presence of an average plasma profile gradient.