Particle-in-cell methods in edge plasma physics.

A. Bottino[1]

[1] Max-Planck Institute for Plasma Physics, Boltzmannstrasse 2, 85748 Garching, Germany

contact: alberto.bottino ⊕ ipp.mpg.de

Over the past decades, within the plasma core multiple gyrokinetic codes have been shown capable of simulating turbulence and transport in tokamak devices. However, their application to the edge and scrape-off layer (SOL) region presents significant challenges. To in particular study the SOL region with its steep temperature and density gradients as well as large fluctuation amplitudes, the full-f particle-in-cell code PICLS has been developed. PICLS is based on a full-f model gyrokinetic molde with linearised field equations, uses kinetic electrons and implies logical sheath boundary conditions. In the past, PICLS was verified by applying it to a well-studied 1D parallel transport problem during an edge-localized mode (ELM) in the SOL for the collisionless [2] and the collisional case for which a Lenard-Bernstein collision operator was implemented [1]. PICLS recently was extended towards three spatial dimensions [3] to study turbulence in open-field-line regions in slab and close-field-line toroidal geometries. In this work, we will focus on the models and methods we used for extending the code towards three spatial dimensions.

References

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