# Extending PICLS, a gyrokinetic full-f particle-in-cell open-field-line code, to 3D

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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 an electrostatic full-f model with a linearized field equation, uses kinetic electrons and implies logical sheath boundary conditions. The electrostatic potential is calculated via the polarization equation, with the help of B-spline finite-elements for the charge deposition and the field solver. 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 (Boesl *et al.* 2019*b*) and the collisional case (Boesl *et al.* 2019*a*), for which a Lenard-Bernstein collision operator was implemented. PICLS recently was extended towards three spatial dimensions to study turbulence in open-field-line regions in slab and cylindrical geometries and simple circular tokamaks. In this work, we will focus on the models and methods we used for extending the code towards three spatial dimensions. Key features, such as the implemented field solver, will be discussed.

## REFERENCES

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