Contribution ID: **49** Contribution code: **P1.25** Type: **Poster**

Simulation of electromagnetic effects in boundary turbulence with the GBS code

Tuesday 3 October 2023 16:20 (4 minutes)

Evolving a two-fluid model based on the drift-reduced Braginskii equations [1], GBS [2] is a three-dimensional flux-driven turbulence code designed for simulating plasma turbulence and kinetic neutral dynamics in the tokamak boundary. The GBS simulation domain covers the entire tokamak volume, avoiding the need for an artificial boundary between the core and edge regions, thus preserving the core-edge-SOL interplay. The GBS code has been used to study turbulent transport regimes in the tokamak boundary, to delineate its operational limits and to describe their dependence on key physical parameters.

In the present work, we introduce a new formulation of the drift-reduced Braginskii equations that properly accounts for electromagnetic effects. In contrast to the implementation in typical turbulence codes, but similar to nonlinear resistive MHD codes such as JOREK [3], which have successfully simulated Edge-Localised-Modes (ELMs) dynamics and cycles, our model does not distinguish between equilibrium and fluctuating components of the time-evolving magnetic field and parallel current (i.e., it employs a full-f approach also for the electromagnetic fluctuations). Indeed, the model we developed allows for the simulation of MHD modes such as the peeling-ballooning instability, known to be the linear precursor to ELMs.
The newly developed electromagnetic model is implemented in the GBS code and we present the first simulation results in an X-point diverted geometry, focusing on the role that electromagnetic perturbations play in boundary transport and turbulence.

This work has been carried out within the framework of the EUROfusion Consortium, via the Euratom Research and Training Programme (Grant Agreement No 101052200 —EUROfusion) and funded by the Swiss State Secretariat for Education, Research and Innovation (SERI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union, the European Commission, or SERI. Neither the European Union nor the European Commission nor SERI can be held responsible for them.

References:
[1] A. Zeiler et al., *Physics of Plasmas* **4**, 872368 (1997)
[2] M. Giacomin et al., *Journal of Computational Physics* **463**, 111294 (2022)
[3] A. Cathey et al., *Nuclear Fusion* **60**, 124007 (2020)

Author: DE LUCCA, Brenno Jason Sanzio Peter (École Polytechnique Fédérale de Lausanne)

Co-authors: Prof. RICCI, Paolo (École Polytechnique Fédérale de Lausanne); Mr SINTRE, Pierre Louis (École Polytechnique Fédérale de Lausanne); Mr TECCHIOLLI, Zeno (École Polytechnique Fédérale de Lausanne)

Presenter: DE LUCCA, Brenno Jason Sanzio Peter (École Polytechnique Fédérale de Lausanne)

Session Classification: Poster session: 01