Impact of reconnection mechanisms on the tearing instability and saturation in the gyrokinetic framework of GYSELA

R. Bigué[1,2], P. Donnel[2], Y. Sarazin[2], X. Garbet[2,3], L. De Gianni[2], G. Dif-Pradalier[2], V. Grandgirard[2], K. Obrejan[2], Z. Qu[3], M. Muraglia[1]

[1]PIIM Laboratory, UMR 6633 CNRS-University of Provence, Marseille
[2]CEA, IRFM, F-13108 Saint Paul-lez-Durance, France
[3]School of Physical and Mathematical Sciences, NTU, 637371 Singapore

E-mail: romeo.bigue@univ-amu.fr

Abstract. Magnetic reconnection phenomena in hot, magnetized tokamak plasmas are linked to confinement degradation. Specifically, Neoclassical Tearing Modes (NTMs) can generate magnetic islands several centimeters wide, that are able to cause major disruptions that risk severe damage to large-scale devices. While NTM control has seen significant progress [1], understanding saturation mechanisms and predicting saturated island widths in collisionless regimes remain open challenges [2].

This work explores advancements using the electromagnetic version of the GYSELA code [3] to model magnetic islands growth and saturation. This contribution will span from benchmarking the electromagnetic version to GENE and ORB5 simulations [4] to investigating the nonlinear saturation of tearing-driven magnetic islands in resistive and collisionless regimes. Central to this effort is the demonstration of the code's self-consistent incorporation of neoclassical effects, including Bootstrap and Pfirsh-Schlüter currents. By addressing these interconnected challenges, we pave the way for fully self-consistent gyrokinetic simulations of neoclassical magnetic islands, including saturation through profile dynamics, thereby improving predictive capabilities for fusion plasma stability.

References

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