Theory and numerical simulations for verification of gyrokinetic codes.

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This talk addresses main achievement of the Enabling Research project VeriGyro *"Verification and development of new algorithms for gyrokinetic codes"* concerning establishment of analytical and numerical tools for verification of gyrokinetic codes.

In the first part of this talk, a review of mathematical models for global electromagnetic gyrokinetic codes GENE (Eulerian) and ORB5 (particle-in-cell) is presented. The base code model is defined from the gyrokinetic theory in electromagnetic case [1]. A detailed analysis and comparison of code implementations to the base model is performed for both codes [2]. In addition, an improved second order fully nonlinear electrostatic gyrokinetic model is established and ready for implementations.

The second part of this talk, resumes results of linear electromagnetic benchmark for participating codes. The hierarchy of the test cases: starting from the adiabatic electrons towards the electromagnetic cases including the ITG/KBM transition is established and illustrated with participation of major European gyrokinetic codes[3]: GENE, GKW (Eulerian), GYSELA (semi-Lagrangian), ORB5 and EUTERPE (Particle-in-cell). Finaly, preliminary results for nonlinear simulations with adiabatic electrons as well as for the case with fully kinetic electrons in a weakly electromagnetic case are presented.

References

[1] N. Tronko and C. Chandre. Second order nonlinear gyrokinetic theory: from the particle to the gyrocenter. *Arxiv*, 1709.05222V1, 2017.

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