High-realism gyrokinetic simulations for solar wind turbulence

D. Told[1], D. Groselj[1], K. Giers[1], G.W. Hammett[2], F. Jenko[1]

[1] *Max Planck Institute for Plasma Physics, Boltzmannstr. 2, D-85748 Garching, Germany*

[2]*Princeton Plasma Physics Laboratory, Princeton, NJ 08543, USA*

One of the most eminent unsolved problems in space plasma physics is the nature of turbulent energy dissipation at small spatial scales, which is thought to explain the heating of the heliospheric plasma that has been consistently observed through space craft measurements[1].

Three-dimensional kinetic simulations (reduced or fully kinetic) are increasingly used to study the properties of turbulence and instabilities that occur in such plasmas[2, 3, 4, 5]. Owing to the large computational expense of such simulations, these are commonly carried out with just a single particular means of turbulence generation, hindering a comparison of the results obtained from different simulations and physics models. Furthermore, no systematic studies have been performed of how the kinetic turbulence properties (and hence the resultant heating) depend on the manner of energy injection.

Here, we address both gaps by means of gyrokinetic turbulence simulations using the GENE code[6]. In particular, we apply the code to parameters comparable to the near-Earth solar wind, and examine the effects of moving from a isotropic, balanced energy injection scheme to a more realistic imbalanced or aligned injection scheme that mimics conditions as they may be found in the solar wind.

References

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