Gyrokinetic turbulence in tokamaks and stellarators: New insights and routes towards transport optimization

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Recently, there has been significant progress in the area of nonlinear gyrokinetic simulation of turbulence in non-axisymmetric fusion devices. This is due to a combination of a substantial effort in the (further) development of codes and the continuing increase of computer power. Employing a local approximation, it is already possible today to perform simulations which are as comprehensive as their tokamak counterparts, including, for example, multiple plasma species (both passing and trapped) and electromagnetic effects. However, interesting new results can already be obtained by means of simplified simulation setups, employing adiabatic electrons (see, e.g., Refs. [1,2]).
This way, novel insights have been gained concerning the nature of both the driving microinstabilities and the role of zonal flows in the nonlinear saturation of these modes. As it turns out, there are many similarities to the axisymmetric case, as well as significant differences. The findings reported in this review talk point to the possibility of a systematic optimization of turbulent transport in stellarators. At the same time, they contribute to a better understanding of tokamak turbulence, especially in the presence of strong shaping or in the proximity of the edge.

[1] P. Xanthopoulos, F. Merz, T. Görler, F. Jenko, Phys. Rev. Lett. **99**, 035002 (2007)
[2] T.-H. Watanabe, H. Sugama, S. Ferrando-Margalet, Phys. Rev. Lett. **100**, 195002 (2008)