P 22: Helmholtz Graduate School HEPP V

Time: Friday 14:00–15:15 Location: P-H12

P 22.1 Fri 14:00 P-H12

Experimental validation of gyrokinetic simulation with scale-resolved multi-field turbulence measurements — •Klara Höfler[1,2], Tobias Görler[2], Tim Happel[2], Pascale Hennequin[3], Pedro Molina Cabrera[2,4], Michael Bergmann[2], Rachel Bielajew[4], Carsten Lechte[5], Anne White[4], Ulrich Stroth[2,1], and the ASDEX Upgrade Team[2] — [1]Physik Department E28, TUM, Garching, Germany — [2]MPI für Plasmaphysik, Garching, Germany — [3]LPP, Ecole Polytechnique, Palaiseau, France — [4]MIT PSFC, Cambridge, Massachusets, USA — [5]IGVP, Stuttgart, Germany

Turbulence is the main driver of heat transport which deteriorates the performance of fusion reactors. To design turbulence optimised devices, simulation codes need to be validated by experiments. Validation work has already been done for single or a reduced number of parameters.

The comprehensive set of turbulence data presented in this contribution is measured on ASDEX Upgrade in different plasma scenarios but at the same radius. It includes wavenumber spectra, density and temperature fluctuation amplitudes and radial correlation lengths, the poloidal dependence of the velocity perpendicular to the magnetic field and the cross phase between density and temperature fluctuations.

These quantities are measured for extensive code validation by Doppler reflectometers and a CECE radiometer. They are compared to non-linear simulations of the gyrokinetic code GENE because of its mature capabilities to assess and reproduce core turbulence. In addition synthetic diagnostic modeling accounts for diagnostic effects.

P 22.2 Fri 14:25 P-H12

The importance of the tertiary instability in the collisionless Dimits regime — •Axel Hallenbert and Gabriel Plunk — Max-Planck-Institut für Plasmaphysik, D-17491 Greifswald, Germany

The upshift from the linear instability threshold until turbulent transport commences, caused by self-generated zonal flows, is known as the Dimits shift. Though this phenomenon could facilitate enhanced magnetic confinement device performance, it has proved difficult to understand and quantitatively predict except in simple cases. These have generally been of the simple fluid model kind, so to proceed towards more realistic scenarios, fully gyrokinetic simulations have been used to investigate the Dimits shift in simple geometries. Here the tertiary instabilty, which describes how zonal flows give way to increasing drift waves, was both the main tool and focus. Many features and dynamics previously linked to this instability in fluid models were indeed confirmed to remain in the presence of kinetic effects. Of greatest importance, in the collisionless regime this facilitates an efficient and here accurate Dimits shift prediction, while also hinting at its further validity in more varied geometries.

P 22.3 Fri 14:50 P-H12

Excitation of High Frequency Waves in Full-6D Kinetic Simulations of Magnetically Confined Plasmas — •Mario Raeth, Klaus Hallatschek, and Katharina Kormann — Max Planck Institute für Plasmaphysik, Garching, Deutschland

Although current gyrokinetic computer simulations are in fair agreement with experimental results in core physics, the assumptions in the derivation make them unreliable in regimes of higher fluctuation amplitudes and stronger gradients, such as the tokamak edge. To correctly describe all phenomena in such regimes, more involved simulations might be necessary. We have developed a novel optimised and scalable semi-Lagrangian solver to simulate ion-temperature gradient modes with the full 6D kinetic equations. It has been verified extensively in the regime of gyrokinetics, including the growth of linear modes and the turbulent saturation. Furthermore, the excitation of high-frequency Bernstein waves (IBWs) has been shown in the nonlinear saturation phase. To increase the understanding of the relevance of such high-frequency waves in turbulence, we investigated various excitation mechanisms. Investigations range from non-linear transfer of energy up the frequency scale, to the presence of secondary linear instabilities. The latter lead to a model which allows us to predict a threshold, in the amplitude of a primary gyrokinetic mode, for the excitation and the resulting growth rate of the secondary instability. This helps us to predict the presence and amplitude of IBWs in nonlinear ITG simulations, which we could confirm by simulations in our full-6D kinetic code.