Modelling of turbulent fluctuations measured in the TCV tokamak with gyrokinetic simulations and a synthetic phase contrast imaging diagnostic

A. Iantchenko[1], G. Merlo[2], S. Coda[1], S. Brunner[1]

[1] *EPFL-SPC, Lausanne, Switzerland*

[2] *University of Texas at Austin, Austin, United States*

Proper comparison of simulated turbulent fluctuations with experimental observations is necessary for code validation, and for establishing a link between experimental fluctuation measurements and the underlying physics. In this contribution we report on the progress of modelling localised measurements of turbulent electron density fluctuations, obtained with the tangential phase contrast imaging (TPCI) diagnostic installed on the TCV tokamak. The modelling is done in two steps. First, nonlinear flux-tube gyrokinetic simulations are performed with the Eulerian (grid-based) GENE code, taking into account realistic TCV geometry and profiles. A synthetic diagnostic that has been developed in MATLAB is then applied to the simulated density fluctuations to model the experimental measurement procedure, allowing detailed comparison between simulation and experiment.

Using these tools, we extended a previous computational analysis of the role of plasma triangularity in improved confinement in TCV. In previous such studies, the focus was on comparing heat flux levels between simulation and experiments. Large discrepancies were found, which were attributed to the large experimental error bars on the input profile gradients, to the simplification of not including electron scales in the simulations, to possible global effects, or to a combination of all three. With the synthetic diagnostic a more in depth comparison is performed, investigating the importance of such effects also in the observed wavenumber and frequency spectrum.

After motivating and verifying the described procedure for modelling density fluctuations at TCV, we make initial predictions on the role of electron scale turbulence on transport levels in highly shaped plasmas. This is performed in preparation of first electron scale measurements that are envisioned to be performed with TPCI, as a result of an upgrade currently underway.