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Recent gyrokinetic turbulence insights with GENE and direct comparison with experimental measurements

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Throughout the last years direct comparisons between gyrokinetic turbulence simulations and experimental measurements have been intensified substantially. Such studies are largely motivated by the urgent need for reliable transport predictions for future burning plasma devices and the associated necessity for validating the numerical tools. On the other hand, they can be helpful to assess the way a particular diagnostic experiences turbulence and provide ideas for further optimization and the physics that may not yet be accessible. Here, synthetic diagnostics, i.e. models that mimic the spatial and sometimes temporal response of the experimental diagnostic, play an important role. In the contribution at hand, we focus on recent gyrokinetic GENE simulations dedicated to ASDEX Upgrade L-mode plasmas and comparison with various turbulence measurements. Particular emphasis will be given to density fluctuation spectra which are experimentally accessible via Doppler reflectometry. A sophisticated synthetic diagnostic involving a fullwave code has recently been established and solves the long-lasting question on different spectral roll-overs in gyrokinetic and measured spectra as well as the potentially different power laws in the O- and X-mode signals. The demonstrated agreement furthermore extends the validation data base deep into spectral space and confirms a proper coverage of the turbulence cascade physics. The flux-matched GENE simulations are then used to study the sensitivity of the latter to the main microinstability drive and investigate the energetics at the various scales. Additionally, electron scale turbulence based modifications of the high-k power law spectra in such plasmas will be presented and their visibility in measurable signals be discussed.