Evolution of micro-turbulence characteristics with collisionality at the tokamak core-edge interface

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Considering traditional core turbulence approach, from the theory side, collisions are believed to have a strong impact on turbulence: linearly on Trapped Electron Modes [1], where a higher collisionality is expected to be stabilizing, and non-linearly on large scale structures such zonal flows or geodesic acoustic modes GAMs [2], where, on the contrary, an increased collisionality is destabilizing for the fluctuations. Dedicated ν^* scan experiments have been performed on Tore Supra, in order to study, in parallel, the impact of the collisionality on micro-turbulence characteristics and on transport coefficients. The parameter ν^* has been varied by a factor of 4 in L-mode , where the conditions are ideal for comparison with core gyrokinetic codes.. Density fluctuations are measured over a wide range of spatial scales using Doppler backscattering system. This technique allows precise determination of both the wavenumber spectrum and the phase velocity of these fluctuations (as a function of the wavenumber), which can be used to represent the dispersion relation of the dominant micro-turbulence. When ν^* is changed both of these characteristics are found to be affected [3]. The shape of the wavenumber spectrum is modified in such a way that the low-k part of the spectrum ($k\rho_s<0.7$) gets flatter with increasing collisionality. In the same time, the behaviour of the dispersion relation changes significantly. These results obtained at the radial position r/a=0.8 are in contrast with the expected behaviour of ITG turbulence and standard results from gyrokinetic simulations. In parallel, the analysis of the global confinement shows a moderate degradation of confinement with increasing collisionality. However, the impact of the modification of micro-turbulence characteristics on local heat transport is unclear. Local transport analysis, performed using the integrated modelling code CRONOS, shows a weak ν^* dependence of the effective heat transport coefficient.

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