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Characteristics of particle transport due to TEM and ITG turbulence in tokamak plasmas

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In MCF plasmas, it is extensively recognized that the micro-turbulence resulting from the trapped electron mode (TEM) and ion temperature gradient (ITG) mode instabilities may govern the anomalous particle and heat transport. Simulations and experiments have shown the coexistence of these two instabilities and the phenomena of transition between ITG and TEM. In many tokamak experiments, the temperature and density gradients can drive both micro-instabilities simultaneously, so that transitional regime is important for a detailed understanding of turbulent transport. In this work, we have performed a comprehensive investigation on the characteristics of turbulent particle flux depending on dominated TEM or/and ITG instabilities using a newly developed and well benchmarked gyro-Landau-fluid code ExFC (Extended Fluid Code). The dynamic transition between ITG and TEM is simulated. Here, the global effects of turbulent fluctuation and transport are emphasized. The ITG and TEM dominant regimes are compared between global and local simulations, showing a notable difference for the growth rate. The parametric regime of the scale-length of density and temperature for different direction of turbulent particle flux is identified as well as the type of dominant instability (ITG or/and TEM). Moreover, application of these theoretical results to understand the experimental observations on the particle transport on J-TEXT and HL-2A tokamaks will be presented.