Multiple Ion Temperature Gradient Modes and Impurity Turbulent Transport in Transport Barriers

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Experiments in tokamaks show that, in addition to neoclassical transport, small-scale turbulence induced by drift instabilities plays a significant role in particle transport. In recent H-mode experiments on HL-2A, it is found that the turbulent fluctuations induce inward particle flux and increases of density, pressure and their gradients. The particle transport in transport barriers is investigated with a gyrokinetic quasi-linear turbulent model for ion temperature gradient modes and trapped electron modes with impurity effects included. Detailed analyses of the particle flux dependence on plasma parameters, including the gradients of density and temperature, magnetic shear, safety factor, collision etc., were performed. The numerical simulation results are compared and shown reasonable agreement with the experimental observations. Moreover, the ion temperature gradient (ITG) mode, intensively studied experimentally and theoretically, has been widely accepted as a major candidate for explaining ion-scale anomalous transports. Nevertheless, most studies are usually focused on the physics of core plasma in tokamaks and performed at the medium temperature and density gradients. Recently, it is found that at steep gradients (H-mode), the most unstable mode is usually not the ground eigen state and the structure of the ballooning mode becomes unconventional. This result may contribute to explaining why H-mode has a better confinement than other regimes [1].

Keywords: Ion temperature gradient modes, impurity turbulent transport, transport barriers

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