Role of ExB Shear and Precession Shear in Electron Thermal Internal Transport Barrier Formation

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Abstract

In tokamaks, ExB shear induced turbulence suppression [1] is known to be an important mechanism in the formation of ion thermal internal transport barriers (ITBs) [2]. However, understanding different behaviour of electron thermal transport still remains a challenging problem in tokamak confinement physics. Trapped electron precession shear induced turbulence suppression was previously proposed [3] as a general nonlinear mechanism to explain electron thermal ITB formation in the presence of reversed magnetic shear configuration and local electron heating [4]. In this work, we confirm that ExB shear, as well as trapped electron precession shear, is naturally included in the two-point decorrelation theory on turbulence associated with trapped electrons by systematic derivation using modern bounce kinetic formalism [5]. We also study ExB shear and precession shear induced turbulence suppression, and synergism between ExB shear and precession shear. Relative sign between ExB shear and precession shear is found to be important as well as their magnitudes in suppressing turbulence. They can either reinforce or interfere with each other in reducing turbulence, depending on local plasma conditions. Our result provides explanations on broad range of experimental observations regarding electron thermal ITB observed in tokamaks such as TFTR and JT-60U [6, 7].

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