# Gyrokinetic Particle Simulation of Energetic Particle Instability in Fusion Plasmas

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The confinement of the energetic particles is a critical issue in the International Thermonuclear Experimental Reactor (ITER), since ignition relies on the self-heating by the energetic fusion products. Shear Alfven wave excitations by energetic particles in toroidal systems, for example toroidal Alfven eigenmode (TAE) and energetic particle mode (EPM) have been investigated as primary candidate for fluctuation-induced transport of energetic particles in fusion plasmas. In this work, TAE excitations by antenna and energetic particles are investigated in large scale first-principle simulations of fusion plasmas using the global gyrokinetic toroidal code (GTC) [Lin, Science 1998]. The capability to simulate global Shear Alfven modes in toroidal geometry has been demonstrated by GTC through systematic simulations of Shear Alfvén wave oscillations, continuum damping, and the TAE frequency gap in the long wavelength fluid limit, where kinetic effect of thermal ions and electrons are suppressed. Linear benchmarking with other kinetic and hybrid codes has been carried out for verification purpose.