Numerical modelling of fast electron transport on neoclassical tearing mode stabilization by electron cyclotron current drive

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Recent studies had shown the beam broadening of electron cyclotron wave due to plasma density fluctuations, which would affect the stabilization of neoclassical tearing modes (NTMs) by electron cyclotron current drive (ECCD) in ITER. The electric and magnetic field perturbation due to plasma turbulence can lead to the anomalous perpendicular transport of fast electrons generated by electron cyclotron wave. Together with the parallel transport, this will broaden the fast electron density profile or the driven current density profile. NTM stabilization by ECCD based on reduced MHD equations has been numerically investigated with a wide wave deposition as predicted for ITER. It is found that the mode stabilization by the modulated current drive is greatly degraded by the perpendicular diffusivity of fast electrons. The necessary modulated driven current for mode stabilization is proportional to the square root of the perpendicular diffusivity of fast electrons. When the perpendicular diffusivity of fast electrons approaches to the anomalous transport level due to plasma turbulence, the necessary modulated driven current for mode stabilization is increased by 2-4 times.