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Transverse energy transfer by Alfven waves in toroidal plasmas

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Destabilized magnetohydrodynamic (MHD) eigenmodes can transfer the energy and momentum from the region where particles (e.g., fast ions) drive the plasma instability to another region, where the destabilized waves are damped. This phenomenon named "spatial channeling" (SC) was predicted in [1,2]. A key element of the SC is that the energy and momentum of particles driving the instability are transferred by the waves (eigenmodes), not by the diffusion or heat conduction. In this work the physics of the transverse energy transfer by Alfven waves in toroidal plasmas is elucidated. It is found that, in contrast to the classical Alfven waves in infinite plasmas, the Alfven waves in toroidal systems produce plasma compression due to coupling with fast magnetoacoustic waves, which provides the energy transfer. The radial group velocities of the traveling waves constituting the Global Alfven Eigenmodes and Toroidicity-induced Alfven Eigenmodes are calculated. It is shown that equation for Alfven eigenmodes derived in the approximation of vanishing wave field along the equilibrium magnetic field reproduce the longitudinal magnetic field of the wave and lead to correct transverse energy flux. The obtained results explain how Alfven eigenmodes can provide the spatial energy channeling. The results of this work are published in [3].
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