Nonlinear dynamics of reversed shear Alfvén eigenmode induced by mode coupling

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In Tokamak plasmas, a variety of shear Alfvén wave (SAW) eigenmodes, such as the toroidal Alfvén eigenmode (TAE), reverse shear Alfvén eigenmode (RSAE) and beta-induced Alfvén eigenmode (BAE) exist due to the equilibrium magnetic geometry. SAWs can be strongly driven by energetic particles (EPs) such as α-particles and in turn, leading to significant EP anomalous transport, degradation of burning plasma performance and potentially damage of the plasma facing components. In future fusion reactor such as ITER, typically characterized by reversed shear configuration, α -particles are generated in the core region where may excite RSAE first. So understanding the generation, evolution and saturation of RSAE is important in the future burning plasmas.

RSAE is localized near the minima of the magenetic safety factor , and is composed by one dominant poloidal harmonic. In this work, two nonlinear coupling channel are analyzed using gyrokinetic theory. One channel is the nonlinear coupling of TAE and RSAE to generate a geodesic acoustic mode (GAM) during current ramping. The other channel is the nonlinear excitation of zero-frequence zonal structure (ZFZS) by RSAE via modulation. The expected results, may contribute to the understanding of SAW dynamics as well as energetic particles confinement in future burning plasma.

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