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Nonlinear Excitation of Kinetic Geodesic Acoustic Modes by Drift Waves in Nonuniform Plasmas

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In this work, nonlinear excitation of geodesic acoustic modes (GAM) by drift wave (DW) turbulence is investigated, taking into account effects of finite kinetic dispersiveness and system nonuniformities. The nonlinear equations describing nonlinear parametric decay of DW into GAM and DW lower sideband are derived using nonlinear gyrokinetic theory。 The corresponding governing equations are solved both analytically and numerically to investigate the effects of finite kinetic dispersiveness and system nonuniformities on the parametric decay process, such as nonuniform diamagnetic frequency, finite radial envelope and DW pump and GAM continuum. It is found that the parametric decay process is a convective instability for typical tokamak parameters when finite group velocities associated with kinetic dispersiveness and finite radial envelope are taken into account. When, however, nonuniformity of diamagnetic frequency is taken into account, the parametric decay process becomes, time asymptotically, a quasi-exponentially growing absolute instability. The nonuniformity of GAM continuum, meanwhile, causes radial symmetry breaking between outward and inward propagating modes, but the qualitative picture remains the same.

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