Effect of Resonant Magnetic Perturbations on Secondary Structures in Drift Wave Turbulence

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The control of Edge Localized Modes is a major concern for next step fusion devices like ITER. One promising technique for ELM control makes use of Resonant Magnetic Perturbations (RMPs) produced by a set of external coils [1-5]. Recent experiments showed a decrease of long range correlations during the application of RMPs [6]. This finding suggests that RMPs damp zonal flows. To elucidate the effect of the RMPs on zonal structures in drift wave turbulence, we construct a generalized Hasegawa-Wakatani model including RMP fields. The effect of the RMPs is to induce a linear coupling between the zonal electric field and the zonal density gradient, which drives the system to a state of radial force balance for large $|\frac{\delta B_r}{B}|^2$. We solve the coupled modulation equations for zonal vorticity and zonal density modes of the generalized H-W system. Both the vorticity flux, (Reynolds stress) and particle flux are modulated, each by both zonal shear an zonal density gradients. A novel product of nonlinear and RMP effects couples the zonal potential and density modes in the eigenvalue equation. RMP-induced zonal flow damping is calculated explicitely and the marginal point for growth of zonal flow modulations is determined. Ongoing work focuses on constructing an extended predator prey model which couples zonal potential and density dynamics to the evolution of turbulence intensity. This model has both turbulence drive and RMP amplitude as control parameters, and will likely predict novel types of transport bifurcations in the presence of RMPs.

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