Zonal Flow Induced by Energetic Particles in Tokamak

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Zonal flow induced by energetic particles in tokamak is investigated with plasma rotating effects. In the rotating plasma a gyro-kinetics is given which can deal with arbitrary frequency problems. A self-consistent dispersion relation is rigorously derived with a finite wave-number. The calculated real frequency is about half of the transit frequency (Figure 1). The frequency is slightly up chirping and damping rates are reduced with increase of hot ion population and plasma rotating (Figure 2) which will be helpful for generating zonal flow and L-H transition [1]. The co-current flow benefits confinement which is consistent with the experiment in the DIII-D tokamak and contrast to the work given by Deng Zhou [2] in which eikonal approximation losses the parallel resonant feature.

References

[1] Zhongtian Wang, Zhixiong He, Jiaqi Dong, Yifan Yan, Huidong Li, Hao Feng, and Libin Fu, Phys. Plasmas 23, 122516 (**2016**)

[2] Deng Zhou, Phys. Plasmas 21, 082508 (**2014**)

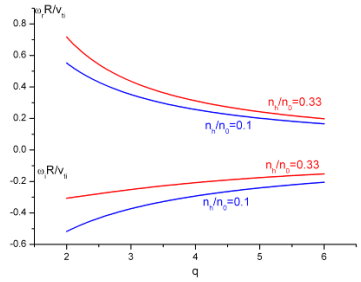

Figure 1. Frequency and damping rate versus q for an energetic particle with $k_r\rho_i = 0.7$

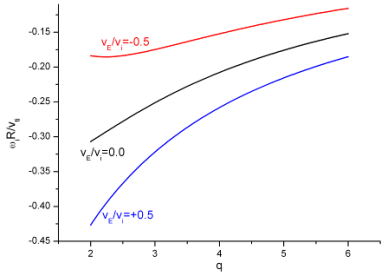

Figure 2. Damping rate versus q for different rotation speeds. Parameters are $n_h / n_0 = 0.33$ and $k_r\rho_i = 0.7$.