1C36

Importance of Non-Linear Effects on Tridimensional Singular Modes of Accretion Disks and Inadequacies of Axisymmetric Modes*

P.S. Coppi[+] and B. Coppi[++]

+Yale University, New Haven, CT 06511
++Massachusetts Institute of Technology, Cambridge, MA 02139

Tridimensional modes [1], which are singular when described by the linearized ideal MHD approximation, are shown to be capable of producing outward transport of angular momentum at a significant rate in thin accretion disks. These modes are localized radially with two sets of singularities where the Doppler shifted frequency equals the shear Alfén mode frequency the latter set of singularities being the most difficult to resolve. The contribution of non-linearities is demonstrated to be important even for very small values of the mode amplitude at these singularities and model equations, which can describe the transition across the singularities, are identified and solved [2]. The rate of the transport of angular momentum is evaluated from the relevant quasilinear theory.

While tridimensional modes can exist in the case where the magnetic energy density is significant relative to the thermal energy density, two dimensional modes can be found only when the magnetic energy is much smaller than the thermal energy. They are vertically localized ballooning modes with relatively small growth rates and are oscillatory but not localized radially [2]. Both the growth rates and the radial mode number have discrete spectra. This feature makes it difficult to construct mode packets in order to resolve the problem of the radial localization of the modes. When all factors are taken into account, the axisymmetric modes that can fit into a thin magnetized disk do not appear to be suitable to produce transport of angular momentum at the rate necessary for realistic accretion disk models. These modes are, in fact, topologically quite different from the original Velikhov instability [3] of a magnetized rotating cylinder.

*Sponsored in part by the U.S. Department of Energy

[1] B. Coppi and P.S. Coppi, *Phys. Rev. Lett.*, **87**, 5, 051101-1 (2001)
[2] B. Coppi and P.S. Coppi, Massachusetts Institute of Technology, R.L.E. Report PTP-01/04 (Cambridge, MA, 2001) Submitted to Phys. Rev. Lett.
[3] E.P. Velikhov, *Soviet Phys.*, JETP, **36**, 995 (1959)