MHD WAVES IN DISKS.

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It is known that the disk particles surrounding a protostar must lose their angular momentum in order to be accreted. The most accepted mechanism in the literature that allows this accretion to occur is the magneto-rotational instability (MRI). However, this mechanism only exists if the gas in the disk is sufficiently ionized to be coupled to the magnetic field.

MHD modes can arise in magnetized and turbulent media as found in star formation sites. Supposing that such turbulent edges cause magnetic field lines displacement, a spectrum of Alfvén waves can be produced. On the other hand, it is known that dust grains are present in this media. Dust grains immersed in an ambient plasma become charged due to plasma ion and electron fluxes into grain surfaces. Although the number of dust particles is smaller than the ions ones, the process of dust charging is usually efficient in astrophysical media and these particles can obtain charges $q_d = -z_d e$ in the order of $z_d \sim 10^0 - 10^3$ (Goertz 1989; Mendis & Rosenberg 1994). Once charged, these particles suffer the influence of the magnetic field giving rise to a cyclotron frequency. Thus, they can modify the plasma behavior in different ways. In particular, charged dust particles introduce a cutoff (resonance) in the Alfvén wave spectrum at the dust cyclotron frequency. For the ions, this resonance occurs in a narrow range of higher frequencies, being unimportant in the systems under consideration here. The dust cyclotron resonance occurs in low frequencies and it can be an important damping mechanism for the waves. If a distribution of grain sizes is considered, then we obtain a band of resonance frequencies.

Besides the viscous heating mechanism often included in the models by means of the α prescription (Shakura & Sunyaev 1973), in this work we study the damping of Alfvén waves as an additional heating source. Although this non-thermal heating mechanism was already suggested by Vasconcelos et al. (2000), it was not considered in the context of the presence of a dusty plasma. As disks are composed by dust grains, if we assume that the waves are damped while propagating through the disk, the propagation of the waves can be affected if the disk particles present some charge. We focus on an early phase of disk formation. In our model, we presume grains and gas well mixed and disk in stationary state. In order to analyze the propagation of Alfvén waves in the disks, we surmise that the disk is geometrically thin, optically thick, and is in Keplerian rotation. Considering that it radiates like a black-body, we obtain its effective temperature by setting the equilibrium between the energy flux liberated by the dissipation processes and the black-body energy flux. To evaluate the midplane disk temperature we then adopt the opacity law of Bell & Lin (1994).

We show that the damping of Alfvén waves can increase the temperature of the disk that leads to an increase on the ionization fraction, making possible the presence of the MRI in a larger part of the disk.

References

- Bell, K. R. & Lin, D. N. C., 1994, Astroph. Journal, 427, 987
- Goertz, C. 1989, Rev. Geophys., 27, 271
- Mendis, D., & Rosenberg, M. 1994, Annual Review of Astron. and Astrophys., 32, 419
- Shakura, N. I., & Sunyaev, R. A. 1973, Astron. & Astrophys., 24, 337
- Vasconcelos, M. J., Jatenco-Pereira, V., & Opher, R. 2000, Astroph. Journal, 534, 967