EPSC Abstracts
Vol. 8, EPSC2013-211, 2013
European Planetary Science Congress 2013

Dead zone inner edge dynamics in protoplanetary disks

J. FAURE (1,2), S. FROMANG (1,2) and H. LATTER (3)
(1) CEA, Irfu, SAp, Centre de Saclay, F-91191 Gif-sur-Yvette, France (julien.faure@cea.fr) , (2) UMR AIM, CEA-CNRS-Univ. Paris VII, Centre de Saclay, F-91191 Gif-sur-Yvette, France, (3) Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Centre for Mathematical Sciences, Wilberforce Road, Cambridge, CB3 0WA, UK

Abstract

In protoplanetary disks, the inner boundary between an MRI active and inactive region has recently been suggested to be a promising site for planet formation. A set of numerical simulations (Dzyurkevich et al. 2010, Lyra et al. 2012) has indeed shown that vortex formation mediated by the Rossby wave instability is a natural consequence of the disk dynamics at that location. However, such models have so far considered only the case of an isothermal equation of state, while the thermodynamics of this region is more complex. Gas is heated by turbulent dissipation and radiatively cools on long timescales because disks are optically thick.

Using a mean field model of the dynamics of that boundary, Latter and Balbus (2012) have shown that this complexity can lead to situation in which the active/dead interface moves systematically inward or outward. This is because turbulent activity is controlled by ohmic resistivity that is itself a sensitive function of temperature. Such a behavior could have catastrophic consequences on vortex formation at the interface.

Using the Godunov code Ramses, we have performed 3D global numerical simulations of protoplanetary disks that relax the isothermal hypothesis. We confirm the existence of such MRI fronts. We find from the detailed study of the dead zone thermodynamics that the front propagation mechanism involves waves generated at the interface. Every fronts obtained in MHD simulations tend to stop at a critical radius which satisfy the criteria given by Latter and Balbus (2012). We finally assert that structures forming at the interface survive the front travel until it reaches its final position.