Direction des Sciences de la Matière
IRFU
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Soutenance de thèse du Service d'Astrophysique

THERMODYNAMICS OF THE DEAD ZONE INNER EDGE IN PROTOPLANETARY DISKS

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Jeudi 25 septembre – 14h00

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The dead zone, a quiescent region enclosed in the turbulent flow of a protoplanetary disk, seems to be a promising site for planet formation.

Indeed, the development of a density maximum at the dead zone inner edge, that has the property to trap the infalling dust, is a natural outcome of the accretion mismatch at this interface. Moreover, the flow here may be unstable and organize itself into vortical structures that efficiently collect dust grains.

The inner edge location is however loosely constrained. In particular, it depends on the thermodynamical prescriptions of the disk model that is considered.

It has been recently proposed that the inner edge is not static and that the variations of young stars accretion luminosity are the signature of this interface displacement.

This thesis addresses the question of the impact of the gas thermodynamics onto its dynamics around the dead zone inner edge.

MHD simulations including the complex interplay between thermodynamical processes and the dynamics confirmed the dynamical behaviour of the inner edge. A first measure of the interface velocity has been realised. This result has been compared to the predictions of a mean field model. It revealed the crucial role of the energy transport by density waves excited at the interface.

These simulations also exhibit a new intriguing phenomenon:

Vortices forming at the interface follow a cycle of formation-migration-destruction. This vortex cycle may compromise the formation of planetesimals at the inner edge.

This thesis claims that thermodynamical processes are at the heart of how the region around the dead zone inner edge in protoplanetary disks works.