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Abstract Template for 1st Asia-Pacific Conference on Plasma Physics

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Circumstellar disks are supposed to form as natural by-products of star formation processes due to large angular momenta in natal molecular cloud cores. As the initial angular momentum is much larger than that of a formed star, efficient mechanisms of angular momentum transport are required in star and disk formation processes. Gravitational torque is important when magnetic fields are weak, but typically magnetic fields observed in molecular clouds are strong enough to remove angular momenta efficiently and overcome the centrifugal barrier. In fact, it was pointed out that magnetic fields transport angular momentum too efficiently and it is difficult to form a circumstellar disk in the early phase of star formation. Obviously this problem cannot be real because many protoplanetary disks and extra-solar planets have been observed, and because the fraction of binaries or multiples is known to be high. In order to circumvent this magnetic braking catastrophe, many solutions have been proposed recently.

Because of the high density and low temperature, the ionizing degree in star forming clouds is so low that non-ideal magnetohydrodynamic effects such as Ohmic dissipation and ambipolar diffusion work effectively. These effects extract magnetic flux from the dense region and suppress angular momentum transport. Using non-ideal MHD simulations, we demonstrate that these effects can resolve the so-called magnetic braking catastrophe in the early phase of star formation and enable disk formation. We also compare our results with an observation of young circumstellar disk using synthetic observation technique and find good agreement.

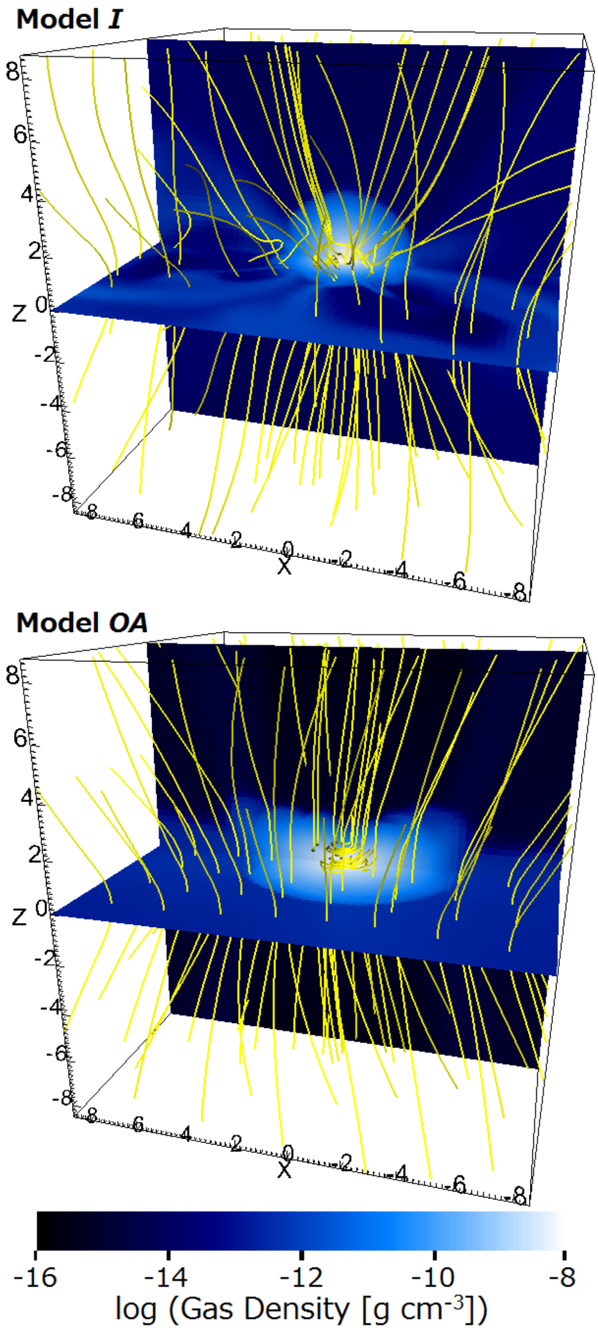

Figure: Density cross-sections (color) and magnetic field lines (yellow) of the ideal MHD model (top) and non-ideal MHD model including both Ohmic dissipation and ambipolar diffusion (bottom). The non-ideal MHD effects suppress angular momentum transport and enable disk formation.

References

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