P123a Synthetic Observations of Early Evolution of Protoplanetary Disks

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Protoplanetary disks are important as the initial and boundary conditions of planet formation. Also, because protoplanetary disks reflect angular momentum transport in star forming clouds and controll accretion onto forming protostars, we need to consisntently understand their formation and evolution in the context of star formation. Theoretically, many physical processes such as magnetic fields and self-gravity are involved but their relative significance is yet unclear. Because now we can directly observe young protoplanetary disks with ALMA, direct comparison between theoretical models and high-quality observations is now highly demanded.

For this purpose, we perform synthetic observations based on the MHD simulations of Machida & Hosokawa (2013). We first recalculate the temperature distribution using radiation transfer since the barotropic approximation adopted in the base models cannot reproduce realistic temperature distribution. Then we perform molecular line transfer assuming local thermodynamic equilibrium. These radiation calculations are done using publicly available Monte-Carlo radiation transfer software RADMC-3D (Dullemond 2012). Our models cover the early phase of disk evolution ($M_* < 0.4 M_\odot$) and typical molecular lines such as ^{12}CO, ^{13}CO and C^{18}O. Based on these models, we use the ALMA simulator and produce data sets that can be directly compared with observations, such as moment maps and position-velocity diagrams. We find that we can measure the rotation profiles even in the early phase of disk evolution with a high spatial and spectral resolution within a resonable observation time. Our models are useful for interpreting observations of young protoplanetary disks.