# Development of a numerical simulation code of the radiative transfer in protoplanetary disks

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Recent advances of the observational facilities supply the detailed spectral energy distributions (SED) and images of scattered light and dust thermal emission of protoplanetary disks. We have developed a numerial simulation code of the radiative transfer to compare such observational results.

We started from reproducing Dullemond et al.(2002). This is so-called 1+1D code in which radiation from the central star is solved by a grazing-angle method and thermal emission from dust is solved by a one-dimensional variable Eddington factor method along the vertical axis of the disk. Importantly, this code calculates the radiation and the disk structure simultaneously because the SED and images from the radiative transfer strongly depend on the disk structure. We have confirmed a very good agreement of the temperature and density structure of the disk between ours and Dullemond et al.

Nest, we have incorporated scatterings of the radiation from the central star and of the thermal emission from dust into the code, assuming the scatterings are isotropic. In particular, the scattering of the dust thermal emission is taken into account in the radiative transfer code in protoplanetary disks, for the first time. This is an improvement to consider that albedo for the thermal emission becomes not negligible as the dust grain size grows. In addition, we are developing a case solving the radiation from the central star with a two-dimensional ray-trace method which has a small problem treating the disk inner edge for the moment.

As an initial result, we have found that there is no significant difference in the disk structure between the cases with and without the scattering for 0.1 micron or 10 micron dust cases. On the conference day, we will discuss the scattering effects on the disk SED and images.