High-resolution multiband imaging for investigating the radial variation of the spectral index in the protoplanetary disk around TW Hya

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Revealing planet formation and material evolution in protoplanetary disks is a key for understanding the origin and diversity of planetary systems. One way to address the planet formation scenario is to reveal the evolution of dust grains, i.e., dust size distribution, in protoplanetary disks. An efficient way to investigate the dust size distribution is to measure the spectral index by multiband observations. In our previous study (Tsukagoshi et al. 2016), we revealed the radial variation of the spectral index in the protoplanetary disk around TW Hya in detail. However, the uncertainty in the distribution of the spectral index still remain because it was taken when the array configuration was not optimized.

In this presentation, we show the result of our new multiband analysis for the protoplanetary disk around TW Hya. We use a set of ALMA archive data at Band 4, 6, and 7, including our new observations, to improve the spectral index map by using high-resolution and high-sensitivity ALMA data. The UV coverage is well sampled, and the sensitivity is approximately three times better than that of our previous study. We find that the spectral index decreases toward the disk center from ~3 to 1.5, as previously reported. The lower spectral index than 2 at the inner part of the disk could be interpreted by the scattering effect at the optically thick region. The enhancement of the spectral index associated with the 25 au gap is slightly decreased to be 2.5. This leads to a flatter beta profile around the gap compared with the previous one if a power-law temperature distribution is adopted. We also report the finding of a tail-like feature that azimuthally extends for ~0.5arcsec (~30au) from the millimeter blob at 52au reported in Tsukagoshi et al. (2019). This new feature may be reminiscent of a dust trail or a spiral arm associated with the blob.

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