Probing the Grain Growth Signatures in Class 0 Young Stellar Objects

Naomi Hirano[1], Jennifer I-Hsiu Li[1,2], Hauyu Baobab Liu[3], and Yasuhiro Hasegawa[4]

[1]*Institute of Astronomy and Astrophysics, Academia Sinica, Taiwan,* [2]*University of Illinois, USA,* [3]*European Southern Observatory, Germany,* [4]*Jet Propulsion Laboratory, U.S.A.*

When and how does the maximum dust grain size grow from micron-size to millimeter-size in protoplanetary disks? This is one of the crucial questions when addressing the formation of planetesimals and planetary systems in star-forming regions. Observationally, the maximum size of dust grains could be constrained by the dust opacity indices β.

We are motivated by the recent measurements of β around young stellar objects (YSOs), which suggest that efficient grain growth may have occurred earlier than the Class I stage. The present work makes use of abundant archival interferometric observations at submillimeter, millimeter, and centimeter wavelength bands to examine grain growth signatures in the dense inner regions (<1000 AU) of nine Class 0 YSOs. A systematic data analysis is performed to derive dust temperatures, optical depths, and dust opacity indices based on single-component modified black body fittings to the spectral energy distributions (SEDs). The fitted dust opacity indices (β) are in a wide range of 0.3 to 2.0 when single-component SED fitting is adopted. Five out of nine observed sources show β values close to or consistent with 1.7, the typical value of the interstellar dust. Remaining four sources show β lower than 1.7, which may be explained by the effect of dust grain growth. Alternatively, the very small observed values of β may be interpreted by the presence of deeply embedded hot inner disks, which only significantly contribute to the observed fluxes at long wavelength bands.

Our current analysis found no firm evidence of grain growth in these YSOs. A comparison with the previous observations of Class II sources implies that grain growth would start to significantly reduce the values of β no earlier than the late-Class 0 stage but before the Class II stage of YSOs.