Resolving the Circumstellar Disk of HL Tauri at Millimeter Wavelengths

Woojin Kwon (1), Leslie W. Looney (1), Lee G. Mundy (2) ((1) University of Illinois at Urbana-Champaign, (2) University of Maryland)

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We present results of high-resolution imaging toward HL Tau by the Combined Array for Research in Millimeter-wave Astronomy (CARMA). We have obtained 1.3 and 2.7 mm dust continua with an angular resolution down to 0.13 arc second. Through model fitting to the two wavelength data simultaneously in Bayesian inference using a flared viscous accretion disk model, we estimate the physical properties of HL Tau, such as density distribution, dust opacity spectral index, disk mass, disk size, inclination angle, position angle, and disk thickness. HL Tau has a circumstellar disk mass of 0.13 solar mass, a characteristic radius of 79 AU, an inclination of 40 degree, and a position angle of 136 degree. Although a thin disk model is preferred by our two wavelength data, a thick disk model is needed to explain the high mid- and far-infrared emission of the HL Tau spectral energy distribution. This could imply large dust grains settled down on the mid plane with fine dust grains mixed with gas. The HL Tau disk is likely gravitationally unstable and can be fragmented between 50 and 100 AU of radius. However, we did not detect dust thermal continuum supporting the protoplanet candidate claimed by a previous study using observations of the Very Large Array at 1.3 cm.

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