Cold Gas and Dust in the Outer Disk

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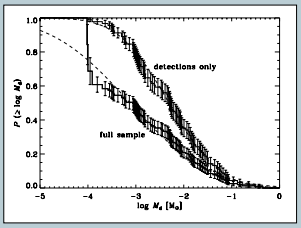
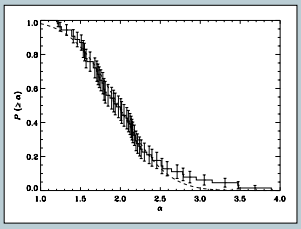
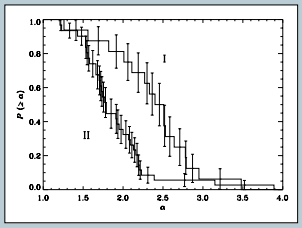
Multiwavelength Submillimeter Continuum Survey of Taurus-Auriga Disks

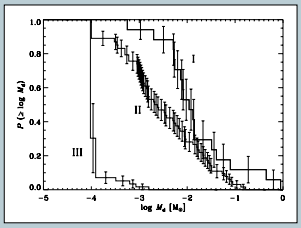
We have conducted a sensitive, multiwavelength submillimeter continuum survey of 153 YSOs in Taurus-Auriga. The inferred circumstellar disk masses are log-normally distributed with a mean mass of ~ 5 x 10^{-3} solar masses, and only ~35% having a mass larger than the Minimum Mass Solar Nebula value. The median disk to star mass ratio is roughly 0.5%. The empirical frequency behavior of the submillimeter continuum is best described as a power law with index 2.0 +/- 0.5 between 350 microns and 1.3 mm, which is likely due to the combined effects of the fraction of optically-thick emission and a flatter frequency behavior of the grain opacity compared to the ISM. There is evidence for a significant decrease in both disk mass and submillimeter continuum slope along the canonical infrared SED evolution sequence. The fraction of objects detected in the submillimeter is nearly identical to the fraction with excess near-IR emission, suggesting that the dust dissipation timescale does not have a strong radial dependence in the disk.





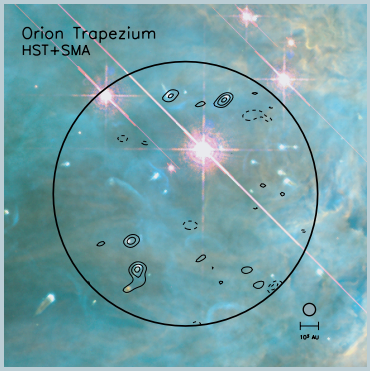
Cumulative distributions of disk masses (top) and power law indices of the submillimeter frequency behavior (bottom). The ordinate is the probability that an object has a disk mass or submillimeter continuum slope greater than or equal to each abscissa value. Disk masses are log-normally distributed and the continuum slopes are normally distributed, with the best fit distributions overlaid as dashed curves.





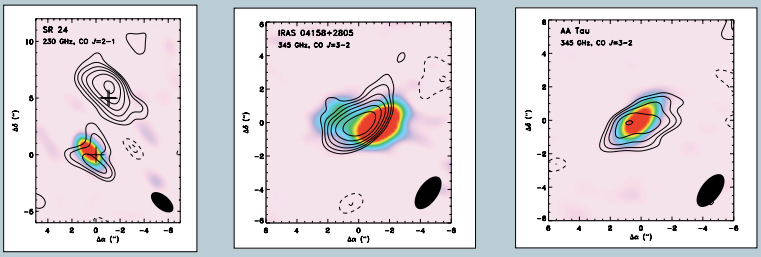
Cumulative distributions of submillimeter continuum slopes (top) and disk masses (bottom) for different SED classes, showing the decreasing values along the evolutionary sequence. The changes are likely due in some part to collisional coagulation of grains in the disk midplane.

Submillimeter Array Detections of Proplyds in the Orion Trapezium



Submillimeter Array (SMA) 880 micron continuum map toward the proplyds in the Orion Trapezium, overlaid on the optical image from Bally et al. (1998, AJ, 116, 854). The contours are 3, 5, 7,... times the rms noise. The 5 detected proplyds have masses similar to the Minimum Mass Solar Nebula (~0.01 to 0.03 solar masses). Another 18 proplyds in the field of view are undetected, with a 3-σ upper limit of ~5 x 10^{-3} solar masses.

High-Resolution Gas and Dust Observations with the SMA



Early results from an ongoing high-resolution interferometric survey of the CO line emission (contours) and dust continuum emission (false color) of Taurus and Ophiuchus disks with the SMA. (left) -- The SR 24 hierarchical triple system. The isolated primary has a normal Class II disk, and the close (~ 30 AU) binary to the north is undetected in the continuum, but has a large CO disk (see Andrews & Williams 2005, ApJL, 619, L175). (middle) -- A resolved, edge-on disk around the Class I M6 dwarf IRAS 04158+2805 which shows evidence for Keplerian CO rotation and possibly a collimated molecular outflow. (right) -- The AA Tau disk, part of a survey to compare CO and dust emission across the IR SED evolutionary sequence.

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