The Transitional Protoplanetary Disk Frequency as a Function of Age: Disk Evolution in the Coronet Cluster, Taurus, and Other 1--8 Myr-old Regions

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Abstract: We present Spitzer 3.6--24 micron photometry and spectroscopy for stars in the 1--3 Myr-old Coronet Cluster, expanding upon the survey of Sicilia-Aguilar et al. (2008). Using sophisticated radiative transfer models, we analyze these new data and those from Sicilia-Aguilar et al. (2008) to identify disks with evidence for substantial dust evolution consistent with disk clearing: transitional disks. We then analyze data in Taurus and others young clusters -- IC 348, NGC 2362, and eta Cha -- to constrain the transitional disk frequency as a function of time. Our analysis confirms previous results finding evidence for two types of transitional disks -- those with inner holes and those that are homologously depleted. The percentage of disks in the transitional phase increases from ~ 15--20% at 1--2 Myr to > 50% at 5--8 Myr; the mean transitional disk lifetime is closer to ~ 1 Myr than 0.1--0.5 Myr, consistent with previous studies by Currie et al. (2009) and Sicilia-Aguilar et al. (2009). In the Coronet Cluster and IC 348, transitional disks are more numerous for very low-mass M3--M6 stars than for more massive K5--M2 stars, while Taurus lacks a strong spectral type-dependent frequency. Assuming standard values for the gas-to-dust ratio and other disk properties, the lower limit for the masses of optically-thick primordial disks is Mdisk ~ 0.001--0.003 M*. We find that single color-color diagrams do not by themselves uniquely identify transitional disks or primordial disks. Full SED modeling is required to accurately assess disk evolution for individual sources and inform statistical estimates of the transitional disk population in large samples using mid-IR colors.