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The Lifetime of Protoplanetary Disks Surrounding Intermediate-mass Stars

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To quantitatively and comprehensively study the lifetime of protoplanetary disks surrounding intermediate-mass stars (~2-6 solar mass), we derived their disk fraction (IMDF) only using near-infrared JHK photometric data with a robust method with which the IMDF can be derived with high accuracy. We applied this method to all well-known nearby (heliocentric distance of <~ 3kpc) and young (<~5Myr) clusters. The derived JHK IMDFs appear to approximately follow an exponential decay with the cluster age. From the best fit of the decay curve, the characteristic decay timescale for intermediate-mass stars is found to be 1.5 plus or minus 0.2Myr with an initial IMDF of 42 plus or minus 11 %. The estimated decay timescale is about half of that for low-mass stars (about 3Myr), showing the decay timescale is proportional to $M_{*}^{-0.5\ plus\ or\ minus\ 0.2}$, where M_{*} is stellar mass. This is consistent with previous works that qualitatively suggest this dependence. As for the disk lifetime, which is defined as the timescale of disk fraction to bottom out, we found that the outer MIR-disk traced by *Spitzer* 8um excess have about 4Myr longer lifetime than K-disk, which is the innermost dust disk traced by K-band excess emission. Because such time-lag is not seen for low-mass stars, this long “transient phase” may be a special characteristics for intermediate-mass stars, such as higher planet formation rate for higher mass stars, and faster inner disk dispersal compared to low-mass stars.

Keywords: protoplanetary disk, disk evolution, intermediate-mass stars, exoplanet