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The Role of Multiplicity in Protoplanetary Disk Evolution

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Abstract. Interactions with close stellar or planetary companions can significantly influence the evolution and lifetime of protoplanetary disks. It has recently become possible to search for these companions, directly studying the role of multiplicity in protoplanetary disk evolution. We have described an ongoing survey to directly detect these stellar and planetary companions in nearby star-forming regions. Our program uses adaptive optics and sparse aperture mask interferometry to achieve typical contrast limits of $\Delta K = 5-6$ at the diffraction limit (5–8 M_{Jup} at 5–30 AU), while also detecting similar-flux binary companions at separations as low as 15 mas (2.5 AU). In most cases, our survey has found no evidence of companions (planetary or binary) among the well-known "transitional disk" systems; if the inner clearings are due to planet formation, as has been previously suggested, then this paucity places an upper limit on the mass of any resulting planet. Our survey also has uncovered many new binary systems, with the majority falling among the diskless (WTTS) population. This disparity suggests that disk evolution for close (5–30 AU) binary systems is very different from that for single stars. As we show in Figure 1, most circumbinary disks are cleared by ages of 1–2 Myr, while most circumstellar disks are not. These diskless binary systems have biased the disk frequency downward in previous studies. If we remove our new systems from those samples, we find that the disk fraction for single stars could be higher than was previously suggested.

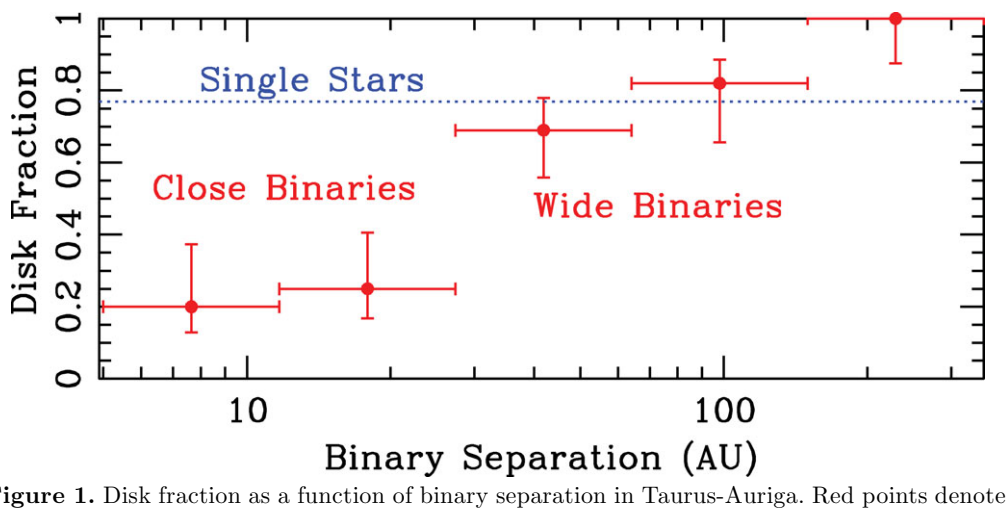

Figure 1. Disk fraction as a function of binary separation in Taurus-Auriga. Red points denote the disk fraction for several ranges of projected binary separations, while the blue dotted line shows the disk fraction for apparently single stars. Binary systems with separations of <30 AU have a significantly lower disk fraction than the population as a whole, whereas the disk fractions for wider binary systems and for single stars are indistinguishable.