THE STAR/DISK CONNECTION IN NGC 2264: SPECTROSCOPIC MEASURES OF ROTATION AND ACCRETION.

K. R. Covey, P. Teixeira, *Harvard-Smithsonian Center for Astrophysics, 60 Garden St, Cambridge, MA 02138, USA, (kcovey@cfa.harvard.edu)*.

We know that stars lose a large fraction of their angular momentum during their formation; otherwise, stars would rotate much more rapidly on the zero age main sequence than they do (Hartmann1989). The interaction of a young star with its circumstellar disk via magnetospheric accretion columns, also known as disk locking, (Ostriker1995) is expected to extract angular momentum, though accretion powered stellar winds could also solve the 'angular momentum problem' (Matt 2005, Matt 2005a). Observations show that slowly rotating young stars preferentially host circumstellar disks (Edwards 1993, Herbst 2001, Rebull et al. 2006), though objects with and without disks possess a wide range of rotation speeds. Recent work even suggests that rotational braking must begin before a star becomes optically visible (Covey 2005).

Hectochelle observations, originally analyzed by Furesz et al. 2006, have identified 471 members of NGC 2264; these spectra have not, however, been analyzed in depth to provide estimates of the rotation velocity (v sin i) or mass accretion rate ($\dot{M}$) for each of these stars. We plan to measure the rotation velocity and mass accretion rate from each spectrum, and then combine this information with parameters previously derived for members of NGC 2264. Specifically, combining our measured v sin is with photometric periods (Lamm et al. 2005; Makidon 2004) will provide a direct estimate of the stellar radius (modulo the inclination; that is, R_* sin i) of each star. IRAC imaging diagnoses the properties of circumstellar disks (most interestingly, R_{trunc}; Teixeira et al. 2008), while Chandra observations provide X-ray fluxes (Flaccomio et al. 2005; Rebull et al. 2006), which have been linked to rotation in main sequence stars.

Using this suite of measured stellar parameters, we will perform several tests of angular momentum evolution in the pre-main sequence phase:

– **Are the rotation axes of stars in young clusters randomly distributed?** Inferring characteristic equatorial rotation velocities from a measured distribution of v sin is values requires an assumption concerning the distribution of inclinations within the system. Typically, investigators assume stellar rotation axes are randomly distributed in space, but one of the few tests of this assumption found a mean value of $<\sin i>$ significantly smaller than would be expected for a random distribution of inclinations (Rhode et al. 2001). Comparing v sin i values to estimates of each star's equatorial velocity (derived from its photometric period and radius) reveals a star's inclination; with photometric periods available for 400+ members of NGC 2264 (Makidon et al. 2004, Lamm et al. 2005), we will be able to test the degree to which stellar rotation axes are truly distributed isotropically.

– **Are rotation studies based on photometric periods potentially biased?** Previous studies (Stassun 2004, Flaccomio et al. 2006, Rebull 2006) have found evidence that stars with photometric periods are biased towards high X-ray luminosities. If stars with low X-ray luminosities possess unique rotational characteristics, conclusions drawn from studies of photometric periods may need to be revisited. Our spectroscopic measurements will provide v sin i rotation rates for all stars with high S/N spectra, testing for the presence of any subtle bias in the rotation properties of stars with measured photometric periods.