Stellar Multiplicity and the Planet-Forming Potential of Low-Mass Stars. K. Ward-Duong[1], J. Patience[1], R. De Rosa[2], J. Bulger[3], A. Rajan[1], S. Goodwin[4], R. J. Parker[5], D. McCarthy[6], C. Kulesa[6], G. van der Plas[7], F. Ménard[8], C. Pinte[9], A. P. Jackson[10,1], G. Bryden[11], N. J. Turner[11], P. M. Harvey[12], and A. Hales[13]
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Introduction: Given their long lifespans and low luminosities and masses, the lowest-mass stars present a particularly intriguing population in the search for exoplanets and potentially habitable systems. However, much is still uncertain regarding the amenability of these stellar systems to host planetary companions. Here we present results from two studies probing the multiplicity and environmental properties of low-mass stars: (1) The MinMs (M-dwarfs in Multiples) Survey, a large, volume-limited survey of 245 field M-dwarfs within 15 pc, and (2) the TBOSS (Taurus Boundary of Stellar/Substellar) Survey, an ongoing study of disk properties for the lowest-mass members within the Taurus star-forming region. Stellar multiplicity provides a critical observational signature of the star formation process, and binaries and higher-order systems, and their protoplanetary disk properties, have important implications for planet formation and evolution. High-resolution direct imaging provides the capability to comprehensively search for companions with projected separations covering a few AU outwards for the nearest stars, and submillimeter interferometry provides a high angular resolution view into the disk dust properties of more distant, young, low-mass systems. For binary studies, nearby M-dwarfs present an ideal balance of achievable contrast and high proper motion allowing both survey completeness beyond the substellar limit and rapid companion confirmation. By combining adaptive optics and wide-field imaging, the MinMs Survey provides new measurements of the companion star fraction, separation distribution, and mass ratio distribution for the nearest K7-M6 dwarfs, and includes ongoing efforts to characterize their substellar companions. For the ALMA survey of Taurus protoplanetary disks, we report 885µm continuum flux densities for 24 low mass members of Taurus, spanning the stellar/substellar boundary with spectral types from M4 to M7.75. With submillimeter obesrvations, our objective is to understand how protostellar disks evolve and form planets around the lowest-mass stars.

The M-dwarfs in Multiples (MinMs) Survey: We have conducted a large-scale M-dwarf companion study covering separations from 3 to 10,000 AU, based on a volume-limited survey of 245 M-dwarfs within 15 pc [1]. By combining adaptive optics imaging (CFHT, VLT, MMT, Subaru) and archival wide-field plate imaging (SuperCOSMOS Sky Survey), we identified 65 co-moving stellar companions exhibiting common proper motion, including four newly-discovered systems. Over a 3-10,000 AU separation range, we find a companion star fraction of 23.5%+/-3.2%. This fraction is significantly lower than that of higher-mass solar-type and A-type stars, providing a critical comparison for low-mass stars, as the binary fraction provides a parameter for the survival of stable planetary systems [2].

An ALMA Survey of Low-Mass Stars and Brown Dwarf Disks: With an ALMA 885µm continuum imaging program to explore the protoplanetary disks around low-mass protostars in the nearby Taurus star-forming region [3], we investigate how the disks' properties vary within a population of young stars of a given age, and whether the lowest-mass stars and brown dwarfs have enough orbiting material in small dust grains to form planets. The target sample consists of 24 low mass members of Taurus with previous *Herschel* detections [4], of which 22 are detected at levels ranging from 1.0 mJy/beam to 55.6 mJy/beam. The two continuum non-detections are transition disk systems, although other transition disks in the sample are detected. Applying standard scaling laws or radiative transfer modeling to convert the ALMA continuum measurements to masses yields dust mass estimates ranging from ~0.3 to ~22 Earth masses. The disk masses inferred from the ALMA data show a trend of declining dust mass with central object mass when combined with results from submillimeter surveys of more massive Taurus members [5]. The mass inventory of solids in small particles in the Taurus disks typically exceeds the average heavy-element mass in *Kepler* short period planets, however the dust in the Taurus disks is distributed across the full disk radius. Assuming a gas:dust ratio of 100:1, only a small number of the low mass stars and brown dwarfs have a total disk mass amenable to giant planet formation, consistent with the low frequency of giant planets orbiting M-dwarfs.

References: [1] Ward-Duong et al. (2015) *MNRAS, 449*, 2618. [2] Parker & Quanz (2013) *MNRAS, 650,* 658. [3] Ward-Duong et al. (2017) *ApJ, in prep.* [4] Bulger et al. (2014) *A&A*, 570, 29. [5] Andrews et al. (2013), *ApJ*, 771, 129.