A SIGNIFICANT POPULATION OF CANDIDATE NEW MEMBERS OF THE RHO OPHIUCHI CLUSTER

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ABSTRACT

We present a general method for identifying the pre-main-sequence population of any star-forming region, unbiased with respect to the presence or absence of disks. We have applied this technique to a new, deep, wide-field, near-infrared imaging survey of the ρ Ophiuchi cloud core to search for candidate low mass members. In conjunction with published Spitzer IRAC photometry, and least squares fits of model spectra (COND, DUSTY, NextGen, and blackbody) to the observed spectral energy distributions, we have identified 948 candidate cloud members within our 90% completeness limits of J = 20.0, H = 20.0, and Ks = 18.5. This population represents a factor of ~3 increase in the number of known young stellar objects (YSOs) in the ρ Ophiuchi cloud. A large fraction of the candidate cluster members (81% ± 3%) exhibit infrared excess emission consistent with the presence of disks, thus strengthening the possibility of their being bona fide cloud members. Spectroscopic follow-up will confirm the nature of individual objects, better constrain their parameters, and allow an initial mass function to be derived.

J, H, and Ks Observations

- IRIS2 on the Anglo-Australian 4.0 meter telescope
- IRIS2 plate scale 0.45 arcsec/pixel
- Filters used: IRIS2 J (1.245 μm), Ks (2.144 μm), H = CH4 (1.570 μm) + CH4 (1.690 μm)
- Total on-source integration time at each position was 5 minutes for the J and Ks filters, and 16 minutes for H-band
- 90% completeness limits: J = 20.0, H = 20.0, Ks = 18.5
- Mass sensitivity: 90% complete to ~1.5 M_Jup for 1 Myr age and photospheric temperature of ~1100K at 124 pc for A_V = 0; falls to 2.0, 4.0, and 8.5, and 10 M_Jup for A_V = 5, 10, 15, and 20, respectively.

Results

- Fig. 2.— Plot of best-fit de-reddened Ks magnitude vs T_eff used to identify 948 new candidate cloud members. Sources are color-coded depending on which model produced the best fit: 1 MYr COND, 1 MYR DUSTY, NextGen, and blackbody models, for an assumed 124 pc distance, are plotted in each panel, as are their respective valid temperature ranges. Background sources fall below the main-sequence; candidate new members lie above the main-sequence or the COND and DUSTY model curves.

Substellar-Planetary Mass IMF

- Fig. 3.— Plot of substellar to planetary mass IMF, assuming all 948 new candidates to be cloud members. De-reddened J magnitudes were used to estimate absolute J magnitudes for all sources, since this band is least affected by disk emission. 1 MYR COND or DUSTY models were then used to infer masses from absolute J magnitudes. The 57 objects in our survey with M<0.1 M_solar are excluded from this plot. The dramatic rise in number of sources across the planetary mass boundary. Follow-up spectroscopy is in progress.

Acknowledgements

A.M. acknowledges the support of the NASA Rocky Mountain Space Grant Consortium.