A Survey of Nearby M-dwarfs with Robo-AO

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1. Abstract

We present the results of a survey of 913 M-dwarf stars from the Lepine and Shara Proper Motion(LSPM) catalog within 25 parsecs of the Sun. Data for these targets was collected with the Robo-AO camera on the Palomar 60-in telescope. Separation and position angles were measured and compared for two epochs, separated by two years, of the images containing multiple stars to look for changes. We analyzed these positional data, combined with available Mearth data, to try to determine which stars are in gravitationally bound common proper motion systems. This research was conducted to measure the statistics of multiple M-dwarf systems within 25pc. Identifying and confirming higher ordered systems at both wide and small separations will help improve understanding of M-dwarf formation by comparing these results to star formation models.

2. Background

M-dwarfs are small, cool stars that compose the majority of stars in the Milky Way. The best quality of information on these stars is obtained by observing the ones that are relatively close to our solar system. Previous studies on m-dwarfs suggest that a large portion of them form multiple star systems(Ward-Duong 2015). The m-dwarf stars in this sample were chosen from the 2005 addition to the LSPM catalog(Lepine 2005). The goal of this program is to further investigate M-dwarf multiplicity with diffraction limited imaging available with Robo-AO for a large sub-sample of the LPSM catalog.

3. Analysis

All of the images were inspected by eye and those which showed companion candidates within the FOV were re-observed to determine whether they exhibited common proper motions. Using the additional epoch of images collected two years later, those stars with a <3 sigma change in their separation and position angle are identified as common proper motion binaries. Fig. 1 shows the distribution of physical separations for those stars believed to be physically bound. The flux and masses were determined for each multiple star system using aperture photometry in IDL and the luminosity mass relation.

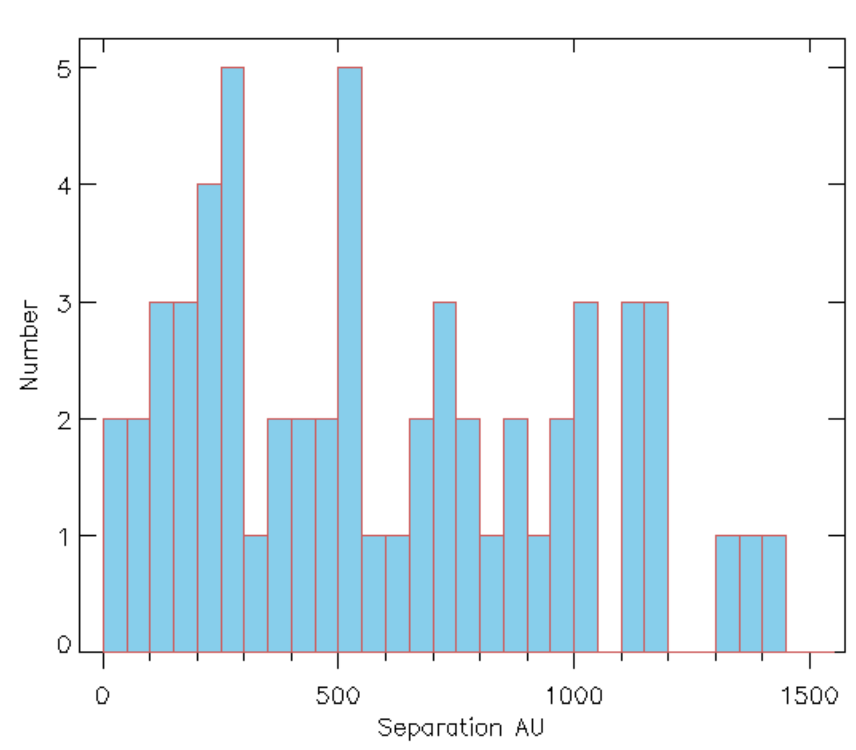

Figure 1. Histogram of the physical separations between primary and secondary stars in AU for out common proper motion candidate systems.

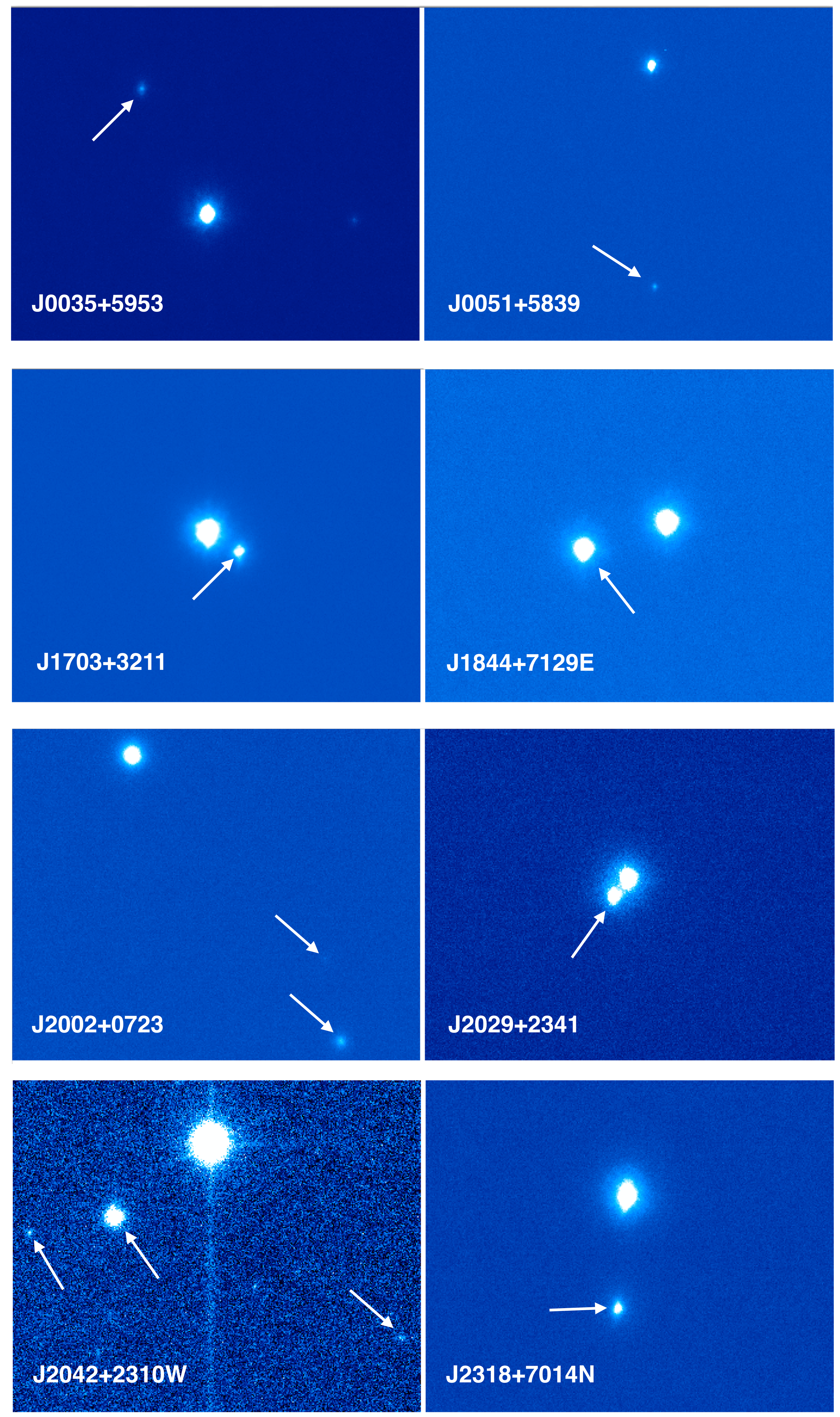

Figure 2. Examples of confirmed multiple star systems. Arrows indicate companions to the primary star in each image. If definitely confirmed some of these will be new discoveries!

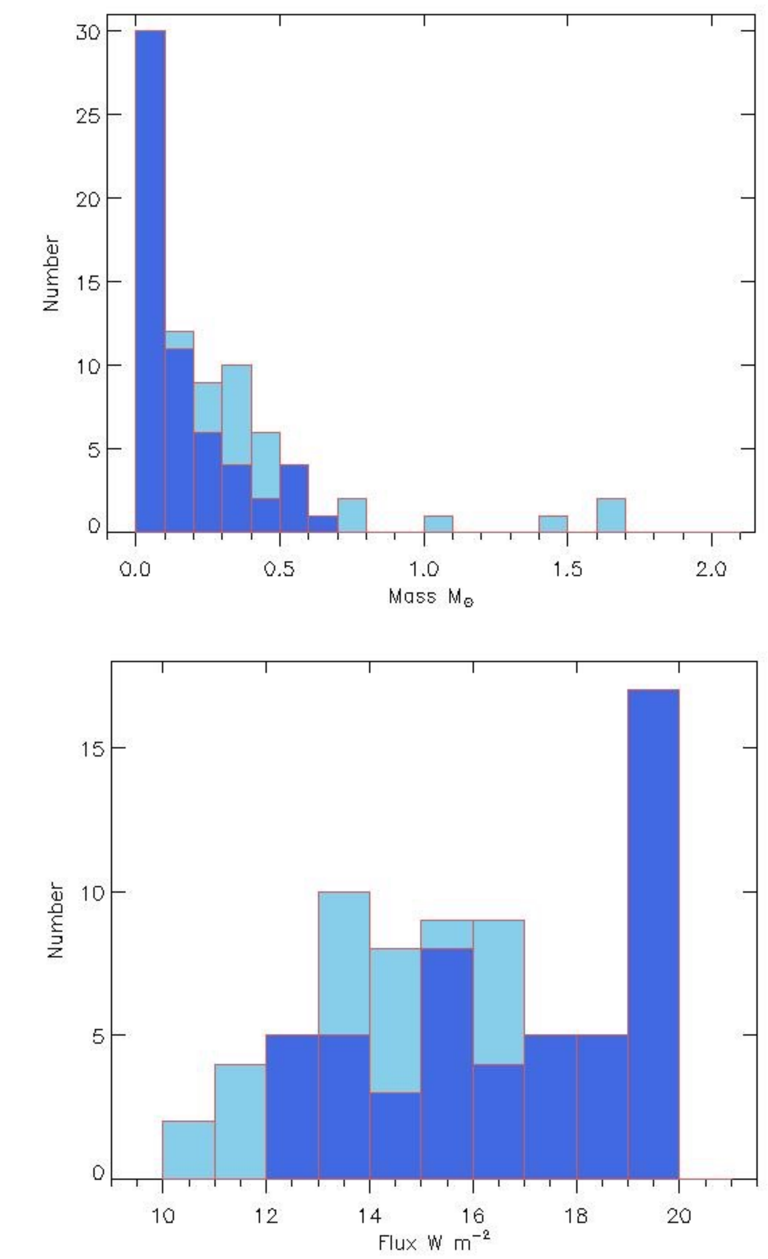

Figure 3. Histogram of the masses of the primary (light blue) and tentative secondary (light blue) stars in out M-dwarf sample. The method used to determine stellar masses is described in Section 3.

4. Results and Future Work

- We have found 46 new or confirmed multiple systems of m-dwarfs
- The fraction of multiple star candidates determined in this survey is less that of a very similar survey conducted by Ward-Duong 2015 however this is expected because we were only interested in common proper motion multiple systems.
- With a third set of observations from the Robo-AO camera now located at Kitt Peak on the 2.1m telescope, the orbits of these systems can be constrained.
- A third set of observations will also allow for the determination of more accurate mass ratios.
- The statistics presented in this survey can also be used with similar statistics of other m-dwarf surveys to build more complete models of m-dwarf star formation.

5. References

- Riddle, R. L., 2015, ApJ, 799, 4
- Lepine, S., 2005, AJ, 130, 1680
- Ward-Duong, K., 2015, MNRAS, 449, 2618

6. Acknowledgements

I thank Dr. Angelle Tanner for giving me the opportunity to be a part of this project. I am also grateful for the opportunity to work with the Robo-AO team as one of the operators of the 2.1m telescope at Kitt Peak National Observatory for 8 months. Dr. Peter Frinchaboy and Dr. Kat Barger have also been an immense help in improving my computer programming skills for this project.