**The Orbital Distribution and Multiplicity Fraction of M-Dwarfs**

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**Abstract**

We present a new estimate to the multiplicity fraction of M-Dwarfs. We used archival data from five M-Dwarf multiplicity surveys to fit a log-normal model to the orbital surface density distribution of these stars. We then used this fit, alongside the companion mass ratio distribution given by Reggiani & Meyer 2013, to calculate the frequency of companions over the ranges of mass ratio (q) and semi-major axis (a) that the referenced surveys were collectively sensitive over – [0.60 < q < 1.00] and [0.04 < a < 10,000 AU]. Over these specific constraints, we found a multiplicity fraction of 0.236 +/- 0.061. We then extrapolated this method to calculate the multiplicity fraction over all ranges of q (0.00 – 1.00) and a (0.00 – inf. AU) to be 0.503 +/- 0.136. Finally, we compared our results to multiplicity findings of other spectral types of stars.

**Introduction**

M-Dwarfs are among the most numerous stars in the universe, and it is suspected that many exist alongside at least one companion. Numerous attempts have been made to find the total fraction of M-Dwarfs which have any number of companions, but this multiplicity fraction is still not well constrained. Working towards knowing this value will have important and broad implications for star formation theories. In order to do so, we compiled data from a variety of different multiplicity surveys (…refs…). It is first necessary to have a firm grasp on the ability of each of these surveys to detect companions at various levels of mass ratio and semi-major axis. The mass ratio, q, is defined as the mass of the companion (lower mass) star divided by the primary (higher mass) star. Furthermore, the semi-major axis, a, of a system serves as a measure of the separation between the primary and secondary stars. We limited our analysis to the range of q which all of our referenced surveys were collectively sensitive to, [0.60 < q < 1.00], in order to ensure the certainty of a detection. In order to adequately investigate a broad range of semi-major axis, we utilized data from surveys which employed radial velocity (…refs…) and direct imaging (…refs…) methods. Radial velocity surveys are better able to detect close companions, while direct imaging surveys are sensitive to wide companions. Combining these sources allowed our analysis to be sensitive to a range of semi-major axis of [0.04 < a < 10,000 AU]. Our method for calculating the multiplicity fraction is built upon a key assumption: that the mass ratio distribution does not depend on orbital separation. Evidence for this is provided by Reggiani & Meyer 2013.

**Methods**

Our work began with a literature search for M-Dwarf multiplicity surveys which were sensitive over a broad range of semi-major axis. This led us to two radial velocity surveys (…ref…) and three direct imaging surveys (…ref…). Once the data from these sources was imported, the detected companions were restricted to be within the ranges of mass ratio that the each of the five surveys were collectively complete to ( 0.60 < q < 1.00), as well as the range of semi-major that the individual surveys were complete to.