University of Michigan Department of Astronomy Undergraduate Research Project

Submitted by Michael R. Meyer 30 August 2016

The Companion Mass Ratio Distribution of M Dwarfs: From Stars to Planets

Description of the Project: Past work by our team has argued that the companion mass ratio distribution of main sequence stars M through A are consistent with having been drawn from a universal “CMRD” (companion mass ratio distribution). This distribution is flat in the ratio of the companion star to the primary, which we call q. However the database used to explore this for M dwarfs in our earlier paper (Reggiani & Meyer, 2013) was not complete. It was a direct imaging survey (Janson et al. 2012) and only complete for a limited range of q. We would like to extend this work by include surveys of the companion mass function available from radial velocity surveys, microlensing surveys, as well as new direct imaging surveys. We seek to constrain the companion mass ratio distribution, compare it to our previous work, and search for a change in the companion mass ratio distribution as a function of orbital separation.

Work to be Done:

The first step in this project is to read up on the subject, including our previous paper Reggiani & Meyer (2013) as well as Reggiani et al. (2016). Next, the student will assemble data from more recent work including radial velocity, microlensing, and direct imaging. Particular attention needs to be paid to completeness limits of various survey databases and collection of electronic data we can use for our analysis. We then will use the Kolmogorov-Smirnov statistical took (KS test) to compare distributions to see if they are consistent with having been drawn from the same parent population. At first, we will only compare one dataset with another. Then we will then use Monte Carlo techniques to create synthetic distributions from analytic models to compare also to data. We expect this project will take 4-6 weeks of work spread over 6-8 months (through spring semester).

Skills Needed (or to be developed) by Student:

Familiarity with scientific literature and search.

Critical reading skills for comprehension and analysis.

Electronic database creation, organization, and management.

Introductory scientific software development using python if possible.