Identifying the ejected population from disintegrating multiple systems

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Introduction

Kinematic studies of the Hipparcos population have revealed associations that are best explained as disintegrating multiple systems, presumably resulting from a dynamical encounter between single/multiple systems in the field (Li et al. 2009).

In this project we explore the possibility that known ultra cool dwarfs may be components of disintegrating multiple systems, and consider the implications for the properties of these objects.

Aim

- To find evidence of disintegrating multiple systems with cool nearby components.
- To find prove that brown dwarf can be ejected like low-mass stars;
- To identify ejected populations from disintegrating multiple systems;
- Look for additional fainter objects using new surveys such as UKIDSS, SDSS, VISTA and WISE.
- To find new benchmark systems (e.g. Pinfield et al. 2012; Day-Jones et al. 2011).

Method

Cross-match: DA-HMC, DA-GJC, HMC-GJC, HMC-HMC, GJC-GJC → Use plots to place distance constrains on objects in order to identify those real multiple systems for possible associations; → Assess proper motion amongst possible associations and identify possible multiples; → Study remaining systems and access the likelihood that they may be disintegrating multiple systems; → Search for additional fainter objects in these associations using new surveys including UKIDSS, SDSS, VISTA and WISE.

Progress so far and first results

The three primary catalogs we are using are Dwarf Archive (hereafter DA), Hipparcos Main Catalog (hereafter HMC) and Gliese-Jahrei Catalog (hereafter GJC) and GJC were chosen because they contain bright nearby stars that would constitute ideal benchmarks systems. They also provide a good range of both spectral types and distance. Using DA is necessary as it is a catalog of ultra cool dwarfs (UCD) and it will allow us to check if any of those UCD is being ejected.

First we will look for groups of objects nearby each other. Since the furthest separations of the wide binary systems are about 100 000 AU, then the stars would be so loosely bound together that gravitational interaction with other nearby objects could disrupt the system. We apply a more conservative distance constraint of 50 000 AU to maximize the number of candidates.

The previous results then will be use to look for ultra cool members of new disintegrating multiples. To do this, I will need to cross match the main-sequence stars catalogs to look for possible multiple system then cross matching them with DA to match up associate UCD with these systems.

We have cross matched HMC with GJC, HMC with HMC, GJC with GJC, DA with HMC and DA with GJC. For the cross matching between HMC and GJC, however, some of the stars appeared on both catalogs. We have to scan the resulting pairs to pick out the duplicates by checking if their spectral types are the same and if their coordinates are too close to each other. If so then we used Super COSMOS Sky Survey and SIMBAD to pick those duplicate out by eye.

Then we cross match DA with HMC and GJC. Many of the objects in DA do not have a measured parallax. So to resolve this problem, we calculate the photometric distance using the polynomial equation from Dupuy & Liu 2012.

There are 53 candidate systems from the cross matching between DA and HMC in addition to 30 between DA and GJC. The results for the rest of our cross matching are summarized in Tables 1-3. In Figure 1 and 2, we plotted the separation distribution of our candidate systems, as expected fainter objects are found at shorter separation compare to brighter objects. In Figure 3, we plotted the relative positions of the brown dwarf and the Gliese star to each other and the arrow represented their proper motions. It shows the brown dwarf of that system have a high proper motion and in the same direction, but also a factor of 2 difference then the Gliese star.

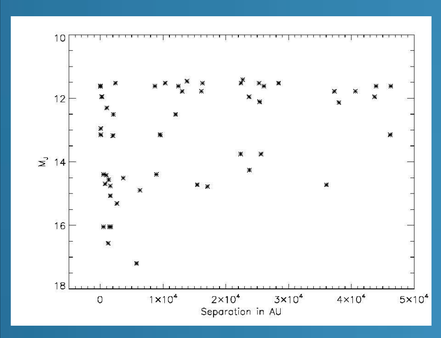

Figure 1. Demonstrates the type of object and systems.

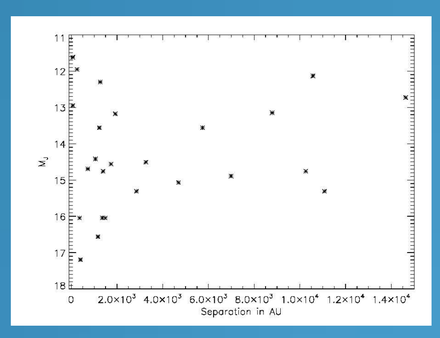

Figure 2. Demonstrates the type of object and systems.

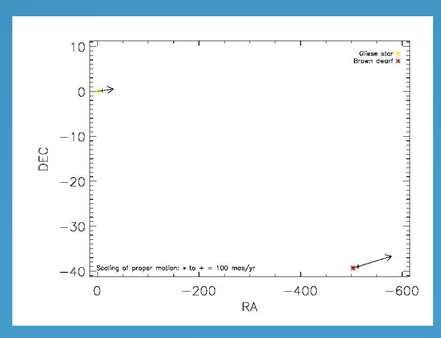

Figure 3. Demonstrates the system have a proper motion in the same direction.

Future works

- To find proof that brown dwarf can be ejected like low-mass stars;
- To confirm a new bench mark system to locate brown dwarf;
- Apply this method and theory on looking for more extra-solar planets.
- Will try to report my finding into a paper.

Table 1. Numbers of candidate systems with multiples components for the HMC-GJC

Candidate systems with number of components	Number of candidate systems
2	1110
3	14
4	10
5	0
6	2
7	1

Table 2. Numbers of candidate systems with multiples components for the HMC-HMC

Candidate systems with number of components	Number of candidate systems
2	10038
3	1316
4	174
5	35
6	9
7	2
8	4

Table 3. Numbers of candidate systems with multiples components for the GJC-GJC

Candidate systems with number of components	Number of candidate systems
2	489
3	37
4	4
5	1

Acknowledgments: The work used data from the Dwarf Archive, Hipprocos and Gliese Libraries. I would like to thank the Royal Astronomical Society and the University of Hertfordshire of this conference for financial support.

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"Exoplanets and Brown Dwarfs: Mind the Gap", Hertfordshire, UK, 2nd – 5th September, 2013