

Low-mass Objects in Moving Groups

M. C. Gálvez-Ortiz,¹ J. R. A. Clarke,¹ D. J. Pinfield,¹ S. L. Folkes,¹
J. S. Jenkins,² A. E. García Pérez,¹ B. Burningham,¹
A. C. Day-Jones,^{2,1} and H. R. A. Jones¹

¹*Centre for Astrophysics Research, Science and Technology Research Institute, University of Hertfordshire, Hatfield, Hertfordshire, UK*

²*Department of Astronomy, Universidad de Chile, Santiago, Chile*

Abstract. We present here the kinematic study of part of a 132 target sample of low-mass objects, previously selected by photometric and astrometric criteria as possible members to five young moving groups (MGs): Local Association (Pleiades moving group, 20 - 150 Myr), Ursa Mayor group (Sirius supercluster, 300 Myr), Hyades supercluster (600 Myr), IC 2391 supercluster (35 Myr) and Castor moving group (200 Myr). We calculated their kinematic galactic components (U,V,W) and apply simple kinematic criteria of membership. The confirmed members will provide a new and substantial population of age and metallicity benchmark ultra cool dwarfs (UCDs). This will give a valuable set to test atmosphere and evolutionary models of ages below 1 Gyr and suitable targets for use in adaptive optic (AO) imaging to search for sub-stellar companions/exoplanets.

1. Sample Selection and Kinematic

Nearby moving group (MG) members will make ideal targets for AO searches seeking faint companions as they provide higher probability of detection compared to typical older field objects. In addition, with well constrained age, composition, and distances, our MG members would provide an ideal population to test atmosphere and evolutionary UCD models.

We compiled our red object sample by cross matching an extended version of the Liverpool-Edinburgh High Proper Motion survey (Pokorny et al. 2004) and Southern Infrared Proper Motion Survey (Deacon et al. 2005) with the Two Micron All Sky Survey and applying colour (for select objects with spectral type $>M6$) and proper motion cuts (by studying the movement of the objects respecting the convergent point of each MG). We found 132 objects possible members of a MG, see Clarke et al. (2009).

We computed the galactic space velocity components (U, V, W) of the sample taking into account their possible membership to one or several MGs, plotted them (see Figure 1) and applied a simple criterion that consists of identifying a possible member of one of the five MGs by its relative position in the UV and VW diagrams with respect to the boxes (dashed lines) that marked the velocity ranges of different MGs. The boxes are defined by studies with higher mass member samples from the literature (Montes et al. 2001; Barrado Y Navacuès 1998). According to their kinematic behaviour, 49 objects lie inside young disk

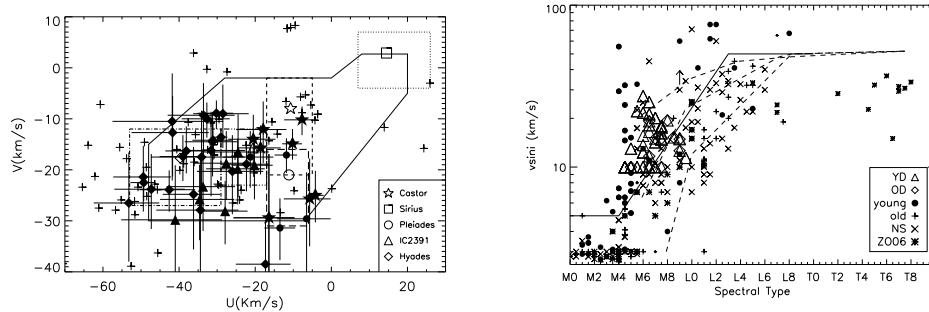


Figure 1. *Left:* UV space motion diagrams for our sample. We have included the boundaries (solid line) that delimit the young disk population as defined by Eggen (1984). The centre of the five main MGs are marked with large open symbols (squares for Sirius, diamonds for Hyades, triangles for IC 2391, circles for Pleiades and stars for Castor), the boxes (dashed line) mark the velocity range of difference MGs and our kinematic members are shown as the corresponding filled symbols. *Right:* Spectral type versus $v \sin i$. See Section 2.

area (YD) and 35 of them are candidates to belong to one of the MGs (see Figure 1 and caption).

2. Youth Constraints: Rotational Velocity

It is known that there is contamination of old objects that share kinematic properties with the genuine young MG members. To provide robust age constraints and assess the membership of our kinematic candidates, we will combine several methods (e.g. lithium I doublet at 6708Å, activity/age relation, etc).

We study here the projected rotational velocity ($v \sin i$) criteria. Following Reiners & Basri (2008), we use $v \sin i$ as an excellent way to discriminate young and old M type UCD populations. We measured the $v \sin i$ of 55 of the total 69 sample and plot them (see Figure 1) in a $v \sin i$ -spectral type diagram from Reiners & Basri (2008), where young and old populations occupy distinct regions. Circles are supposed to be young, pluses old and crosses have unknown age. Asterisks come from Zapatero-Osorio et al. (2006). Our data sample is overplotted in different symbols depending on whether they have been classified as YD or old disk (OD). We mark the ages of 2, 5 and 10 Gyr (from upper left to lower right) as dashed lines and plotted the “apparent” separation between the considered “young” and “old” objects as a solid line, and used it as a criterion for determining the possible membership of our targets. From the 42 kinematic YD candidates, 31 present a $v \sin i$ in agreement with being young and 13 can not be dismissed from the $v \sin i$ information.

References

- Barrado Y Navacués, D. 1998, A&A, 339, 831
- Clarke, J. R. A., Pinfield, D. J., et al. 2009, MNRAS, 402, 575
- Deacon, N. R., Hambly, N. C., & Cooke, J. A. 2005, A&A, 435, 363

- Eggen, O. J. 1984, AJ, 89, 1358
Montes, D., López-Santiago, J., Gálvez, M. C., et al. 2001, MNRAS, 328, 45
Pokorny, R. S., Jones, H. R. A., Hambly, N. C., & Pinfield, D. J. 2004, A&A, 421, 763
Reiners, A., & Basri G. 2008, AJ, 684, 1390
Zapatero-Osorio, M. R., Martín E. L., Bouy, H., et al. 2006, ApJ, 647, 1405