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Brown Dwarf and Low-Mass Star Sequences in the Pleiades and Praesepe

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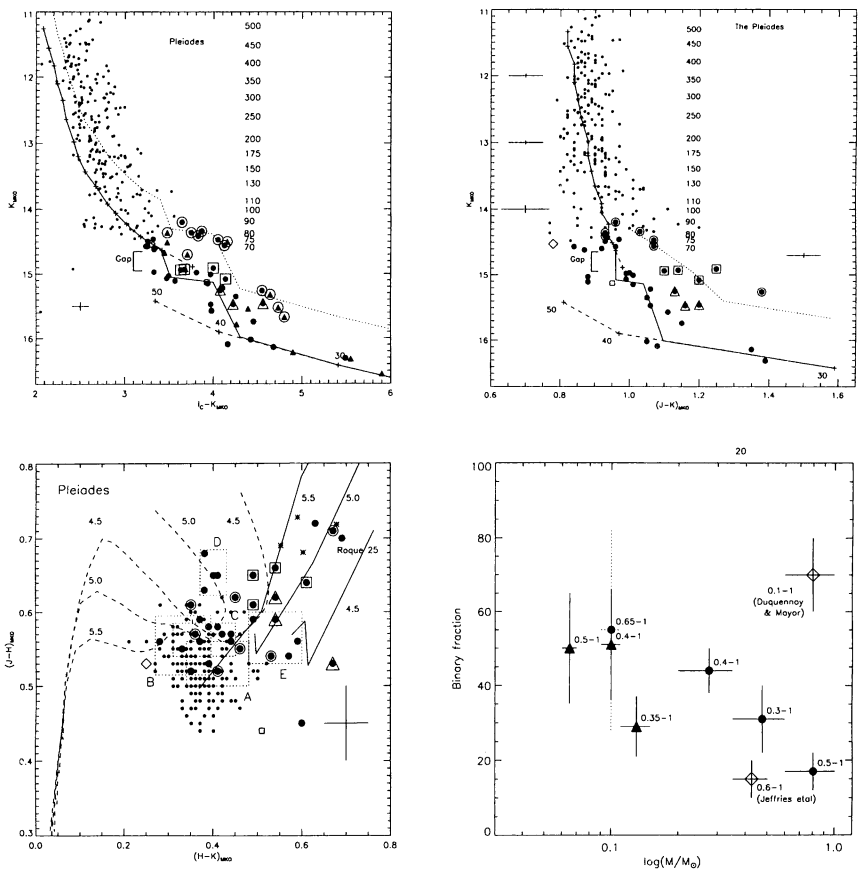
Abstract. We present new infrared photometry of Pleiades and Praesepe sources, and define the cluster sequences in colour magnitude and 2-colour diagrams. We identify non-members and unresolved binaries, and discuss the clusters binary fractions.

1. Introduction

Open cluster populations of low-mass stars and brown dwarfs (BDs) make ideal test beds for studying these objects. Their known distance, age and composition make it possible to estimate theoretical masses. And binarity for example, can be used to test formation theories. However, dust begins to form in the atmospheres of late M dwarfs – a process that is not well understood. And unresolved binarity will affect the brightness (and hence mass estimates) of some sources.

2. Results & Discussion

We combined new UKIRT J- H- and K-band measurements with those from the literature for our Pleiades and Praesepe samples (summarised in Pinfield et al. 2002). The first 3 plots below show our results for the Pleiades. Larger filled symbols are BD candidates. Triangles have no J or H measurement. Symbols ringed with a circle, square or triangle are likely unresolved binaries identified from the IK colour magnitude diagram (CMD), the JK CMD or the 2-colour diagram respectively (see below). An obvious feature in the CMDs is a gap in the cluster sequence from K$\sim$14.6-14.9 ($\sim$M7). This is probably caused by a change in the mass magnitude relation (see Dobbie et al. 2002). Above this gap the data agree well with the Lyon group's NextGen models. Also, the near infrared colours of these sources (boxes A and B in the 2-colour diagram) are very similar. Below the gap, the cluster sequence initially follows a shallow path in the CMDs ($\sim$M7-8), and moves up the 2-colour diagram (ΔJ-H$\sim$0.1). Next the cluster sequence follows a steep path in the CMDs, and moves down and across the 2-colour diagram (ΔJ-H$\sim$-0.1, ΔH-K$\sim$0.15). Finally, the sequence joins onto the Lyon group's Dusty model predictions in the CMDs and the



Phoenix dusty atmosphere predictions in the 2-colour diagram. These features presumably result from atmospheric dust formation. Using our cluster sequence as a guide we identified likely unresolved binaries in 3 ways. They lay above the sequence in the IK CMD, redward of the sequence in the JK CMD, and in the "wrong" box in the 2-colour diagram (i.e., . 2 lower T_{eff} sources). We made a similar analysis of our Praesepe sample (see Pinfield et al. 2002). We were then able to calculate binary fractions (BFs) in each cluster, which we show in the last plot (triangles and circles are Pleiades and Praesepe points respectively). The BD BF$\sim$50%, at odds with predictions from the hydrodynamic simulation of Bate et al. (2002). However, if all BD binaries are very tight, then a higher resolution simulation may be needed to model them.

References

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