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A Search for Disk Emission in Young Brown Dwarfs: L'-band Observations of σ Orionis and TW Hydrae

Ray Jayawardhana

Department of Astronomy, University of Michigan, Ann Arbor, MI 48109, U.S.A.

David R. Ardila

Department of Astronomy, University of California, Berkeley, CA 94720, U.S.A.

Beate Stelzer

Max-Planck-Institut für extraterrestrische Physik, 85741 Garching, Germany

Abstract. Studies of disks around young brown dwarfs are of paramount importance to our understanding of the origin, diversity and early evolution of sub-stellar objects. Here we present first results from a systematic search for disk emission in a spectroscopically confirmed sample of young objects near or below the sub-stellar boundary in a variety of star-forming regions. Our VLT and Keck L'-band observations of the σ Orionis and TW Hydrae associations suggest that if a majority of brown dwarfs are born with disks, at least the inner regions of those disks evolve rapidly, possibly clearing out within a few million years.

1. Introduction

The current paradigm of low-mass star formation holds that a young star accretes material from a circumstellar disk during the first (few) million years of its lifetime. The disk also provides the building material for planets. Over the past two decades, substantial observational evidence has accumulated to support this picture (Mannings, Boss & Russell 2000). However, much of that evidence rests on studies of stars within a relatively narrow mass range. In particular, there are few observational constraints on the formation of objects near or below the sub-stellar boundary.

If a large fraction of young brown dwarfs indeed harbor disks, the implication is that extremely low-mass objects may form via a mechanism similar to higher mass stars. Thus, reliable determination of the disk frequency as a function of age in young sub-stellar populations is critical to our understanding of their origin, diversity and early evolution.

We have commenced a program to obtain L'-band data on a large, *spectroscopically confirmed* sample of young objects near or below the sub-stellar boundary in a number of nearby star-forming regions. L'-band photometry is

much better at detecting disk excess above the photospheric emission, and is less susceptible to the effects of disk geometry, than measurements at shorter wavelengths.

2. Observations

L'-band photometric observations of six σ Ori brown dwarfs (Béjar et al. 2001) were obtained at the ESO Very Large Telescope using ISAAC in January 2002 in service mode. We also observed two brown dwarf member candidates in the TW Hydrae Association, recently found by Gizis (2002), in JHK_sL' at Keck using NIRC in April 2002. The 2MASS database contains JHK_s for all objects.

3. Results and Discussion

Of the six σ Ori sources, only one (SOri 12) shows significant K-L' excess, compared to field objects of the same spectral type (from Leggett et al. 2002). Neither of the two TW Hydrae targets harbors measurable excess consistent with an optically thick inner disk.

A large fraction –$\sim$65%– of brown dwarf candidates in the Trapezium cluster show K-band excess (Muench et al. 2001; also see Liu et al., this volume). Our results, albeit for a small sample of objects so far, in the somewhat older σ Ori and TW Hydrae associations suggest lower disk fractions. It may be that small grains in the inner disks have cleared out already by the age of these associations. If so, brown dwarf disks could deplete rapidly, at timescales comparable to or smaller than those for T Tauri disks (Jayawardhana et al. 1999; Haisch et al. 2001). L'-band photometry of larger brown dwarf samples in several young clusters, spanning a range of ages, could provide a more definitive answer. Further constraints on disk properties await mid- and far-infrared observations with SIRTF and SOFIA.

Gizis (2002) reported strong Hα emission (equivalent width $\approx$ 300 Å) from one of the TW Hydrae objects, the M8 dwarf 2MASSW J1207334-393254, and suggested it could be due to either accretion, flaring, or chromospheric/coronal activity. Given the lack of substantial L'-band excess in this object, accretion now appears less likely as the cause of its strong Hα emission.

References

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