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THE SUBSTELLAR COMPONENT OF THE ORION DISPERSED POPULATION

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RESUMEN

Presentamos los resultados iniciales de un sondeo fotométrico a gran escala, en bandas ópticas y del cercano infrarrojo, para detectar la población dispersa de estrellas de muy baja masa y enanas marrones de la región de formación estelar de Orión. Empleando fotometría óptica profunda, fotometría del sondeo 2MASS y espectros ópticos obtenidos con el espectrógrafo Hectospec, hemos confirmado 22 nuevos miembros de Orión, 6 de los cuales son enanas marrones. Nuestros resultados indican que a una edad de ~ 3 Maños el número de estrellas de muy baja masa y enanas marrones con fenómenos de acreción es similar al derivado para estrellas pre secuencia principal de baja masa y que la fracción de estos acretores cae significatvamente a edades entre 8 y 10 Maños, apoyando la idea de un mecanismo común de formación para estrellas de baja masa y enanas marrones.

ABSTRACT

We present the initial results of a large-scale optical-near infrared survey to detect very low mass stars and brown dwarfs in the dispersed populations of the Orion star forming region. Using deep optical photometry, infrared photometry from 2MASS survey and optical spectra from the Hectospec spectrograph, we confirmed 22 new members, 6 of which are bonna fide brown dwarfs. Our findings indicate that at ages of about 3 Myr the number of accretors in very low mass stars and brown dwarfs is similar to that derived for low-mass pre-main sequence stars and that the overall number of accretors, both in low-mass stars and among very low mass stars and brown dwarfs, falls off by a significant amount at ages $\sim 8 - 10Myr$, supporting the idea of a common formation scenario for VLMS and BD.

Key Words: stars: low mass, brown dwarf — stars: formation — stars: pre-main sequence

1. INTRODUCTION

During the last years the observational study of the formation of brown dwarfs (BD), has had an important development with the discovery of similarities within the spatial distribution, kinematics, initial mass function, and acretion processes at both sides of the substellar limit, supporting the idea of a common formation process for very low mass stars (VLMS) and BD in, at least, some star forming regions (SFR) (Luhman et al. 2007). These studies were based on the observation of few SFR, that don't represent the entire range of physical conditions under which the stars and BD are expected to form (Briceño et al. 2005) and having ages of about ∼2 Myr, do not allow evolutionary studies during the period of disipation of circumstellar disk (Calvet et al. 2005, 10 Myr). A required next step in this subject is the detection of stellar and substellar populations in SFRs showing a variety of environmental conditions and spaning an age range up to 10 Myr. We present the initial results of a large scale survey for VLMS and BD in the Orion SFR which meets all these requirements.

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2. PHOTOMETRIC CANDIDATES

The candidate selection was performed based on IR photometry from the 2MASS survey and optical photometry obtained with the Quest-I camera installed at the 1.0/1.5 m Schmidt telescope of the National Observatory of Venezuela (Baltay et al. 2002), for which the completitude magnitude in I band was improved up to 19.5 using a coadding technique. Point sources were clasified as candidates, depending on its position respect to theoretical evolutionary tracks and isochrones from Baraffe et al. (1998) and reddening lines in color-magnitudes and color-color diagrams respectively. Our present catalogue contain ∼300 candidates with mases $0.3 > M/M_{\odot} > 0.02$ with completitud down to 0.05 $M_{\odot}$ at $A_V < 0.5$ in an area of ~ 30 deg^2 covering most of the OB1a (∼7.9 Myr) and part of the OB1b (∼3.2 Myr) Orion subasociations (Briceño et al. 2005).

3. MEMBERSHIP DIAGNOSTICS

We obtained optical spectra using the Hectospec spectrograph at 6.5 m MMT SAO telescope. A total number of 30 candidates covering ~ 3.3 deg^2 were observed and 22 were confirmed as VLMS and BD members of OB1a and OB1b subasociations using youth indicators as Hα emissions and NaI absorption. The spectral classification of the members was performed comparing the equivalent width of TiO and VO features with a sequence of standard spectra, following the Hernández et al. (2004) scheme. At the age of both subassociations, the substellar limit is placed at M6 and hence, later objects are bonna fide BDs. Figure 1 shows the HR diagram in which confirmed BD and VLMS are indicated.

4. TTAURI AND DISK SIGNATURES

The paradigm of low-mass star formation draws a picture in which a central low-mass star (TTauri star) accretes mass from a circumstellar gas and dust disk, via magnetospheric accretion (Königl 1991; Shu et al. 1994). This scenario is supported by observed accretion indicators, as strong Hα emission and IR excesses produced by dust emission from the inner circumstellar disk. The TTauri stars are classified as classical (CTTS) if they show accretion signatures and as weak (WTTS) if these signatures decrease. The WTTS/CTTS fraction at both sides of the substellar limit is an indicator of the extention of the star formation process down to the BD domain.

We classify the new members as WTTS or CTTS applying the criteria proposed by White & Basri (2003). Figure 1 shows the resulting HR diagram of the new confirmed members in both subassociations in wich WTTS and CTTS are indicated.

5. SUMMARY AND CONCLUSIONS

Our results can be summarized as follows:

• Through spectral signatures we confirmed 22 new members of the OB1a and OB1b dispersed populations of the Orion SFR, 6 of which are clearly substellar.

• We found that all three members confirmed in OB1a are WTTSs, while $39^{+25}_{-22}\%$ of the members confirmed in OB1b are CTTSs. It indicates that in OB1b the number of accretors in VLMSs/BDs is similar to that derived for low-mass pre-main sequence stars (Briceño et al. 2005) and that the overall number of accretors, both in low-mass stars and among VLMSs/BDs falls of by a significant amount by ages $8-10$ Myr, supporting the idea of a common formation scenario for VLMS and BD.

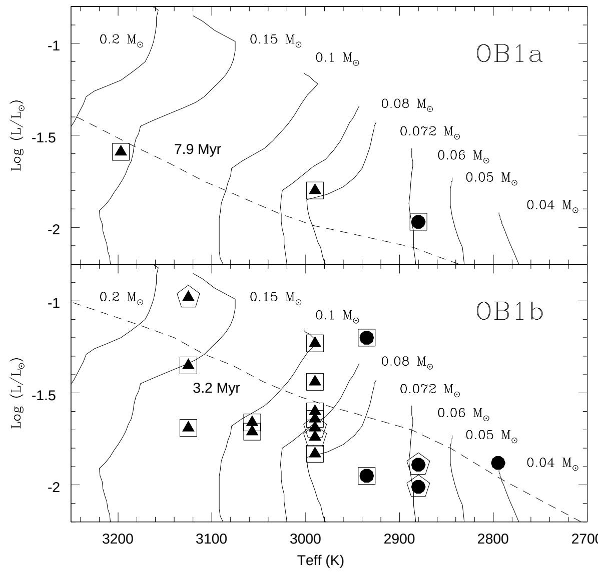

Fig. 1. HR diagram of new members. Solid circles and triangles indicate BDs and VLMSs respectively. Squares represent members classified as WTTSs and pentagons indicate members classified as CTTSs. Dashed lines indicate isochrones corresponding to the age of each subregions and solid lines evolutionary tracks from Baraffe et al. (1998).

Details on observations, analysis and conclusions can be found in Downes et al. (2008).

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