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Probing the physical conditions surrounding young star clusters

Jane Gregorio-Hetem, Beatriz Fernandes and Felipe Navarete

Universidade de São Paulo IAG/USP,
Departamento de Astronomia, Rua do Matão, 1226, 05508-090, São Paulo, SP, Brazil
email: gregorio-hetem@usp.br

Abstract. The scenario of star cluster formation can be better understood based on the detailed study of the dynamical conditions of the associated gas, clustering properties and effects of ionizing sources, among others. Some of these characteristics are explored in our ongoing work based on observations with the *SOAR* and *T80-S* telescopes. With these data we have obtained a complete multi-band photometric catalogue of selected clusters that we characterize using color-color diagrams and flux ratios. In particular, this work is focused on *SOAR/Spartan* (near-infrared) observations of the Canis Major star-forming region.

Keywords. stars: pre–main-sequence, open clusters and associations: general.

1. Introduction

The early evolution of star clusters can be deciphered by comparing the cinematic and structural parameters of stars distributions with dynamical conditions of their local interstellar medium. This study can bring us valuable information about the clustering properties of star-forming regions and the possible effects of feedback from massive stars.

One example of this scenario is found in the Canis Major (CMa) OB1/R1 Association, a wide ($\sim 10^o \times 10^o$) complex of molecular clouds, emission and reflection nebulae that show evidence of star formation induced by supernova events (Fernandes *et al.* 2019). About two hundred emission-line stars, most having spectral type B, were reported by Shevchenko *et al.* (1999) in the area of about ($\sim 2^o \times 2^o$) covering several reflection nebulae, called CMa R1 region, which is located at d $\sim$ 1kpc (for a review, see Gregorio-Hetem 2008).

The most prominent nebula belonging to CMa R1 is Sh2-296, which shows an arc-shaped structure associated with more than 300 low-mass young stars (Fernandes *et al.* 2015). However, less than 10% of them shows evidence of circumstellar disks, which is quite rare when compared with most of the star-forming regions younger than 3 Myr (Haisch *et al.* 2001, Hernández *et al.* 2008, Fedele *et al.* 2010) suggesting that some external factor accelerated the disk dissipation.

2. Characterization of pre-main sequence stars

Our long-term goal is to study the young stellar population in different Galactic regions, and investigate the influence of the environment and feedback from massive stars (ionization, winds) in the formation and evolution of star clusters and circumstellar disks.

The present work is focused on the census of the CMa young stellar population, improved by means of the infrared (IR) characterization.

Following Navarete *et al.* (2015), we performed three observing runs with the *Spartan* camera at the 4m *SOAR* telescope (Cerro Pachón, Chile) to acquire near-IR images (H_2,

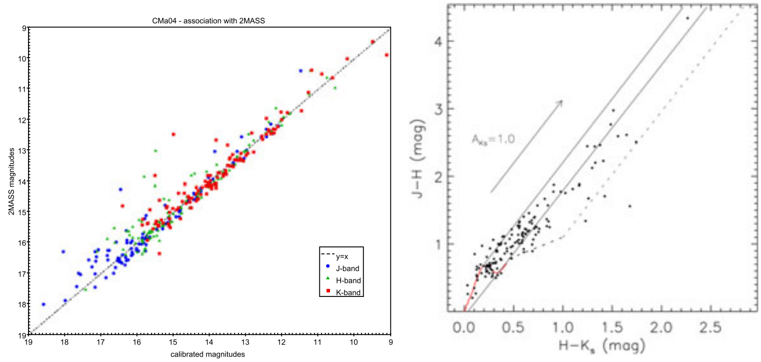

Figure 1. *SOAR/Spartan* data for one of the CMa R1 fields. *Left:* Calibrations of JHK magnitudes. *Right:* Color-color diagram.

Brγ) that are often used as probes of extended and filamentary structures and could bring us some light on the conditions of the molecular and atomic gas associated with our targets.

Figure 1 shows the calibration (based on 2MASS data) of the *Spartan* JHK magnitudes, and the color-color diagram of the sources detected in one of the CMa fields. Our near-IR observations greatly increased the number of detected sources (when compared with the previously known objects having good 2MASS photometry, i.e., AAA flags).

3. Partial results and conclusion

In the field around Z CMa we detected 219 near-IR sources, 99 of them have 2MASS counterpart with good photometry. This means that 120 are new sources, not previously identified or that had an improvement on their photometric measurements. In two other fields, we detected a total of 281+144 sources, revealing 178+97 new objects.

These near-IR results have significantly improved the census of low-mass stars in CMa R1. However, H_2 and Brγ images do not reveal filamentary or extended structures in the fields observed with *Spartan*. Next steps of this ongoing project is to study the ionized gas based on Hα, SII and OIII observations obtained with *SAMI* (*SOAR Adaptative Module Image*) for CMa R1 and other young clusters.

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