

Infrared Study of Embedded Clusters at $l = 345^\circ$

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JB, JRAC, DM, MC are supported by the Ministry for the Economy, Development, and Tourism's Programa Inicativa Científica Milenio through grant P07-021-F, awarded to The Milky Way Millennium Nucleus; A.N.C. received support from Comité Mixto ESO-GOBIERNO DE CHILE 2009 and by BASAL Center for Astrophysics and Associated Technologies PFB-06; J.R.A.C. is supported by GEMINI-CONICYT FUND No.32090002; R.K. acknowledges support from Centro de Astrofísica de Valparaíso and DIPUV 23/2009.

Abstract

We have studied several embedded clusters located in the fourth quadrant of the Galactic plane ($l \sim 345^\circ$; $b \sim +1.5^\circ$). Used data involve infrared photometry and spectroscopy (*JHKs* bands and single scattering respectively). This analysis has provided a preliminary estimation of the fundamental parameters of these objects and basic information about the behavior of the interstellar medium in this direction in the Galaxy.

Introduction

The aim of this study is to understand the global properties of some embedded clusters placed inside or behind dust clouds by combining infrared photometric and spectroscopic observations. Regarding the former, we have studied the *JHKs* bands from 2MASS data (Skrutskie et al. 2006) and PSF photometry (see Mauro et al. 2011) performed on the "pawprints" obtained from the VVV survey (VISTA Variables in the Milky Way, Minniti et al. 2010). In particular, the 2MASS data were used for the brightest objects ($K_s < 13$), while VVV data were used for the faintest objects. Regarding the spectroscopic observations, we used the instrumental configuration SOFI / NTT of ESO with a resolution $R \sim 2000$ (see Fig. 2) to obtain spectra of some of the brightest stars in the DBS 114 region. These observations were used to perform spectral classification of these stars and verify their membership to the cluster (see Table 1).

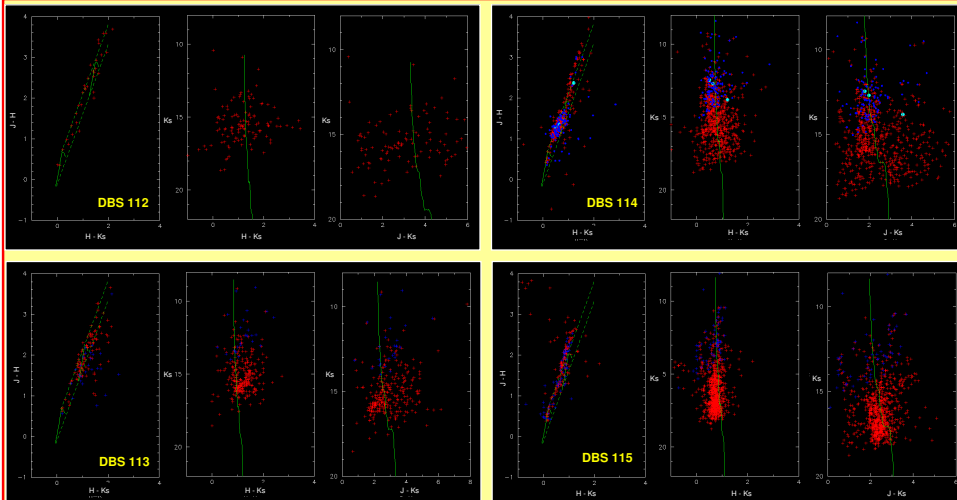


Figure 3: Photometric diagrams of four of the seven studied clusters. Different symbols indicates objects with PSF-VVV photometry (red) and 2MASS photometry (blue). DBS 114 member stars with spectroscopic data are indicated by light blue symbols. Green curves corresponds to the Koomneeff (1983) main sequence, properly displaced and reddening vectors are from Cambresy et al. (2002).

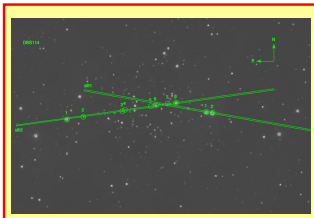


Figure 2: Location of the long-slit spectra over stars in DBS 114 field.

Table 2: Parameters of studied embedded clusters

Id. DBS	α_{J2000}	δ_{J2000}	$D [']$	E_{H-K}	$K_O - M_K$
110	16:56:39	-40:13:43	0.6	1.30	13.0
111	16:56:41	-40:15:18	1.0	1.30	13.0
112	16:56:47	-40:14:33	1.0	1.30	13.0
113	17:00:35	-40:33:44	1.2	0.90	11.5
114	16:59:10	-40:12:05	2.2	0.74	11.2
115	16:59:14	-40:07:04	2.2	0.80	11.5
117	16:59:39	-40:11:11	2.2	0.90	11.5

Table 1: Spectral classification of stars observed in the BDS114

Id	<i>K</i>	<i>H-K</i>	<i>T.E. + C.L.</i>	<i>Comments</i>
Slit1-1	9.20	0.17	B0/2la?	nm
Slit1-2	8.39	0.75	B7la	nm
Slit2-1	9.30	0.60	Be	
Slit2-2	12.07	0.61	PCyg ? *	
Slit2-3	12.35	0.74	B6-8V	m
Slit2-4	13.81	1.21	B6-8V	m ?
Slit2-5	13.93	0.42	B late? *	
Slit2-6	10.59	0.89	Cold star	nm ?
Slit2-7	12.18	0.64	B6-8V	m
Slit2-8	9.44	0.89	B7-8la	nm ?

Note: Asterisks indicate spectra with very low SNR

References

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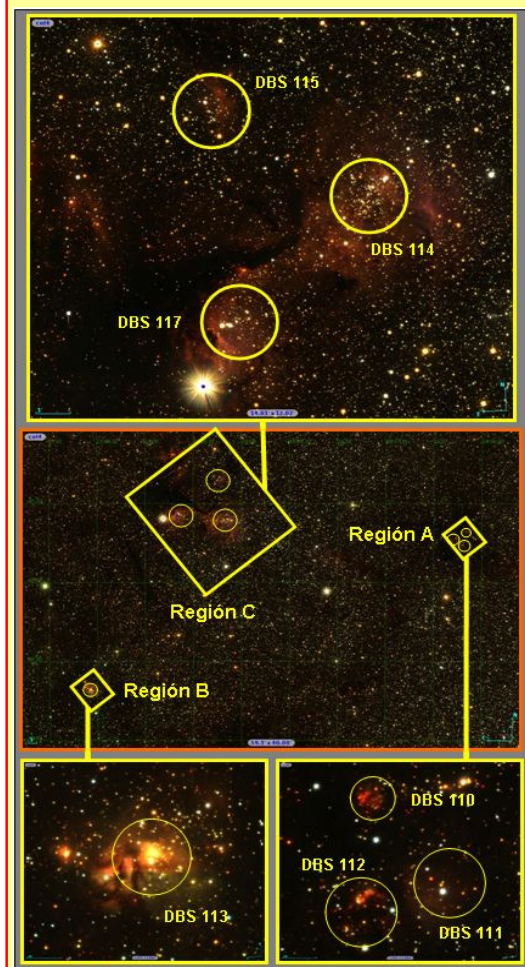


Figure 1: RGB images obtained from the *JHKs* observations (VVV survey). Central panel shows a field covering an area of $60' \times 40'$ centered at $\alpha_{J2000} = 16:58:45.0$; $\delta_{J2000} = -40:20:00.0$ ($l = 345.15$, $b = +1.45$). Yellow boxes indicate regions shown in detail in the remainder panels. Circles represents approximate positions and sizes of studied clusters.

Selected Clusters

We selected an area in the fourth quadrant of the Galactic plane ($l \sim 345^\circ$; $b \sim 1.5^\circ$) where is located a group of seven embedded clusters (Dutra et al. 2003 catalogue). All these objects are placed near dark clouds and/or emission nebulae. They are a challenge to the algorithms used to detect clusters automatically. All the selected clusters were observed in the "d149" tile (VVV survey) and they are indicated in Fig. 1:

- DBS 110, DBS111, DBS 112,
- DBS 113
- DBS 114, DBS 115, DBS 117

Analysis

Photometric diagrams of each studied cluster and their surrounding area (see Fig. 3) enabled us to estimate the main parameters of different populations "foreground", "background" and "cluster itself". The color-color diagrams and color-magnitude (CMDs) were analyzed by comparing the observations with the main sequence tabulated by Koomneeff (1983) and reddening vectors given by Cambresy et al. (2002). This procedure made then possible to estimate the corresponding color excesses (E_{H-K}) and distance moduli ($K_O - M_K$) of each cluster (see Table 2). In the special case of DBS 114 region, the values of these parameters could be verified with those obtained from a spectrophotometric study of the brightest stars in the area (see Fig. 2 and Table 1), as their spectral classification allows to set an independent reference point for photometry in the CMDs. It may also be noted that DBS 114 suffers from a significant differential reddening ($0.74 < E_{H-K} < 1.33$).