RevMexAA (Serie de Conferencias), **35**, 54–55 (2009)

REVEALING THE GALACTIC "UNDERGROUND" STAR FORMATION

J. Borissova,[1] V. D. Ivanov,[2] and R. Kurtev[1]

RESUMEN

Reportamos algunos resultados recientes de nuestro programa a largo plazo destinado a obtener una mejor comprensión de la población actual de cúmulos de estrellas ocultos en la Galaxia. Hasta ahora, muchos cúmulos de nuestro estudio tienen edades típicas de 3–10 Maños y masas típicas de unos miles de masas solares. Únicamente dos de ellos –[DBSB2003] 179 y RCW 87– tienen masa moderadamente alta (igual o cercana a 10^4 $M_\odot$).

ABSTRACT

We are reporting some recent results from our long-term program aimed at better understanding of the hidden present-day star cluster population in the Galaxy. So far, most clusters from our studies have typical ages of 3–10 Myr, and typical masses of order of a few thousand solar masses. Only two of them –[DBSB2003] 179 and RCW 87– are moderately massive (at or approaching 10^4 solar masses).

Key Words: Galaxy: open clusters and associations — infrared: general — stars: formation

1. INTRODUCTION

Open clusters are formed in, and distributed throughout the disk and they are reliable tracers of the Galactic disk structure. It is relatively straightforward to derive their basic parameters like distance, proper motion, age, metallicity, etc. Historically, for many years the most comprehensive open cluster catalog was the Lund Catalogue of Open Cluster Data (Lynga 1987). However, considerable improvement has been achieved since its publication. In the era of the all-sky surveys like Hipparcos/Tycho in the optical, 2MASS (Skrutskie et al. 1997) in the near infrared and GLIMPSE (Benjamin et al. 2003) in the mid-infrared bands new and homogeneous observations have been made. The data generated by these surveys provide a foundation for definitive, systematic and complete inventory of the Milky Way star cluster population, especially the dust-"hidden" ones. The studies based on the new all-sky surveys have shown that the infrared clusters might outnumber the optically visible ones by an order of magnitude and until now more than 2000 infrared "hidden" star cluster candidates have been catalogized (i.e. Dutra et al. 2003a; Bica et al. 2003; Mercer et al. 2005; Froebrich et al. 2007).

[1]Departamento de Física y Astronomía, Facultad de Ciencias, Universidad de Valparaíso, Ave. Gran Bretaña 1111, Playa Ancha, Casilla 5030, Valparaíso, Chile (jura.borissova, radostin.kurtev@uv.cl).

[2]European Southern Observatory, Av. Alonso de Córdoba 3107, Casilla 19, Santiago 19001, Chile (vivanov@eso.org).

2. OBSERVATIONS

Six years ago we started a large program aimed at characterizing the hidden current star population in the Galaxy. Our analysis is based on observations gathered with the 6.5 meter Magellan Telescopes located at Las Campanas Observatory, Chile and includes data collected with the Very Large Telescope of the European Southern Observatory within the Observing Program 79.D-0149(A).

3. RESULTS

So far, we observed and analyzed ∼50 "hidden" star cluster candidates selected from different IR catalogs (Ivanov et al. 2002; Borissova et al. 2003; Dutra et al. 2003a; Bica et al. 2003; Mercer et al. 2005). They are all within 20 degrees from the Galactic center and only ∼1/3 of these objects appear to be genuine star clusters (Ivanov et al. 2005; Borissova et al. 2005; Borissova et al. 2006). An example of spurious star cluster candidate [BDSB2003] 101 is shown in Figure 1. These are two very bright stars, well above the 2MASS saturation limit. Such stars closely resemble compact clusters at the 2MASS resolution. Thus, we have determined the contamination rate of ∼70% for the 2 MASS-selected cluster candidates due to large pixel scale, poor seeing, crowding, variable background, etc. Dutra et al. (2003b) and Froebrich et al. (2007) give similar estimates: ∼80% within 5 degree from the Galactic center and ∼40–50% in the entire Galactic plane, respectively.

Most clusters in our studies have typical ages of 3–10 Myr, and typical masses of order of a few thou-

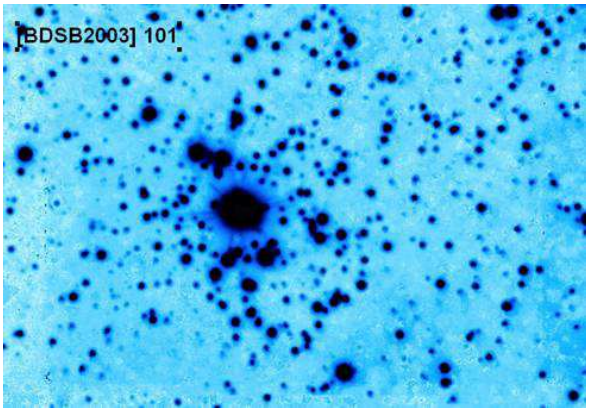

Fig. 1. An example of a spurious star cluster candidate [BDSB2003] 101. The K_S band image is shown, the field of view is 1.4×1.4 arcmin. North is up, and East is to the right.

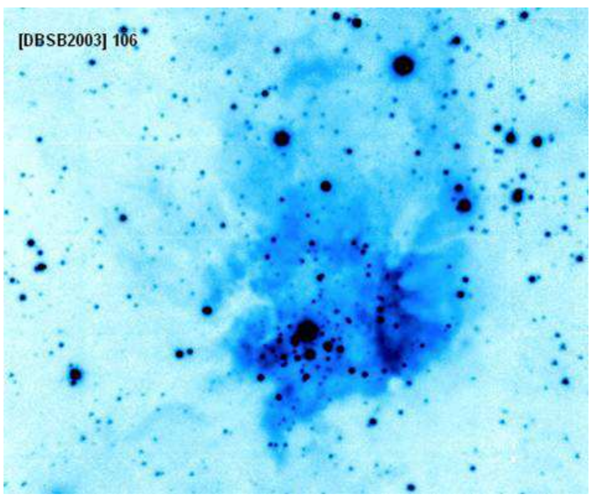

Fig. 2. The small, very young star cluster [DBSB2003] 106. The K_S band image is shown, the field of view is 1.8×1.8 arcmin and the orientation is the same as in Figure 1.

sand solar masses. Most of the mass in these small clusters still is in the gas. There is evidence for presence of young stellar objects and continuing star formation (Figure 2).

Medium-resolution ISAAC (ESO, VLT) K-band spectra were used to derive the spectral types of eight member stars of **[DBSB2003] 179**. Seven stars with spectra show emission lines and the comparison with template spectra indicated that they are early O-type supergiants. Knowing the spectral types of the members and the color excesses, we determined extinction $A_V \sim 16.7$ and distance modulus $(m-M)_0 \sim 14.73$ mag (D∼8.8 Kpc). The

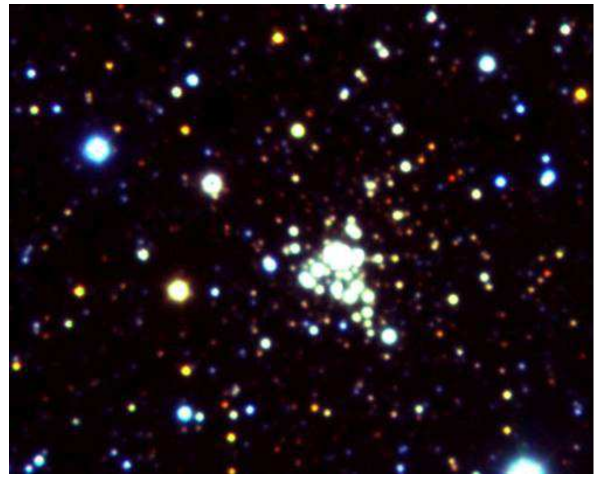

Fig. 3. Pseudo-true color JHK_S image of [DBSB2003] 179. The field of view is 1.1×1.1 arcmin and the orientation is the same as in Figure 1.

presence of early O-stars suggests a cluster age of 2.5–5 Myr. The preliminary estimation of the total mass is (0.8–1.0)×10^4 $M_\odot$ and the cluster is not dynamically relaxed. Its true-color image is shown in Figure 3.

RCW 87 is 25 Myr old, located at a distance of 7.6 Kpc in the general direction of the Galactic center. From the most probable member stars we estimate a total cluster mass of 10^5 $M_\odot$. There is an indication, that at least ten late-type (red) supergiants can be identified among the cluster members.

JB acknowledges support from Fondap Center for Astrophysics 15010003, the Center of Astrophysics in Valparaiso and the FONDECYT grant 1080086.

REFERENCES

Bica, E., et al. 2003, A&A, 397, 177
Benjamin, R., et al. 2003, PASP, 115, 953
Borissova, J., et al. 2003, A&A, 411, 83
Borissova, J., et al. 2005, A&A, 435, 95
Borissova, J., et al. 2006, A&A, 455, 923
Dutra, C. M., et al. 2003a, A&A, 400, 533
Dutra, C. M., et al. 2003b, A&A, 408, 127
Ivanov, V. D., et al. 2002, A&A, 394, L1
Ivanov, V. D., et al. 2005, A&A, 435, 107
Froebrich, D., Scholz, A., & Raftery, C. L. 2007, MNRAS, 374, 399
Lynga, G. 1995, Open Cluster Data (5th ed.; VizieR Online Data Catalog VII/92A)
Mercer, E., et al. 2005, ApJ, 635, 560
Skrutskie, M. F., et al. 1997, in The Impact of Large Scale Near-IR Sky Surveys, ed. F. Garzon, N. Epchtein, A. Omont, W. B. Burton, & P. Persi (Dordrecht: Kluwer), 25