Fifty Years of Wide Field Studies in the Southern Hemisphere
ASP Conference Series, Vol. 491
S. Points and A. Kunder, eds.

Determination of Fundamental Astrophysical Properties of Poorly Known Galactic Open Clusters from Washington Photometry

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Abstract. As a complement to our photometric studies on southern open clusters (OCs), we present preliminary results obtained from a photometric analysis in the Washington system C and T_1 passbands of some poorly known Galactic OCs. The observations were made using the CTIO 0.9 m telescope. Basically, we determine reddening, distance, and age of the observed objects. The present results are part of a major project which aims to characterize almost a hundred OCs observed and analyzed in a homogeneous way.

1. Photometric Observations and Reductions

Several telescopes at CTIO have been used by our group to perform a systematic investigation of OCs using the Washington photometric system. The obtained results constitute significant contributions not only for the individual characterization of the observed OCs, but also for the global understanding of some Milky Way's properties (Piatti et al. 2009, see e.g.). As part of this systematic study, we obtained images in the Washington system C and T_1 passbands of almost a hundred poorly studied Galactic OCs. Preliminary results are presented here for BH 84, BH 211, NGC 5381, Ruprecht 128 and Dias 6. Images were taken using the CTIO 0.9 m telescope with a 2048x2048 pixel CCD and a typical seeing of 1". The images were reduced at the Observatorio Astronómico de la Universidad Nacional de Córdoba (Argentina) with IRAF.

2. Structural Characteristics and Fundamental Parameters

For each OC, we first built the stellar radial density profile following the usual procedure described in detail in Piatti et al. (2009). Figures 1 and 2 show, as examples for the cluster Dias 6, the radial profile and color-magnitude diagrams (CMDs) for different circular extractions, respectively. The fiducial characteristics of the studied clusters are well appreciated in the inner circular extractions. For this reason, we decided to use these extractions to fit theoretical isochrones of Girardi et al. (2002), using Z = 0.019 (Figure 4). The expressions E(C-T_1) = 1.97 E($B-V$) and $M_{T1} = T_1 + 0.58$ E($B-V$) − ($V - M_V$) given by Geisler (1996) were used to relate both color excesses and distance moduli. The resulting reddenings, distances, and ages are listed in Table 1. We also

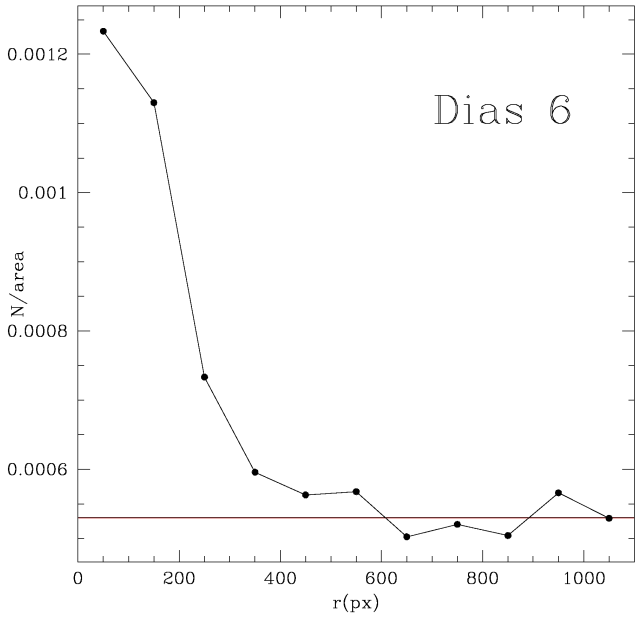

Figure 1. Stellar density profile centered on the cluster Dias 6. The horizontal line represents the measured background level.

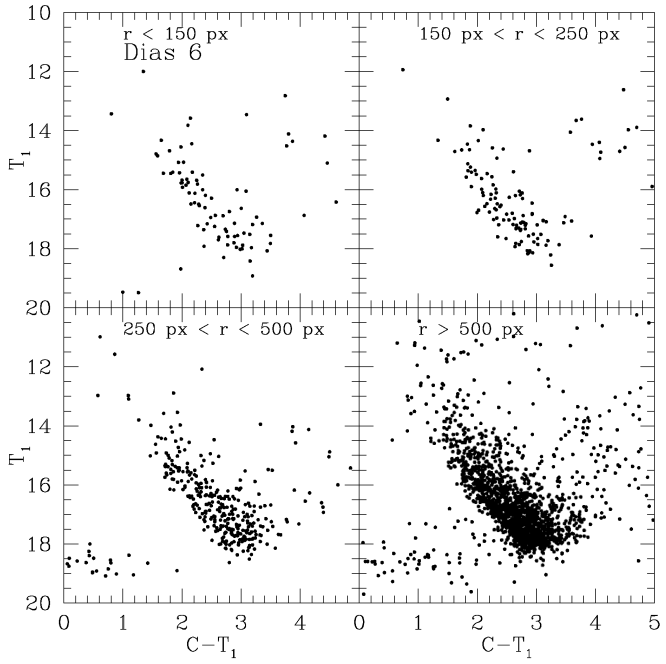

Figure 2. CMDs of Dias 6 for stars observed in different circular extractions as indicated in each panel.

list in Table 1 the values published for BH 84 and BH 211 (Bukowiecki et al. 2011), Ruprecht 128 (Seleznev et al. 2010), Dias 6 (Dias et al. 2012) and NGC 5381 (Tadross 2011). The parameters previously reported for BH 84, BH 211 and NGC 5381 are based

on Two-Micron All-Sky Survey (2MASS) data. Our results appear to be in good agreement with previous determinations, except for BH 84 which has an age that seems to have been previously underestimated (Bukowiecki 2013). Also, NGC 5381 seems to be a redder cluster – we find E($B - V$) = 0.46 ± 0.05 mag as opposed to E($B - V$) = 0.06 ± 0.02 mag – than reported by Tadross (2011). Our age is also smaller (0.18 ± 0.02 Gyr) than that previously reported age of 1.6 Gyr (Tadross 2011). It would seem somewhat amazing, if NGC 5381, located ~ 1.5 kpc from the Sun in the direction towards the Galactic center, had as small of a reddening as reported previously. Unfortunately, Tadross (2011) does not show the Padova isochrone that best matches the (J,$J - H$) CMD, so we are not able to explain the large difference in age found for this cluster.

Table 1. Derived fundamental parameters

Cluster	Age (Gyr)	E(B-V)	d (kpc)	Published Age (Gyr)	Published E(B-V)	Published d (kpc)
BH 84	0.56 ± 0.07	0.63 ± 0.05	3.4 ± 0.4	0.02	0.60	2.92 ± 0.19
BH 211	1.0 ± 0.1	0.61 ± 0.05	1.4 ± 0.2	1.6	0.48	1.38 ± 0.09
NGC 5381	0.18 ± 0.02	0.46 ± 0.05	2.6 ± 0.3	1.6 ± 0.1	0.06 ± 0.02	1.2 ± 0.1
Rup 128	0.8 ± 0.1	0.76 ± 0.05	1.6 ± 0.2	0.8 ± 0.1	0.74 ± 0.15	1.6
Dias 6	0.56 ± 0.07	0.87 ± 0.05	2.3 ± 0.3	0.7 ± 0.2	0.87 ± 0.03	2.239 ± 0.213

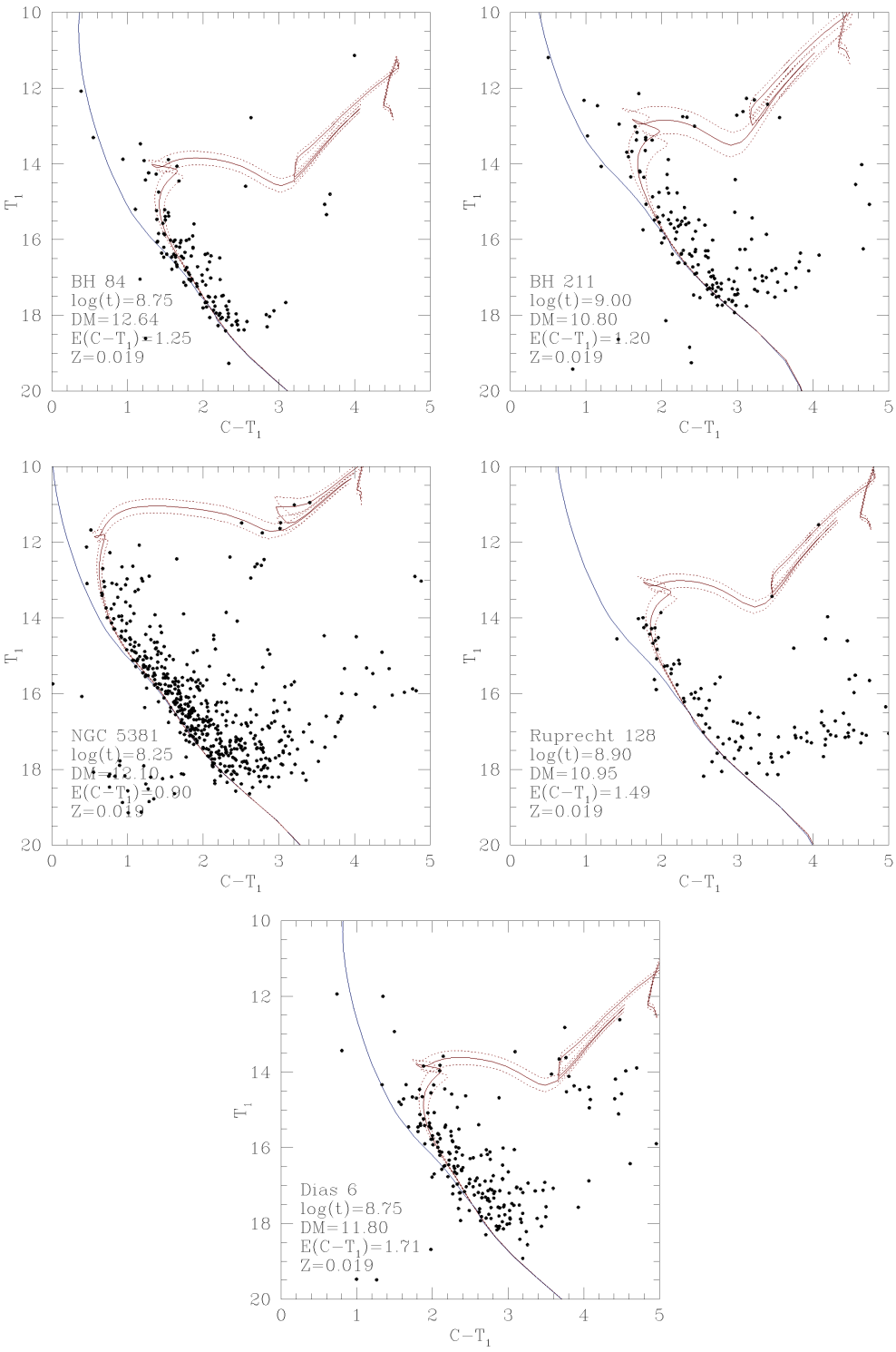

Figure 3. Adopted (T_1,$C - T_1$) CMDs for stars in the five observed clusters. The ZAMS and the adopted isochrones from Girardi et al. (2002), computed taking into account overshooting, are overplotted with solid lines. We included in dashed lines the isochrones obtained taking into account the associated errors, for comparison purposes. The resulting fundamental parameters are indicated in each diagram.

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