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Deep and accurate near-infrared photometry of the Galactic globular cluster ω Cen

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Abstract. We present deep and accurate Near-Infrared (NIR) photometry of the Galactic Globular Cluster ω Cen . Data were collected using the Multi-Conjugate Adaptive Optics Demonstrator (MAD) mounted on the VLT (ESO). We combined the NIR photometry with optical space data collected with the Advanced Camera for Surveys (ACS) for the same region of the cluster. Our deep optical-NIR CMD indicates that the spread in age among the different stellar populations in ω Cen is at most of the order of 2 Gyr.

Key words. globular clusters: general – globular clusters: Omega Centauri

1. Introduction

Optical data were collected with ACS on board the HST and the reduction strategies have already been discussed by Calamida et al. (2008). MAD is a prototype instrument performing wide Field of View real-time correction for atmospheric turbulence (Gilmozzi & Spyromilio 2007; Marchetti et al. 2007). We adopted nine K-band and six J-band images collected during MAD on-sky demonstration. They cover two 1'×1' fields in a region close to the centre of ω Cen . The on sky seeing changed from 0.7 to 1.2". The full-width half maximum of the images is typically better than 0.1" in the K-band and 0.25" in the J-band. The photometry was

Send offprint requests to: A. Calamida performed using DAOPHOTIV/ALLSTAR and ALLFRAME. The reader interested in more details concerning the data reduction is referred to Bono et al. (2008). In order to increase the temperature sensitivity of NIR images we matched them with multi-band optical ($F435W$, $F625W$, $F658N$) images collected with ACS. The two NIR pointings overlap with four out of the nine available ACS pointings. The ground-based (15) and space (48) photometric catalogues were rescaled to a common geometrical system with DAOMASTER. Then NIR and optical images were simultaneously reduced using ALLFRAME and the final catalogue includes $\approx 7.5 \times 10^5$ stars with at least one measurement in two different photometric bands. The photometry was kept in the Vega system following the prescriptions suggested by Sirianni et al. (2005). The photometric calibration of NIR data into the 2MASS photometric system was performed using a sizable sample (~ 5000) of local standard stars provided by Del Principe et al. (2006). The accuracy of the absolute zero-point calibration is ~0.02 mag for the ACS bands and the K-band and ~0.03 mag for the J-band. We ended up with an optical-NIR catalogue including ≈50,000 stars with at least one measurement in an optical and in a NIR band.

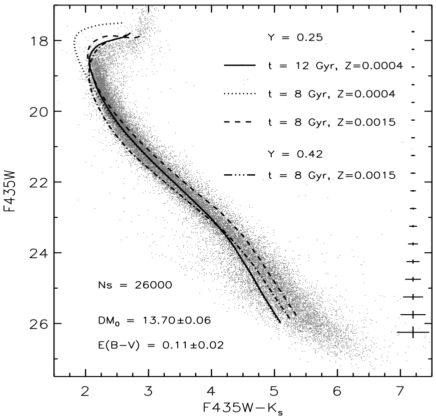

Fig. 1. $F435W, F435W - K_s$ CMD of the optical-NIR data collected with ACS and MAD. Only stars with Sharpness ≤ 0.7 and selected in Separation (Stetson et al. 2003) are plotted. Isochrones by Pisa evolutionary Code (Cariulo et al. 2004) are overplotted for different ages, metallicities, He abundances (see labelled values). The adopted distance modulus and reddening are labelled. Error bars account for photometric uncertainties. The isochrone fit indicates that we detected MS stars with mass values $M \approx 0.3 M_{\odot}$ ($K_s \approx 21$).

2. Discussion and conclusions

By using both photometry and spectroscopy it was recently suggested that ω Cen stellar populations present a large spread in age (~4 Gyr Stanford et al. 2006; Villanova et al. 2007). The presence of an He-enhanced (Y=0.42) metal-intermediate population has also been suggested (Norris 2004; Piotto et al. 2005). The old metal-poor isochrone plotted in Fig.1 (solid line) fits the cluster main population (~65% of stars). A younger metal-poor isochrone (dotted) and two young metal-intermediate isochrones with different He abundances are also displayed (dashed and dashed-dotted), according to the age/metallicity stellar groups defined by Villanova et al. (2007). Fig. 1 shows that the age spread in ω Cen is limited ($\Delta t \lesssim 2$ Gyr) for a fixed distance modulus and reddening ($DM_0 = 13.70 \pm 0.06$, $E(B-V) = 0.11 \pm 0.02$ Del Principe et al. 2006; Calamida et al. 2005). Moreover, it shows that the 8 Gyr metal-intermediate He-enhanced isochrone (dashed-dotted) is systematically bluer than the cluster MS. In this investigation we did not account for the anomalous RGB.

References

Bono, G., et al. 2008, arXiv: 0803.2207
Calamida, A., et al. 2005, ApJ, 634, L69
Calamida, A., et al. 2008, ApJ, 673, L29
Cariulo, P., et al. 2004, A&A 421, 1121
Del Principe, M., et al. 2006, ApJ, 652, 362
Gilmozzi, R., & Spyromilio, J. 2007, Msngr, 127, 11
Norris, J.E. 2004, ApJ, 612, L25
Marchetti, E., et al. 2007, Msngr, 129, 8
Piotto, G., et al. 2005, ApJ, 621, 777
Sirianni, M., et al. 2005, PASP, 117, 1049
Stanford, L.M., et al. 2006, 115, 413
Stetson, P.B., et al. 2003, PASP,
Villanova, S., et al. 2007, ApJ, 663, 296