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Near-Infrared photometry of the Galactic Globular Cluster NGC 6441

M. Dall'Ora[1], J. Storm[2], G. Bono[3], P. B. Stetson[4], G. Andreuzzi[5], R. Buonanno[6], F. Caputo[3], M. Marconi[1], M. Monelli[8], A. Piersimoni[7], V. Ripepi[1], L. Vanzi[9] and A. K. Vivas[10]

[1]INAF - Osservatorio Astronomico di Capodimonte, via Moiariello 16, I-80131, Napoli, Italy, email: dallora,marconi,ripepi@oacn.inaf.it; [2]Astrophysikalisches Institut Potsdam, An der Sternwarte 16, D-14482 Potsdam, Germany, email: jstorm@aip.de; [3]INAF, Osservatorio Astronomico di Roma, Via Frascati 33, 00040, Monte Porzio Catone, email: bono,caputo@mporzio.astro.it; [4]Dominion Astrophysical Observatory, Herzberg Institute of Astrophysics, National Research Council, 5071 West Saanich Road, Victoria, BC V9E 2E7, Canada, email:Peter.Stetson@nrc-cnrc.gc.ca; [5]INAF, Centro Galileo Galilei and Telescopio Nazionale Galileo, P.O. Box 565, 38700 Santa Cruz de La Palma, Spain, email: andreuzzi@tng.iac.es; [6]Universit di Roma Tor Vergata, Via della Ricerca Scientifica 1, 00133 Rome, Italy, email: buonanno@mporzio.astro.it; [7]INAF, Osservatorio Astronomico di Collurania, via M. Maggini, 64100 Teramo, Italy; piersimoni@oa-teramo.inaf.it; [8]Instituto de Astrofisica de Canarias, Calle Via Lactea, E38200 La Laguna, Tenerife, Spain, email: monelli@iac.es; [9]European Southern Observatory, Alonso de Cordova 3107, Vitacura, Santiago, Chile , email: lvanzi@eso.org; [10]Centro de Investigaciones de Astronoma, Apartado Postal 264, Merida 5101-A, Venezuela, email: akvivas@cida.ve

Abstract. We present new near-infrared K_s photometry of the interesting Galactic globular cluster NGC 6441. The optical-NIR color-magnitude diagram shows evolutionary features that seem to agree with a canonical evolutionary framework. The K-band Period-Luminosity-Metallicity relation of RR Lyrae stars gives a distance estimate of 15.51 ± 0.07 that is slightly larger previous estimates.

Keywords. (Galaxy:) globular clusters: individual (NGC 6441) - stars: horizontal-branch - stars: variables: other - techniques: photometric

1. An interesting Galactic globular cluster

The Galactic globular cluster NGC 6441, and its "twin" NGC 6388, presents several interesting features: a high metal abundance and an extended Blue Horizontal Branch (EHB) together with a sizable sample of RR Lyrae stars. In order to explain these peculiar features and the occurrence of a tilted red HB it has been suggested a higher Helium content (e.g. Lee *et al.* 2005), up to $Y \sim 0.4$. Even though, NGC 6441 is a metal-rich cluster, the mean period of its fundamental RR Lyrae is <Pab>~ 0.759 days, even longer than those typical of most metal-poor GGCs. In order to explain this peculiar feature it has been suggested a new Oosterhoff classification (Catelan 2006). Moreover, accurate estimates of mean V-band magnitudes of RR Lyrae in NGC 6441 are hampered by diffential reddening, since this system is located at low Galactic latitudes. To overcome the problem concerning the evolutionary status of these objects we plan to use the K-band Period-Luminosity-Metallicity (PLZK) relation. Theoretical and empirical evidence indicate that this approach is marginally affected by evolutionary effects and reddening uncertainties and presents a mild dependence on the stellar mass. We present new K_s photometry of NGC 6441 and provide an independent estimate of its distance.

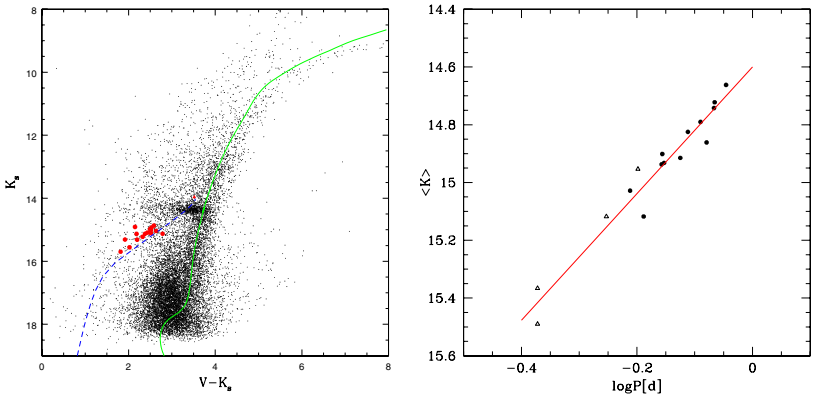

Figure 1. Left panel: $K_s, V-K_s$ CMD of NGC 6441, with superimposed a 12 Gyrs isochrone for $Z = 0.008$ and $Y = 0.251$, while the dashed line shows the ZAHB for the same metallicity. Filled circles mark the RR Lyrae stars. Right panel: the observed RR Lyrae PLZK relation.

2. Color-magnitude diagram and the PLZK relation

Five epochs J, K_s data were collected with SOFI@NTT, and correlated with optical B, V, I photometry (PBS). We obtained K_s light curves for 16 out of the 49 cluster RR Lyrae identified by Pritzl *et al.* (2001). The left panel of Figure 1 shows the $K_s, V-K_s$ Color-Magnitude Diagram (CMD), with superimposed the RR Lyrae stars (larger dots) with Ks light curves. The CMD shows the strong contamination of the field Bulge population and several cluster features. The red HB is clearly visible at $K_s \sim 14.5$ mag, and the RGB bump at $K_s \sim 14.7$ mag, just below the red HB (Pritzl *et al.* (2001)). The blue HB is barely detectable, and it is traced by RR Lyrae stars. The solid line shows a 12 Gyr isochrone for $Z = 0.008$ and $Y = 0.251$, while the dashed line the ZAHB for the same chemical composition scaled-solar. The evolutionary models are from the BASTI library (e.g. Pietrinferni *et al.* 2004). The right panel of Figure 1 shows the observed PLZK relation for the RR Lyrae stars for which we have K_s light curves. The observed slope is $-2.19(\pm 0.14)$. By using the Bono *et al.* (2001) theoretical calibration of the PLZK relation, the metallicity ($[Fe/H] = -0.53$) and reddening ($E(B-V) = 0.47$ mag) values pulished by Harris (1996), we obtained for NGC 6441 a true distance modulus of $\mu_0 = 15.51 \pm 0.07$ mag. This estimates accounts for uncertainties on metal abundance (0.25 dex) and in reddening (0.05 mag) evaluations and it is slightly larger than the RR Lyrae distance $\mu_0 \sim 15.3$ mag based on optical-metallicity relations ($\mu_0 \sim 15.3 \pm 0.15$, Pritzl *et al.* 2001). By adopting the empirical calibration of the PLZK relation by Sollima *et al.* (2006), we find a true distance of $\mu_0 = 15.69 \pm 0.08$ mag. The difference between these two estimates gives an idea of the present uncertainty in the PLZK calibration.

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References

Bono, G., Caputo, F., Castellani, V., Marconi, M., & Storm, J. 2001, *MNRAS*, 326, 1183
Catelan, M. 2006, Revista Mexicana de Astronomia y Astrofisica Conference Series, 26, 93
Harris, W. E. 1996, *AJ*, 112, 1487
Lee, Y. W., *et al.* 2005, *ApJ*, 621, L57
Pietrinferni, A., Cassisi, S., Salaris, M., & Castelli, F. 2004, *ApJ*, 612, 168
Pritzl, B. J., Smith, H. A., Catelan, M., & Sweigart, A. V. 2001, *AJ*, 122, 2600
Sollima, A., Cacciari, C., & Valenti, E. 2006, *MNRAS*, 372, 1675

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