Mem. S.A.It. Vol. 87, 683

Memorie della

Deriving physical parameters of M31 star clusters using the PHAT survey

P. de Meulenaer[1,2] and V. Vansevičius[1,2]

[1] Vilnius University Observatory, Čiurlionio 29, Vilnius LT-03100, Lithuania
[2] Center for Physical Sciences and Technology, Savanorių 231, Vilnius LT-02300, Lithuania
e-mail: philippe.demeulenaer@ftmc.lt,pdemeulenaer@gmail.com

Abstract. This work presents the derivation of the physical parameters of 1287 M31 star clusters using the catalog of the Panchromatic Hubble Andromeda Treasury survey. The star cluster parameters are derived using a large grid of star cluster models, generated with stochastically populated IMF, that are compared to the integrated broad-band WFC3+ACS photometry of the observed clusters. We derive the age, mass, and extinction of the sample of M31 star clusters with fixed solar metallicity. For clusters older than 1 Gyr, we also derive the metallicity. For globular clusters, we show that the metallicity derived is in good agreement with the metallicity previously derived using spectroscopy in literature.

Key words. galaxies: individual: M31 – galaxies: star clusters: general

1. Introduction

Using the Wide Field Camera 3 (WFC3) and the Advanced Camera for Surveys (ACS) on board the Hubble Space Telescope (HST), the Panchromatic Hubble Andromeda Treasury (PHAT) team (see, e.g., Dalcanton et al. 2012; Beerman et al. 2012; Johnson et al. 2012) performed a photometric survey of 1/3 of the M31 galaxy, providing a large catalog of new clusters. Recently the survey was completed and published in a final catalog containing 2753 clusters(Johnson et al. 2015).

In this work, the objective followed is first to select a sample of clusters from the Johnson et al. (2015) catalog with reasonably good photometry, and then to derive their parameters using a grid of cluster models with stochastically populated IMF (see de Meulenaer et al. 2013, 2014, 2015a,b for details on the method).

2. Application to the M31 PHAT star clusters

We perform a selection of two cluster samples from the Johnson et al. (2015) catalog: a first one (referred to as “group 1” in the following) with very good photometric accuracy and a second one (“group 2”) with poorer accuracy. The selected clusters are displayed in the colour-colour diagram of Fig 1, colour-coded according to their brightness in ultraviolet (using the F275W passband). In group 1 (180 clusters), the photometric accuracy is $<$ 0.15 mag in F275W and F336W, $<$ 0.1 mag in F475W and F814W, and $<$ 0.2 mag in F110W and F160W. In group 2 (1107 clusters), the photometric accuracy in each filter is $<$ 0.4 mag. In total, we analyze 1287 clusters.

The age, mass, and extinction derived in this work are found in reasonable agreement

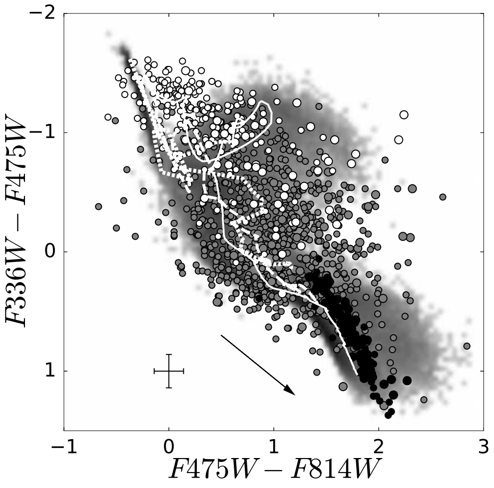

Fig. 1. Colour-colour diagram of the sample of PHAT clusters, superposed on a grid of star cluster models (density plot). The clusters are colour-coded according to their type: bright in UV (F275W < 19, white dots), faint in UV (F275W ≥ 19, gray dots), globular clusters (black dots). Large dots are from group 1 while small dots are from group 2. The error bar indicates the maximum photometric error for the group 1 clusters. The three lines show SSP evolutionary tracks of metallicity [M/H] = 0 (solid line), −1 (dashed line), and −2 (dotted line). The arrow indicates the direction of the extinction ($A_V = 1$).

with the parameters derived for common clusters by Caldwell et al. (2009, 2011) for both young and old clusters, as shown in Fig 2a,b,c.

Also, for globular clusters, we derived the metallicities which were found in agreement with the spectroscopically derived parameters by Caldwell et al. (2011), as shown in Fig 2d.

3. Conclusions

In this work, we studied a sample of 1287 M31 star clusters from the PHAT catalog of Johnson et al. (2015). We derived the parameters of these star clusters and found consistent agreement with spectroscopic studies of the same clusters by Caldwell et al. (2009, 2011) for both young and old clusters. The entire catalog with derived parameters will be made available in a forthcoming paper.

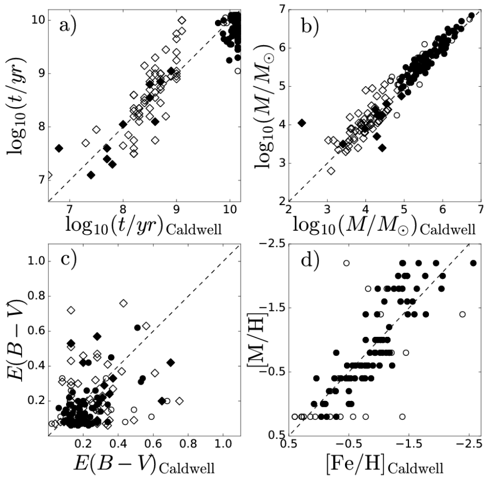

Fig. 2. Our results vs those of Caldwell et al. (2009, 2011) for the common young (open and filled diamond symbols) and old (open and filled dots) clusters, shown for the age (panel **a**), the mass (panel **b**), the extinction (panel **c**), and the metallicity (panel **d**). Filled symbols are the group 1 clusters and open symbols are the group 2 clusters.

Acknowledgements. PdM is very grateful to the organizers of the MODEST-16 conference in Bologna.

References

Beerman, L. C., Johnson, L. C., Fouesneau, M., et al. 2012, ApJ, 760, 104
Caldwell, N., Harding, P., Morrison, H., et al. 2009, AJ, 137, 94
Caldwell, N., et al. 2011, AJ, 141, 61
Dalcanton, J. J., Williams, B. F., Lang, D., et al. 2012, ApJS, 200, 18
de Meulenaer, P., et al. 2013, A&A, 550, A20
de Meulenaer, P., et al. 2014, A&A, 569, A4
de Meulenaer, P., et al. 2015a, A&A, 574, A66
de Meulenaer, P., et al. 2015b, A&A, 581, A111
Johnson, L. C., Seth, A. C., Dalcanton, J. J., et al. 2012, ApJ, 752, 95
Johnson, L. C., Seth, A. C., Dalcanton, J. J., et al. 2015, ApJ, 802, 127