Communications of BAO, Vol. 67, Issue 2, 2020, pp.311-315

FSR19 and FSR25 confirmed as two new faint and metal-rich globular clusters in the galactic bulge

C. Obasi*[1], M. Gómez†[1], D. Minniti‡[1,2], and J. Alonso-García[3]

[1] Depto. de Ciencias Físicas, Facultad de Ciencias Exactas, Universidad Andres Bello, Av. Fernandez Concha 700, Las Condes, Santiago, Chile.,
[2] Vatican Observatory, V00120 Vatican City State, Italy.,
[3] Centro de Astronomía (CITEVA), Universidad de Antofagasta., Av. Angamos 601, Antofagasta, Chile.

Abstract

We combined the near-IR photometry from the VISTA Variables in the Vía Láctea extended Survey (VVVX) with Gaia EDR3 catalog to study some properties of FSR19 and FSR25. These are confirmed to be low luminosity metal-rich bulge globular clusters (Obasi et al. 2020). The proper motions (PM) remain unchanged and the Color magnitude diagrams (CMD) are consistent with what we previously reported and the red giant branches are narrower than the field.

Keywords: *Galaxy: bulge - globular clusters: general - Red-clump stars, MK formation and evolution, Star clusters*

1. Introduction

GCs are powerful probes in our understanding of the galactic evolution, each confirmation of a new GC in the Milky Way is a treasure as they are key tracers of the field stellar populations, and provide valuable evidence for the formation of the Galaxy. Those found in the Galactic bulge in particular, may probably be among the oldest objects in the Galaxy (e.g., Barbuy et al., 2016). Bica et al. (2019) presented a catalog of star clusters, Associations and Candidates in the Milky Way which contains over 10000 star clusters, including many new low-luminosity candidates discovered by the VVV Survey (e.g., Camargo, 2018, Minniti et al., 2017b), these have significantly increased the bulge GC sample. While many of these have already been confirmed or discarded by follow up studies (e.g., Gran et al., 2019, Palma et al., 2019, Piatti, 2018), it is clear that the bulge GC census is incomplete (Ivanov et al., 2005, Minniti et al., 2017a). In our first paper (Obasi et al., 2020, submitted) hereafter known as paper I, we demonstrated that both FSR19 and FSR25 are genuine low luminosity bulge globular clusters by combining clean photometry data from VVVX, 2MASS and Gaia DR2. We measured distances (D)=7.3± 0.4 and 7.6±0.4, integrated luminosities M_{Ks}(FSR19)=-7.72 and M_{KS}(FSR25)=-7.31 core-radii=2.76 pc and 1.92 pc, tidal radii=5.31 and 6.85 pc for both FSR19 and FSR25. Also, metallicilty [Fe/H]=-0.50 dex and -0.55 dex and ages of 11 Gyr were estimated. These measurements are in agreement with other studies (Buckner & Froebrich, 2013, Froebrich et al., 2007, Kharchenko et al., 2013, 2016). These two objects are located in an interesting complex dark nabulae (FSR19 next to Barnard 268, and FSR25 next to Barnard 276). Figure 1 shows that this is a complicated region in terms of extinction, we have checked different extinction maps (Schlafly & Finkbeiner, 2011, Schlegel et al., 1998) and found that they are not located in any particular region of low extinction, so they can not be confused with extinction window. In this paper we used the Gaia EDR3 and VVVX catalogs to reexamine some of the clusters properties such as CMD, differential reddening and PM

In section 2 we describes the data, differential reddening and CMD of the field stars as well as the PM selected samples. and finally summarize our conclusions in section 3.

*c.obasi@uandresbello.edu, Corresponding author
†matiasgomez@unab.cl
‡vvvdante@gmail.com

DOI: 10.52526/25792776-2020.67.2-311

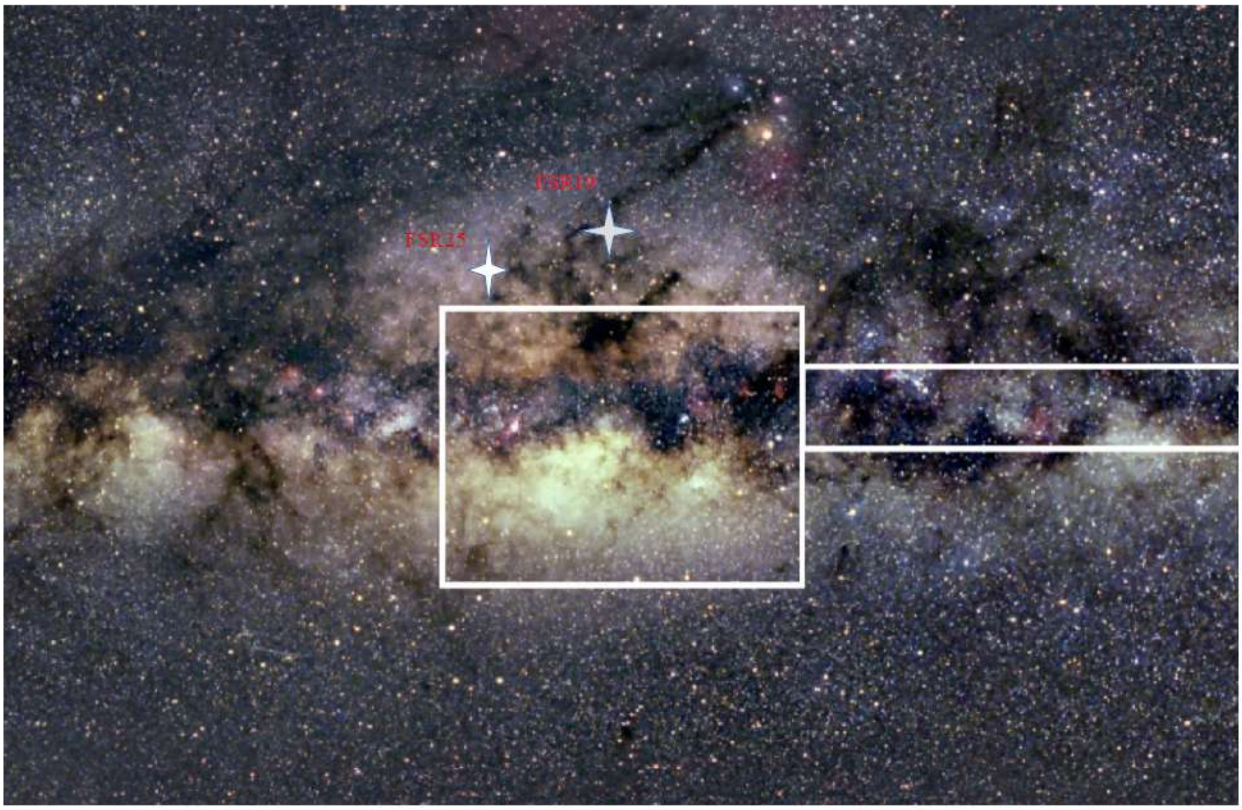


Figure 1. This shows the complex region where the clusters are located in terms of extinction, The white rectangle is the region covered by the VVV, the approximate positions of the clusters are shown. The image was adapted from (Mellinger, 2009)

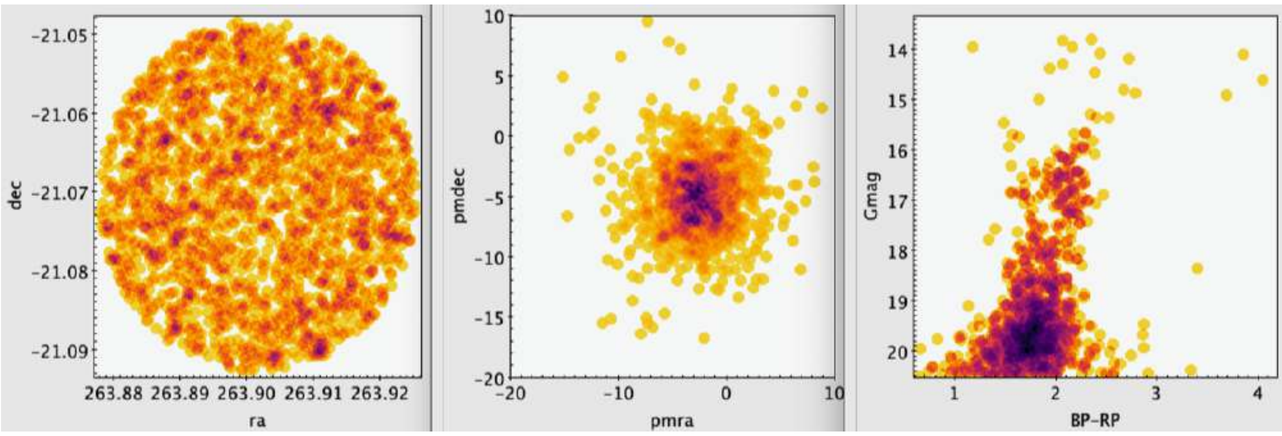


Figure 2. The central 3 arcmin region of the cluster FSR19 from Gaia EDR3, Gaia star density map (left), the vector PM diagram (middle) and CMD of both field and cluster stars (right)

2. Gaia EDR3 and VVVX Data

The major challenge in probing the galactic bulge with photometric surveys is the non-uniform reddening toward our Galactic centre (Schlafly & Finkbeiner, 2011) this probably had been mitigated through the extinction maps derived from the VVV (Alonso-García et al., 2017, 2018, Gonzalez et al., 2012), to minimize any systematics, we have used the combination of near-IR VVVX and the recently released Gaia EDR3 to build our clean sample. Gaia EDR3 contains the apparent brightness in G magnitude for over 1.8×10^9 sources which are brighter than 21 mag, and for 1.5×10^9 sources, passbands G_{BP} covering 330-680 nm and G_{RP} covering 630-1050 nm, which are not available in DR1 and DR2. (Gaia Collaboration et al., 2020). The data have been processed by the Gaia Data Processing and Analysis Consortium (DPAC).

The VVVX Survey (Minniti, 2018) maps the Galactic bulge and southern disk in the near-IR with the VIRCAM (VISTA InfraRed CAMera) at the 4.1 m wide-field Visible and Infrared Survey Telescope for Astronomy (Emerson & Sutherland, 2010)(VISTA) at ESO Paranal Observatory (Chile). In the Galactic bulge, the VVVX Survey covers about 1700 sqdeg., using the J (1.25 μm), H (1.64 μm), and K_s (2.14 μm) near-IR passbands.

2.1. Physical parameters of FSR19 and FSR25

By combining the Gaia EDR3 with VVVX catalog, we selected the central 3 arcmin region of the clusters. We plotted the Gaia star density map showing the differential reddening in the *RA* and *Dec* for both FSR19 and FSR25 as shown in figures 2 and 3 (left) showing the improved systematics and accurancy in the Gaia EDR3. The middle plot shows the vector PM diagrams of FSR19 and FSR25 centred at $PMRA$=-3.5 masyr^{-1}; $PMDE$= -5.0 mas yr^{-1} for FSR19, and $PMRA$= -4.0 mas yr^{-1}; $PMDE$=-2.0 mas yr^{-1} which is consistent with paperI though of a better quality. In the right we plotted the CMD of the field and clusters members. Figure 4 shows the PM selected CMD for both FSR19 and FSR25. From this plot it evident that the red giant branches are narrower than the field as reported in paper I.

3. Summary

Using the improved data from Gaia EDR3, we examined some of the properties of FSR19 and FSR25 and compared the results to paperI. We established that the PM centred at $PMRA$=-3.5 masyr^{-1}; $PMDE$= -5.0 mas yr^{-1} for FSR19, and $PMRA$= -4.0 mas yr^{-1}; $PMDE$=-2.0 mas yr^{-1} remains unchanged, the CMD is consistent in all cases. It is clear that the red giant branches of the clusters are narrower than the field as first reported in paper I.

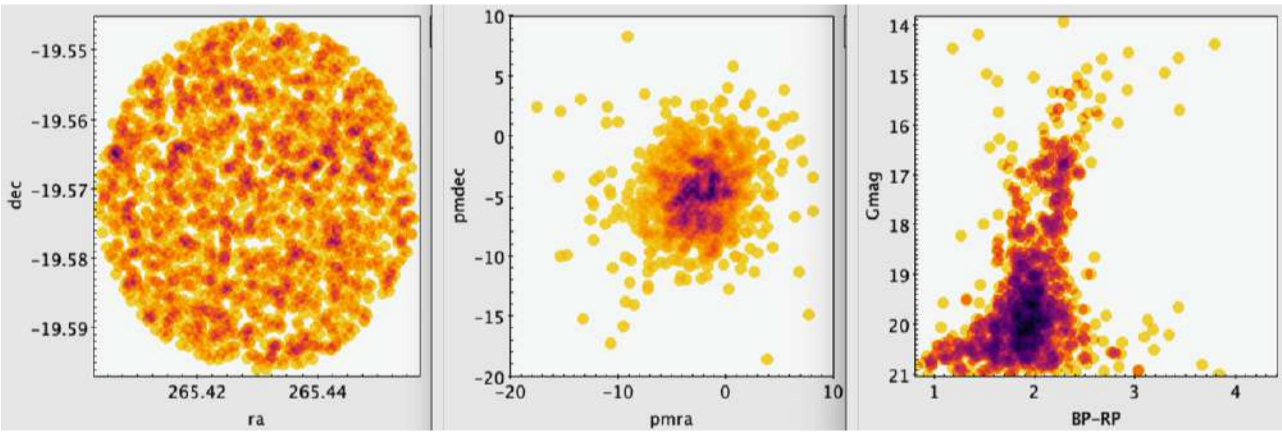
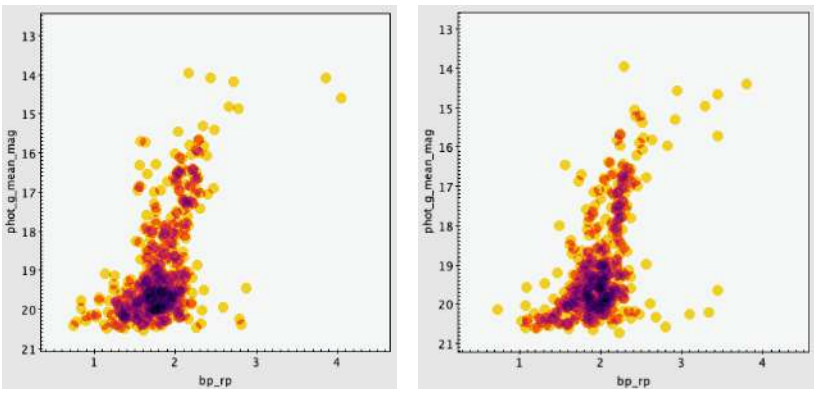


Figure 3. Shows the central 3 arcmin region of the cluster FSR25 from Gaia EDR3, Gaia star density map (left), the vector PM diagram (middle) and CMD of both field and cluster stars (right)



(a) (b)

Figure 4. PM selected CMDs for both clusters. (a) CMD of G vs BP-RP showns the narrow red giant branch of FSR19 . (b) CMD of G vs BP-RP showns the narrow red giant branch of FSR25.

References

Alonso-García J., et al., 2017, ApJ, 849, L13

Alonso-García J., et al., 2018, AJ, 619, A4

Barbuy B., et al., 2016, A&A, 591, A53

Bica E., Pavani D., Bonatto C., Lima E., 2019, yCAT, 515

Buckner A. S., Froebrich D., 2013, MNRAS, 436, 1465

Camargo D., 2018, ApJ, 860, L27

Emerson J., Sutherland W., 2010, MSNGR, 139, 2

Froebrich D., Scholz A., Raftery C., 2007, MNRAS, 374, 399

Gaia Collaboration B., et al., 2020, arXiv preprint arXiv:2012.01533

Gonzalez O., et al., 2012, A&A, 543, A13

Gran F., et al., 2019, A&A, 628, A45

Ivanov V. D., Kurtev R., Borissova J., 2005, A&A, 442, 195

Kharchenko N., et al., 2013, A&A, 558, A53

Kharchenko N., et al., 2016, A&A, 585, A101

Mellinger A., 2009, Publications of the Astronomical Society of the Pacific, 121, 1180

Minniti D., 2018, in , The Vatican Observatory, Castel Gandolfo: 80th Anniversary Celebration. Springer, pp 63–71

Minniti D., et al., 2017a, ApJ, 838, L14

Minniti D., et al., 2017b, ApJ, 849, L24

Palma T., et al., 2019, MNRAS, 487, 3140

Piatti A. E., 2018, MNRAS, 477, 2164

Schlafly E. F., Finkbeiner D. P., 2011, AJ, 737, 103

Schlegel D. J., Finkbeiner D. P., Davis M., 1998, ApJ, 500, 525