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New low latitude globular clusters

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Abstract. We present our recent identification of new, low latitude, globular clusters. One (AL3) is located in the galactic bulge and belongs to the family of intermediate metallicity bulge clusters. The others are low surface brightness clusters, resembling Palomar clusters, and are among the nearest globular clusters to the Sun. These, and the recent detection of other candidates, suggest that the number of low luminosity globular clusters in the Galaxy is much higher than previously thought. Further studies are needed to see if the fraction of halo stars bounded into clusters is significantly higher than the current assumptions.

Key words. Stars: photometry – Stars: Population II – Galaxy: globular clusters

1. Introduction

The globular clusters and old open clusters are relatively rare objects. The number of globular clusters in Harris (1996) compilation was 146, and the updated 2003 catalogue lists 150 objects. The total number of confirmed globular clusters in June 2007 is 158, but the number of candidates is high. The recent wide field surveys, in the optical, near and far infrared, revealed a very high number of new star clusters candidates (open and globular). Dutra et al. (2003) and Bica et al. (2003) used 2MASS and reported about 300 new infrared clusters and candidates. Kronberger et al. (2006) give a list of about 100 optically identified objects. Froebrich et al. (2007) give about 1000 objects, from automated search on 2MASS data. Ivanov et al. (2002) found 10 cluster candidates, also from 2MASS. Kobulnicky et al. (2005) and Mercer et al. (2005) used GLIMPSE on board the Spitzer Space Telescope, and detected 92 objects. Some globular clusters have been found in the SDSS archive. The vast majority of candidates are low latitude open clusters, but still they include some globular clusters.

The recently discovered globular clusters can be classified into two groups: (1) low galactic latitude, very reddened globular clusters, and (2) very low surface brightness high galactic latitude clusters. Among the latest 9 clusters, 5 are low latitude ones, located within ±5° from the galactic plane (GLIMPSE-C01, FSR1735, FSR1767, FSR584, AL3) and 4 high latitude ones (Whiting 1, Segue 1, Koposov 1 and 2), plus a few very distant objects of uncertain nature between globular clusters and dwarf galaxies. All these new clusters are very

Send offprint requests to: S. Ortolani faint, with a typical absolute magnitude around M_V=-2, compared to about M_V=-8 for the typical globular clusters.

In the last 7 years our team identified, and studied in detail 4 new globular clusters: AL3, ESO280-SC06, FSR 1767 and FSR 584. With the exception of ESO280-SC06 all the other clusters are peculiar, rather reddened and located at very low galactic latitude.

2. Observations and results

AL3 (Ortolani, Bica & Barbuy 2006) and ESO280-SC06 (Ortolani, Bica & Barbuy 2000) have been observed with the Danish/ESO 1.5 m telescope at La Silla equipped with the EFOSC focal reducer, while the very reddened clusters FSR 1767 (Bonatto, Bica, Ortolani & Barbuy) and FSR 584 (Bica, Ortolani, Bonatto, Barbuy & 2007) have been studied from 2MASS photometry. ESO280-SC06 appears to be a poor globular cluster, similar to the Palomar clusters, characterized by an old age and an intermediate metallicity. The cluster is located in the inner halo at a distance from the Sun of 21.9 kpc, on the opposite side of the Galaxy.

AL3 (Ortolani et al. 2006) is a peculiar object projected at l=3.4° and b=-5.3°, and located in the inner bulge, at 6.0 kpc from the Sun. The best fit of the color magnitude diagram is obtained with the mean locus of a moderately metal poor globular cluster M55 ([Fe/H]=-1.3), rather unusual for a cluster located in a region dominated by relatively metal rich field stars. Its blue extended horizontal branch could indicate a second parameter effect due to a slightly old age if compared to the typical halo globular clusters, a characteristic similar to a few recently studied globular clusters in the bulge such as HP1 (Ortolani, Bica & Barbuy 1997; Barbuy et al. 2006). These clusters could be the oldest fossils in the bulge and also in the Galaxy.

FSR 1767 (Bonatto et al. 2007), is another very nearby globular cluster, located at only 1.5 kpc from the Sun, in the direction of the galactic center and at about 50 pc below the galactic plane. From the proper motions of the member stars we concluded that the cluster is moving away from the galactic plane at an angle of about 50°. FSR 1767 has a color magnitude diagram morphology similar to M4 ([Fe/H]$\sim$ -1.2). Its integrated magnitude is around M_V = -4.7, corresponding to 2.5 magnitudes less than M4, and placing it among the Palomar-like globular clusters characterized by an integrated magnitude below M_V = -6. From the structural point of view these clusters, including FSR 1767, have smaller core radii than those of the massive globular clusters.

FSR 584 (Bica et al. 2007) is the 160th detected globular cluster in our galaxy. The cluster is poorly populated, similarly to FSR 1767, resembling the low luminosity Palomar clusters. It is projected at only 0.8° from the galactic plane and it is possibly the globular cluster closest to the Sun, at only 1.4 Kpc versus the 2.1 kpc of the well known nearby globular cluster M4, but in the anticenter direction. In the colour magnitude diagram, cleaned from field stars using the external field and the proper motions, this cluster shows a steep giant sequence and blue extended horizontal branch, fitted with the globular cluster NGC 6397, indicating a very metal poor abundance ([Fe/H]$\sim$ -2.0). The cluster is located at about 20 pc above the galactic plane. The proper motions indicate that it is moving almost perpendicularly (at about 70°) towards the galactic plane, with a transverse velocity exceeding 100 km/s, a motion compatible with the halo clusters.

3. Conclusions

The study of the recently discovered globular clusters revealed very peculiar objects. At high galactic latitude they appear in the gap of the size between the dwarf galaxies and globular clusters, but considerably fainter than both the globular clusters and the dwarf galaxies. They could be relics of dwarf galaxies or globular clusters stripped from dwarf galaxies.

The low galactic latitude clusters are faint and poorly populated. They are nearby the Sun, and two of them are the nearest so far known, even closer than the globular cluster M4. This discovery seems to indicate that many faint

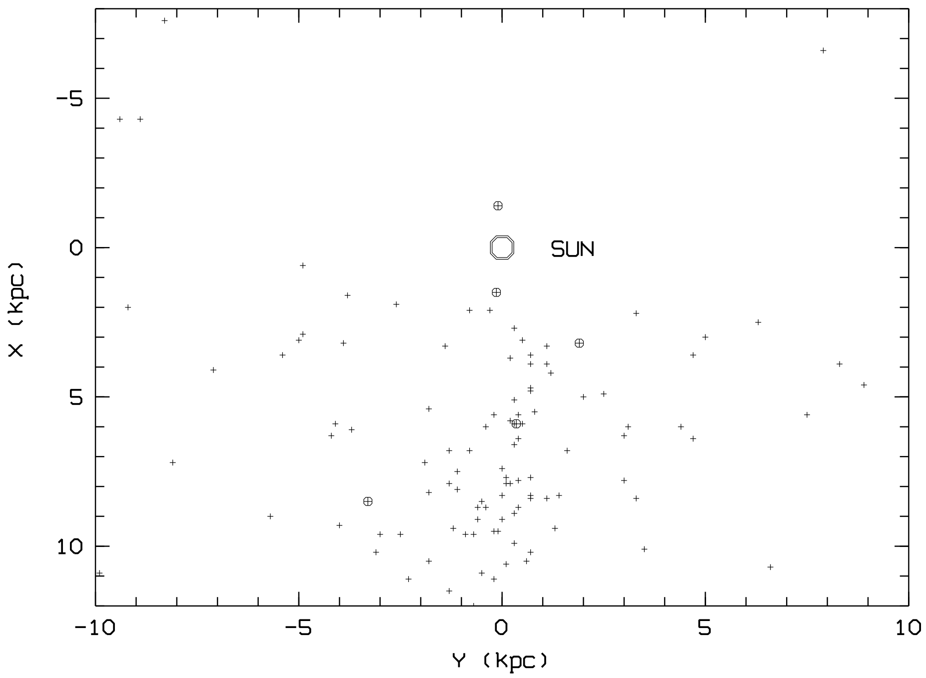

Fig. 1. Galactic coordinate distribution of the 5 recently discovered low galactic latitude globular clusters (circles+crosses) compared to all the previously known globular clusters within 8 kpc from the galactic plane (crosses). The big circle corresponds to the Sun position.

globular clusters could be hidden in the inner disk

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