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Metal-poor globular clusters of the galactic bulge

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Abstract. Very few abundance analyses of individual stars in metal-poor globular clusters in the galactic bulge are available. The main purpose of this study is to derive abundances in individual stars of such clusters, in order to establish their abundance pattern, trying to characterize the oldest bulge stellar populations.

Keywords. globular clusters, galactic bulge, metal-poor stars, abundances

1. Introduction

We have identified a sample of globular clusters in the Galactic bulge that show a moderate metallicity of [Fe/H]∼-1.0, combined with an extended blue horizontal branch (EHB), given in Table 1. Lee *et al.* (2007) suggested that NGC 6522 is among relics of the first building blocks that first assembled to form the Galactic nucleus, and that are now observed as relatively metal-poor EHB globular clusters.

We carried out high resolution spectroscopy of HP 1 using UVES data, and NGC 6558 and NGC 6522 using FLAMES in GIRAFFE mode, all at the VLT UT2.

2. Abundances in bulge metal-poor globular clusters

Among the metal-poor clusters of the inner bulge, Terzan 4 ([Fe/H]=-1.6) has been studied with high resolution infrared spectroscopy by Origlia & Rich (2004), revealing significant enhancement of α-elements. HP 1, NGC 6522 and NGC 6558 show moderate metallicity of [Fe/H]∼-1.0, with high enhancements of O, Mg, Si and Eu, and lower enhancements of Ca and Ti (Barbuy *et al.* 2006, 2007, 2009). The abundance pattern of these clusters is shown in Fig. 1.

3. Conclusions

Lee (1992) pointed out that RR Lyrae in the Galactic bulge have a peak metallicity of [Fe/]∼-1.0. This population should be older than the halo, because being more metal-rich these stars should be more massive, and expected to populate the red HB, whereas given that they populate the RR Lyrae gap, then a lower mass and a lower age are implied.

Table 1. Metal-poor clusters within 5°×5° of the Galactic center.

Cluster	E(B-V)	$d_\odot$(kpc)	[Fe/H]	v_r(km/s)
Terzan 4	1.8	8.3	–1.6	–50
Terzan 9	1.95	4.9	–2.0	—
HP 1	1.21	6.4	–1.0	46
NGC 6522	0.45	7.4	–0.86	–25
NGC 6558	0.38	7.7	–0.97	–197
AL 3	0.36	6	–1.3	—
Terzan 10	2.4	4.8	–1.0	—
NGC 6540	0.60	3.5	–1.0	—

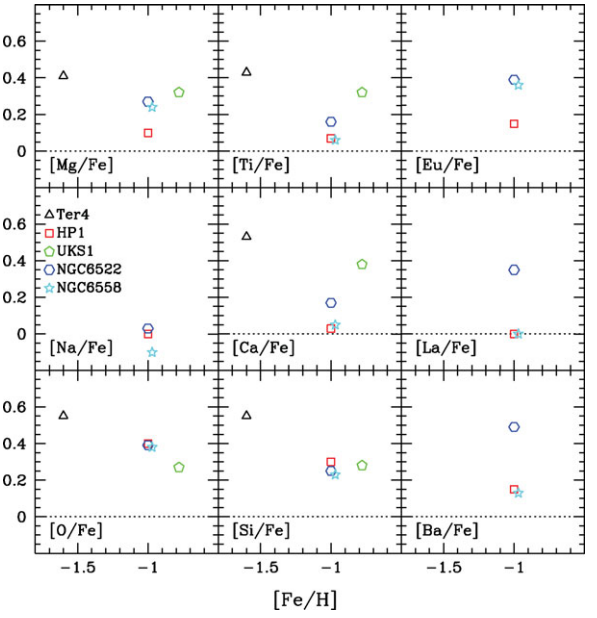

Figure 1. Abundance pattern of the bulge globular clusters HP 1, NGC 6558, NGC 6522, UKS 1 and Terzan 4.

Abundance ratios in HP 1, NGC 6558 and NGC 6522 show enhancements of the α-elements O, Mg and Si, whereas Ti and Ca enhancements are shallower. This might be a signature of nucleosynthesis having occurred at very early times in the Galactic bulge.

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