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High resolution abundance analysis of 5 giants in the globular cluster 47 Tucanae

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Abstract. Abundances in Galactic globular clusters are important for understanding Galactic chemical evolution and the formation of the Milk Way. 47 Tucanae (NGC 104) is a template metal-rich globular cluster ([Fe/H] $\sim$ - 0.7 dex). From the point of view of high resolution spectroscopy, there is still a lack of abundance analyses in the literature. In this work we present a detailed analysis carried out for 5 giants stars ($12.10 < V < 14.30$) of 47 Tucanae, using high resolution spectra ($\lambda/\Delta\lambda \sim$ 60,000) with high signal-to-noise ratio (S/N > 200), obtained at the ESO VLT-UT2 8m telescope, equipped with the UVES spectrograph. Abundances of α- (O, Mg, Ca, Si, Ti), **s**- (Ba, Y, Sr) and **r**- (Eu) process elements are obtained.

1. Introduction

47 Tucanae is the second brightest globular cluster. Its distance is 4.5 kpc (Harris 1996, as updated in http://physun.physics.mcmaster.ca/Globular.html), and it has a low reddening E(B-V)=0.04 mag (Harris 1996). It is located in the direction (J2000) $\alpha = 00^{h}24^{m}05.19^{s}$, $\delta = -72^{o}04'49.9''$, at a high Galactic latitute (l= 305.90°, b = −44.89°).

Brown, Wallerstein & Oke (1990) and Brown & Wallerstein (1992) have used high resolution CCD spectra to analyse 4 stars, two of them located in the Red Giant Branch (RGB) and the other two in the Asymptotic Giant Branch (AGB). These authors found a spread in abundances and discussed the possibility of primordial abundance variations.

Carretta et al. (2004) have analysed 3 dwarfs and 9 subgiants of 47 Tucanae, using high resolution spectra obtained with the VLT-UT2 and the UVES spectrograph.

In this work we present detailed abundance analysis of five giants in 47 Tucanae using high resolution spectra obtained with UVES at the ESO VLT-UT2 8m telescope.

2. Photometry

The $UBVI$ observations of 47 Tuc were obtained on 2002 June with the Wide-Field Imager (WFI) at the 2.2 m ESO-MPI telescope (La Silla, Chile). Infrared J, H and K_s observations are from the 2MASS Atlas (Skrutskie et al. 1997).

3. Results and Discussion

A metallicity of [Fe/H] = - 0.69 ± 0.03 is obtained. The main abundance values obtained for the five stars compared to results from the literature are given in table 1.

We found that the α-elements ratios relative to iron behave in different ways depending on the element: O, Mg, Si and Ti are enhanced likewise in metal-poor halo stars. On the other hand, the α-element Ca shows solar values relative to iron. It is interesting to note that a low Ca abundance relative to iron was also found for metal-rich bulge stars analysed by McWilliam & Rich (1994, 2003) and Zoccali, M., Barbuy, B., Hill, V. et al.

Table 1. Abundances in 47 Tucanae

Abundance	Alves-Brito et al. (2004)	Brown & Wallerstein (1992)	Carretta et al. (2004)
[Fe/H](I)	-0.66 ± 0.03	-0.81 ± 0.04	-0.67 ± 0.07
[Fe/H](II)	-0.69 ± 0.03	$- - -$	-0.56 ± 0.07
[O/Fe]	$+0.35 \pm 0.04$	$+0.43 \pm 0.07$	$+0.23 \pm 0.12$
[Mg/Fe]	$+0.27 \pm 0.02$	$+0.39 \pm 0.04$	$+0.40 \pm 0.09$
[Ca/Fe]	$+0.00 \pm 0.02$	-0.05 ± 0.08	$+0.20 \pm 0.04$
[Si/Fe]	$+0.22 \pm 0.01$	$+0.25 \pm 0.09$	$+0.30 \pm 0.10$
[Ti/Fe]	$+0.21 \pm 0.03$	$+0.25 \pm 0.06$	$+0.26 \pm 0.05$
[Na/Fe]	$+0.07 \pm 0.08$	$+0.08 \pm 0.09$	$+0.23 \pm 0.12$
[Al/Fe]	$+0.13 \pm 0.04$	$+0.59 \pm 0.03$	$+0.23 \pm 0.07$
[Zr/Fe]	-0.17 ± 0.06	-0.43 ± 0.05	$- - -$
[Ba/Fe]	-0.14 ± 0.03	-0.28 ± 0.19	$- - -$
[La/Fe]	$+0.20 \pm 0.03$	$+0.17 \pm 0.04$	$- - -$
[Eu/Fe]	$+0.03 \pm 0.02$	$+0.31 \pm 0.05$	$- - -$

(2004). We find that the odd-Z element Na show a solar abundance and Al is mildly enhanced. Among s-process elements studied here Ba and Zr are deficient while La is overabundant by +0.20 dex. The r-process element Eu behaves like Ca relative to iron; this suggests a possible connection between astrophysical sites in the formation of these two elements.

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References

Alves-Brito, A., et al. 2004, A&A, in prep.

Brown, J. A., Wallerstein, G., & Oke, J. B. 1990, AJ, 100, 1561

Brown, J. A., & Wallerstein, G. 1992, AJ, 104, 1818

Carretta, E., Gratton, R. G., Bragaglia, A., Bonifacio, P., & Pasquini, L. 2004, A&A, 416, 925

Harris, W. 1996, AJ, 112, 1487

McWilliam, A., & Rich, R. M. 1994, ApJS, 91, 749

McWilliam, A., & Rich, R. M. 2004, in *Origin and Evolution of the Elements, from the Carnegie Observatories Centennial Symposia, Carnegie Observatories Astrophysics Series*, (eds. A. McWilliam and M. Rauch, 2004) Pasadena: Carnegie Observatories, (http://www.ociw.edu/ociw/symposia/series/symposium4/proceedings.html)

Skrutskie, M., et al. 1997, in *The Impact of Large Scale Near-IR Sky Surveys*, (eds. Garzon et al.), Kluwer Netherlands, 210, 187

Zoccali, M., et al. 2004, A&A, submitted