New results on field and cluster RR Lyraes

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Abstract

RR Lyrae stars both in the field and in clusters can be used to derive the metal abundance of the regions and systems where they are found.
(1) New data have been collected on a sample of field ab-type RR Lyraes with the aim of studying the composition of the halo and the disk of the galaxy, (Clementini *et al.* 1992a, in preparation), using the relation found by Clementini *et al.* (1991), (hereafter CTM91), between [Fe/H] and the equivalent width of the Ca II K-line W'(K). (2) A quantitative chemical abundance analysis of the ab type RR Lyrae (V29) in the globular cluster M4 has been performed using high resolution, high S/N spectroscopy. We obtain [Fe/H]$=-1.3\pm0.2$ and the $\alpha-$ elements (Mg and Ti) are overabundant by 0.6 dex. These results are in good agreement with determinations from high resolution spectra of giants and blue horizontal branch stars (Clementini *et al.* 1992b, in preparation).

1. Abundances of field RR Lyrae stars

To study the composition of the halo and the disk of our Galaxy, and to get hints on the existence of a thick and/or thin galactic disk we have selected 7 field ab-type RR Lyraes which, from data in the literature, appear to be located at distances from the galactic plane varying in the range $0< |Z| <9$ kpc and that according to their pulsational properties (periods and Bailey type) are expected to have high metal abundance (Castellani *et al.*, 1981). Photometric and spectroscopic data have been collected to check the pulsational properties of these stars and to derive their metal abundance using the relation [Fe/H] = $0.53(\pm0.09)$W'(K) $- 3.08(\pm0.22)$ (CTM91). The new data show that 5 out of 7 of the stars in our sample had improperly been classified as Bailey type-ab RR Lyraes and that among the remaining two ab-type stars only one, (RS Boo), has short period and high metallicity ([Fe/H]$=-0.10$), but this star is also the closest to the galactic plane. We conclude that the selected sample was not the proper one to study the [Fe/H] *versus* $|Z|$ variation and that caution should be taken when selecting samples from data that may be not updated.

2. Chemical abundances in a globular cluster RR Lyrae

Echelle spectra of the variable V29 in M4 were obtained with the 3.6 m ESO telescope, at La Silla, Chile, equipped with the CASPEC spectrograph. Eight spectra (for a total exposure time of about 4 hr) taken between phase 0.65 and 0.8 (close to the

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minimum of the light curve, where the temperature is constant within ±100 K and the effective gravity varies less than 3 %) were coadded after appropriate shifts to account for the different radial velocities. The resulting spectrum has a $S/N > 50$ and a resolution of $R = 15,000$. Equivalent width (EW)s for about 40 lines due to various elements were measured using a special gaussian fitting routine. The abundances we derive are shown below.

[A/H]	No. lines	$T_{\rm eff} = 6,000$ K	$T_{\rm eff} = 6,200$ K
[Mg/H]	1	−0.7	−0.6
[Sc/H]	1	−1.5	−1.4
[Ti/H]	10	−0.85	−0.75
[Cr/H]	5	−1.2	−1.15
[Mn/H]	1	−1.25	−1.05
[Fe/H] I	13	−1.5	−1.35
[Fe/H] II	9	−1.3	−1.3
[Ni/H]	1	−1.1	−1.0
[Y/H]	1	−1.1	−1.0
[Ba/H]	1	−1.5	−1.3

Our abundances compare very well with other determinations from high resolution spectra of M4 stars, both giants (Gratton et al. 1986) and blue HB stars (Lambert et al. 1992). A comparison with other abundance determinations (ΔS index), is also quite satisfactory, given the uncertainties and the large scatter in abundances obtained from low dispersion spectra.

References:

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Discussion:

KOVACS : How large is the dependence of your [Fe/H] values on the puls ation phase?

CLEMENTINI : We have used only spectra taken at phase corresponding to minimum light so I don't expect our determinations to be phase-dependent.

SMITH : The ΔS results for M4 are made uncertain by the strong interstellar K-line in the direction of M4. This may introduce some scatter in the comparison of ΔS and echelle abundances for this cluster.

FERNLEY : Why do you not use the 'c' type field RR Lyraes in your anal ysis?

CLEMENTINI : For the c-type RR Lyraes it is more difficult to properly take into account the effect of temperature on abundance determinations from intermediate resolution spectroscopy.