HD 152786: a lithium giant?

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We were analysing spectrum of the late-type lithium star HD 152786 obtained within UVES Paranal Observatory Project. The theoretical part is focused on summary of present publications about the star and understanding of the lithium problem. Using the Synspec code for synthetic spectrum calculations we obtained some physical characteristics of the star and chemical abundances of some elements including Fe and Li. On ground of this study we could make some suggestions about the star presented below.

HD 152786 in present publications

Basic data of HD 152786 presented in Astronomical Database Simbad [1] with some others citations:

Position (2000.0)	$\alpha = 16^{\mathrm{h}}\,58^{\mathrm{m}}\,37.21^{\mathrm{s}}$ $\delta = -55^{\circ}\,59'\,24.51''$ $\lambda = 332.8^{\circ}$ $\beta = -8.2^{\circ}$	[2]
Proper motion	$\mu_\alpha = -18.31$ mas/yr $\mu_\delta = -35.29$ mas/yr	[2]
Parallax	(5.68 ± 0.91) mas	[2]
Radial velocity	(-6.0 ± 0.9) km/s	[3]
Magnitude	filter B: 4.770 mag filter V: 3.127 mag	
Colour index	B − V = +1.60 mag U − B = +1.96 mag	[4]
Spectral type	K3 III	[5]

Results of spectral analysis publicated elsewhere:

T_{ef} [K]	$\log g$	[Fe/H]	A_{Li}	References
3310				1989 [6]
4350	1.50	−0.4	+1.42	1992 [7]
3980	0.75	−0.4	+0.88	
(4270 ± 200)	(0.50 ± 0.30)	+0.2	+1.30	1999 [8]

The star lies near the Galactic plane and it is classified as young star of population I. None X-ray emission has been detected and a flux in the microwave region of the spectrum is negligible – star does not appear to have hot corona neither chromosphere [9, 10].

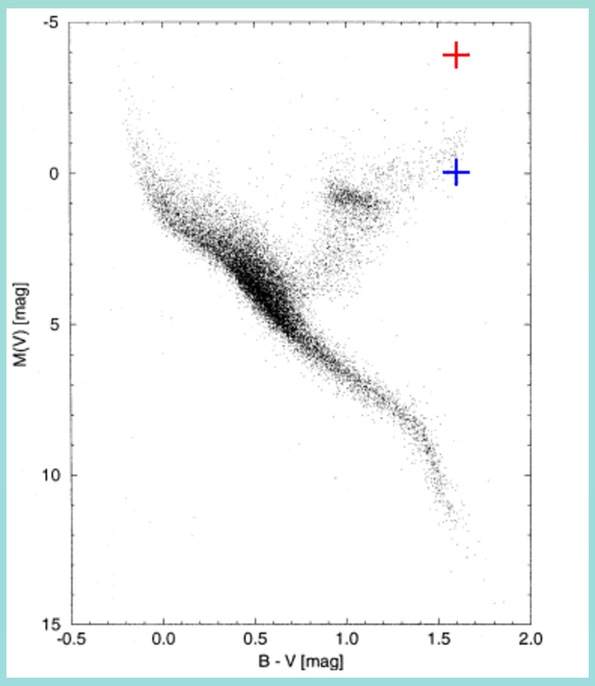
Luminosity class – revision

A parallax of the star obtained by Hipparcos astrometric satellite is nearly an order of magnitude smaller then its earlier estimates. Therefore, the luminosity of the star as well as the luminosity class of giants estimated before Hipparcos are not in agreement with the Hipparcos measurement.

According to Hipparcos mission, a distance of the star and related characteristics are as follows:

Distance	176 pc	[2]
Absolute magnitude in filter V	−3.95 mag	[8]
Bolometric correction	−0.80 mag	[8]
Radius	48 $\mathrm{R}_\odot$	[11]

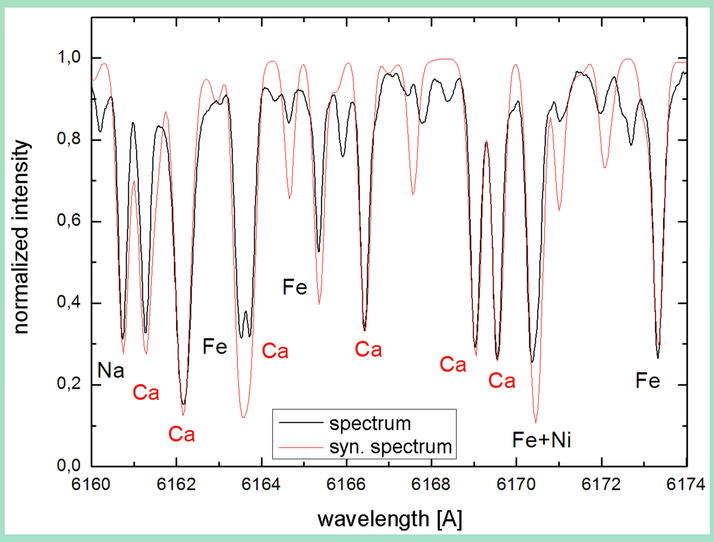
The luminosity of HD 152786 can be estimated as about 6310 $\mathrm{L}_\odot$. A position of the star in the H-R diagram has been dramatically changed after the Hipparcos measurements were done (*blue* and *red crosses* denote the position prior and after the Hipparcos, respectively).

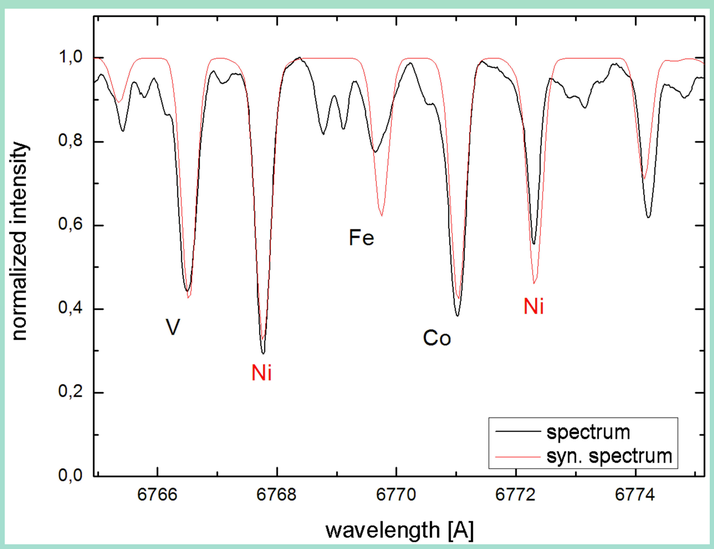


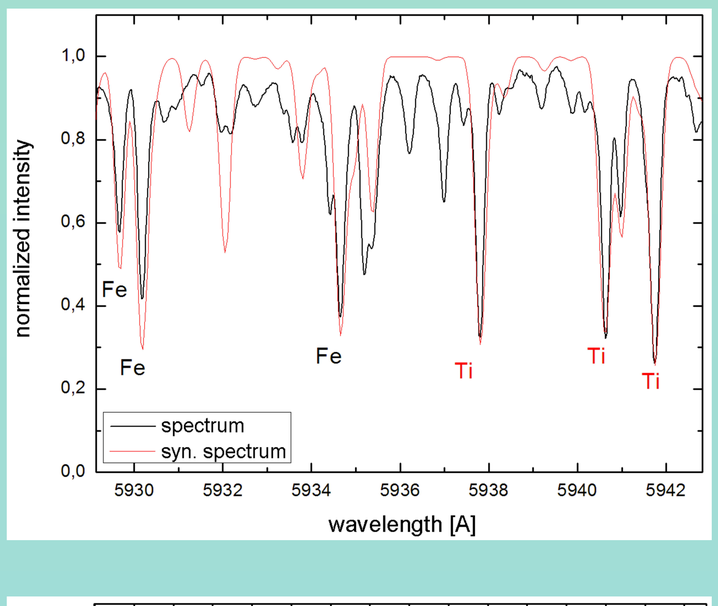
Based on new measurements, the star should be classified as a bright giant or a supergiant, with the luminosity class of II or Ib.

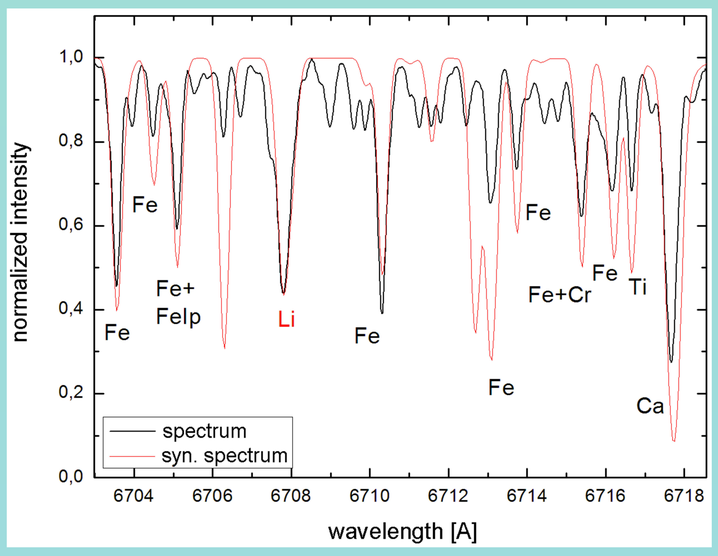
Spectral analysis

Using the Synspec code [12] we calculated synthetic spectra for several parameters of star atmosphere. The parameters of the star atmosphere can be considered to be the same as that of the calculated spectrum with the best fit to normalized measured data. Four different regions of the matching spectra are presented here (*red line* – calculated spectrum, *black line* – measured spectrum).









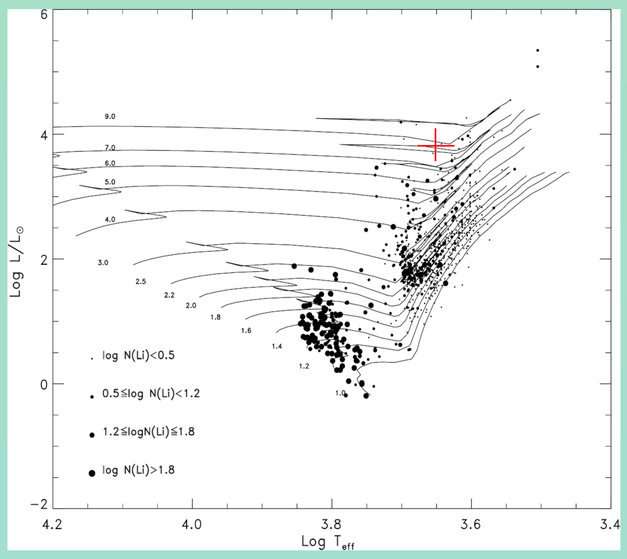
Results

By means of comparing syntetic and measured spectra we determined the effective temperature as $T_{\mathrm{ef}} = 4500$ K, surface gravity $\log g = 0.5$ and abundances of some chemical elements for the star:

A (element)	A_{A}	[A/H]
Li	1,15	+0,10
Al	5,60	−0,77
Ca	5,90	−0,41
Ti	5,90	+1,00
V	4,95	+0,95
Fe	7,04	−0,41
Co	4,78	−0,14
Ni	5,30	−0,93

The value of surface gravity confirms assigning the star to the supergiants class.

From the physical parameters the star can be placed into the H-R diagram with evolutionary tracks (a diagram from Mallik, 1999 [13], with HD152786 denoted as *cross* is shown below) and than its mass and approximate evolutionary state could be estimated (see Conclusion).



Conclusion

According to research HD 152786 appears to be supergiant of spectral class K3 II or K3 Ib with effective temperature $T_{\mathrm{ef}} = 4500$ K, surface gravity $\log g = 0.5$ and metallicity of [Fe/H] $= -0.41$, which confirms that HD 152786 is a metal-rich population I star. Obtained lithium abundance $A_{\mathrm{Li}} = 1.15$ does not correspond to values of lithium stars. The mass estimated from H-R diagram is (6–9) $\mathrm{M}_\odot$. Therefore, the evolutionary state must be close to the point where the energy source in the star's interior is changing. As consistent with current theories, the measured value of lithium abundance is in a good agreement with the gussed state of the star.

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