ON THE PROBLEM OF THE CHEMICAL COMPOSITION OF β LYRAE

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Two determinations of helium abundance in the primary β Lyrae's component existed before 1975. According to Boyarchuk (1959) helium is 631 times overabundant relative to hydrogen and according to Hack and Job (1965) the ratio He/H varies from 1 to 2.25 depending on the effective temperature. We started to examine this probleme with the aim to decide between these extreme results. In the meantime there were published two papers by Leushin at al. (1977, 1979) in which there was found, that He/H = 1.5 for T_{eff} = = 12 000°K and log g = 2.5. The earlier results were based on equivalent widths analysis with curve of growth method. The authors of newly published papers have started from convenient models of the atmosphere, calculated equivalent widths and compared them with observation. In our paper (Bahýl' 1979) we started from models of the atmosphere, too. Then we calculated the theoretical profiles. We have found the best fit for the model Böhm-Vitense (1967), T_{eff} = 12 900°K, log g = 2 and He/H = 2.72, as shown in Fig. 1.

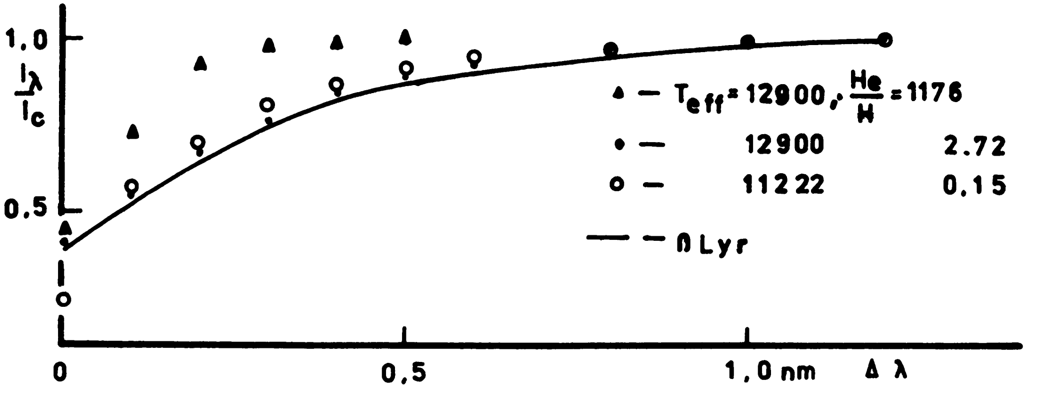

Figure 1. H 6 - some theoretical and the infinum of the observed profiles.

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The methods designed for spectra which are stable in time were applied in the cited papers to study β Lyrae's spectrum. In this paper we shall try to check out to what extent is this approach appropriate in the β Lyrae's case and whether it is not just the reason of the discrepancies.

The data used in this paper were obtained from 19 high-dispersion spectrograms (D = 0.8nm/mm) in the spectral range from 365 nm to 490 nm covering the whole light chrve as shown in Fig. 2.

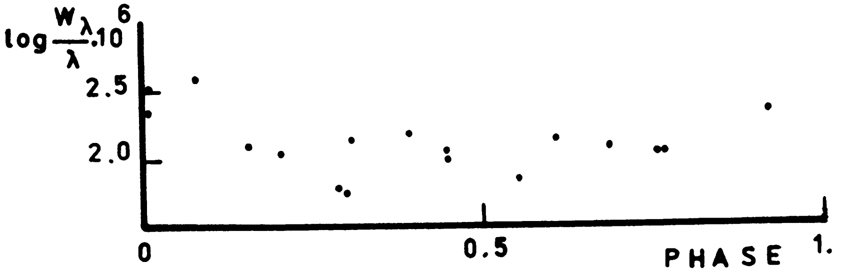

Figure 2. The phase diagram of the equivalent width of the Ca II K line.

An important feature was noticed immediately on the spectral intensity tracings. Marked changes occurs in the absorption line profiles, and these affect not only the shape of the profiles, but also the changes of the equivalent widths of the spectral lines with the phase. The equivalent widths tend to increase around the minimum phase, as shown for the Ca II K line in Fig. 2.

In the framework of the commonly accepted β Lyrae's model as a close binary with an envelope, it is possible to interpret the spectral changes as a result of the envelope's influence on the spectrum of the primary. In an effort to work with the profiles as stable as possible, we directed our attention to the high members of Balmer hydrogen series. The point is that these come from deeper layers of the atmosphere, where we can most likely assume conditions close to LTE, and neglect the influence of the disc-shaped envelope as a reasonable approximation. We have not reached this aim, as we were unable to find "stable" lines in β Lyrae's spectrum; the changes with phase were observable in the high members of the Balmer series, too. The conditions are most stable within the phases $0^p_.2$ to $0^p_.8$, but the dispersion is still large. The H 11 profile is plotted in Fig. 3. The crosses indicate the mean profile from the range $0^p_.2$ to $0^p_.8$. The observed mean intensity dispersion is indicated by vertical bars. The mean profile from the neighbourhood of the primary minimum $P \in (0.8;1) \cup (0;0.2)$ is denoted by circle with a dot and it is given without dispersion, because we have at our disposal only two goot observations from this period.

Like Leushin at al. (1979) we tried to compare the H 11 profile with the theoretical ones of Klinglesmith (1971). We have found this theoretical profiles deeper than the observed mean

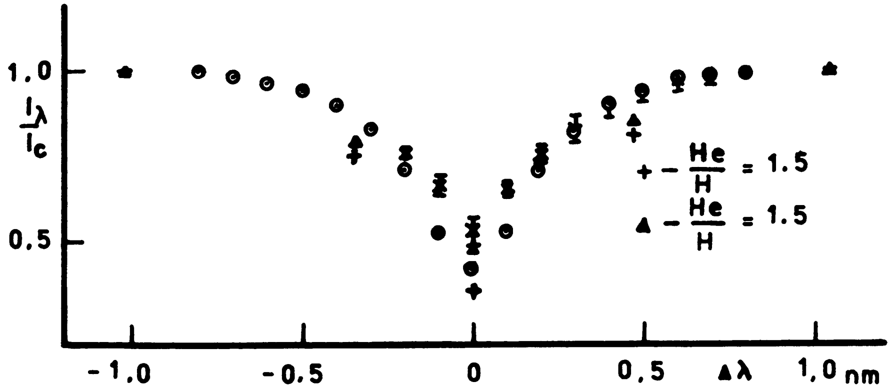

Figure 3. Comparison of the theoretical and observed profiles of the H 11 line.

profile from the interval $0^{p}.2$ - $0^{p}.8$. In case of the primary minimum the profile is indeed deeper, but it is steeper and the agreement of observation with theory is not improved. The situation is similar in the other Balmer spectral lines, or the agreement is still worse. Even then the model with He/H = 0.125 is in better agreement with observation then the model with He/H = 1.5, as suggested by Leushin at al. (1979).

Since the application of methods convenient for stable spectra on the β Lyrae's spectrum may result in different models of its atmosphere, we finally conclude, that these methods give us the first approximation to reality only. To find the real abundance values it would be desirable to compute the model atmosphere taking into account the common envelope of the whole system and the processes which take place in its vicinity. Anyway the present results definitely contradict the helium overabundance in the β Lyrae's primary component atmosphere as suggested by Boyarchuk (1959).

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DISCUSSION

Sonneborn: Before you include the effects of circumstellar material, the effects of rotation must be taken into account. For a star such as β Lyr (v sin i = 240 km/s) the temperature variation over the surface will be important for the hydrogen lines. Using a model atmosphere with a single effective temperature can only produce misleading results, especially in abundance determinations.

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