ON THE RADIATION DEFICIENCY OF SHELL STARS IN THE BALMER CONTINUUM

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The present report gives the results of a statistical comparison of shell stars with normal Be stars to establish the differences in the parameters of the gaseous envelopes, such as the radiation power in the Paschen continuum and the optical depth of the envelopes in the Balmer continuum.

Let us consider Figure 1, showing the dependence of the Q_{BVK} parameter on the spectral type of shell and normal Be stars (Q_{BVK}=(B-V)-0.36 (V-K). The figure 1 illustrates a well-known property of the emission line B stars : the radiation power of the gaseous envelope rises when passing from late to earlier spectral subclasses.

Figure 2 shows the Hα emission line intensity dependence on the Q_{BVK} parameter. It should be noted that there is a definite correlation. Thus it can be assumed that the parameter Q_{BVK} can be used as a certain qualitative measure of the radiation power of a gaseous envelope in the Paschen continuum.

Let us turn to Figure 3, giving the distribution on the parameter Q_{BVK} for shell and normal stars. According to the criteria of Kolmogorov-Smirnov and Fisher and Student (Mitropolsky, 1961) both distributions turned out to be identical at the 95 % confidence level.

Hence the conclusion can be drawn that gaseous envelopes of shell and normal Be stars do not differ from each other in their radiation power in the Paschen continuum.

In our previous paper (Chkhikvadze, 1980) we concentrated our attention on the fact that some of the shell stars are observed to have anomalously high Balmer jumps. In certain cases (EW Lac, Tau, 48 Lib) the anomaly was expressed as additional absorption jumps. It is easy to understand that such a phenomenon must be due to an appreciable opacity of the envelopes of such stars in the Blamer continuum.

M. Jaschek and H.-G. Groth (eds.), Be Stars, 141–146.

To solve the problem whether the radiation deficiency is specific of all shell stars in the Balmer continuum, it would be desirable to take high resolution spectra of such objects in the Balmer limit rẽgion, although this is a very laborious process. However, as we shell see later, one can use the following difference $\Delta Q_{UBV} = Q_{UBV}$ (observed) - Q_{UBV} (intrinsic) where Q_{UBV} is Johnson's well known parameter.

Figure 4 borrowed from our previous paper (Chkhikvadze, 1980) displays the dependence between ΔQ_{UBV} and ΔD, where ΔD is the difference between the observed and intrinsic Balmer jump. It can be seen that for normal Be stars, having a small value of Balmer jump compared with normal B stars of the same subclasses, there is a pronounced correlation between ΔD and ΔQ_{UBV}, which are, besides, negative. On the other hand for shell stars with an anomalous jump the differences ΔQ_{UBV} proved to be positive.

Hence, the technique of investigation is based upon the suggestions as follows :

1. Optically thin gaseous envelope in the Balmer continuun must result in the radiation excess in the ultraviolet and consequently ΔQ_{UBV} must be negative.

2. If the optical depht of the envelope is not small then there must be observed a certain deficiency of the ultraviolet radiation with similar values of the rest of the parameters of the star and the envelope. That is, for stars with optically thick envelope in the Balmer continuum the difference ΔQ_{UBV} must be algebraically higher than the similar value determined for a star with optically thin envelope.

Let us consider Figure 5 showing the distributions of ΔQ_{UBV} parameters for shell and normal Be stars.

Estimates of standard statistics of the above mentioned distributions are given in Table I.

TABLE I.

Statistics	shell	Be
Mean value	+ 0.011	- 0.066
Dispersion	6.68 (-3)	6.22 (-3)
Asymmetry	+ 0.30	- 0.279
Excess	0.80	0.18

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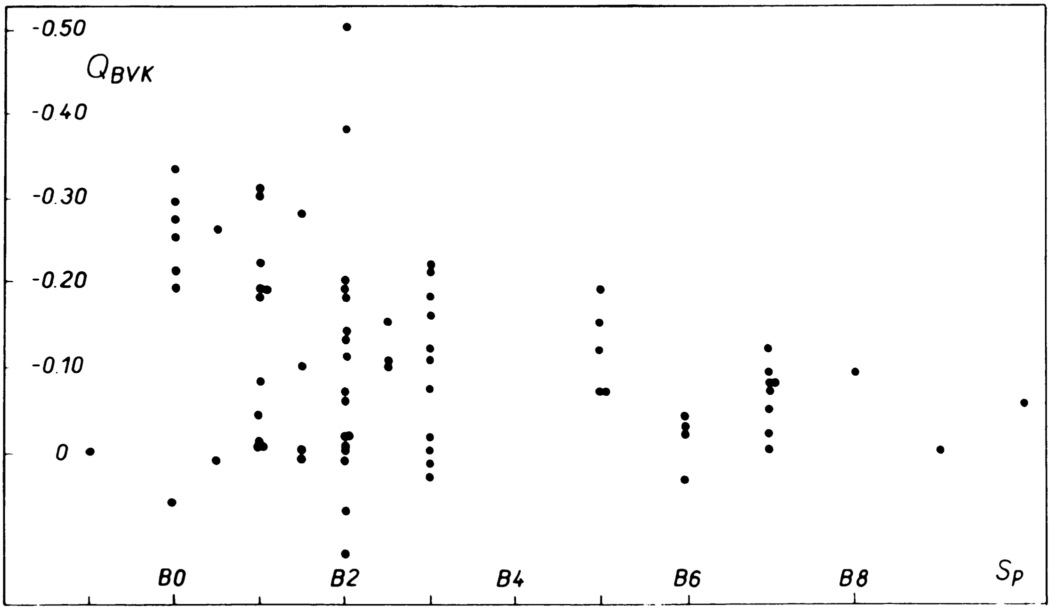

Figure 1.

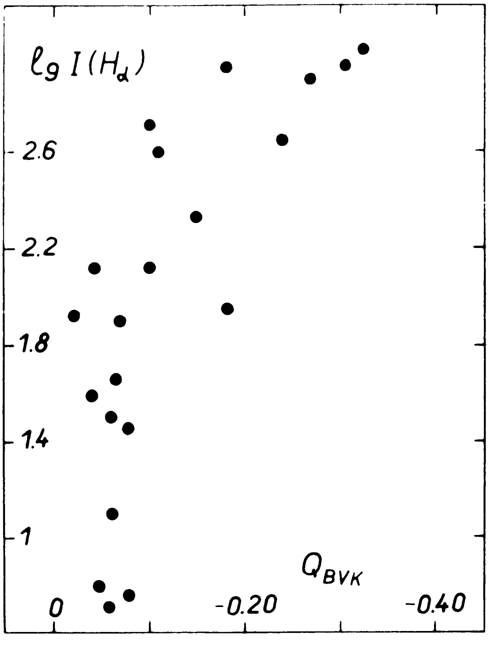

Figure 2.

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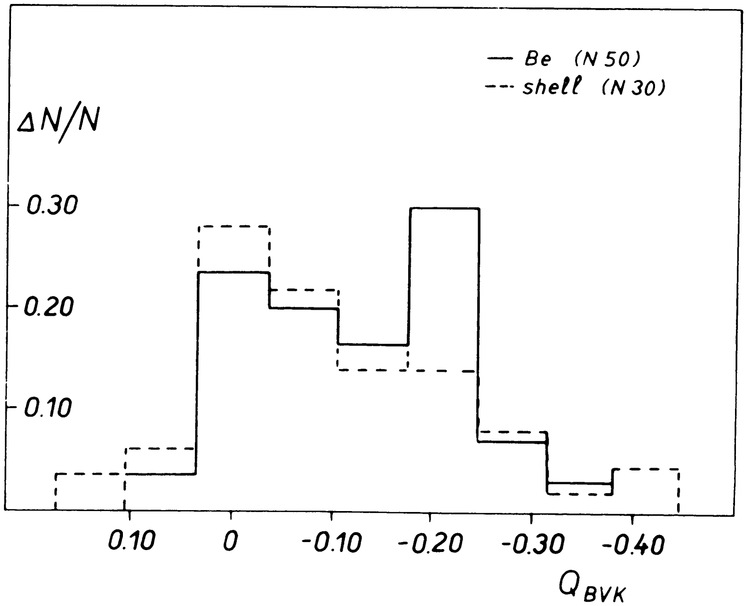

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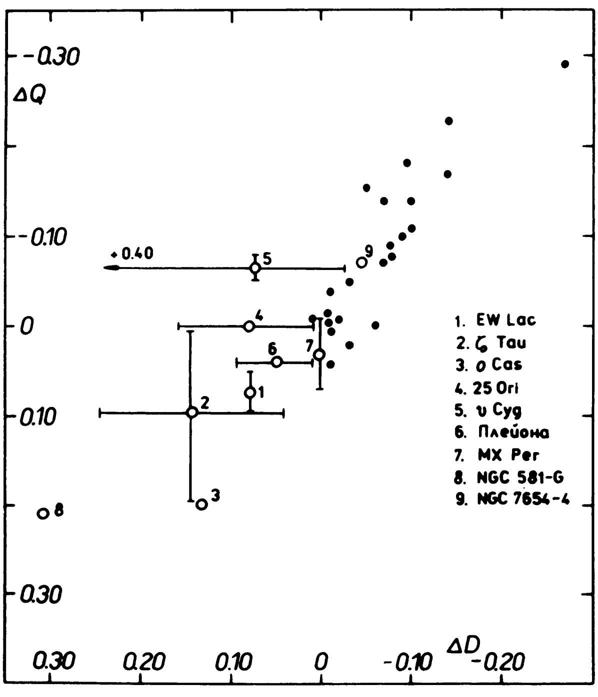

Figure 4.

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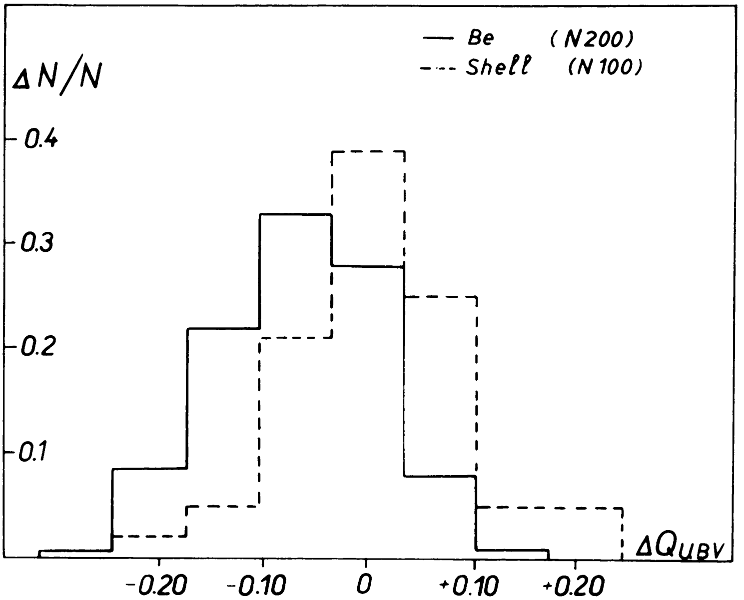

Figure 5.

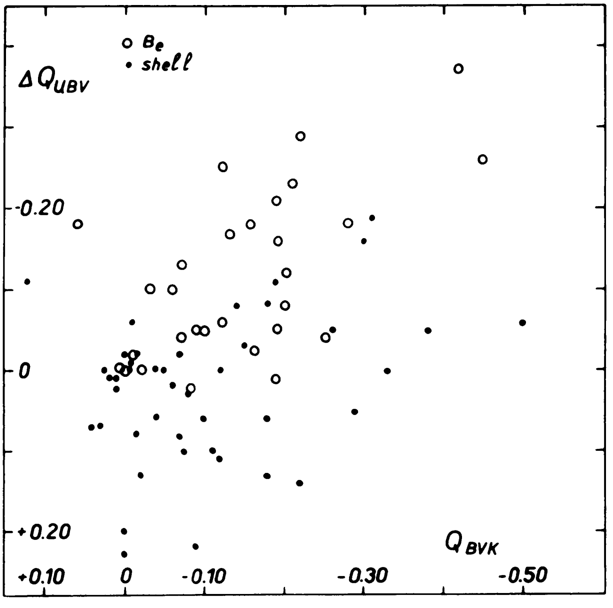

Figure 6.

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The calculation showed that at the 95 % confidence level these distributions don't represent samples from one general totality. Hence, the conclusion is drawn that shell stars are characterized by the radiation deficiency in the ultraviolet being due to the fact that the optical depth of the envelopes of shell stars in the Balmer continuum is not small.

The above conclusion is well illustrated in Figure 6 where the shell stars compared with normal Be ones are located otherwise : with the same values of the parameters Q_{BVK} algebraically greater values of ΔQ_{UBV} are specific to shell stars.

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