THE ESTIMATION OF 53 Cam MAGNETIC FIELD VALUE BY MEANS OF SPECTRAL LINES WIDTH ANALYSIS

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The systematical studies of 53 Cam spectral lines widening were carried out in order to find the possible structural features and the mean value of the surface magnetic field. The spectral region 4000 - 4700 A was registered on photoplates on 6-m telescope with the inverse dispersion 1.3 and 1.7 A/mm. Nearly 100 unblended lines were selected for analysis and for each of thee we have measured the total width on 10, 30, 50, and 70 % of central depth (Fig. la). Unsecure measurements were not included in subsequent study. For every level we have plotted the dependence between width and Lande factor and obtained the linear regression parameters: the inclination, the zero Lande factor line width and the correlation. The results are listed in Table 1.

Table 1.

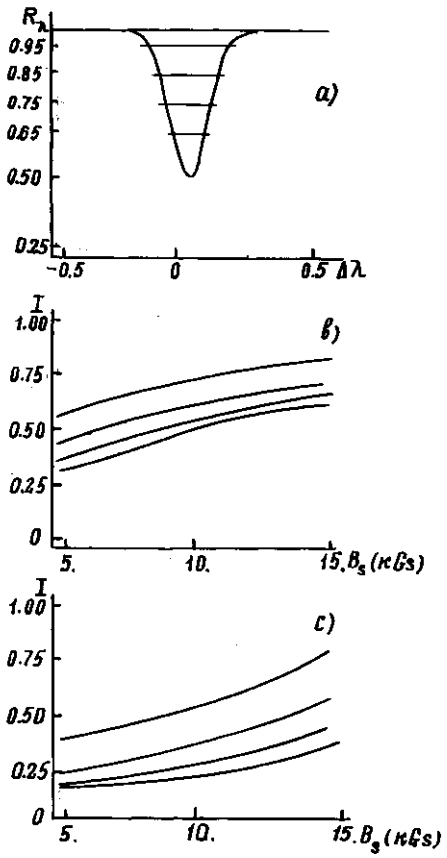
Width measuring level	Number of reliable measurements	Correlation value	Surface magnetic field in kGs
0.1	82	0.915	21.1 ± 2
0.3	95	0.940	15.8 ± 1
0.5	104	0.969	11.7 ± 0.6
0.7	104	0.921	8.0 ± 0.5

We know from the theory of magnetic intensification of spectral lines that the line widths $\Delta\lambda$ must be proportional to the surface magnetic field B_s, but our results have shown strong dependence from the level of width measurements (see Table 1 and Fig. 2).

To control the reliability of the method the whole procedure was repeated for the spectrophotometry standard star Procyon. Line profiles were taken from Griffin (1979). No significant correlation between Lande factor and line width has been found.

The systematical increase of the surface field value with the level of width measurements is quite unbelievable, so we tried to find some spectroscopical effect like a fine structure, which was not yet accounted. The importance to account for the fine structure was proved by numeric experiments. Fig. 1. presents a model line with 10 components, the intensity of which decreases (b) and increases (c) to the center of spectral line (the field is 12 k6s). Zeeman effect is working in a different way for different splitting patterns. So for the correct use of line intensification theory for every depth level we need to use a special "effective" Lande factor.

Fig. 1.



To account for the fine structure we have divided the full list of lines on 4 parts corresponding to the Zeeman components pattern:

1) pure triplets;
2) the intensity of σ components increases to the line center;
3) the intensity of σ components decreases to the line center;
4) all other cases.

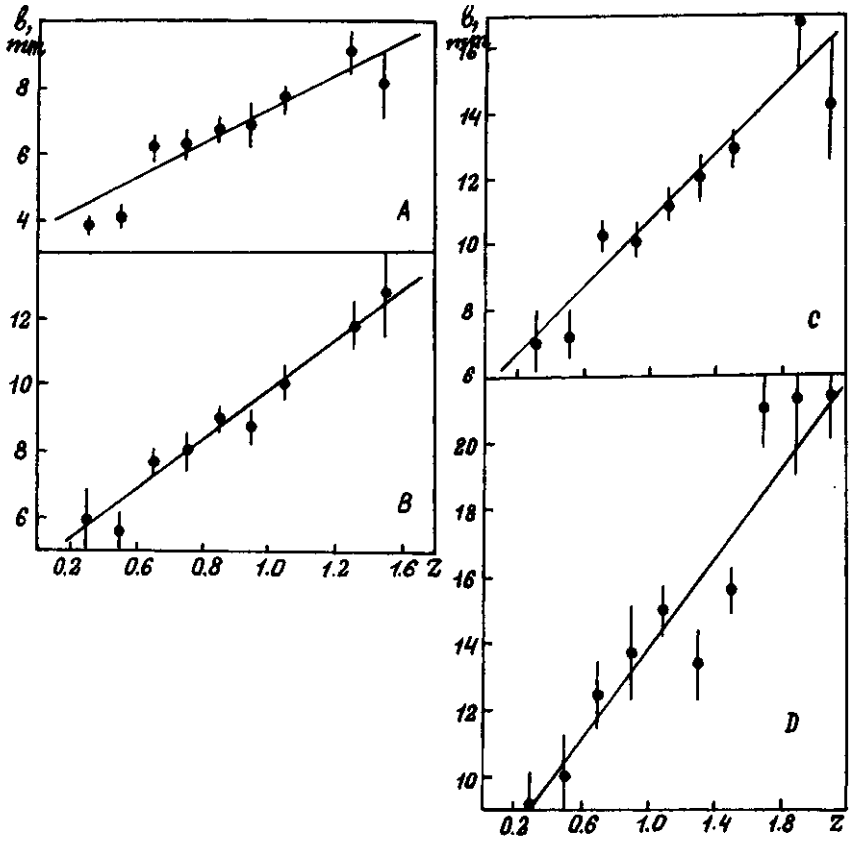


Fig. 2. The averaged line widths b as a function of Lande factor z for 53 Cam in 0.75 phase of rotational period. a) level 0.7, b) level 0.5, c) level 0.3, d) level 0.1.

For every group we carried out the independent regression analysis and numerically calculated line width on different levels for some typical Zeeman patterns using effective Lande factor for each level. The effective Lande factor for 70% level was calculated as intensity weighted mean of all σ - components which are stronger than 70X of maximal intensity. The comparison between calculations and regression parameters (Fig. 3) provided the B_s value for a given rotation phase.

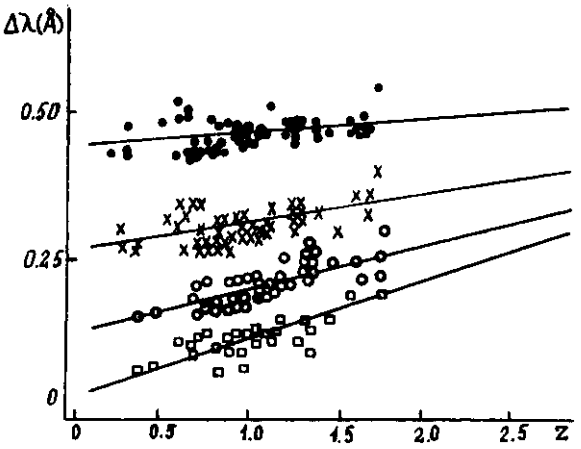


Fig. 3. A comparison of the observed (solid lines) and computed dependencies of line width from Lande factor for different levels.

RESULTS

1. Our results show strong dependencies of line width on the level of width measurements.

2. The magnetic field of 53 Cam in rotation phase 0.75 is properly described by magnetic dipole model with B_s =11.96 ± 0.56 kGs. Deviations froe dipole are smaller than the observational errors. The proposed method proved to be usefull for statistical surface field determination for magnetic stars;

3. Using direct splitting measurements Preston (1969) found B_s = 15 kGs which is quite close to our estimation 12.7 kGs for the same phase. So the same dipole model is proved by different type of observations;

4. Better Lande factor calibration procedure is required for this method because for some Zeeman patterns the agreement was rather poor. An influence of possible toroidal component is not also excluded, but it is the problem of future investigations.

REFERENCES

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