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INFLUENCE OF PECULARITY EFFECT ON BALMER DISCONTINUITY IN THE ATMOSPHERES OF MAGNETIC CP STARS

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On the basis of 10 color photometric materials Balmer jumps were determined for different magnetic stars taking into account the peculiarity effect - the presence of a strong magnetic field (Be> 1000 gauss) and chemical anomalies in the spotted areas of the stars studied. The influences of chemical anomalies and the magnetic field on the structure and physical conditions, including Balmer jumps, in the atmospheres of MCP stars are analyzed. It was found that due to an excess (for 2–5 orders) of peculiar elements (Si, Cr, Sr, Eu, Nd, etc.), energy absorption by the lines of these elements (blanketing effect) occurs in spotted regions of the atmosphere of these stars. Thus, chemical anomalies owing to additional blanketing effect, have an essential influence on the occurrence of additional source of opacity and correspondingly on the change of continuum spectrum in the region of the Balmer discontinuity. The magnetic field makes some contributions to the distribution of pressure (P = Pg + Pe), temperature and other parameters, as well as Zeeman effect leads to the strengthening blanketing effect with all associated effects. It is concluded that the decrease in the Balmer jump mainly depends on the spectral (P) and photometric indices (Z,$\Delta\alpha$) of the of peculiarity and the intensity of the magnetic field of the studied MCP stars.

Keywords: CP stars–peculiar effects–chemical abundances–magnetic fields–stellar parameters

1. INTRODUCTION

Magnitude of Balmer discontinuity depends on the ratio of H-, HI and HII which are very sensitive to the changes of electron density. In lower atmospheric layers ($\tau \leq$ 0,5 - 0,7) where continuum spectrum and the first members of Balmer series (Hα - Hγ) on which electron density (method Unsold) are effectively formed, the calculated electron densities in spot area are 2-3 times more than in normal atmosphere of MCP stars [1]. Due to excess peculiar elements (2-5dex) increase in temperature and electron concentration in peculiar fields continuous absorption coefficient rises. In this connection the role of the main absorbing element - hydrogen decreases. The structure of atmosphere and magnitude of Balmer discontinuity in peculiar fields of MCP stars changes.

Thus, due to anomaly in chemical composition the change of the structure of atmosphere and redistribution of flux along wavelengths occur in peculiar fields which partially "fill" Balmer discontinuity decreasing its magnitude. The main reasons which cause anomaly (decrease) of Balmer discontinuity in MCP stars were given below. Similar question has already been analyzed in [2] in which it was stated that anomaly was caused, mainly, by anomalies of the chemical composition. It should be noted that due to anomaly of the chemical composition following effects which lead to the decrease of Balmer discontinuity appear in peculiar field.

1. At high increase of absorption in ultraviolet field of spectrum redistribution of absorbing flux along wavelengths occurs, due to which altitudes of Balmer discontinuity decreases.

2. Additional blanketing effect occurs due to the intensification of spectral lines of peculiar elements and distribution of temperature with atmosphere depth and Balmer discontinuity changes, correspondingly.

3. The role of the main absorbing element – hydrogen [3] and continuous absorption coefficient and the structure of atmosphere in peculiar fields change (decrease), while decreasing the magnitude D.

It is concluded that the change of magnitudes of Balmer discontinuity, photometrical ($\delta\alpha$, Z) and spectral indexes (P(E)) of peculiarity are related to anomalies of the chemical composition. The change of these parameters and structure of atmosphere are also related to magnetic field which intensifies anomaly of the chemical composition.

It is known that magnitude of Balmer discontinuity and inclination of Paschen continuum strongly depends on the temperature of star. At high temperatures Te$>$10000K magnitude D decreases, since decreases the relation of absorptions in Balmer and Paschen continua. Ionization degree of hydrogen increases together with the growth of Te as a result of which the magnitude D decreases.

Results of our studies show that the decrease of Balmer discontinuity in silicon stars is much higher (δ D =0,06) than in rare-earth stars (δ D =0,02) for which Te$\leq$9000K. The reason of the impact of excess silicon on D was considered in the work [3]. It was noted there that when Te$\leq$9000K the magnitude D must be decreased due to high absorption by negative hydrogen ions H-. At lower temperatures Te ≤9000K absorption by neutral hydrogen decreases due to small degree of its excitation.

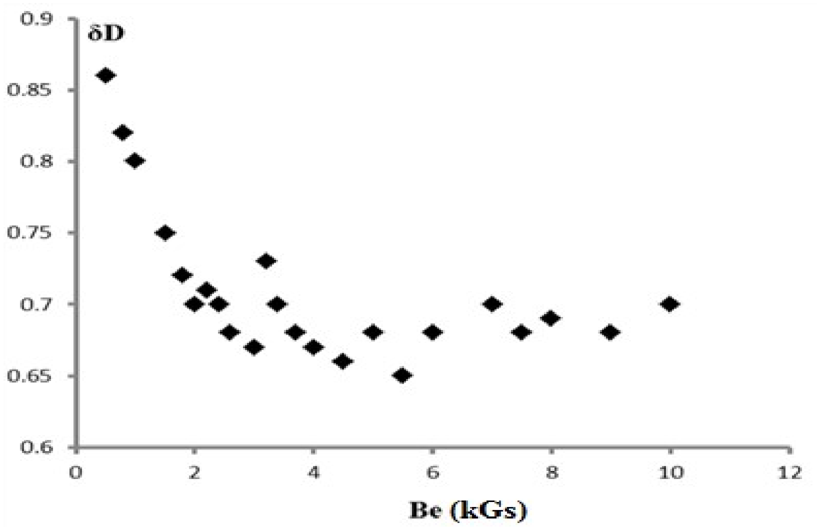

Fig. 1. Comparison of magnitudes D for normal (Dn) and peculiar (Dp) fields in silicon stars

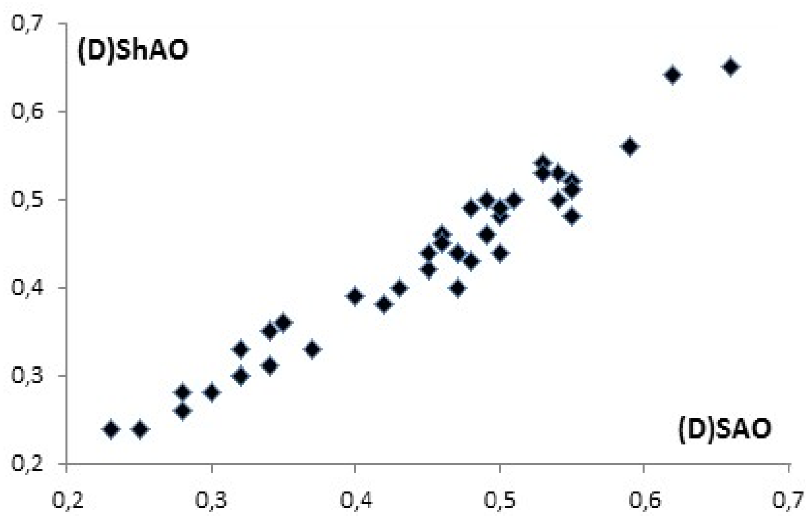

Fig. 2. 2 shows the comparison Balmer discontinuity received in SHAO (NANA) and SAO (RAS).

For quantitative coincidence it is necessary to take into account not only the impact of anomalies of silicon and rare-earth elements, but also the impact of all

Table 1. ΔD (average) = 0,06

№	HD	Sp	m_v	Type of peculiarity	D(P)	D(N)	Δ D
1	19832	B 7.3	5,65	Si λ4200	0,26	0,30	0.04
2	25823	B 6.8	5.27	Sr, Si λ4200	0,45	0,50	0.05
3	27309	A0	5,24	Siλ4200	0,45	0,52	0.07
4	124224	B8	4,9	Siλ4200	0,56	0,62	0.06
5	170000	Ḃ8	4,12	Siλ4200	0,27	0,32	0.05
6	192913	A0	6,59	Siλ4200	0,64	0,70	0.06
7	193722	B9	6,40	Siλ4200	0,43	0,55	0.08
8	215441	A0	8.84	Si 4200	0,62	0,70	0.08
9	219749	B9	6,45	Si 4200	0,63	0,68	0.05

Table 2. ΔD (average) = 0,02

№	HD	Sp	mv	Type of peculiarity	D(P)	D(N)	ΔD
1	15089	A 3.8	4.59	Sr, Cr, Eu	0,48	0,51	0.03
2	65339	A2	6.00	Sr, Cr, Eu	0,47	0,50	0.03
3	71866	A5	6.75	Si, Cr, Eu	0,55	0,57	0.02
4	112185	A1	1.68	Cr, Eu	0,60	0,61	0.01
5	119213	A1	6.39	Sr, Cr, Eu	0,56	0,59	0.03
6	140160	A0	5.26	Sr, Eu, Cr	0,55	0,55	0
7	153882	B9	6.29	Cr, Sr	0,47	0,48	0.01
8	184905	A0	6.62	Si, Sr, Cr, Eu	0,65	0,68	0.03
9	188041	F0	5,84	Sr,Cr,Eu	0,57	0,57	0
10	196502	A2	5.2	Sr, Cr, Eu	0,47	0,50	0.03
11	224801	B9	6,30	Cr, Sr, Si, Eu	0,40	0,44	0.04

peculiar elements. Thus, it should be taken into account the effect of uneven distribution of chemical anomaly from height of atmosphere which is probably due to radial gradient of magnetic field in atmospheres of magnetic stars. It should be added that due to strong magnetic field the most observed anomalous effects and changes in the structure of atmosphere in MCP stars intensify. Figure1 shows the dependence of abnormality of Balmer discontinuity (Δ D) on magnetic field. The main conclusions:

1. Decrease of Balmer discontinuity is due to anomalies of the chemical composition which leads to increase of blanketing effect as a result of which continuum and the value of Balmer discontinuity change, correspondingly;

2. Due to strong magnetic field (Be $>$ 1000 Gs) distribution of pressure (P=Pg + Pe), temperature and other parameters of atmosphere (k_λ, n_e and so on) change, as well as blanketing effect intensifies, which leads to the decrease of Balmer discontinuity.

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