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THE SYSTEM OF EQUIVALENT WIDTHS OF FeI-ABSORPTION LINES FOR DETERMINING REGIONAL TEMPERATURES IN PHYSICAL VARIABLE STARS

A number of peculiarities of absorption spectra of physical variable stars do not permit to obtain unambiguous physical-chemical parameters of their atmospheres in separate phases of light variation. The temperature determination of a spectrum-forming layer by different methods (the level of a continuous spectrum, ionization temperature) does not give us any conformity results. It is practically impossible to construct "the curve of growth" by a classical method even having a rather reliable system of oscillators' forces. As is known at maximum light in the short-periodic cepheids and stars of RR Lyrae-type (Bappu and Raghavan, 1969, Rautela et al., 1981, Rodgers and Bell, 1963, Romanov et al., 1980, Romanov and Fenina, 1981, 1983) there is an anomalous intensity of heavy elements' lines observed in the spectra. Some authors suppose that this may be due to the short temperature decrease before maximum light (Whitney, 1967). Besides the profiles of hydrogen lines are distorted by emission, i.e. there occurs a drastic heating up of upper layers of the atmosphere. It is obvious that the temperature distribution in the levels of different lines formation does not correspond to the standard one at light maximum in cepheids. In connection with this, one can assume that the ratio of emission coefficients and atmospheric gas absorption is given by Planck's function in the regional kinetic temperature. This is known as the assumption of a regional thermodynamic equilibrium. In the absence of scattering this is equivalent to the assumption on the possibility of calculating the microscopic gas state by equations of thermodynamic equilibrium in the regional kinetic temperature. The RTE is not valid in the outer layers but it is the best approximation in the layers forming a continuous spectrum.

In the present work a method is shown for determining regional kinetic temperature from equivalent widths of absorption lines of neutral iron. It is based upon the property of equivalent widths of FeI-absorption lines to increase with the temperature excitation decrease irrespective of the ob-

Table I

The system of equivalent widths of FeI-absorption lines for determining regional temperature

N	λ	θ_{ex} / 0.70	0.85	1.00	1.19
		- lg W_λ/λ			
1	4005.24	4.74	-	4.24	-
2	4044.61	5.10	4.64	4.40	4.05
3	4045.24	4.44	-	3.88	-
4	4063.60	4.42	4.18	3.98	3.74
5	4071.74	4.86	4.40	4.12	3.80
6	4072.52	5.42	4.74	4.62	4.25
7	4079.85	5.20	4.65	4.68	4.21
8	4112.35	-	4.96	-	4.30
9	4143.87	4.65	4.37	4.08	3.82
10	4147.67	4.96	4.58	4.31	3.87
11	4174.94	5.00	4.71	4.44	4.08
12	4175.64	4.82	4.59	4.36	4.08
13	4187.04	4.96	4.62	4.30	3.96
14	4199.97	5.74	5.27	4.77	4.13
15	4206.71	-	4.89	-	3.97
16	4233.61	4.68	4.70	4.31	3.80
17	4250.79	4.66	4.43	4.21	3.93
18	4260.48	4.68	4.41	4.15	3.78
19	4265.26	5.70	5.36	4.95	4.44
20	4267.83	5.70	5.09	4.57	3.86
21	4271.76	4.88	-	4.06	-
22	4276.68	5.72	5.25	4.80	4.26
23	4325.56	4.54	-	4.00	-
24	4383.56	4.53	4.37	4.00	3.70
25	4387.90	5.40	5.05	4.66	4.20
26	4389.24	5.72	5.16	4.70	4.15
27	4392.58	-	5.84	-	4.60
28	4404.75	-	4.44	-	3.68
29	4430.62	4.96	4.70	4.46	4.15
30	4432.57	5.76	5.37	4.98	4.48
31	4433.22	5.00	4.94	4.70	4.27
32	4442.34	4.89	4.59	4.32	3.98
33	4447.72	5.18	4.76	4.44	3.93
34	4466.55	5.02	4.66	4.33	3.92
35	4485.68	5.10	4.85	4.62	4.33
36	4489.74	-	4.90	-	4.01
37	4517.53	-	5.21	-	4.29
38	4587.13	5.48	5.24	4.88	4.45
39	4602.94	-	4.70	-	4.04
40	4611.28	5.16	4.83	4.70	4.10
41	4625.05	4.93	4.73	4.53	4.26
42	4637.51	4.96	4.78	4.58	4.33
43	4638.02	5.50	-	4.63	-
44	4647.44	5.26	-	4.50	-

Table II

Temperature parameters of stationary stars

Star name	θ_{ex}(regional)	$T_{reg.}$	θ_{ex} of other authors
γ Cyg	1.08 ± 0.01	5690	0.969 ± 0.05
41Cyg	1.01 ± 0.01 0.926 ± 0.01	6085 6630	0.926
ν Her	0.927 ± 0.01 0.813 ± 0.01	6640 7560	0.85

ject studied, a stationary or a variable one. Linear dependences of $(-\lg W_\lambda / \lambda)$ -value upon the parameter of excitation temperature θ_{ex} for 44 lines of neutral iron have been found by the analysis of equivalent lines of FeI in three cepheids RT Aur, T Vul, $\varkappa$ Pav (Bappu and Raghavan, 1969, Rautela et al., 1981, Rodgers and Bell, 1963). In Table I there are given four $(-\lg W_\lambda / \lambda)$ -values for each of the lines depending upon θ_{ex}. The The detailed procedure of obtaining Table I is presented in the work by Fenina et al., 1988. The validity of θ_{ex}-determination was estimated from the equivalent widths of stationary stars with known parameters of temperature: γ Cyg (Zeinalov, 1970), 41 Cyg and ν Her (Kipper, 1967). In case of the star not having spectral peculiarities, for instance, γ Cyg, the regional kinetic temperature in the level of absorption line formation is determined as precisely as $\pm\ 50^{\circ}$ K.

$$T_{ex}\ (\text{reg.}) = 4670^{\circ} \pm 50^{\circ}\ \text{K}$$

With that the "curve of growth" constructed for γ Cyg from all the FeI lines is uniquely approximated by a Wrubel theoretical "curve of growth". 41 Cyg and ν Her proved to be the stars having a mixed spectrum. In this case in each of the stars there are distinguished two layers with different optimum regional temperatures. In Table II the data are given for stationary stars obtained by using Table I. The transition from θ_{ex} to the regional temperature is carried out by means of the formula $T_M = 5040^{\circ}\ (0.82\ \theta_{ex})^{-1}$.

The use of Table I for determining the regional temperature permits to find out spectral pecularities not only of physical variable stars (Fenina et al., 1988) but also of stationary stars having a mixed spectrum as well as of peculiar stars.

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