CHLORINE IN THE MAGNETIC STAR HR 1732

MERCEDES JASCHEK AND ZULEMA LÓPEZ GARCÍA

Observatorio Astronómico
Universidad Nacional de La Plata, Argentina

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HR 1732* is a peculiar star belonging to the so-called "Si-λ4200" type. The rather extensive bibliography on this star is listed in Bertaud's catalog and its appendices (Bertaud 1959, 60, 65). The star is also a spectrum variable (Deutsch 1947), helium and calcium varying together in phase, opposite to silicon and iron. It is also the bluest known spectrum variable, its color indices being $(U-B) = -0\overset{m}{.}63$ and $(B-V) = -0\overset{m}{.}21$ (Provin 1953). Most of the studies so far were made at low dispersion, and we are very fortunate that Dr. H. W. Babcock generously loaned us two 10 Å/mm plates from the Mount Wilson files upon which the present study is based. The two plates correspond to a phase in which silicon is very strong.

Both plates were measured in the conventional way, and a line identification was made, complemented by microphotometer tracings. The lines are rather broad – a fact already indicated by Babcock (1958). Full details of the measurements will be given elsewhere; here we summarize the behavior of the elements positively identified.

Elements identified in HR 1732

Hydrogen – Present up to n = 15. The profiles suggest an early B-type spectrum.

Helium – Only two lines are present, namely λ 4471 and λ 4026, normal for a late B spectral type.

Carbon – Ionized carbon is present with normal strength for an early spectral type (multiplets 4 and 6).

Nitrogen – λ 3995 and λ 4242 of N II are present.

Magnesium – Ionized magnesium is very intense; besides λ 4481, other lines with $I \geqq 5$ are also present. This element is strong even for a late B-type star.

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* = HD 34452: $\alpha = 5^h12\overset{m}{.}4$, $\delta = +33°39'$ (1900).

Aluminum — Only the most intense line of Al III.

Silicon — Very enhanced. Besides the lines of Si II listed in Moore's (1945) table, practically all lines from high-excitation levels listed by Shenstone (1961) are present. According to Searle and Sargent (1964) in this object ionized silicon reaches its maximum strength for any silicon star. Si III is also enhanced.

Chlorine — See below.

Calcium — Only the H and K lines.

Scandium — Only λ 4246 of Sc II.

Titanium — Lines with $I > 50$ of Ti II.

Chromium — Lines with $I > 25$ of Cr II.

Iron — Only present in ionized state, with lines with $I > 4$.

Strontium — Only λ 4077, λ 4215 of Sr II.

Europium — λ 4205 of Eu II.

The presence of chlorine seems definitely established, although this element has been identified only in three stars up to now, namely γ Pegasi (Aller and Jugaku 1959), HR 6870, and τ Capricorni (Bidelman 1966). Table I lists the lines belonging to this element, ordered as in Moore's table.

TABLE I

LINES OF Cl II FOUND IN HR 1732

Mult.	λ	Int.	Mult.	λ	Int.
1	4794.54	250	29	4132.48	200
	4810.06	225			
	4819.46	200	35	4572.13	100+100
25	3860.80*	150	49	3843.26	100
	3850.97*	100			
	3845.42*	50	52	4372.91	80
	3860.98	100			
	3851.38	75	69	3833.40	200
	3845.69	75		3827.62	150
				3820.25	100

* Blended with other lines of the same multiplet.

Discussion

As mentioned before, HR 1732 is a spectrum variable, and therefore from the present material one cannot derive far-reaching conclusions. It seems however that several points can be established with fair confidence.

The first is the great deficiency in helium, derived from the presence of helium lines corresponding to a spectral type around B8-9 while the color and the hydrogen lines correspond to a much earlier type. The discrepancy between color and helium-line strength seems to be too large to be explainable merely by line intensity variations. The large helium deficiency seems to be the outstanding characteristic of the bluest peculiar stars which until now were classed in the group of Si-λ4200 stars.

The second point is the coexistence of lines of elements usually present in B5 stars with those from elements present in later-type stars. If one adopts a temperature corresponding to the color (and therefore to the earlier type) one must have large overabundances of magnesium, silicon, titanium, chromium, and strontium, beside chlorine, and great underabundance of helium.

If one takes the contrary view, i.e. that the color is abnormal and that the temperature corresponds to a spectral type around B9, helium is normal, but large overabundances of carbon, nitrogen, and silicon, besides of course chlorine, follow. At present it seems more reasonable to adopt the first alternative, because in all other types of peculiar A stars the color and the temperature are always closely correlated, and because the absolute magnitude of the object, as determined by Sargent and Eggen (1965), corresponds to a B4 star on the zero-age main sequence (see also Jaschek and Jaschek (1958)). This is in line with Sargent (1964) who grouped HR 1732 together with other stars deficient in helium and normal in carbon. The third fact that emerges clearly is the considerable overabundance of chlorine, which can be estimated to be of the order of two hundred times the normal abundance. In γ Pegasi, which has a normal abundance of chlorine, lines of this element are very weak.

In conclusion, this star shows again the necessity of studying in detail each peculiar star, because individual stars (even those belonging to the same peculiarity group) show different abundance anomalies, and it seems that much more detailed work is necessary before definite conclusions can be reached regarding the abundances and the mechanism that produces them.

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