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Hα AND OI PHOTOMETRY OF Ap STARS

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RESUMEN

Se da la fotometría $\alpha(16), \Lambda(9)$ de veintitrés estrellas Ap. Los resultados muestran que las estrellas Ap se separan considerablemente de las estrellas normales de tipo A, en el plano $\alpha(16), \Lambda(9)$. Las estrellas Am y Ap forman una secuencia (con poco traslape) en Hα, de menor a mayor absorción. Esta secuencia es similar a la formada por las estrellas normales. Las estrellas A-normales, Am y Ap forman una secuencia en OI prácticamente sin traslape. Las primeras tienen el índice $\Lambda(9)$ más intenso, y las últimas el menor.

ABSTRACT

$\alpha(16), \Lambda(9)$ photometry of 23 Ap stars is presented. The results indicate that Ap and normal A-stars are neatly separated in the $\alpha(16), \Lambda(9)$-plane. The Am and Ap form a continuous sequence in $\alpha(16)$ with strongest absorption for the Ap stars. A similar sequence is defined by the normal main sequence A-stars. The normal A, Am and Ap-stars also form a continuous sequence in $\Lambda(9)$. The strongest absorption corresponds to the normal A-stars, the weakest to the Ap stars.

Key words: NARROW BAND PHOTOMETRY — PECULIAR A-STARS — STARS, INDIVIDUAL.

I. INTRODUCTION

There are several kinds of peculiarities among the type-A stars which make their stellar spectra depart from normality. The classical Ap stars (Bp and Ap) have strong magnetic fields and bizarre chemical composition. The most frequently encountered of the peculiar A stars are the 'silicon', 'strontium', and 'manganese' groups. These elements are overabundant. The abundance anomalies also include excesses of rare-earths, osmiun, platinum, mercury, phosphorus, gallium, yttrium, xenon, possibly uranium, and many others elements.

Theories on surface nuclear reactions, non nuclear processes and selective accretion from the interstellar medium have been proposed to explain the abundance anomalies observed in the Ap stars.

In this paper we show the $\alpha(16)$, $\Lambda(9)$ photometry of 23 possibly Ap stars.

II. THE OBSERVATIONS

The $\alpha(16), \Lambda(9)$ photometric system has been outlined (Mendoza 1976). A full definition of it will be published later. Herein, we recall that the Hα-system measures the total absorption of the hydrogen line Hα, through three interference filters with the characteristics shown in Table 1. The OI-system measures the total absorption of the neutral oxygen triplet at λ7774Å, also through three interference filters with the characteristics also shown in Table 1. In each system one filter measures the 'line' (F_l);

TABLE 1
Hα, OI-FILTERS

S	$F_b(\lambda)$	$F_l(\lambda)$	$F_r(\lambda)$	$F_b(W)$	$F_l(W)$	$F_r(W)$
$\alpha(16)$	6497.0	6567.4	6639.0	37.0	16.2	38.0
$\Lambda(9)$	7747.7	7776.4	7805.3	14.0	9.0	12.5

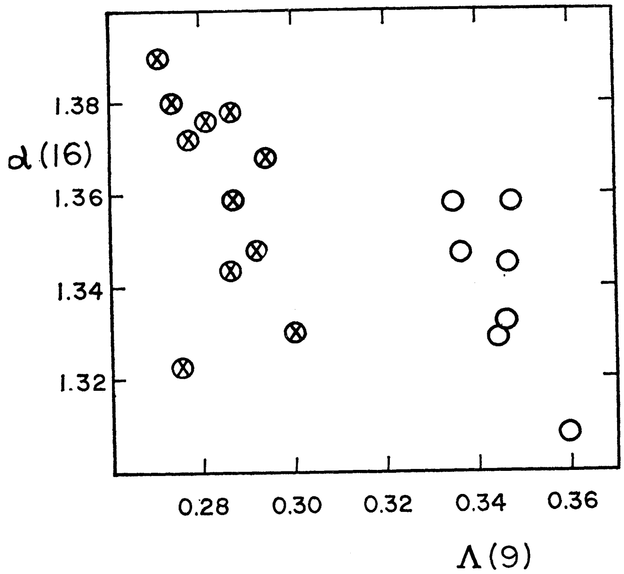

FIG. 1. The Λ(9), α(16)-array for Ap stars. Open circles, represent normal A0V-A7V type stars; crossed circles, Ap stars with α(16) >1.32 (see Table 1).

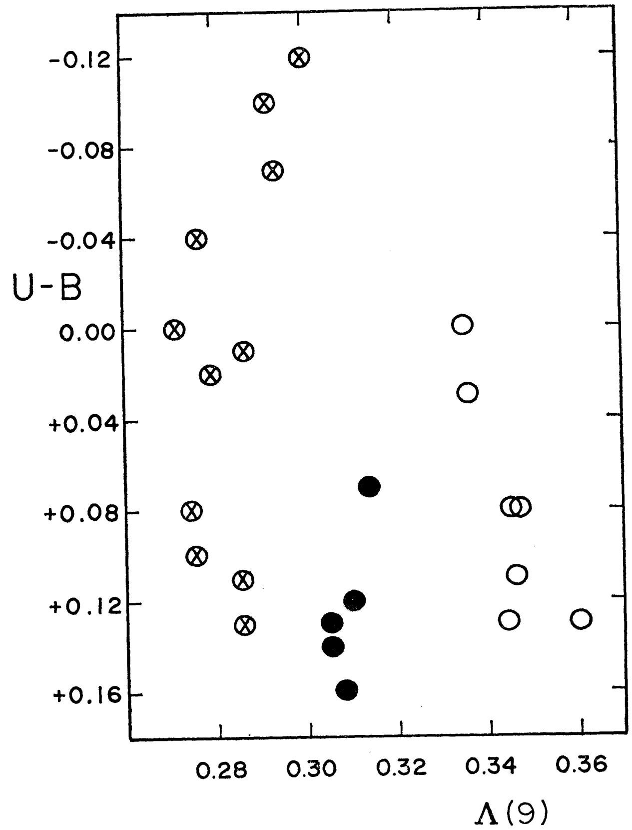

FIG. 2. The Λ(9), (U − B)-array for Ap and Am stars. The symbols have the same meaning as in Figure 1. The filled circles represent Am stars (see Mendoza 1976).

and two filters, the continuum on each side of the line (F_b and F_r). The first column of Table 1 contains the name of the photometric system; columns second through fourth, the peak wavelengths (in Ångstroms) of the 'blue-continuum', $F_b(\lambda)$, the 'line' $F_l(\lambda)$, and the 'red-continuum', $F_r(\lambda)$ respectively; the last three columns, the half passband (in Ångstroms) of each of the former filters, respectively. The observations have been carried out with the 40-inch telescope at Tonantzintla in 1976 and 1977. The results are summarized in Table 2 for 23 possibly Bp and Ap stars. The columns of this table contain: first, the BS number; second, the name of the star; third the spectral type; fourth, the Ap-group; fifth through seventh, the UBV-photometry; eighth, the α(16)-index; ninth the Λ(9)-index; and last, the number of independent observations in the α(16), Λ(9)-photometry. All the photometry is given in magnitudes.

III. DISCUSSION

The α(16), Λ(9)-indices measure the total absorption of the Hα-line, and the triplet neutral oxigen lines at λ7774Å, respectively. The Λ(9)-index is weaker in Ap stars than in normal A-stars. To see this more easily, we have plotted in Figure 1 α(16) versus Λ(9) for both normal and peculiar A-stars. We have taken from Table 2 only those stars with α(16) > 1.32 mag. and from Mendoza (1977) seven normal A0V-A7V type stars. The former were drawn as crossed-circles, and the latter as open circles. The two groups are extremely well separated. The Λ(9)-index seems to be also weaker in Ap stars than in Am stars. To show this we have plotted in Figure 2 U-B versus Λ(9) for the very same stars graphed in Figure 1 and in addition five classical A-metallic-line stars (cf. Mendoza 1976). The Am stars, on the average, lie between the Ap and the normal A-stars in the (U-B), Λ(9)-plane.

IV. CONCLUSION

We aver from the data given in Table 1, and Figs. 1 and 2, the following:

TABLE 2

Hα AND OI PHOTOMETRY OF Ap STARS

BS	Name	Sp	Remarks	V	B—V	U—B	α (16)	Λ (9)	n
465	...	B9p(v)	Cr, Eu, (Sr)	6.30	0.10	−0.07	1.368	0.294	2
873	21 Per	B9p	Si	5.12	−0.01	−0.24	1.278	0.287	2
954	SX Ari	B9p	Si	5.7	−0.10	−0.42	1.218	0.299	1
1268	41 Tau	B9p	Si	5.2	−0.13	−0.47	1.192	0.289	2
1702	μ Lep	B9p	Hg, Mn	3.29	−0.11	−0.40	1.216	0.324	4
3623	κ Cnc	B8p	Hg	5.2	−0.11	−0.43	1.216	0.313	4
3665	θ Hya	A0Vp?	...	3.88	−0.07	−0.12	1.330	0.300	2
4752	17 Com	B9p	Cr, Eu	5.29	−0.06	−0.10	1.348	0.292	4
4766	21 Com	A3p	Sr, (Cr)	5.46	0.05	0.10	1.380	0.274	3
4905	ε UMa	A0p	Cr	1.77	−0.02	0.01	1.359	0.287	4
4915	α^2 CVn	A0p	Si, Eu, Hg	2.89	−0.12	−0.12	1.285	0.289	6
5105	78 Vir	A1p	Cr, Sr, Eu	4.94	0.02	0.00	1.390	0.271	5
5747	β CrB	F0IIIp	Sr, Cr, Eu	3.68	0.29	0.11	1.344	0.286	4
5971	ι CrB	A0p?	Hg?	5.00	−0.06	−0.20	1.310	0.329	3
5982	υ Her	B9III?	Mn?	4.76	−0.11	−0.32	1.238	0.324	3
6153	ω Oph	A7p	Sr, Cr	4.45	0.11	0.13	1.378	0.286	3
6234	45 Her	B9p	(Cr)	5.24	−0.02	−0.02	1.314	0.294	3
6254	52 Her	A2p	Sr, Cr, Eu	4.82	0.09	0.02	1.376	0.281	3
7113	112 Her	B9p	Hg	5.48	−0.08	−0.42	1.245	0.318	3
7167	10 Aql	F0p	Sr, Eu	5.9	0.25	0.08	1.322	0.275	3
7287	21 Aql	B8p	Si	5.13	−0.07	−0.40	1.183	0.330	3
8911	κ Psc	A0p	Cr, (Sr, Si)	4.94	0.04	−0.04	1.372	0.277	2
9031	108 Aqr	B9p	Si, Sr, Cr	5.16	−0.16	−0.43	1.239	0.292	2

a) Ap and normal A-stars are neatly separated in the α(16), Λ(9)-diagram.

b) Ap stars have stronger Hα-line than Am stars, on the average. They form a continuous Hα-line sequence which, approximately covers the same range as the normal main sequence of spectral type A. The overlap is little.

c) Ap stars have, on the average, weaker OI-lines than normal A and Am stars. The normal main sequence A-stars, the Am stars, and the Ap stars form a Λ(9)- index continuous sequence with the strongest absorption for the normal A-stars, and weakest for the Ap stars. The Am stars, on the average, lie in the middle. The overlap, if any, is little.

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REFERENCES

Mendoza, E. E. 1976, *Rev. Mex. Astron. Astrof.*, **2**, 29.
Mendoza, E. E. 1977, unpublished.