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ULTRAVIOLET CONTINUUM OF A SAMPLE OF Be STARS

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RESUMEN

Se analizó la distribución de energía en el espectro UV de las estrellas α Dra, τ Ori, 53 Per, 48 Lib, π Aqr y 27 CMa. α Dra y τ Ori no presentan discrepancia entre las temperaturas y gravedades obtenidas en el UV y los valores que resultan de la región fotográfica; 53 Per puede ser variable; 48 Lib corresponde a un modelo con $T_{eff} = 18\,000$ °K y log g = 4 ó 4.5; π Aqr y 27 CMa corresponden a un modelo con $T_{eff} = 30\,000$°K y log g = 5. Este resultado plantea una alternativa interesante.

ABSTRACT

The energy distribution of α Dra, τ Ori, 53 Per, 48 Lib, π Aqr and 27 CMa is analyzed in the UV. α Dra and τ Ori show no discrepancies with the effective temperature and gravity obtained from the photographic region; the continuum of 53 Per may be variable; 48 Lib fits log g = 4 or 4.5 and $T_{eff} = 18\,000$°K model; π Aqr and 27 CMa fit models with $T_{eff} = 30\,000$°K and log g = 5. This result poses an interesting alternative.

Key words: **STARS-Be – STARS-SPECTRA**

The energy distributions of α Draconis, τ Orionis, 53 Persei, 48 Librae, π Aquarii and 27 Canis Majoris was analyzed in the UV. This was done on the basis of spectra obtained with the *IUE* (Boggess *et al.* 1978*a*, *b*) n the low dispersion mode. Absolute fluxes were determined applying the calibration by Bohlin and Snijders (1978) and the further correction by Bohlin, Holm and Snijders (1980).

The first three stars were originally chosen because there are discrepancies between the spectral types derived from the line spectrum (MK system) and the types derived from the continuum (BCD system). The other three stars are well known V/R variables and were the subject of a former study (Ringuelet, Fontenla, and Rovira 1981). Relevant data on the six stars is presented n Table 1.

In order to compare the continua of these stars with the LTE line-blanketed (by using line blocking) model atmospheres of Kurucz (1979), we corrected them for nterstellar absorption according to Seaton (1979). The fitting was done using the published grid of models; no ntermediate models were computed since the differences we are looking for exceed the steps provided by the grid. The flat continuum and the line-blocked continuum of each model were used as upper and lower limits, respectively, to bracket the observed spectrum.

In Table 2 we present the effective temperature and gravity of the model atmospheres which provided the best fits to the stellar spectra of α Dra, τ Ori, and 53 Per respectively. The quantity ρ, which is the ratio R/d, was determined from the following expression

$$F'(\lambda) = F^0(\lambda)\,\frac{R^2}{d^2}$$

where F′(λ) is the measured flux in the *IUE* image, $F^0(\lambda)$ is given by the model atmosphere, d is distance to the star, R is the stellar radius and $R/R_\odot$ is the resulting stellar radius when the distance is taken from column 9 in Table 1. For these stars there is a general agreement between absolute magnitude corresponding to the spectral type (Arp 1958), apparent magnitude, and colour excess; the same is true for the radii obtained. In Table 2 we have two stars in common with Underhill (1979); τ Ori and 53 Per. For the first one the agreement is within 10% but in the case of 53 Per some discrepancies arise. The first is the assigned spectral type. Underhill fits IR through UV observations with a model (also using Kurucz 1979) of log g = 3.8 and T = 16 797°K. Our spectrum does not support such a comparison, as we see in Figure 1, so we conclude that there is a real difference between both observations. This could be due to the fact that 53 Per is a pulsating star (Africano 1976). We have also found a different slope in the continuum between our data and the TD1-A data (Jamar *et al.* 1976). As to 48 Lib, π Aqr and 27 CMa the best fit to the theoretical models is indicated in Table 3.

In Figures 2, 3 and 4 we show the spectra of the three stars and the models used in the fit. Again in this group we have two stars in common with Underhill (1979), 48 Lib and π Aqr. In general, our results agree with hers. In

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TABLE 1

RELEVANT DATA ON THE OBSERVED STARS

Star	HD	α (1950)	δ	MK type[a]	$(B-V)$[b]	$(B-V)_0$[c]	V sin i[d] (km s^{-1})	d (pc)
α Dra	123299	14^h03^m	+ 64°35′	A0 III	−0.06	−0.06	12	100
τ Ori	34503	05 15	−06 54	B5 III	−0.12	−0.17	35	230
53 Per	27396	14 18	+46 23	B6 III	−0.03	0.15	20	210
27 CMa	56014	07 12	−26 15	B4 Ve	−0.16	−0.19[e]	173	< 200
π Aqr	212571	22 23	+ 01 17	B1 Ve	−0.03	−0.26[f]	278	< 200
48 LIb	142983	15 55	−14 08	B3 Ve	−0.09	−0.22[g]	400	170

a. Selected from Jaschek *et al.* (1964).
b. Iriarte *et al.* (1965).
c. From Heintze (1973).
d. Uesugi and Fukuda (1970).
e. Other good quality data range from −0.16 to −0.19.
f. Other good quality data range from −0.01 to −0.18.
g. Other good quality data range from −0.08 to −0.10.
h. Parallax by Jenkins (1952).
i. Distance modulus; absolute magnitudes from Arp (1958).
j. Ringuelet *et al.* (1981)
k. Bertiaud (1958).

TABLE 2

COMPARISON WITH THEORETICAL MODELS

Star	T_{eff} (°K)	log g	ρ[a]	R ($R_\odot$)	Sp[b]
α Dra	10000	3	15.0	6.6	A0 III
τ Ori	14000	3	18.3	12.5	B5.5 III
53 Per	14000	3	24.2	12.3	B5.5 III

a. Obtained from the effective temperature of model and applying the temperature scale given by Underhill (1979).
b. The upper limit of the errors is 20%.

TABLE 3

COMPARISON WITH THEORETICAL MODELS

Star	T_{eff} (°K)	log g	ρ[a]	R ($R_\odot$)	Sp[b]
48 Lib	18000	4.0-4.5	29.4	5.8	B3
π Aqr	∿ 30000	5.0	45.1	4.5	∿ B0
27 CMa	∿ 30000	5.0	> 120.4	2.0	∿ B0

a. The upper limit of the errors is 20%.
b. From the temperature scale of Underhill (1979).

the case of 48 Lib we have also checked against a log g = 3 model, since Eggen (1975) found this star to fall with the giants in the colour diagram of the Pleiades Group.

Our spectrum does not support Eggen's results even though we have to keep in mind that the behavior and even the characteristics of the spectrum are different at different phases of the shell radial velocity curve. Unfortunately, there is not enough data on the continuum of this object as to discuss the problem any

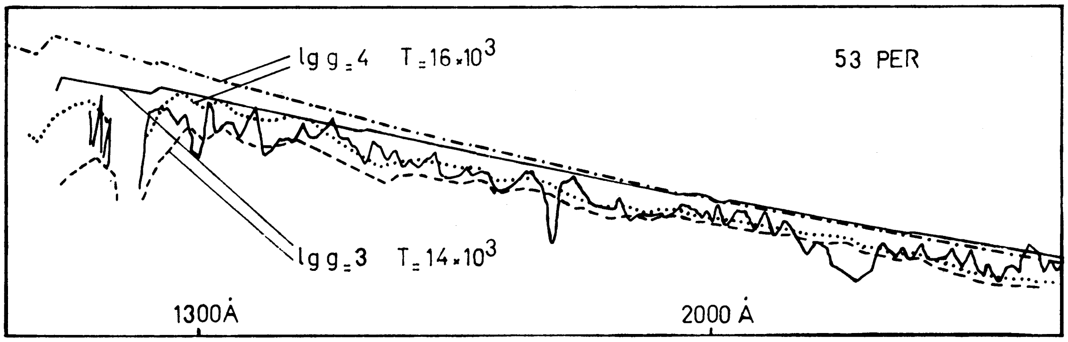


Fig. 1. A model atmosphere with log g = 3 and T = 14 000°K fits fairly well the *IUE* low dispersion spectrum of 53 Per obtained in January 1979.

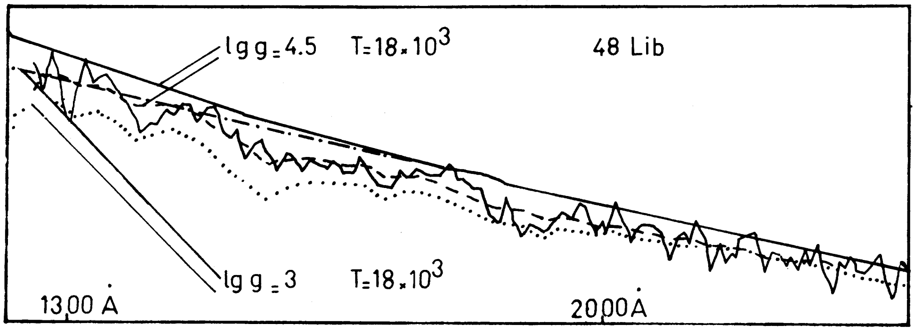
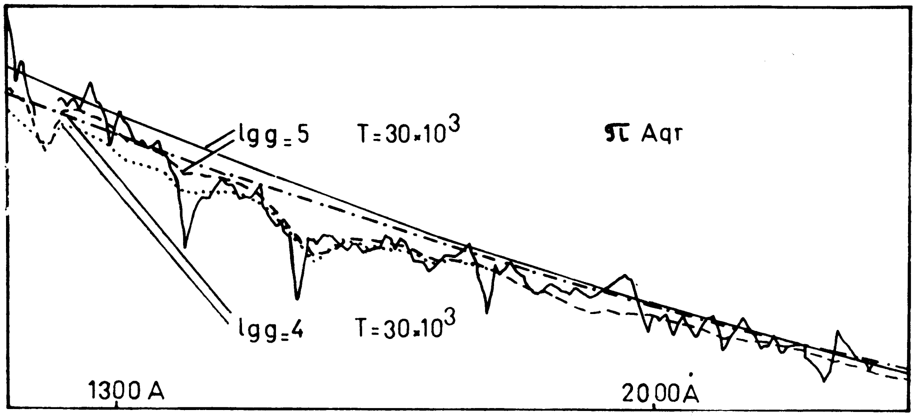


Fig. 2. The *IUE* low dispersion spectrum of 48 Lib, obtained in January 1979, fits a model atmosphere with log g = 4.5 and T = 18 000°K. The very strong absorption features are resonance lines originated outside the stellar photosphere.



ig. 3. The *IUE* low dispersion spectrum of πAqr, obtained in January 1979, fits a model atmosphere with log g = 5 and T = 30 000°K. he very strong absorption features are resonance lines originated outside the stellar photosphere.

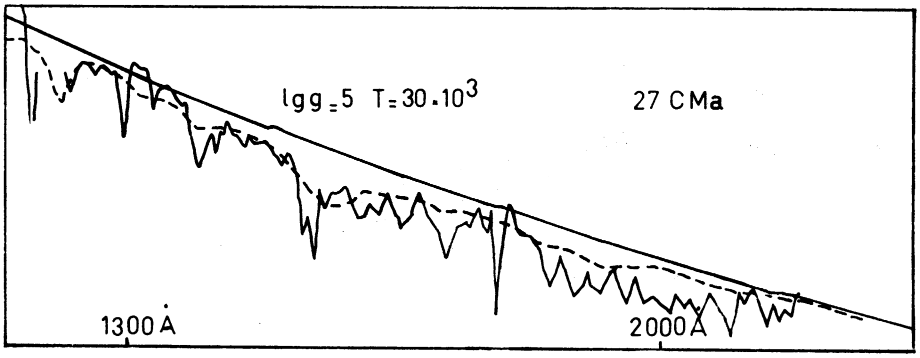


Fig. 4. The *IUE* low dispersion spectrum of 27 CMa, obtained in January 1979 fits a model atmosphere with log g = 5 an T = 30 000°K. The very strong absorption features are resonance lines originated outside the stellar photosphere. In the regio 1850 < λ < 2100 A the continuum is lowered by the presence of conspicuous Fe III absorption lines, which are clearly visible in hig dispersion spectra.

further. However, Underhill's results agree with ours.

In regard to π Aqr, the continuum we obtained in January 1979 does not fit with a log g = 4 model, unless we increase the temperature; the same is true for 27 CMa. Of course, we know that the UV spectrum of π Aqr underwent remarkable changes in an interval of 6 months in 1979 (Pacheco 1981).

In the case of π Aqr the difference in the value of log g between Underhill's and our results could be due to the difference in the wavelength interval considered.

Supporting the possibility of a large gravity would facilitate the solution of other points which are still conflictive, such as: 1) the width of the observed photospheric lines, and 2) the radii of these objects which seem to be smaller than normal.

In order to discuss the problem of gravity (among others) and its implications we plan simultaneous UV and photographic observations.

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