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ENERGY DISTRIBUTIONS AND FUNDAMENTAL PARAMETERS OF 6 A STARS

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ABSTRACT The energy distributions (EDs) of 6 peculiar (3 Aps and 3 λ Bootis) stars are presented from 1200Å up to about 12000Å. For those stars having infrared photometry, the integrated flux from 1200Å to 22000Å has been calculated and the Infrared Flux Method (IRFM, Blackwell and Shallis, 1977) applied to derive effective temperatures and angular diameters. For all stars, the effective temperature T_{eff}, the surface gravity $logg$ and metallicity [M/H] were also derived by matching the EDs to a grid of model atmospheres. A chisquare techniques is used to sort out the best fit to the observed EDs.

OUTLINE OF THE METHOD

The stars studied here are 3 early Ap stars: 78Vir (A2p), 52HerA (A2p) and CS Vir (A0p) and 3 λ Boo stars: λ Boo, π^1 Ori and 29 Cyg (all A0). The Ap stars are known to have overabundances of heavy elements (metals) whereas the λ Bootis have underabundances of these elements. The comparison of the EDs of these stars to model atmospheres computed for peculiar metallicities (Kurucz, 1979) is expected to yield information on their temperature, gravity and chemical composition.
To construct the EDs, low resolution IUE spectra (1200Å to 3200Å) were merged with published optical spectrophotometry (3300Å to 8000Å) (Pyper and Adelman,1983, Pyper and Adelman,1985, Breger,1975) and ,for the 3 Aps, with infrared photometry in the J and K bands from Groote and Kaufmann (1983) (no infrared photometry is available for the λ Bootis). The optical spectrophotometry has been transformed into absolute fluxes using Hayes and Latham's (1975) calibration of Vega and the infrared magnitudes were converted into absolute fluxes using Hayes' (1979) infrared calibration of Vega. The IFRM (Blackwell and Shallis,1977) was then applied to the three Ap stars. This method allows a direct determination of the effective temperature from the integrated flux, F, which defines it. The later was measured by fitting cubic splines throughout the entire ED and integrating under the splines. The infrared fluxes were then used together with predicted fluxes to derive the angular diameter using the relation:

$$f_\lambda = 0.25\theta^2 H_\lambda \quad (1)$$

f_λ is the observed infrared flux and H_λ is the model flux at the infrared wavelength computed for a first guess effective temperature. Once θ is

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derived, the effective temperature is found from its definition:

$$F = 0.25\theta^2\sigma T_{eff}^4 \quad (3)$$

For all stars,a grid of models was then computed varying the IRFM effective temperature (or a guessed temperature derived from Stromgren's indices for the λ Bootis stars) inside its allowed range $T_{eff} \pm \delta T_{eff}$ (δT_{eff} is typically 200K to 300K) , the surface gravity in the range 4.25 $\pm$ 0.25, and for different abundance sets ($\odot$, 3 $\odot$ and 10 $\odot$ for the Ap stars and 0.10 $\odot$ and 0.033 $\odot$ for the λ Bootis). The observed and model fluxes were ratioed to their values at 5000Å to allow for comparison. The best fit to the observed energy distribution was then searched by minimizing the chisquare χ^2 of the model flux ,H_λ, versus the observed flux, f_λ. The chisquare was calculated as:

$$\chi^2 = \sum_i (w_i/\sigma_i)^2$$

where

$$w_i = \frac{f_{\lambda_i}}{f_{5000}} - \frac{H_{\lambda i}}{H_{5000}}$$

from 2000Å up to the longest wavelength of the optical spectrophotometry (the far ultraviolet range is discarded because of the poor knowledge of conitnuous opacity in that range).

To obtain an even number of data over all wavelengths, the observed and model fluxes were interpolated to a common and even wavelength scale. The ultraviolet, optical and infrared fluxes were weighted by their respective uncertainties σ_i : $\pm$ 5% in the ultraviolet , $\pm$ 1.5% in the optical and $\pm$ 3.5% in the infrared . Also, the hydrogen lines were removed from the model in the chisquare calculation since the optical spectrophotometry carefully avoids these strong features. *Note that the best fit is not expected to be unique since a slight adjustment in each parameter around the optimal solution usually allows to reproduce the energy distribution within the uncertainties on the data.*

RESULTS

The found parameters are collected in table 1 and the energy distribution of one star, CS Vir, is compared to its best fit in figure 1.

Table 1: Found parameters

Star name	Integrated flux	θ	$ModelT_{eff}$	$IRFMT_{eff}$	$logg$	[M/H]
78 Vir	2.68 E-7	0.343	9250K	9200K	4.50	10$\odot$
52HerA	2.76 E-7	0.390	8900K	8550K	4.50	3 $\odot$
CS Vir	1.29 E-7	0.210	9700K	9600K	4.25	10$\odot$
λ Boo	-	-	8600K	none	4.20	0.033 $\odot$?
π^1 Ori	-	-	8600K	none	4.20	0.033 $\odot$?
29 Cyg	-	-	7800K	none	4.00	0.033 $\odot$?

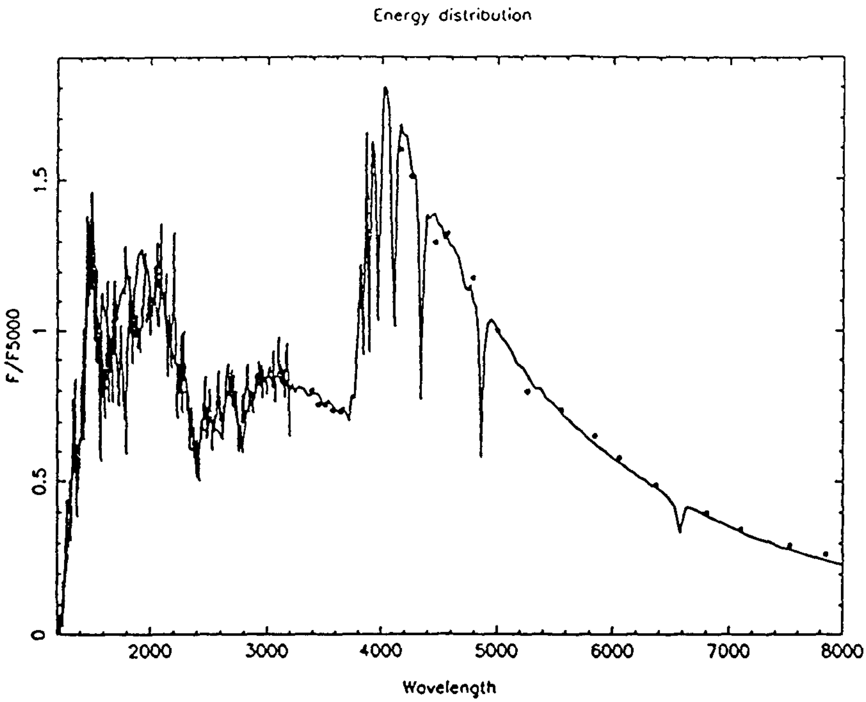

Figure 1: Comparison of the energy distribution of CS Vir (thin line and dots) with its best fit (thick line)

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