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A computed spectrum for the normal star ι Her (B3 IV) in the Region 1228–1950 Å

ABSTRACT

We have compared high resolution IUE and Copernicus spectra of the sharp-lined normal star ι Her (B3 IV) in the region 1228-1950 A with an LTE synthetic spectrum, in order to investigate to what extent we are able to reproduce observations of B stars in far UV with the available line data and models. We have found that in spite of the great number of lines used for computing the spectrum, more lines must be added. Furthermore, we have obtained a large scatter in the abundances for nearly all the elements investigated, in agreement with the results of Peters and Polidan (1985) for the same star.

THE DATA AND THE DATA ANALYSIS

The observational data used for this study are the following: a) The Copernicus ultraviolet spectral Atlas by Upson and Rogerson (1980) from 1228 to 1467.7 A. b) The IUE HR images SWP5720 from 1228 to 1950 A and SWP3243 from 1467.7 to 1950 A, taken from the IUE archive. SWP5720 was reprocessed with the new software IUESIPS2.

We have compared the spectra in the whole range studied by superimposing two different images normalized to the continuum. This comparison, as well as the comparison with the synthetic spectrum, have shown that the resolution of the reprocessed IUE image SWP5720 is comparable with that of the second order Copernicus spectrum (nominal resolution 0.05 A from 999.3 to 1422.2 A), while the FWHM in SWP3243 is larger.

The model parameters Teff=17180±110 K and log g=3.43±0.02 for ι Her have been derived with a fit of the observed Strömgren indices c_0=0.290 and β=2.661 to the computed ones of the grid of Lester et al. (1986). The index c_1=0.294 has been dereddened by means of the UVBYBETA code (Moon, 1985), which makes use of empirical calibrations. The values of the observed indices c_1 and β have been taken from Hauck and Mermilliod (1980).

A model computed with the ATLAS8 code (Kurucz,1970) and the atomic line lists provided by Kurucz (1988) have been used in the SYNTHE code (Kurucz and Avrett,1981) to obtain a synthetic spectrum. We have made some changes in the log gf of CI, CII, SiII, SiIII of Kurucz's line lists.

The input line lists for computing the synthetic spectrum in the region 1228-1950 A have a total number of about 76000 lines.

As a first step we have adopted, for all elements, the photospheric solar abundances of Anders and Grevesse (1989).

SOME RESULTS FROM THE COMPARISON

1) Broadening Velocities: By comparing large regions of the observed spectrum with spectra computed with different values of macrovelocity V (rotational +macroturbulent+ instrumental) and microturbulence ξ, we have found that the best agreement is given by ξ= 0 Km/s and V= 15 Km/s for Copernicus and IUE SWP5720 spectra and V =20 Km/s for the IUE SWP3243 image.

2) Identification: A very high number of the observed features can be readily identified, and at first glance the agreement between observed and computed spectra seems good. However, some strong features are still unidentified and several blends require either more predicted components or different log gf for the predicted lines. We have compared our identification with those made by Upson and Rogerson (UR)(1980) for ι Her and by Artru et al. (1989) for the B stars π Ceti and ν Capricorni. We have found that some lines are missing in Kurucz's lists. Furthermore, the SiII lines identified by Artru (1986), some lines of Moore's tables (1950), and all the CuIII lines are also missing. However,numerous lines correctly predicted by using our line data and model are not considered by Upson and Rogerson (1980) and by Artru et al. (1989). We have inserted in Kurucz's lists the lines for which we have found the corresponding atomic data in the literature; the most important are the lines of Ga III at 1495 and 1534 A.

3) Abundances: To determine the abundances we have compared, for each image, the observed profiles of several lines with the profiles computed by changing the starting solar abundance at steps of about 0.25 dex. Nearly always the abundances derived from the same lines of different images agree remarkably well. We have found that different ionisation states of the same element and different lines of the same ionisation state can yield different abundances.

In Table 1 we compare our results with those of Peters and Polidan (PP)(1985), who analysed both the UV and visual spectra of ι Her. The solar abundances from Anders and Grevesse (AG) (1989), relative to the total number of atoms, are also given for comparison. The large errors in the derived abundances given by Peters and Polidan confirm the scatter found by us. However, for PII, PIII and SiIV, our results clearly disagree with those of Peters and Polidan (1985).

Table 1: Abundances logε for some elements.

	Sun (AG)	ι Her(This paper)		ι Her (PP)
B	-9.44	BII	-10.00	
C	-3.48	CI	-4.75 to -4.00	
		CII	-3.75	-3.62±0.46
		CIII	-3.48	-3.13
N	-3.99	NI	-4.50 to -5.00	
		NII		-4.15±0.39
O	-3.11	OI	$\geq$-3.11	-3.05±0.15
		OII		-3.38±0.44
Mg	-4.46	MgII	-4.46	-4.62±0.09
Al	-5.57	AlII	-5.75 to -6.0	
		AlIII	-5.75	-5.62±0.24
Si	-4.49	SiII	-4.49 to -4.75	-5.00±0.47
		SiIII	-4.49	-4.63±0.44
		SiIV	-4.00	-4.65
P	-6.59	PII	-7.5 to -6.59	-5.67±0.55
		PIII	$\geq$-6.59	-7.02±0.60

The close analogy with the results of an abundance analysis performed by Castelli et al.(1985) from the UV spectrum of the peculiar Bp star HR 6000 seems to indicate that the scatter in the abundances is probably due to the model and to the atomic data available, rather than to the quality of the data and to stellar peculiarities.

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