DETECTION OF NARROW C IV AND SI IV ABSORPTION FEATURES IN SPECTRA OF STARS WITHIN 200 PC OF THE SUN

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ABSTRACT

Detection of narrow ($\delta\lambda < 0.5$ A) absorption features in C IV at $\lambda\lambda$ 1548 and 1550 have been made in the spectra of 4 late B dwarfs within 200 pc of the sun; the Si IV doublet at $\lambda\lambda$ 1393 and 1403 shows up in two of them. We argue that it is difficult to account for the strengths, widths, shapes , and C IV/Si IV ratios in terms consistent with a circumstellar origin except possibly for an asymmetric C IV component in one star (HD 185037). The most probable source is "semi-torrid" gas (cf. Bruhweiler _et al._ 1980) in the 50,000 K range forming the interfaces between cooler H I clouds and the ambient medium at coronal temperatures. Our technique, using late B rapid rotators, is useful for LISM probing of this kind.

INTRODUCTION

Sharp line detections of Si IV and C IV have been made widely using the SWP spectrograph of IUE in the spectra of O and early B stars (Cowie _et al._ 1981 , Bruhweiler _et al._ 1980) and also of Wolf-Rayet stars (Smith _et al._ 1980, Black _et al._ 1981). In at least some of these stars the observed C IV and Si IV features can be formed by photoionization in the H II regions around the parent objects, while there is also evidence that C IV and Si IV absorptions can originate in an intermediate phase at temperature between the cool neutral and the hot coronal gas. In order to distinguish circumstellar contributions from true interstellar absorption it is desirable to use cooler stars. Although the strong photospheric absorption spectrum would normally make such detection very difficult, the use of rapid rotators allows us to detect narrow features even when quite faint ($W \geq 30$ mA). This method also offers the possibility of exploring the intermediate temperature phase in a volume of space significantly closer to the sun than

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previous methods have permitted.

OBSERVATIONS

High resolution spectra of 4 late B dwarfs were taken on 4 April 1984 with the SWP spectrograph of IUE as part of a programme for observing stars rotating at close to their break-up velocities. The relevant observational parameters are given in Table 1.

Table 1

Star(HD)	SWP No.	Type	Vsin i	l	b	d(pc)	z(pc)
23383	22664	B9 V	415	146	1	165	3
38831	22666	B8 V	400	154	16	180	50
135734	22669	B8 V	310	327	8	77	11
185037	22665	B8 V	400	71	8	185	25

RESULTS

Figs. 1 and 2 show the C IV and S IV doublet resonance regions respectively. Abscissae are in A and ordinates are linear in relative flux. All the Si IV regions and two of the C IV regions have been smoothed once with a triangular filter to reduce high frequency noise. C IV features are present in all four objects whereas unambiguous detection of Si IV was possible in only two of them (HD 23383 and HD 185037). Table 2 gives equivalent widths (W), widths at half maximum (FWHM) and column densities (N) derived from the lines. Column densities were computed assuming no saturation and should therefore be regarded at this stage as lower limits.

Table 2

Star(HD)	W(mA) CIV		W(mA) SiIV		FWHM(A) CIV	FWHM(A) SiIV	Log N CIV	Log N SiIV	CIV/SiIV
23383	172	94	75	40	0.4	0.2	13.2	12.5	5.3
38831	50	50	<30	<30	0.25	-	12.7	<12.2	>3.9
135734	122	116	<30	<30	0.4	-	13.1	<12.2	>9.5
185837	58	26	60	33	0.25	0.2	12.8	12.5	2.2

ARE THE LINES INTERSTELLAR OR CIRCUMSTELLAR?

Because our stars are so cool ($T_{eff} \simeq 12,000$ K) it is not possible for the C IV or Si IV to be formed by photoionization from stellar UV, nor do these stars have powerful stellar

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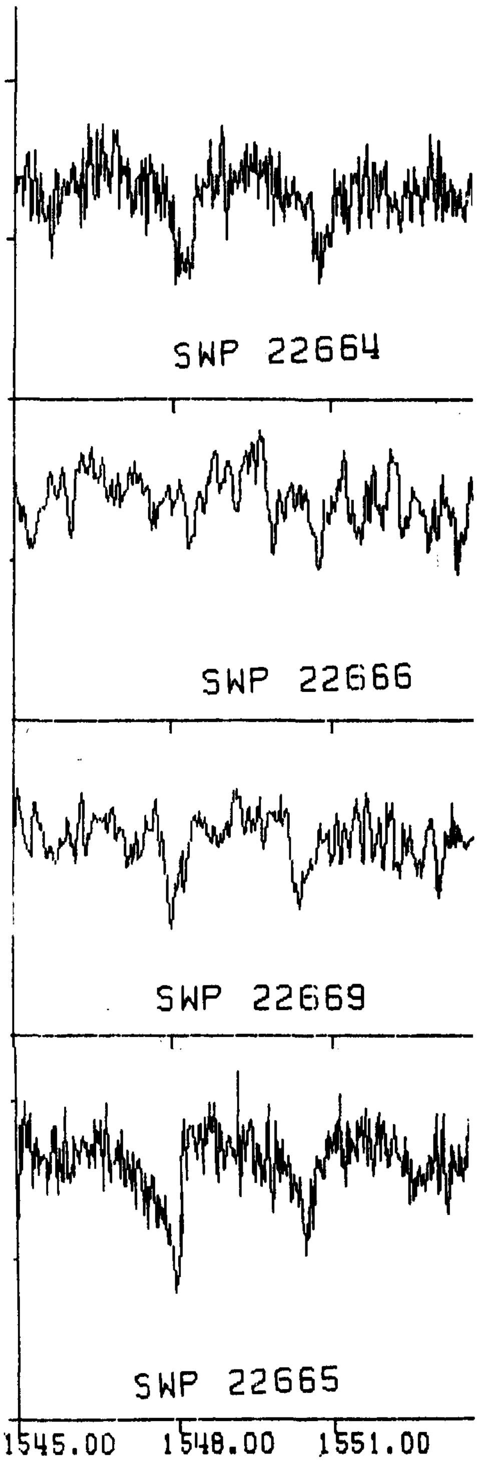

Fig. 1 C IV doublet

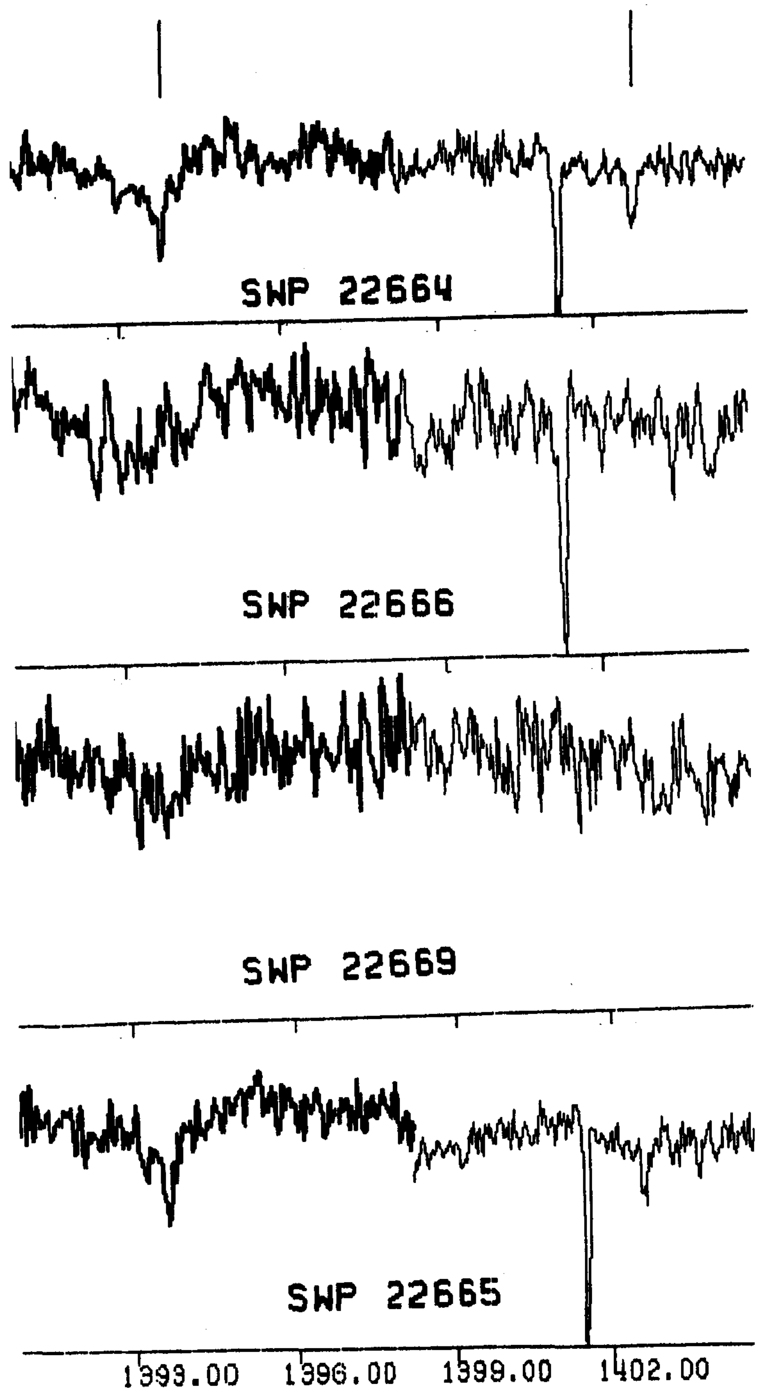

Fig. 2 Si IV doublet

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winds which might collisionally produce the lines. Theoretically, values for C IV/S IV of order 0.2 arise from photoionization (Cowie *et al.* 1981), even in stars with Teff 30,000 K, and of order 16 collisionally in stellar bubbles (Weaver *et al* 1977). These should be compared with our observed ratios of 2.8 and 5.3 and lower limits of 3.9 and 9.5. We cannot rule out the possibility that our present stars are causing the observed lines by the unknown mechanism that produces observed "superionization" in somewhat hotter stars (Slettebak and Carpenter 1983). However the lines here are considerably narrower. The best agreement with models appears to be with the "semi-torrid" gas scenario of Bruhweiler *et al.* (1979,1980). Our FWHM's are consistent with collisional ionization in an ambient plasma at around 50,000 K. We cannot apply a radial velocity test for the LISM as we have deliberately chosen rotationally broadened objects. But the weight of the evidence points to an intestellar origin for these lines. If the IS nature of the present detection is confirmed the importance of direct measurements of the nearby 50,000 K plasma is clear. Our column densities are not strongly longitude or latitude dependent implying a general pervasion of the galactic plane by this medium, in addition to its known presence in the galactic corona (Pettini and West 1982). The method of late B rapid rotators offers a new tool for detailed exploration of the intermediate temperature LISM, and for elucidating its geometrical relation to the cool neutral component and to the higher temperature medium characterized by such ions as O VI. The present detections are not co-spatial with local O VI observations (Jenkins 1978).

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