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SIMULTANEOUS IUE AND GROUND-BASED OBSERVATIONS OF 48 LIBRAE

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RESUMEN. En julio de 1981 se realizaron observaciones simultáneas de 48 Librae en el rango visible y en el ultravioleta. Estas observaciones corresponden a una fase positiva de la curva de velocidad radial.

Nuestros principales resultados son los siguientes:
a) No se observa progresión en las líneas de la serie de Balmer;
b) Las líneas metálicas de la región fotográfica tienen velocidades radiales de alrededor de +30 km/s;
c) Las velocidades radiales de las líneas en el rango ultravioleta que se forman en la envoltura fría están agrupadas alrededor de +20 km/s con una dispersión mayor que las líneas citadas en b);
d) Las líneas que se originan en la región de transición tienen velocidades radiales negativas;
e) La distribución de energía en el continuo corresponde a T_e = 16000 K y log g = 4.5 y
f) La línea 3933 Å del Ca II no tiene componente cromosférica.

ABSTRACT. *IUE* and ground-based observations of 48 Librae were carried out simultaneously in July, 1981.

These observations correspond to a positive phase of the radial velocity curve.
Our main results are:
a) No progression was observed in the Balmer lines;
b) The photographic metallic lines have radial velocities around +30 km/s;
c) The radial velocities of the UV lines formed in the cool envelope are grouped around the value +20 km/s with a higher dispersion than the photographic metallic lines;
d) The lines originating in the transition region yield negative velocities;
e) The continuum energy distribution corresponds to T_e = 16000 K and log g = 4.5, and
f) Ca II λ3933 Å has no chromospheric components.

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I. INTRODUCTION

48 Librae (HR 5941 = HD 142983, α = 15^h55^m; δ = -14°08' (1950.0). Spectral Type: B3 Ve, m_V = 4.80 mag.) is a Be star with V/R cyclic variations.

Lesh (1968) classified the star as luminosity class III. However, Ringuelet *et al.* (1981) have shown that the UV continuum fits better a model for log g = 4.

This star has been intensively studied, mainly in the photographic region of the spectrum, and the results have been summed up by Underhill (1966) and by Aydin and Faraggiana (1978). 48 Lib has been described as a fast rotator surrounded by a hydrogen shell, which in 1935 became variable. The radial velocity curve yielded by the shell shows no periodicity. Until 1974 it seemed that the *oscillation* time increased with increasing amplitude, but, as we can see from Fig. 1, this correlation does not hold for the last observed *oscillation* because, in this case, although the amplitude is larger, the *oscillation* time is shorter.

The star is not an X-ray source and the small excess of radiation in the IR (Allen 1973) can be explained by including free-free transitions in the H II region of the extended atmosphere.

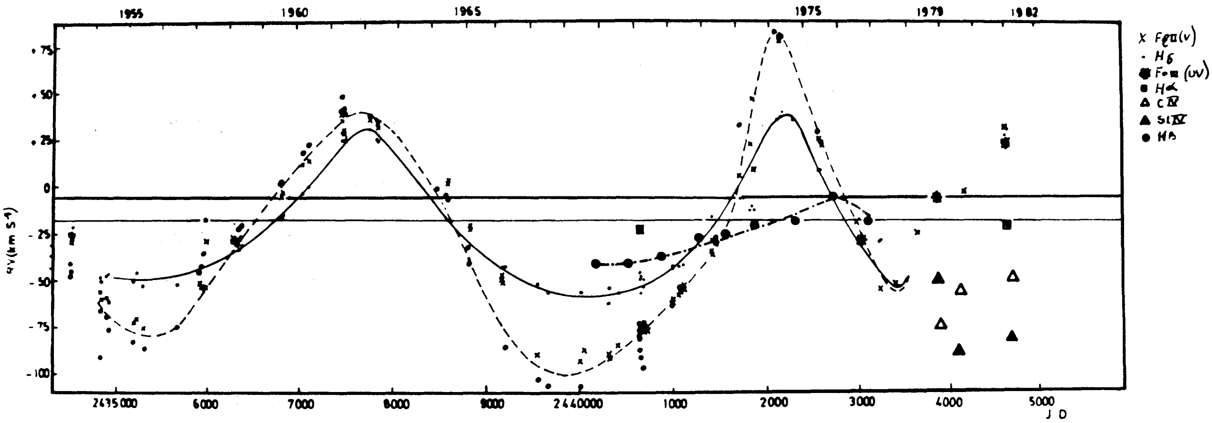

Fig. 1. The radial velocities of 48 Librae from 1953 to 1982: . H_δ , x Fe II (photographic), * Fe III (UV), • H_β , Δ C IV , ▲ Si IV , ■ H_α.

48 Lib was recently studied by Ringuelet *et al.* (1981) and by Hubert-Delplace *et al.* (1983) in the ultraviolet range.

The spectra, secured in 1979 and 1980, were apparently similar and yet the epochs of the two sets of material corresponded, respectively, to negative and incipient positive velocity phases in the evolution of the shell. The question then arose as to whether we would find differences in the UV spectra if we would be able to secure an image at some time during the shell positive phase. In consequence, new *IUE* observations of 48 Lib were planned and secured simultaneously with ground-based spectra, at a time that corresponded to a positive phase of the shell. The hope was that this material would allow us to reach a better understanding of the physical conditions and evolution of the gaseous structure that surrounds the star.

II. THE OBSERVATIONS

The *IUE* spectra were secured, in the high dispersion mode, from the ground observatory at NASA's Goddard Space Flight Center, Maryland, U.S.A., in July, 1981.

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The ground-based observations were collected at the Cerro Tololo Interamerican Observatory, Chile, with the coudé spectrograph of the 1.5-m reflector. The spectra covered the blue region in the second order of the grating with the dispersion of about 9 Å mm^{-1}, and the red region in the first order of the grating with the dispersion of about 18 Å mm^{-1}. These spectra were measured with the Grant comparator of the Instituto de Astronomía y Física del Espacio and reduced with the PDP11-44 computer with the use of the software (FAPES) prepared by J.M. Fontenla so as to deal with tracings calibrated in wavelength and intensity.

Table 1 lists the material obtained in the ultraviolet and in the photographic ranges of the spectrum.

TABLE 1

OBSERVATIONS OF 48 LIBRAE

Plate/Image*	UT Starting exposure time year	day	hour	minutes	Exposure (sec)	Emulsion (Kodak)	Spectral Range(Å)
SWP 14480	1981	196	05	52	200		1165-2126
LWR 11065	1981	196	05	52	130		1845-3230
D-1234	1981	195	0	21	3960	IIa-O	3600-4650
						098-04	5500-6300
D-1251	1981	200	0	37	5040	IIIa-J	3600-4650
						IIa-F	5500-6300

* SWP = short wavelength prime camera; resolution = 0.15 Å.
LWR = long wavelength redundant camera; resolution = 0.20 Å.

Radial velocities for both ranges of the spectra were corrected for the orbital motion of the Earth, -28 km/s in the present case.

III. THE PHOTOGRAPHIC SPECTRUM

The photographic spectrum covers a wavelength range from 3600 Å to 6300 Å with a gap between 4650 Å and 5500 Å.

It is mainly an absorption spectrum with emissions only in H_α and H_β.

Ti II, Cr II and Fe II are the elements which display larger number of lines in our wavelength range; most of them are narrow and symmetric.

In the Balmer series we count up to 33 components, i.e., up to H_{36}.

Table 2 gives the spectral lines used for radial velocity determinations and Table 3 lists the average of the radial velocities and their M.S.E. from the two photographic spectra and the values are plotted in Fig. 2 against the ionization potential of the preceding state of ionization of the relevant ion.

In Ca II λ3933 Å no chromospheric component was found, at variance wiht what has just been found in the case of σ Scorpii, a Bi III β CMa object (Costa and Ringuelet, 1984).

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TABLE 2

ABSORPTION LINES IN THE PHOTOGRAPHIC REGION OF THE SPECTRUM OF 48 LIBRAE USED FOR RADIAL VELOCITY DETERMINATION

λ_{D-1234} (Å)	λ_{D-1251} (Å)	Element	Multiplet	λ_{lab} (Å)
4481.621	4481.662	MgII	4	4481.130
4469.378	4469.339	TiII	31	4468.500
4417.627	4417.697	FeII	27	4416.817
4395.793	4395.855	TiII	19	4395.031
4386.194	4385.103	FeII	27	4385.381
4352.507	4352.538	FeII	27	4351.764
4303.920	4304.029	FeII	27	4303.166
4290.922	4291.168	TiII	41	4290.222
4274.342	4274.271	FeII	27	4273.317
4262.841	4262.834	CrII	31	4261.900
	4243.311	CrII	31	4242.380
4234.084	4234.040	FeII	27	4233.167
4179.789	4179.788	FeII	28	4178.855
	4174.366	FeII	27	4173.450
4131.724	4131.799	SiII	3	4130.884
4128.955	4129.002	SiII	3	4128.053
4068.062	4067.878	NiII	11	4067.051
3969.500	3969.382	CaII	1	3969.470
3934.460	3934.478	CaII	1	3933.664
3914.276	3914.363	TiII	31	3913.550
3901.357	3901.317	TiII	70	3900.550
	3838.952	MgI	3	3838.290
	3833.191	MgI	3	3832.300
3770.047	3770.064	NiII	4	3769.465
3762.003	3762.125	TiII	13	3761.320
3760.001	3760.050	TiII	13	3759.291
3742.321	3742.327	TiII	72	3741.633
3685.978	3687.940	TiII	14	3685.192
3678.441	3578.554	CrII	12	3677.900
3625.646	3625.729	FeII	144	3624.890
3621.938	3621.899	FeII	144	3621.273

TABLE 3

RADIAL VELOCITIES DERIVED FROM DIFFERENT IONS IN THE PHOTOGRAPHIC RANGE

Ion	RV±ε (km s^{-1})	Number of lines measured
MgI	32.8±9.1	2
MgII	6.0	1
SiII	38.0±3.8	3

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TABLE 3 (continued)

Ion	RV±ε (km s^{-1})	Number of lines measured
CaII	40.0±5.4	2
TiII	30.0±1.6	12
CrII	30.0±8.4	3
FeII	32.0±2.1	12
NiII	29.0±10.4	2

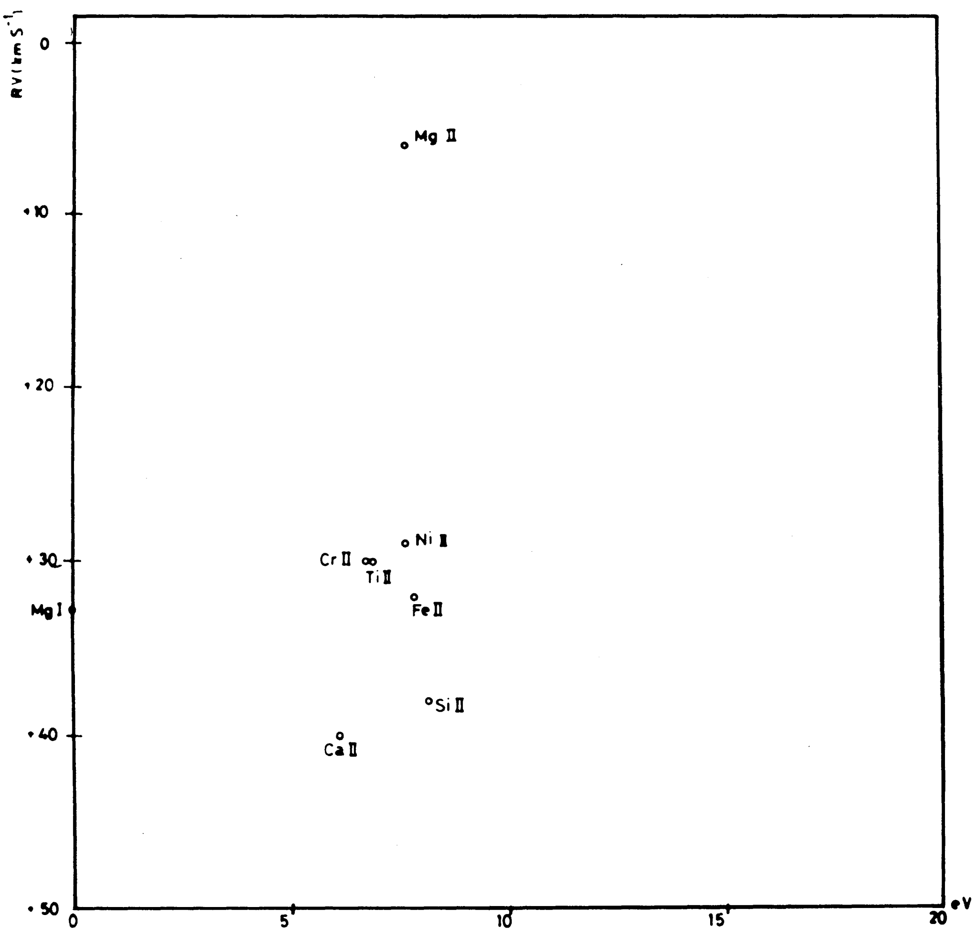

Fig. 2. Radial velocities of different ions in the visible spectrum of 48 Librae, as a function of ionization potential of the preceding stage of ionization of the relevant ion.

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IV. THE ULTRAVIOLET SPECTRUM

a) THE CONTINUOUS SPECTRUM

We calibrated the continuum on the high dispersion *IUE* images by means of the method suggested by Cassatella, Ponz and Selvelli (1981) and then we compared such a continuum with Kurucz's model atmosphere calculations. The best fit was found for T_e = 16000 K and log g ∿ 4.5, which corresponds to a B4 V object (Underhill, 1979).

It is interesting to note the agreement between these parameters and those derived in our previous paper (Ringuelet *et al.* 1981), hereafter called paper I, where we found T_e ∿ 18000 K and log g ∿ 4. We are not in a position to decide whether or not the difference in 2000 K has any significance.

b) THE LINE SPECTRUM

The line spectrum in 1981 was very similar to that described in Paper I on the basis of the 1979 observations.

Let us summarize the main characteristics of our spectra of 48 Lib:

1. C IV and Si IV absorptions, symmetrical and several Angstroms wide, as is shown in Fig. 3;
2. Si III absorption profiles, symmetrical and fairly wide;
3. Si II deep absorptions in the resonance and non-resonance lines;
4. Al III wide absorptions in the resonance and non-resonance lines;
5. C II resonance absorptions lines fairly narrow and saturated;
6. Ni II narrow and deep absorptions;
7. Very deep and narrow absorptions of Fe II and Fe III, Fe II being more prominent than Fe III;
8. Conspicuous Mg II resonance lines;
9. Narrow and deep absorptions of the resonance lines of C I, N I, O I, Mg I, Fe I and N II.

Table 4 lists the spectral lines used for radial velocity determinations and Table 5 gives the average radial velocities values and their M.S.E., obtained for the different elements they are represented in Fig. 4, as function of the ionization potential of the preceding stage of ionization of the relevant ion.

TABLE 4

ABSORPTION LINES IN THE ULTRAVIOLET SPECTRUM OF 48 LIBRAE USED FOR RADIAL VELOCITY DETERMINATIONS

λ meas. (A)	Element	Mutl.	λ lab. (A)	λ meas. (A)	Element	Mutl.	λ lab. (A)
1234.36	SII	7	1234.14	1301.36	SiIII	4	1301.12
1245.40	CrIII	6	1245.23	1303.56	SiIII	4	1303.30
1248.08	CrIII	6	1247.86	1305.04	OI	2	1304.84
1248.60	SiII	8	1248.40	1306.16	OI	2	1306.02
1252.80	CrIII	6	1252.61	1310.88	NI	13	1310.57
1253.92*	SII	1	1253.79	1327.80	TiIII	4	1327.60
1259.65*	SII	1	1259.53	1350.32	SiII	7	1350.07
1266.80	FeII	9	1266.69	1352.92	SiII	7	1352.68
1267.56	FeII	9	1267.44	1353.96	SiII	7	1353.75
1272.10	FeII	9	1272.00	1361.04	FeII	111	1360.87
1272.80	FeII	9	1272.64	1393.46*	SiIV	1	1393.73
1275.32	FeII	9	1275.15	1402.53*	SiIV	1	1402.73
1277.80	CI	7	1277.62	1417.92	FeII	143	1417.74
1286.56	TiIII	2	1286.38	1424.96	FeII	47	1424.75
1289.52	TiIII	2	1289.32	1465.22	FeII	193	1465.04
1290.36	FeII	88	1290.20	1492.96	NI	4	1492.63
1296.94	SiIII	4	1296.72	1495.00	NI	4	1494.67
1299.20	SiIII	4	1298.90	1499.00	TiIII	3	1498.65

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TABLE 4 (continued)

λ meas. (Å)	Element	Mutl.	λ lab. (Å)	λ meas. (Å)	Element	Mutl.	λ lab. (Å)
1500.68	NiII	7	1550.44	1841.96	FeII	65	1841.70
1511.08	NiII	6	1510.86	1849.08	FeII	141	1848.77
1526.88*	SiII	2	1526.70	1854.94*	AlIII	1	1854.72
1533.68	SiII	2	1533.44	1862.94*	AlIII	1	1862.78
1548.08*	CIV	1	1548.20	1870.16	FeIII	52	1869.83
1550.67*	CIV	1	1550.77	1877.20	FeII	97	1876.83
1564.00	FeII	45	1563.79	1877.80	FeII	125	1877.46
1567.04	FeII	44	1566.82	1882.36	FeIII	62	1882.05
1570.44	FeII	45	1570.25	1887.08	FeIII	52	1886.76
1575.12	FeII	45	1574.93	1888.98	FeII	125	1888.73
1580.84	FeII	44	1580.63	1891.00	FeIII	52	1890.67
1581.60	FeII	44	1581.29	1914.28	FeIII	34	1914.06
1585.17	FeII	44	1584.95	1915.44	FeIII	51	1915.08
1588.48	FeII	44	1588.29	1923.08	FeIII	51	1922.79
1618.68	FeII	8	1618.46	1935.60	FeII	96	1935.30
1623.36	FeII	43	1623.10	1937.68	FeIII	51	1937.34
1625.76	FeII	43	1625.52	1943.84	FeIII	51	1943.48
1629.36	FeII	8	1629.15	1951.36	FeIII	68	1951.01
1631.36	FeII	8	1631.12	1953.02	FeIII	68	1952.65
1634.14	FeII	43	1633.91	1991.96	FeIII	50	1991.61
1634.60	FeII	8	1634.35	1996.76	FeIII	50	1996.42
1635.60	FeII	68	1635.39	2159.08	NiII	13	2158.73
1636.52	FeII	8	1636.33	2184.92	NiII	13	2184.61
1637.60	FeII	42	1637.40	2216.80	NiII	12	2216.48
1639.64	FeII	8	1639.40	2247.52	NiII	30	2247.24
1642.00	FeII	68	1641.76	2270.56	NiII	12	2270.21
1643.80	FeII	42	1643.59	2275.12	NiII	38	2274.75
1646.40	FeII	68	1646.19	2287.48	NiII	22	2287.08
1647.40	FeII	68	1647.16	2288.00	NiII	38	2287.66
1659.00	FeII	41	1658.78	2305.64	NiII	38	2305.24
1659.72	FeII	40	1659.49	2327.76	FeII	3	2327.39
1663.45	FeII	40	1663.23	2334.92	NiII	20	2334.59
1673.72	FeII	102	1673.47	2337.10	NiII	50	2336.70
1677.12	FeII	41	1676.87	2341.56	NiII	50	2341.18
1679.68	FeII	102	1679.39	2359.48	FeII	3	2359.11
1686.18	FeII	41	1685.95	2365.20	FeII	3	2364.82
1690.12	FeII	85	1689.82	2381.12	FeII	3	2380.76
1697.00	FeII	38	1696.80	2384.76	FeII	36	2384.39
1699.48	FeII	85	1699.20	2410.88	FeII	2	2410.52
1702.22	FeII	38	1702.04	2413.68	FeII	2	2413.31
1703.68*	NiII	5	1703.41	2430.36	FeII	180	2430.07
1709.88*	NiII	4	1709.60	2465.48	FeII	148	2465.19
1713.24	FeII	38	1713.00	2463.64	FeII	208	2463.28
1720.84	FeII	38	1720.62	2466.24	FeII	208	2465.91
1726.60	FeII	38	1726.39	2467.16	FeII	179	2466.81
1741.84*	NiII	5	1741.56	2473.60	FeII	148	2473.31
1743.04	NI	9	1742.73	2475.16	FeII	208	2474.76
1748.56	NiII	5	1748.30	2484.64	NiII	61	2484.32
1752.16*	NiII	4	1751.92	2486.77	FeII	208	2486.34
1755.08	NiII	4	1754.81	2498.16	FeII	175	2497.82
1761.64	FeII	101	1761.38	2516.54	SiI	1	2516.11
1774.22*	NiII	3	1773.96	2523.28*	FeI	7	2522.85
1785.52	FeII	191	1785.26	2534.00	FeII	159	2533.63
1787.00	FeII	191	1786.74	2534.76	FeII	159	2534.41
1788.28	FeII	191	1788.00	2542.21	FeII	158	2541.83
1788.76	NiII	5	1788.50	2543.78	FeII	159	2543.38
1793.68	FeII	99	1793.37	2562.82	FeII	64	2562.53
1798.41	FeII	142	1798.16	2574.76	FeII	144	2574.36
1808.24*	SiII	1	1808.01	2578.32	FeII	64	2577.92
1809.64	FeII	142	1809.32	2586.27*	FeII	1	2585.88
1817.16	SiII	1	1816.94	2591.96	FeII	64	2591.54
1817.72	SiII	1	1817.42	2594.04	FeII	64	2593.72
1818.80	FeII	66	1818.51	2598.76	FeII	1	2598.37
1822.36	FeII	66	1822.15	2599.76*	FeII	1	2599.39

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TABLE 4 (continued)

λ meas. (Å)	Element	Mutl.	λ lab. (Å)	λ meas. (Å)	Element	Mutl.	λ lab. (Å)
2607.52	FeII	1	2607.09	2762.28	FeII	63	2761.81
2612.32	FeII	1	2611.87	2791.36	MgII	3	2790.77
2618.04	FeII	1	2617.62	2795.72*	MgII	1	2795.52
2622.08	FeII	1	2621.67	2798.49	MgII	3	2797.99
2628.68	FeII	1	2628.29	2802.84*	MgII	1	2802.70
2665.04	FeII	263	2664.66	2803.20	MgII	1	2802.70
2667.08	FeII	263	2666.63	2836.14	CrII	5	2835.63
2714.82	FeII	63	2714.41	2852.24*	MgI	1	2852.12
2727.92	FeII	63	2727.54	2881.20	FeII	61	2880.75
2731.16	FeII	62	2730.73	2927.04	FeII	60	2926.58
2737.37	FeII	63	2736.97	2937.12	MgII	2	2936.50
2740.00	FeII	63	2739.54	2948.08	FeII	78	2947.66
2743.62	FeII	62	2743.20	2954.24	FeII	60	2953.77
2756.16	FeII	62	2755.73	2985.32	FeII	78	2984.83
				2985.94	FeII	78	2985.54

* The asterisk indicates the resonance lines.

TABLE 5

RADIAL VELOCITIES DERIVED FROM DIFFERENT IONS IN THE ULTRAVIOLET RANGE

Ion	RV ± ε (km s^{-1})	Number of lines measured	Ion	RV ± ε (km s^{-1})	Number of lines measured
FeI*	23.0	1	SiII	20.0±2.3	7
CI	15.0	1	SiIII	32.0±3.7	4
CIV*	-49.3±2.0	2	SiIV*	-78.4±7.7	2
NI	36.0±4.0	4	SII*	2.0±1.3	2
OI	11.0±6.8	2	SII	25.5	1
MgI*	-15.4	1	TiIII	23.0±6.4	4
MgII*	-10.8±3.9	2	CrII	26.0	1
MgII	29.0±4.0	4	CrIII	18.0±3.4	3
AlIII*	2.0±5.0	2	FeII	17.0±0.6	109
SiI	23.0	1	FeIII	23.0±1.5	13
SiII*	8.8±1.4	2	NiII	18.0±0.8	23

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V. DISCUSSION

Figure 2 shows that the radial velocities values derived from the photographic region of the spectrum are around +30 km/s.

The distribution of the different elements in Fig. 2 is comparable to that obtained from the observations in 1979 (Paper I).

In Fig. 4 we see that the radial velocities of the *interstellar lines* (O I, C I, Mg I) do not yield a unique value, most of them are very close to those from the shell lines (+12 km/s) except the Mg I and one component of the resonance lines of Mg II which yield radial velocities around -15 km/s, a value which is normally considered to be the value from the photographic interstellar lines (Merrill and Sanford 1944). However, Underhill and Geuverink (1969) noted that the -15 km/s component of Na I is rather broad to be interstellar.

This spread of the velocities was also found by Hubert-Delplace *et al.* (1983) for 48 Lib, but was not present in the observations made in 1979 (Paper I). This may be an indication that not all the lines which are usually considered as interstellar are of purely interstellar origin and that the unresolved interstellar and shell components are variable as it should be the case of the resonance lines of Si II and S II.

In the visible range, Na I displays two components, one of them yielding a radial velocity of +23 km/s, of the order of the values given by the envelope lines, and the other one with a radial velocity of -26 km/s, similar to the lines arising in the outer regions of this envelope but exceeding the interstellar value, at variance to what Aydin and Faraggiana (1978) had found for 48 Lib.

The same structure is sometimes present also at the K line of Ca II, but on our present material only the component with a radial velocity close to that of the lines of the envelope (+30 km/s) is seen.

The model suggested in Paper I for the gaseous structure of 48 Lib envisaged a geometrically thin, high electron temperature region, later called *transition region* (Fontenla *et al.* 1981), which covers the whole star and is surrounded by a very extended, cool zone, known as the *cool envelope*, which does not rotate with the star.

The radial velocities from the transition region were more negative than those that characterized the cool envelope, and from the analysis of the line profiles, it was concluded that the Al III and Si II lines form in the inner parts of the cool envelope while the Mg II and Fe II lines form in the outer parts. It is interesting to note that the model in Paper I finds support in the conclusions reached by Slettebak and Carpenter (1983) in a recent paper based on the analysis of a fairly large sample of Be stars where 48 Lib is included. The relevant statement in Slettebak and Carpenter's paper reads as follows: *Marlborough and Peters (1982) have noted some dependence of the strength of superionized lines in their B2e-B3e stars on v sin i. Visual inspection of their spectra revealed that the range of strengths of C IV lines depends on v sini: while stars of large v sini may have a range of C IV line strengths, stars of low v sini seem to have only weak C IV lines. Although our sample is small, our spectra would seem to confirm this result... Be stars with small v sini generally have weaker lines of Si IV and C IV than Be stars of the same spectral type with large v sini*".

From our present work we can state that:

1) As shown in Fig. 5 no significant progression is present in the Balmer lines; the higher members lie around +26 km/s;

2) As a consequence, we would expect that the photographic metallic lines would have approximately the same velocity as the higher members of the Balmer lines and this is so;

3) The velocities of the UV lines formed in the cool envelope are grouped around the value +20 km/s with a higher dispersion than the one that characterizes the metallic lines in the photographic region;

4) The lines originating in the transition region yield negative velocities;

5) Ca II $\lambda 3933$ Å has no chromospheric components.

In order to discuss our results we will refer to Fig. 1 which is the radial velocity curve of 48 Lib -for H_δ and the metallic lines- published by Aydin and Faraggiana (1978) where we have added their H_β and H_α values as given in the paper, the data for the UV and photographic regions in the years 1979 and 1981 given by Hubert-Delplace *et al.* (1983), our ultraviolet data from Paper I and the results from our observations in 1981.

On the basis of this Figure we can infer that a) the lines arising in the cool envelope, the ones observed in the UV as well as the ones observed in the photographic region (Fe II and Fe III), yield approximately the same velocity values at the different phases where they were measured; b) H_β radial velocities describe an *oscillation* of $\sim$ 10 km/s of amplitude and apparently phase-shifted relative to the curves drawn for H_δ. The mean value of this *oscillation*

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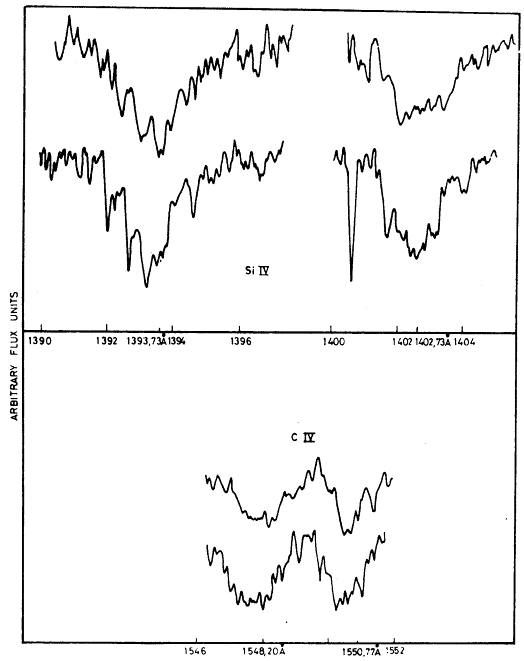

Fig. 3. Absorption profiles of the Si IV and C IV transitions λλ1393, 1402, 1548 and 1550 Å. The flux intensity scale is in arbitrary units.

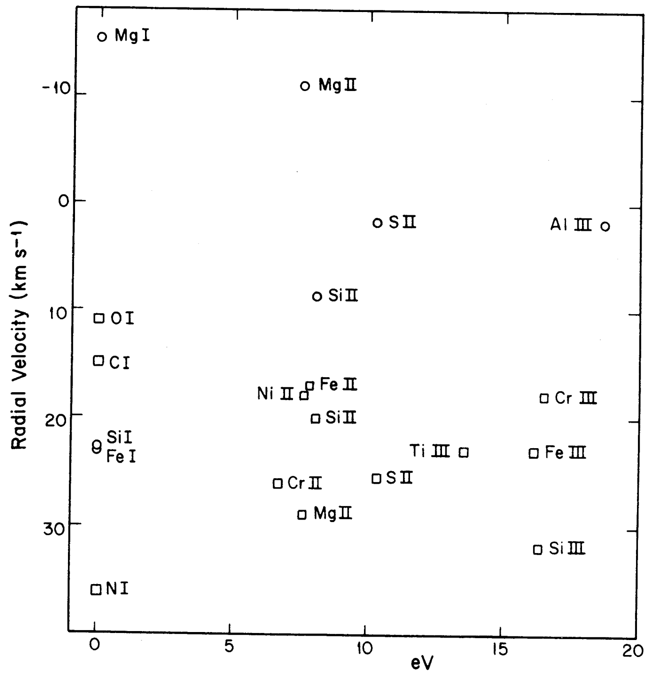

Fig. 4. Radial velocities of different ions in the UV spectrum of 48 Librae, as a function of ionization potential of the preceding stage of ionization of the relevant ion. o resonance lines (mean of two or more lines), ● resonance lines (one line), ◘ non-resonance lines (mean of several lines), ■ non-resonance lines (one line).

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does not differ significantly from the value given by the interstellar lines; c) there are only two H measurements, one in 1970 and another one in 1981; both yield similar values, close to the interstellar value.

We find, as Hubert-Delplace *et al.* (1983) already noted, that the UV Si IV and C IV resonance transitions at λλ 1393 and 1402 and at λλ 1548 and 1550 Å yield negative radial velocities, independently of the phase of the envelope radial velocity curve. For 27 Canis Majoris we have also found, as reported in Paper I, that the radial velocities of Si IV and C IV are negative although the rest of the elements have positive values.

The 48 Lib line profiles of the resonance lines of C IV and Si IV obtained in both periods of observations are, in principle, very similar, as is shown in Fig. 3. Nevertheless, a careful analysis reveal that the long-wavelength wing remains the same while in 1981 the shor-wavelength wing corresponds to a lower *terminal velocity* -increasing its slope- and that this effect is larger in Si IV than in C IV. This comparison was made possible by reprocessing the 1979 observations with Turnrose and Bohlin's (1981) corrected ITF.

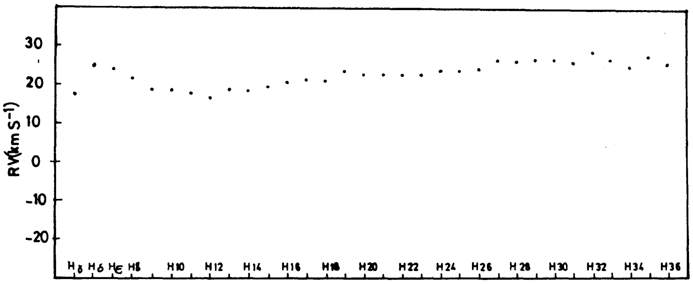

Fig. 5. The Balmer progression for 1981.

Although this set of observations does not permit us to reach conclusions about the structure of the transition region we should point out that Fig. 1 shows that during the negative phase of the envelope (January, 1979), the radial velocity is more negative for C IV than for Si IV, while in the positive phase, which begins at the end of 1979, the situation in regard to these radial velocities is exactly the opposite.

This result may be completely fortuitous. However, we find that a similar situation is present when we consider Fig. 1a in Hubert-Delplace *et al.*'s (1983) paper, which represents the radial velocity curve from the shell lines of ζ Tau in the photographic region. If, on this plot, we add the Si IV and C IV data for the three different epochs in which the authors observed the star, the behavior of the radial velocities of C IV and of Si IV relative to the shell velocity, is just the same as in 48 Lib. The confirmation of the behavior of the resonance lines of C IV and Si IV from future observations would give valuable information about the possible relation between the transition region and the envelope through the velocity and temperature gradients. If that relation exists it will favor a model such as the one we proposed in Paper I.

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