Wolf-Rayet Phenomena in Massive Stars and Starburst Galaxies
Proceedings IAU Symposium No. 193, ©1999 IAU
K.A. van der Hucht, G. Koenigsberger & P.R.J. Eenens, eds.

Spectroscopic analysis of OB stars in Cygnus OB2

Luis Corral, Artemio Herrero, M.R. (Charo) Villamariz

Instituto de Astrofísica de Canarias,
E-38200 La Laguna, Tenerife, Spain

Eduardo L. Martín

University of California, 601 Campbell Hall, Berkeley, CA 94720, USA

Abstract. We obtain the stellar parameters of eleven OB stars in Cyg OB2 using model atmospheres. Each of the analysed stars shows an enhanced Helium abundance. We releate this is to the young agae of the OB association and/or the low rotational velocity of the stars.

1. Introduction

Herrero *et al.* (1992, Paper I) found that some galactic OB stars show a surface helium abundance larger than predicted by evolutionary theories: *a helium discrepancy.* This discrepancy is present in supergiants and among fast rotators of luminousity class V. Recent evolutionary theories propose rotationaly-induced additional mixing (Maeder & Zahn 1998; Langer & Heger 1998) as an explanation, as it could affect the stellar mass-luminosity relation and the surface helium abundances. These differences with classical evolutionary theories are functions of the rotational velocity of the star and the stellar age.

2. Observations

To study these discrepancies in an homogeneous sample we observed eleven stars that belong to the Cyg OB2 association, a rich, young association studied by Massey & Thompson (1991, MT) among others. MT, with *UBV* photometry and spectra of selected stars, found that Cyg OB2 contains 108 stars earlier than B1.5V, the distance modulus is 11.2 ± 0.10, and the reddening is high ($<E_{B-V}> \simeq 1.8$). There are seven giants and supergiants in the sample that we observed at the *INT* with the IDS with different grids during a run in August 1995. We covered the region 4000–5000 Å with spectral resolutions of 0.6 and 1.3 Å.

3. Analysis and discussion

The spectral profiles of H, He I and He II lines were compared with those generated with NLTE plane-parallel, hydrostatic atmosphere models with line-blocking. We checked for the model which better fits line-profiles, not only

https://doi.org/10.1017/S0074180900204956 Published online by Cambridge University Press

Table 1. Parameters determined for the stars observed in Cyg OB2.

star #	sp. type	$T_{\rm eff}$	$\log g$	ϵ	$v_r \sin i$ (km s^{-1})	M_v	R ($R_\odot$)	$\log (L/L_\odot)$	M_s ($M_\odot$)	M_{ev} ($M_\odot$)	M_i ($M_\odot$)
8c	O5 If	48.0	3.77	0.09	145	-5.61	13.3	5.93	37.8	73.1	74
22	O4 III(f)	47.0	3.61	0.12	125	-6.69	22.7	6.36	76.2	118.7	131
9	O5 If	44.5	3.52	0.09	135	-6.53	22.0	6.24	57.5	98 .9	107
516	O5.5 V((f))	44.0	3.61	0.15	135	-6.89	25.2	6.33	94.5	100.1	123
11	O5 If+	43.0	3.42	0.09	120	-6.51	22.4	6.17	47.5	80.7	94
29	O7 V	40.0	3.83	0.09	180	-4.71	9.5	5.32	22.3	34.2	35
4	O7 III((f))	39.0	3.52	0.07	125	-5.44	13.9	5.60	23.2	42.1	44
20	O9.5 V	35.0	4.00	0.09	25	-3.88	7.0	4.82	17.9	21.8	22
21	B0.5 V	34.5	3.90	0.09	30	-3.58	6.3	4.70	11.4	20.2	21
10	O9.5 I	31.0	3.11	0.09	85	-6.86	31.6	5.92	46.9	54.2	61
19	O9.5 III	30.0	3.02	0.09	75	-5.41	16.4	5.29	10.3	26.7	28

equivalent widths. With the parameters of the best-fit model ($v_{\rm rot} \sin i$, $T_{\rm eff}$, $\log g$ and helium content, ϵ), we calculate radii, luminosities and spectroscopic masses following the method presented in Paper I. The final parameters determined are presented in Table 1. Errors are $\pm 1\,500$ K in $T_{\rm eff}$, ± 0.1 dex in $\log g$ and ± 0.03 in ϵ. $M_{\rm s}$, $M_{\rm ev}$ and $M_{\rm i}$ are the spectroscopic mass, the present evolutionary mass and the initial evolutionary mass, respectively. The initial masses have been obtained from evolutionary tracks by Schaller *et al.* (1992) for non-rotating stars.

As can be seen, the stars observed have low or moderate projected rotational velocities, six of them between 120 and 140 km s^{-1}. We confirm that Cyg OB2 is a young association because three of the stars analysed have initial masses, as derived from evolutionary tracks, greater than 100 $M_\odot$. Only star #516 shows a He-enhanced abundance, however the non-rotating evolutionary tracks of Schaller *et al.* (1992) predict for this star a surface He abundance of $\epsilon = 0.14$.

In conclusion, no helium discrepancy is found in the analised stars. This result can be explained by the young age of the association, the low rotational velocities observed, or both properties combined. We need to study more OB stars in other galactic associations before we can prove this hypothesis.

References

Herrero, A., Kudritzki, J.M., Vílchez, J.M., Kunze, D., Butler, K., Hasser, S. 1992, A&A 261, 209 (Paper I)

Langer, N., Heger, A. 1998, in: I. Howarth (ed.), Boulder-Munich II: Properties of Hot, Luminous Stars, ASP-CS 131, 76

Maeder, A., Zahn, J.-P. 1998, A&A 334, 1000

Massey, P., Thompson, A.B. 1991, AJ 101, 1408 (MT)

Schaller, G., Schaerer, D., Meynet, G., Maeder, A. 1992, A&AS 96, 269

https://doi.org/10.1017/S0074180900204956 Published online by Cambridge University Press