SPECTROSCOPIC ANALYSES OF HdBe STARS

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1. The hydrogen-deficient Be stars

A few hydrogen-deficient B stars (or extreme helium stars: EHes) exhibit Be-type behaviour (the HdBe stars). The principal class members are BD $-9°4395$, LSE 78 and DY Cen. The hot RCrB stars MV Sgr and V348 Sgr and the hot EHes HD 160641 and LSS 5121 are related to these objects. Since there are wide abundance variations amongst the EHes, as well as wide variations in Be-type behaviour, the principal HdBes have been analysed for atmospheric parameters, including $T_{\rm eff}$, $\log g$ and composition.

2. Atmospheric parameters

Improved model atmosphere techniques, including line blanketing, have been adopted, together with high resolution high S/N spectra (Jeffery & Heber 1992,1993, Jeffery 1993). The H abundance is found to vary from less than 0.01% up to 10%. The C abundance is uniformly about 1 dex above solar, but the O abundance varies between a subsolar value up to about 1/3 of the C abundance. This very high value of the O/C ratio is similar to that found at the end of core He burning and has important consequences for the evolution of HdBe and EHe stars. In summary the HdBe (EHe) surface compositions reflect the history of the star, including primordial abundance variations (Fe), the residual component of the H-rich envelope (H), CNO (N,He) and 3α (C) and α-capture (O,Ne) processed material. The results for all analysed EHes and HdBes are shown in the table.

3. Related Objects

It is proposed that EHes share a common evolutionary origin with several other H-deficient objects (Jeffery 1994, in preparation). Whilst most analyses of EHes have been carried out using consistent methods (plane-parallel static atmospheres in LTE), successive improvements have modified the results. This process is incomplete, since line-blanketing and non-LTE effects have been shown to be severe. For example, new non-LTE calculations for C II in EHe atmospheres indicate that LTE methods considerably underestimate the C abundance (Dundas 1993, priv. comm.). These processes must be correctly treated before EHes can be reliably compared with other objects.

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Atmospheric parameters for HdBes (normalized to $\log \Sigma_i \mu_i \nu_i = 12.15$)

Star	HD 168476	MV Sgr	HD 124448	BD+10 2179	DY Cen	BD−9 4395	LSE 78	V348 Sgr*	γ Peg
Class	EHe	RCrB HdBe	EHe	EHe	RCrB HdBe	EHe HdBe	EHe HdBe	RCrB WC11	B
$T_{\rm eff}$/kK	13.7	15.4	15.5	16.8	19.5	22.7	18.0	19.0	
$\log g$	1.35	2.5	2.5	2.55	2.15	2.55	2.00	2	
H	< 7.8		< 7.5	8.5	10.76	8.74	< 7.54	0.20	12.00
He	11.54	11.6	11.53	11.53	11.52	11.54	11.54	0.50	10.96
C	9.4	7.8	9.46	9.54	9.51	9.17	9.54	0.25	8.45
N	8.9	8.0	8.83	8.11	8.01	7.97	8.33		7.82
O	8.4		8.5	8.1	8.85	7.90	9.06	0.05	8.66
Ne	9.3:				9.6	8.8			8.5
Mg	7.7		8.2	8.0	7.3	7.3	7.2		7.5
Al	7.2:		6.2	6.3	5.9	5.6	5.8		6.5
Si	7.7	6.9	7.5	7.3	8.1	7.8	7.1		7.4
P	6.3		5.6	5.5	5.8	6.2	6.3		5.2
S	7.0	6.5	7.2	7.12	7.1	7.8	7.1		7.2
Ar			6.6	6.4	6.1	7.2	6.6		6.7
Ca	7.0		< 6.9	< 5.9 :			6.3		6.4
Fe	7.5		7.4	6.49	5.0	6.6	6.8		7.4

* V348 Sgr – relative abundances by number : value uncertain

HD 168476	Walker & Schönberner 1981	BD −9°4395	Jeffery & Heber 1992
MV Sgr	Jeffery et al. 1988	DY Cen	Jeffery & Heber 1993
HD 124448	Schönberner & Wolf 1974	LSE 78	Jeffery 1993
BD +10°2179	Heber 1983	V348 Sgr	Leuenhagen et al. 1993a,b
γ Peg	Peters 1976		

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