ASP Conference Series, Vol. 226, 2001
J. L. Provencal, H. L. Shipman, J. MacDonald, & S. Goodchild, eds.

Spectral monitoring of HS 0209+0832 a DAB white dwarf in the DB gap

H. Edelmann, U. Heber, R. Napiwotzki

Dr. Remeis Sternwarte, Sternwartstraße 7, 96049 Bamberg, Germany

Abstract. We report results of a spectral monitoring campagne of the DAB white dwarf HS 0209+0832, for which helium line profile variations were reported earlier (Heber et al. 1997). This finding is confirmed by our descovery of a second epoch (October 1997) of unusually low helium line strength and of their subsequent recovery. The observed changes in line strength correspond to a variation of the (average) helium abundance by a factor of 2.

1. Introduction

The DAB white dwarf HS 0209+0832 was discoverd by Jordan et al. (1993) from follow-up spectroscopy of the Hamburg Schmidt objectiv prism survey. They derived an effective temperature of 36 000K which places the DAB within the DB gap region of 28 000K $\leq T_{\rm eff} \leq$ 40 000K.

However, Jordan et al. could not exclude the possibility the object being a spectroscopic binary. Heber et al. (1997) therefore reobserved the star at 3 different epochs with improved spectral resolution. The detection of the He II line at 4686Å excluded a DA+DB model for HS 0209+0832. In addition, Heber et al. (1997) discovered a helium line profile variation in their spectra. At one epoch helium was reduced by a factor of 2...3, whereas the other epochs show a constant helium abundance within the error range. The derived effective temperature of about 36 000K and the gravity of $\log(g/{\rm cm\,s^{-2}}) = 7.91$ are constant at all epochs and consistent with the results of Jordan et al. (1993). Heber et al. (1997) favor a slowly rotating star with an inhomogeneous surface composition, i.e. a helium enriched spot at the surface, to explain the variable helium features.
To test this model, a spectroscopic monitoring of HS 0209+0832 was performed.

2. Observations

New spectra of HS 0209+0832 were obtained at 11 epochs (1997-2000) at the German-Spanish Astronomical Center on Calar Alto (CA), Spain and at the European Southern Observatory (ESO) on La Silla, Chile. Nine spectra were obtained with the TWIN spectrograph at the CA 3.5m telescope and one spectrum with the CAFOS spectrograph at the CA 2.2m telescope. Furthermore one spectrum was obtained with the EMMI spectrograph at the ESO 3.5m NTT telescope and another one with the B&C spectrograph at the ESO 1.52m telescope. The observing data of all spectra are shown in Table 1.

For comparison purposes we convolved all spectra with a spectral resolution better than 5.0Å to a nominal resolution of 5.0Å. These normalized and folded spectra are plotted in Figure 1 and compared with the older ones (1990-1996) from Heber et al. (1997). As can clearly be seen, the helium spectrum, especially the He I 4471Å line, is time variable. The spectra taken on December 1995 and October 1997 show notable minima in the helium line strength whereas in August 1996 the spectra show a maximal helium line strength.

Within the limits there is no radial velocity variation detectable. The value we get is about (110 ± 30)km/s for all epochs.

3. Spectral Analysis

The fundamental parameters (effective temperature, gravity and helium abundance) were derived from the spectra by means of a χ^2 fit using partial blanketed non-LTE model atmospheres (Napiwotzki 1997).

Table 1 summarizes the results of all available epochs, including the old spectra of Heber et al. (1997) which were re-analyzed, to guarantee the same fitting procedure and model atmospheres for a better comparison. Within the limits all individual temperature and gravity determinations agree very well.

Table 1. Times of observation (start of exposure), spectral resolution, wavelength coverage and atmospheric parameters for HS 0209+0832 for all available epochs.

date	time (UT)	exp. time/s	spec. res.(Å)	wav. cov. Å	T_{eff} K	$\log g$	log (He/H)
10/08/1990	01:17	1200	7.0	3800...5540	35990	7.97	-1.95
10/09/1990	01:20	1200	7.0	3800...5540	36080	7.94	-2.00
12/23/1995	21:03	1800	3.6	3900...7000	36190	7.89	-2.36 ←
08/17/1996	04:00	1800	3.6	3900...7000	36200	7.84	-1.96
08/18/1996	03:54	1800	3.6	3900...7000	36040	7.79	-1.95
08/29/1997	02:35	1800	3.4	3500...7000	36240	7.83	-2.14
08/31/1997	01:47	2400	3.4	3500...7000	36040	7.79	-2.16
10/27/1997	04:49	1200	5.0	3500...5200	36360	7.80	-2.37 ←
10/01/1998	23:21	3600	8.0	3500...6300	36270	7.83	-2.16
07/20/1999	03:07	1800	3.0	3500...7000	35950	7.78	-2.10
07/21/1999	03:03	600	1.5	4465...6590	36530	7.81	-2.08
07/21/1999	03:36	1800	1.5	4465...6590	36400	7.80	-1.98
07/23/1999	03:43	1800	1.5	3700...4800	36140	7.78	-2.11
01/28/2000	18:27	1800	3.4	3500...7000	37020	7.83	-2.17
01/28/2000	19:01	1800	3.4	3500...7000	36660	7.81	-2.18
				He-strong phases:	36274	7.83	-2.07
					±278	±0.057	±0.09

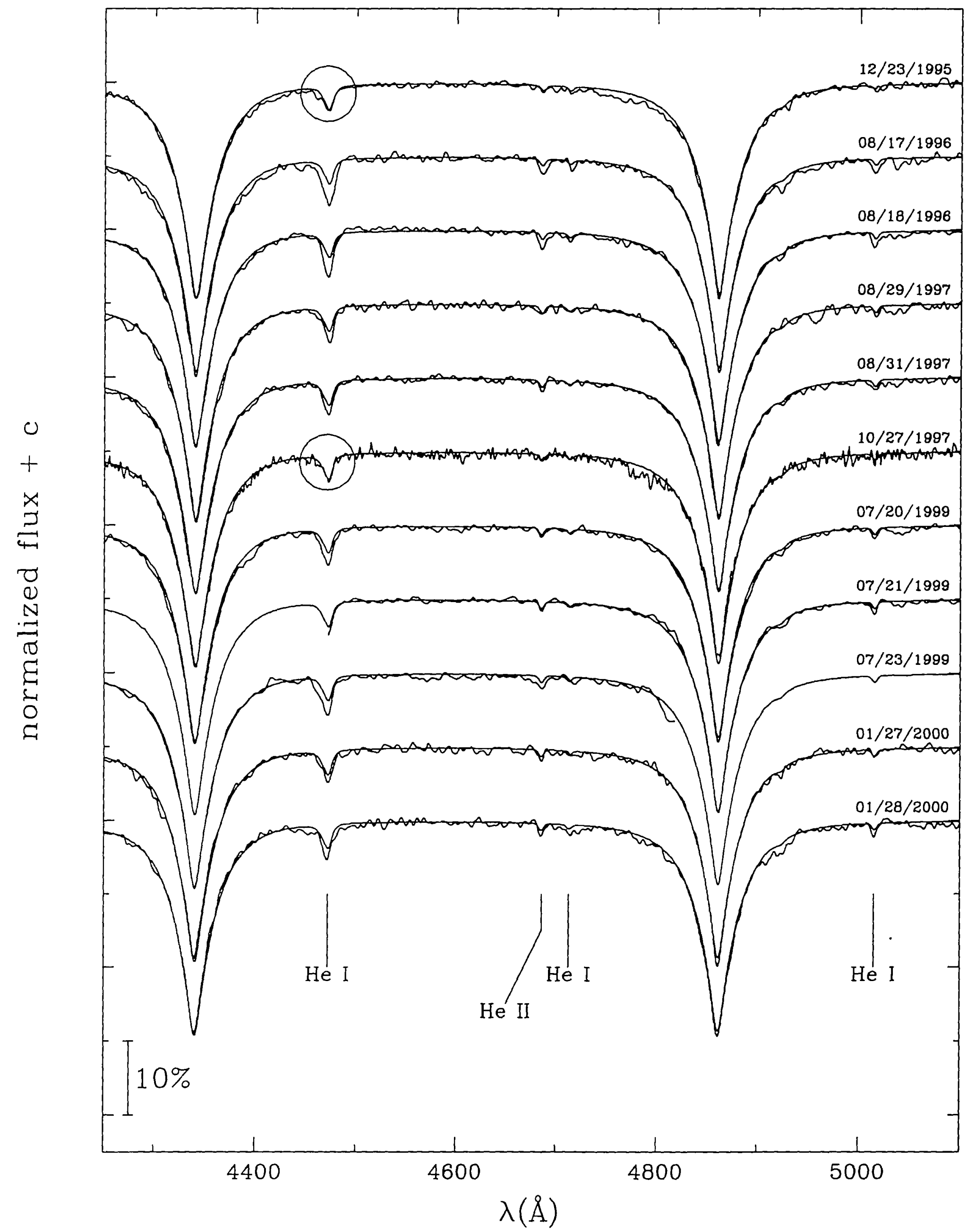

Figure 1. Spectra of HS0209+0832, taken at 11 epochs in comparison to a synthetic spectra $T_{\rm eff}$ = 36 400K, $log(g/{\rm cm\,s^{-2}})$ = 7.82 and He/H=0.005) which represents the state of low helium abundance reported by Heber et al. (1997) for December 1995. Note that in the spectra taken in December 1995 and in October 1997 He I 4471Å is in perfect agreement with the theoretical model, whereas for all other epochs the helium lines are stronger.

4. Conclusion

¿From spectral monitoring of the DAB HS 0209+0832 in the optical we find that its effective temperature ($T_{\rm eff}$ = 36 300K) and gravity ($\log(g/{\rm cms}^{-2})$ = 7.83) stay constant with time. However, the helium abundance is time variable. At two epochs (12/23/1995 and 10/27/1997) the helium abundance (He/H=0.005) is significantly lower than at the 14 other epochs observed. Wolff et al. (2000) have proposed accretion from an inhomogeneous interstellar medium to account for the variable helium abundance. Alternatively, a spotted rotating white dwarf model is conceivable. Additional observations are required to search for a periodicity.

References

Heber U., Napiwotzki R., Lemke M., Edelmann H. 1997, A&A 324, L53

Jordan S., Heber U., Engels D., Koester D. 1993, A&A 273, L27

Napiwotzki 1997, A&A, 322, 256

Wolff B., Jordan S., Koester D., Reimers D. 2000, A&A in press