The peculiar abundance pattern of HR 7098

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Introduction

HR 7098, currently assigned an A0V spectral type, is one of the northern slowly rotating late-B stars stars we are currently monitoring (see Royer et al. (2014) for a similar campaign on early A-stars). We have synthesized selected lines of elements ranging from Helium up to Mercury present in the archival SOPHIE spectrum of HR 7098 using model atmospheres and spectrum synthesis including hyperfine structure of various isotopes when necessary. These synthetic spectra were iteratively adjusted to the high resolution high signal-to-noise spectrum of HR 7098 in order to derive the abundances of these elements. The puprose of this work is to present the abundances we derived for HR 7098 and discuss the nature of this interesting object.

Observations and Reduction

HR 7098 has been observed once at Observatoire de Haute Provence using the High Resolution (R =75000) mode of SOPHIE on 05 August 2008.

One 20 minutes exposure yielded a well exposed spectrum whose $\frac{S}{N}$ ratio is 224 at 5000 Å.

Conclusions

The abundance analysis yields distinct underabundances of He, C, nearly solar abundances for O, Mg, Al, S, Ca, Sc, and Fe, mild overabundances for P, most of the iron-peak elements, the Sr-Y-Zr triad , Ba and Hg above the ± 0.20 dex representative of the uncertainties on abundances. The Hg II 3983.93 Å line is present and yields an estimated overabundance of Hg of about 2000 ⊙. This pattern of abundances suggests that HR 7098 was a mild CP star, possibly a cool Hg-Mn star at the time it was observed. The star should however be reobserved at a better signal-to-noise shortwards of 4000 Å in order to confirm the presence of the Hg II line. The fact that the overabundances gradually increase with atomic number suggests that radiative diffusion is important in HR 7098.

References

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Abundance analysis of HR 7098

The lines used to derive elemental abundances from the SOPHIE spectrum of HR 7098 are collected in Table 1 along with the derived abundance for each transition. These lines are mostly unblended or weakly blended.

Laboratory Wavelength (Å)	**Identification**	**Abundance**	**Comment**
4471.47	He I	0.50 ⊙	
4267.00	C II	0.50 ⊙	
4267.26	C II	0.50 ⊙	
6155.96	O I	1.25 ⊙	6 lines
4390.57	Mg II	1 ⊙	
4427.99	Mg II	1 ⊙	
4663.06	Al II	1 ⊙	
	Si II	1.33 ⊙	5 lines
6043.13	P II	5 ⊙	
4153.06	S II	1 ⊙	
4162.67	S II	0.8 ⊙	
5019.98	Ca II	1.0 ⊙	
4246.82	Sc II	1.3 ⊙	
	Ti II	2.21 ⊙	11 lines
	V II	3.30 ⊙	4 lines
	Cr II	1.94 ⊙	5 lines
4206.37	Mn II	2.0 ⊙	
4259.19	Mn II	2.0 ⊙	
	Fe II	1.31 ⊙	6 lines
4679.16	Ni II	3.00 ⊙	
4077.71	Sr II	3.00 ⊙	
4215.52	Sr II	3.00 ⊙	
5662.92	Y II	4.00 ⊙	
	Zr II	7.00 ⊙	4 lines
4130.70	Ba II	10.00 ⊙	
4554.03	Ba II	10.00 ⊙	
4934.08	Ba II	10.00 ⊙	
5873.70	Ba II	10.00 ⊙	
6141.70	Ba II	10.00 ⊙	
3983.93	Hg II	2000 ⊙	

Table 1: A selection of the lines used to derive abundances in HR 7098

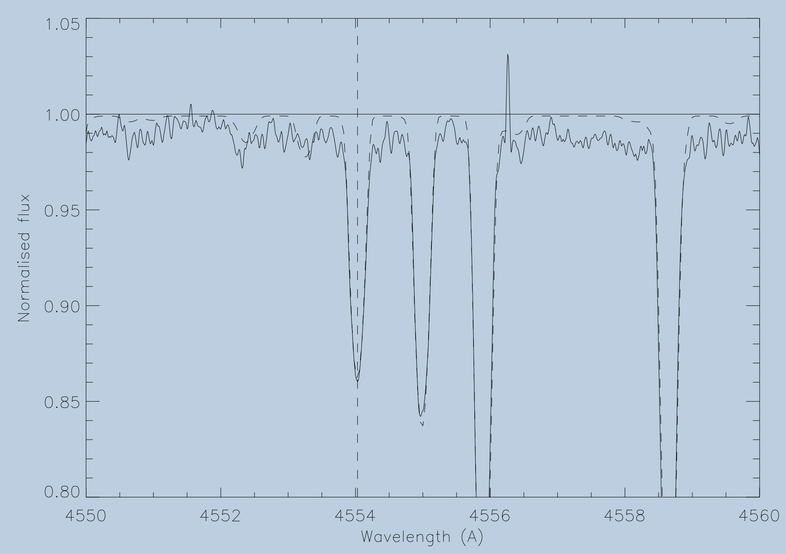

Figure 1: Spectrum synthesis of the Ba II 4554.03 Å line (observed: thick line, model: dashed line)

Model atmospheres and spectrum synthesis calculation

A grid of synthetic spectra was computed with SYNSPEC49 (Hubeny & Lanz, 1992) to model selected lines with good atomic data. A 72 layers plane parallel model atmosphere was computed assuming Local Thermodynamical Equilibrium, Radiative Equilibrium and Hydrostatic Equilibrium using ATLAS9 for an effective temperature of 10200 K and a surface gravity log(g) = 3.55. A low microturbulent velocity of 0.9 km.s^{-1} was derived by minimising the iron abundances inferred from Fe II lines of various strengths. In figure 1, the observed line profile of Ba II at 4554.03 Å is compared with the synthetic profile computed for an overabundance of Barium of 10 ⊙ which provides the best fit to the observed profile.