

The peculiar abundance pattern of the new HgMn star HD30085

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Introduction

HD 30085, currently assigned an A0IV spectral type, is one of the 47 northern slowly rotating early-A stars stars studied by Royer et al (2014). We have recently synthesized several lines of Mn II, Fe II and Hg II present in the SOPHIE spectra of HD 30085 using model atmospheres and spectrum synthesis including hyperfine structure of various isotopes when necessary. These synthetic spectra were iteratively adjusted to high resolution high signal-to-noise spectra of HD 30085 in order to derive the abundances of these elements. The lines of Mn II and Hg II are strong in HD 30085. The abundance analysis yields overabundances of 40 times solar for Mn and 32000 solar for Hg. This definitely shows that this star must be reclassified as an HgMn star (Monier et al, 2015). We here focus on the lines of Sr, Y, Zr and Hg which are strong in the spectra of HD 30085. We find that the Sr-Y-Zr triad is inverted in HD 30085 with respect to the solar system Sr-Y-Zr triad. This strongly suggests that several physical processes (radiative diffusion, chemical fractionation) must be at work. Sr, Y and Zr are of interest in nucleosynthetic studies because they comprise the first blocking place in the neutron absorption cross-section for s-process synthesis of heavy elements in red giants

Observations and Reduction

HD 30085 has been observed twice at Observatoire de Haute Provence using the High Resolution ($R = 75000$) mode of SOPHIE in February 2012 and December 2013.

Three 15 minutes exposures were secured in February 2012 and coadded into a single mean spectrum whose $\frac{S}{N}$ ratio of about 316. One 20 minutes exposure acquired in December 2013 has a $\frac{S}{N}$ of about 300.

Conclusions

HD 30085 has overabundances in Mn, Sr, Y, Zr, Pt and Hg which are characteristic of an Hg-Mn star. We find that **HD 30085 displays large overabundances of the Sr, Y, Zr triad which is however inverted compared to the solar system triad**

References

Hubeny, I., Lanz, T., 1992, A&A, 262, 501
Monier, R., Gebran, M. & Royer, F., accepted for publication at A&A, April 2015
Royer, F., Gebran, M., Monier, R., Adelman, S., Smalley, B., Pintado, O., Reiners, A., Hill, G., Gulliver, G., 2014, A&A, 562A, 84R

Acknowledgements

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The line spectrum of Sr II, Y II and Zr II in HD 30085

The strongest Sr II, Y II and Zr II lines in the SOPHIE spectra of HD 30085 are collected in Table 1 along with their measured equivalent width and derived abundance for each transition. Only a few of these lines are unblended. Most are blended with Cr II, Mn II and Fe II lines.

Laboratory Wavelength (Å)	Identification	Multiplet	EW (mÅ)	Abundance	Comment
4077.71	Sr II	M 2	74.0	40 ⊙	blend
4161.80	Sr II	M 3	11.0	40 ⊙	
4215.52	Sr II	M 2	64.7	40 ⊙	blend
4305.45	Sr II	M 3	14.6	40 ⊙	
4177.53	Y II		46.0	300 ⊙	blend
4235.73	Y II		18.3	300 ⊙	
4309.63	Y II		42.1	250 ⊙	blend
4358.73	Y II		31.8	300 ⊙	blend
4398.01	Y II		49.6	250 ⊙	blend
4422.59	Y II		32.9	500 ⊙	blend
4682.32	Y II		15.1	300 ⊙	blend
4823.30	Y II		16.1	275 ⊙	blend
4883.68	Y II		50.9	500 ⊙	
4900.12	Y II		49.4	500 ⊙	blend
5205.72	Y II		48.2	500 ⊙	
5497.41	Y II		31.4	500 ⊙	blend
5662.93	Y II		51.2	500 ⊙	
4443.00	Zr II		27.4	200 ⊙	
4457.43	Zr II		10.0	100 ⊙	
4496.98	Zr II		22.2	200 ⊙	
5112.30	Zr II		12.6	150 ⊙	

Table 1: The strongest lines of Sr II, Y II and Zr II in HD 30085

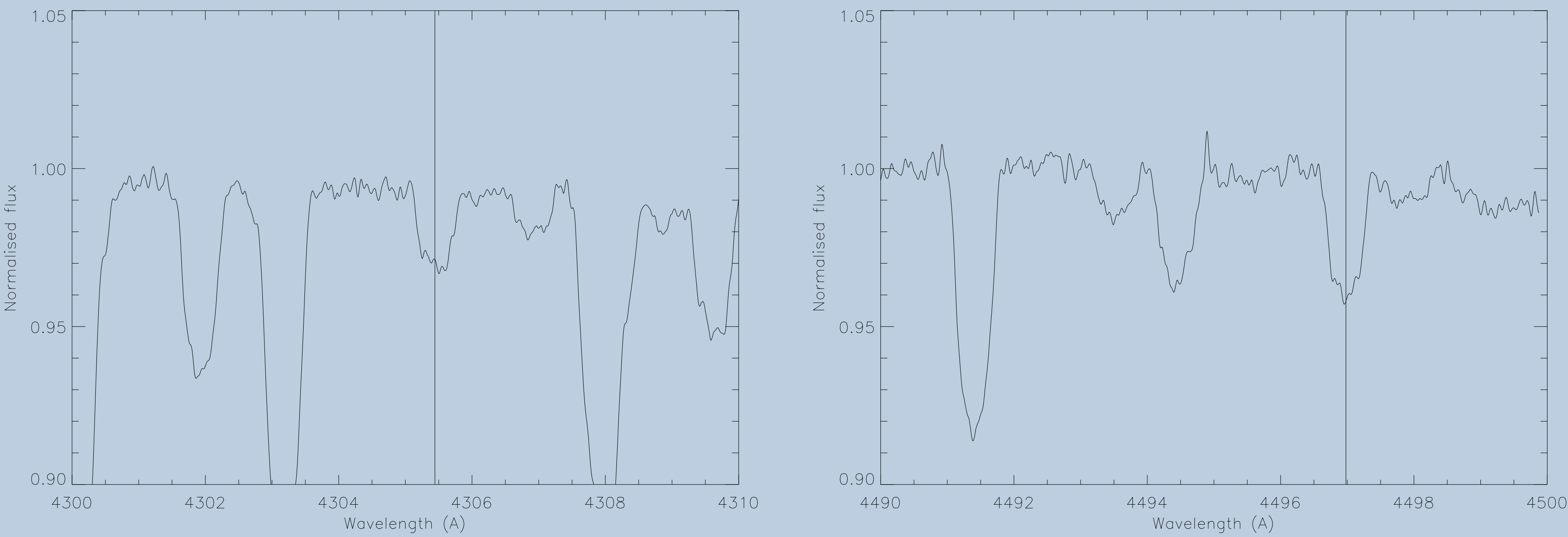


Figure 1: Sr II 4305.45 Å spectral region (left) and Zr II 4496.98 Å spectral region (right)

Model atmospheres and spectrum synthesis calculation

A grid of synthetic spectra was computed with SYNSPEC48 (Hubeny & Lanz, 1992) to model the Sr II, Y II and Zr II lines. In figure 2, the observed line profile of Y II at 5662.93 Å is compared with the synthetic profile computed for an overabundance of Yttrium of 500 ⊙ which provides the best fit to the observed profile.

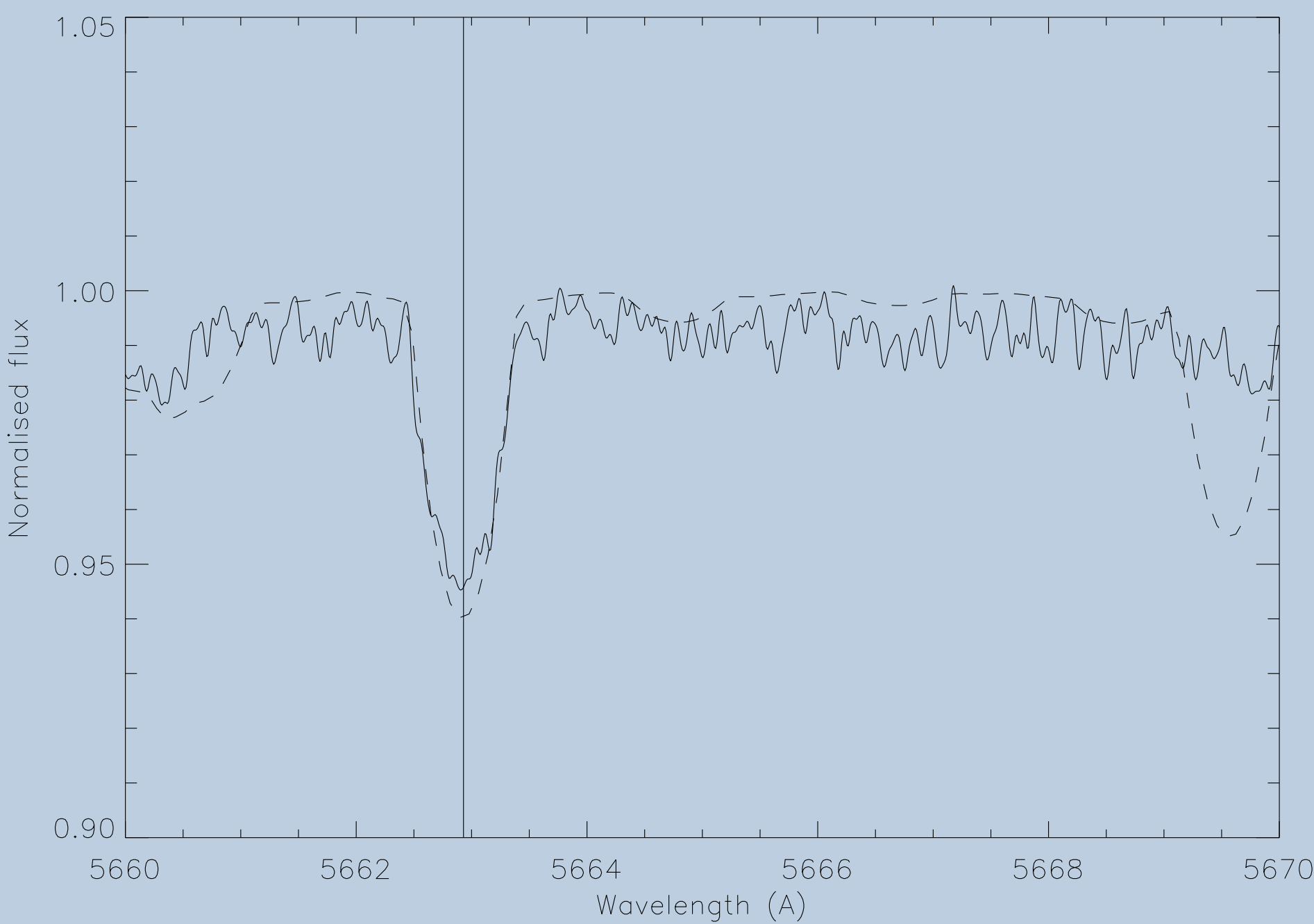


Figure 2: Spectrum synthesis of the Y II 5662.93 Å line (observed: thick line, models: dashed line)