Cosmic Magnetic Fields:
From Planets, to Stars and Galaxies
Proceedings IAU Symposium No. 259, 2008
K.G. Strassmeier, A.G. Kosovichev & J.E. Beckman, eds.

doi:10.1017/S1743921309031032

HD 232862: a magnetic and Lithium-rich giant field star

Agnès Lèbre[1], A. Palacios[1], J. D. do Nascimento Jr[2], J. R. De Medeiros[2], R. Konstantinova-Antova[3], D. Kolev[3] and M. Aurière[4]

[1]GRAAL, Université de Montpellier,CNRS, Montpellier, France
email: lebre@graal.univ-montp2.fr

[2]DFTE, Federal University of Rio Grande do Norte, Natal, Brazil

[3]Institute of Astronomy, Bulgarian Academy of Sciences, Sofia, Bulgaria

[4]LATT, Université de Toulouse, CNRS, Tarbes, France

Abstract. From spectropolarimetric data and spectral synthesis analysis, we report the serendipitous discovery of an unusually high lithium content field giant. HD 232862, classified as a G8II star, appears to be the first Lithium-rich field giant star hosting a surface magnetic field.

Keywords. Stars: abundances – stars: evolution – magnetic fields

1. HD 232862, a Li–rich giant star

This X-ray source in the ROSAT data basis is a G8II (field) giant, namely a bright giant star (mass range from ∼2.5 to 9 $M_{\odot}$), with a high rotational velocity ($v \sin i$ = 20.6 $\mathrm{km\,s^{-1}}$). Specific features in its IUE spectra point to a coronal and chromospheric activity. It has also been resolved as a visually tight binary (Couteau, 1988).

We have collected spectropolarimetric data of HD 232862, with ESPaDOnS (Donati *et al.*, 2006) at the CFHT (Mauna Kea), using the circular polarimetric mode to collect informations in Stokes V and I parameters. The two components of HD 232862 were easily separated on the guiding camera during our subarcsec seeing observations ensuring to access to the first high resolution and high S/N spectra of the giant star alone.

With synthetic spectra computed from MARCS models of stellar atmosphere (Gustafsson *et al.* 2008), we have derived stellar parameters and Lithium abundance of HD 232 862. Adopting $T_{\rm eff}$ = 5000 K, $\log g$ = 3.0 and $[Fe/H] = -0.3$, and adopting the solar abundances from Grevesse and Sauval (1998), we measured a high Li content: $\mathrm{A_{Li}} = 2.45 \pm 0.1$ dex. Comparison of these data to predictions from evolutionary models computed with the STAREVOL code (Siess, 2006) helped to precise the evolutionary status of HD 232862. It appears to be a low mass star (1.5 $M_{\odot}$ $<$M$<$ 2.5 $M_{\odot}$) at the bottom of the Red Giant Branch. Its Li abundance is hence far in excess from the values predicted by standard theory. Indeed, the deepening of the convective envelope on the lower RGB dilutes the preserved surface Li with material from Li free regions. The Li abundance derived in HD 232862 is unusually high, as expected values for its mass range and evolutionary stage are less than 1.5 dex.

This high Li content is also quite peculiar for a bright giant star, as to date there is no clear register of Li-rich objects among the luminosity class II stars (Lèbre *et al.* 2006).

2. Magnetic field detection in HD 232 862

From the ESPaDOnS data, we have also detected the presence of a magnetic field at the surface of HD 232862. Complex and time variable Stokes V signatures are detected

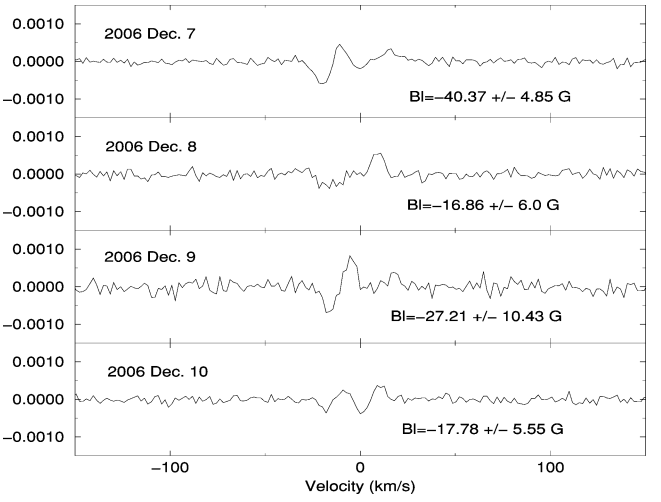

Figure 1. Variation of Stokes V profiles (extracted with LSD method) over a 4-days timescale. A clear signal, hosting a complex structure strongly variable from one night to another, is obtained. Date is indicated in each panel, as well as the longitudinal magnetic field component B_l (in G).

(Fig. 1), pointing to a dynamo origin for the field. We also suspect a complex structure for the parent field, with likely topology variations over a period that has to be specified. Longitudinal B_l magnetic field has been derived from LSD analysis (Donati *et al.*, 1997), using a specific mask computed with $T_{\rm eff}$=5000 K and $\log g$=3.0 (involving ∼12,000 lines). The B_l component shows strong variations over 4-days timescales and points – under dipolar field assumption – to an intense magnetic field (∼100 G) at the surface of HD 232862.

This is the very first detection of such an intense magnetic field in a Lithium rich giant. Further observations are now needed to infer the mean magnetic field of HD 232862, to clarify its origin, and to assess the star's progenitor (that may be a magnetic A star). Only then, will it be possible to disentangle whether the high Li content of HD 232862 is due to its binary status, to the presence of a surface magnetic field, or to another process.

Acknowledgements

We thank the french PNPS/INSU-CNRS for financial support.

References

Couteau, P. 1988, *A&AS* 75, 163
Donati, J. F. *et al.* 2006, in: R. Casini & B. W. Lites (eds.), *Solar Polarization 4*, ASP Conf. Series, Vol. 358, p. 362
Donati, J.-F., Semel, M., Carter, B. D., Rees, D. E., & Cameron, A. C. 1997, *MNRAS* 291, 658
Grevesse, N., & Sauval, A. J. 1998, *SSRv* 85, 161
Gustafsson, B., Edvardsson, B., Eriksson, K., *et al.* 2008, *A&A* 486, 951
Lèbre, A., de Laverny, P., do Nascimento, J. D., & de Medeiros, J. R. 2006, *A&A* 450, 1173
Siess, L. 2006, *A&A* 448, 717

https://doi.org/10.1017/S1743921309031032 Published online by Cambridge University Press