Cosmic Magnetic Fields:
From Planets, to Stars and Galaxies
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Dynamo-generated magnetic fields in fast rotating single giants

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Abstract. Red giants offer a good opportunity to study the interplay of magnetic fields and stellar evolution. Using the spectro-polarimeter NARVAL of the Telescope Bernard Lyot (TBL), Pic du Midi, France and the LSD technique we began a survey of magnetic fields in single G-K-M giants. Early results include 6 MF-detections with fast rotating giants, and for the first time a magnetic field was detected directly in an evolved M-giant: EK Boo. Our results could be explained in the terms of α–ω dynamo operating in these giants.

Keywords. Magnetic fields – stars: evolution – stars: late-type – stars: activity

1. Introduction

Magnetic fields (MF) in single evolved stars are still poorly studied. Most of the G–K–M giants presently been known as active are fast rotators. (Fekel&Balachandran, 1993; Huensch *et al.*, 2004). Angular momentum dredge-up has been suggested to provide the fast rotation, driven by the convective zone reaching near the stellar core (Simon&Drake, 1989). In this way, MFs could be generated by a new dynamo.

2. Observations and data processing

The new generation spectro-polarimeters like NARVAL at TBL, Pic du Midi, France (Aurière, 2003) and the LSD technique (Donati et al., 1997) are very suitable for precision detections of MFs in giants (Konstantinova-Antova *et al.*, 2008; Aurière *et al.*, 2008). We observed 7 fast rotating giants with NARVAL in the period of November 2006 to April 2008. A precise computation of the longitudinal MF B_l using the First Moment Method (Donati *et al.*, 1997; Rees & Semel, 1979) was carried out, and the time-behavior of the activity indicator CaII K (S index) was studied.

3. First results

MF structures, indicative of a dynamo, were detected for 6 of the 7 giants (exception: HD233517), see Table 1 listing the S index and B_l. We determined the evolutionary status and masses of these 6 giants, using Hipparcos parallaxes, $T_{\rm eff}$ from the Wright catalogue (2003), and matching evolutionary tracks from Schröder *et al.* (1997) (Fig. 1).

All 6 giants with MF-detection have masses $\geqslant$1.5 $M_{\odot}$ and their convective zones are currently deepening while the stars are evolving. Their evolutionary stages reach from the

Table 1. Data for the studied giants.

Star	Sp class	M/$M_\odot$	Vsini km/s	L_x 10^{30} erg/s	CaII K S index	B_l Gauss	error B_l Gauss
V390 Aur	G8III	1.85	29	5.04	0.64	-5 – -15	4.4
FI Cnc	G8III	2.25	17	26	1.04 – 1.35	-16.48 – +3.45	1.87
37 Com	G9III-II	4.2	11	5.20	0.34	+5.62	0.63
7 Boo	G5III	3.6	14.5	3.72	0.24	+1.83	0.84
κHerA	G8III	2.8	9.4	2.98	0.29	-3.94	0.67
HD233517	K2III	1.5?	15			no detect.	
EK Boo	M6III	1.9	11	14.12	0.21–0.26	-3.19 – -6.76	0.62

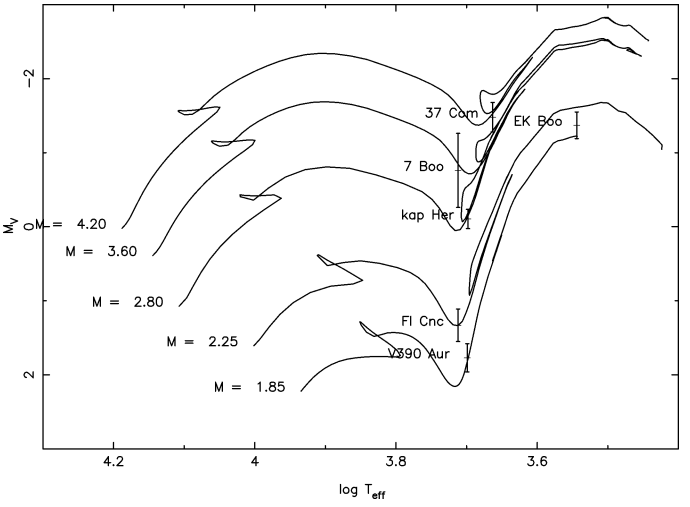

Figure 1. Situation of the fast rotating giants on the HR diagram.

Hertzsprung gap to the AGB. While the particular reasons for the fast rotation could be different, depending on mass and evolutionary history, an α–ω dynamo presents a likely reason for the detected magnetic activity.

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