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# Lithium in cool magnetic CP stars: Some new results of observations, using CAT (ESO) 2.6m (CrAO), (NOT) La Palma telescopes.

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## 1. Introduction

Lithium in cool magnetic CP stars in still poorly studied and estimations of the Li abundance in these stars are scarce. There is some evidence of variability of the LiI 6708 Å line, but this variability has not been studied systematicaly. Even the identification of the 6708 Å line with the LiI resonance doublet is still in doubt. This problem is important in the broader context of the Li abundance in various types of stars, as well as for deeper undersfanding of the magnetic star phonomenon itself. The reason for fhis is that the Li abundance in very sensitive to evolutionary status of the stars and their properties, such as the character and intensity of mixing processes.

## 2. Observations

The majority of the observations presented here were made by P. North with the European Southern Observatory (ESO) Coudé Auxiliary Telescope (CAT). The Coudé Echelle Spectrograph was used with resolving power R=3D 100000 and the S/N ratio for an individual spectrogram better than 100 per pixel in 1 $\sigma$ level. The detector was the ESO CCD 34 with 2048 pixels along the dispersion. A Thorium-Argon lamp was used for the wavelength calibrations with accuracy better than 0.3 km/s. The wavelength range observed was 6675-6735 Å. The spectra were reduced by PN using the standard IRAF procedures. The observations made at the CrAO were a part of a long-term program, some results of which were published in Hack *et al.*(1997) and North *et al.*(1998). A Coudé spectrograph of the Shajn 2.6-m telescope was used; it is equipped with a CCD camera with a red-sensitive detector with a 600x400 pixel array. The linear dispersion is 2.5 Å/mm in the region of 6708 Å and R=3D65000.

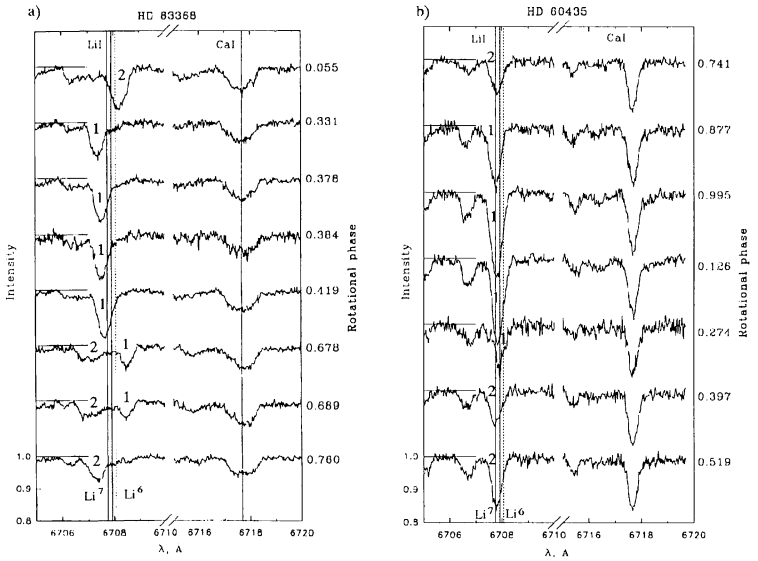


Figure 1. The spectra of ro Ap stars HD 83368 and HD 60435 in LiI 6708Å region in residual intensity scale. At the left side of each spectrum the position of the continium is shown by line. At the right side is indicated rotation phases. The doppler components of Li line 6708Å are marked 1,2.

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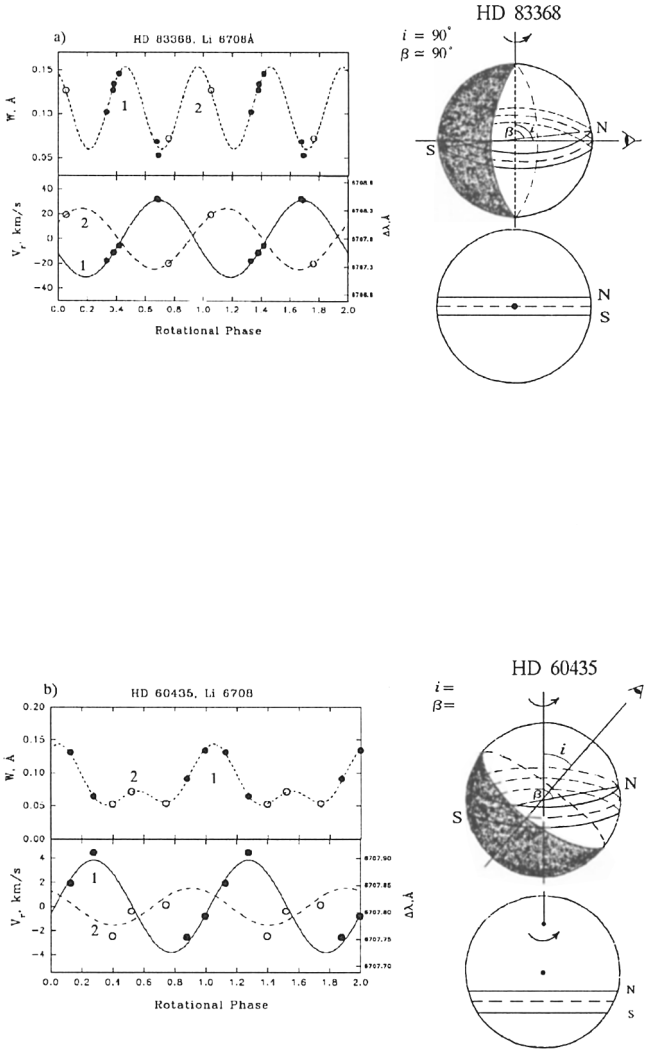


Figure 2. Variations of the equivalent widths EW(top) and of the radial velocities Vr of Li line 6708Å (bottom). The black dots indicate the spot 1, and circles - spot 2. At the right side is shown model oblique rotator for every star. N, S - poles of magnetic dipole are coincided with Li spots 1, 2.

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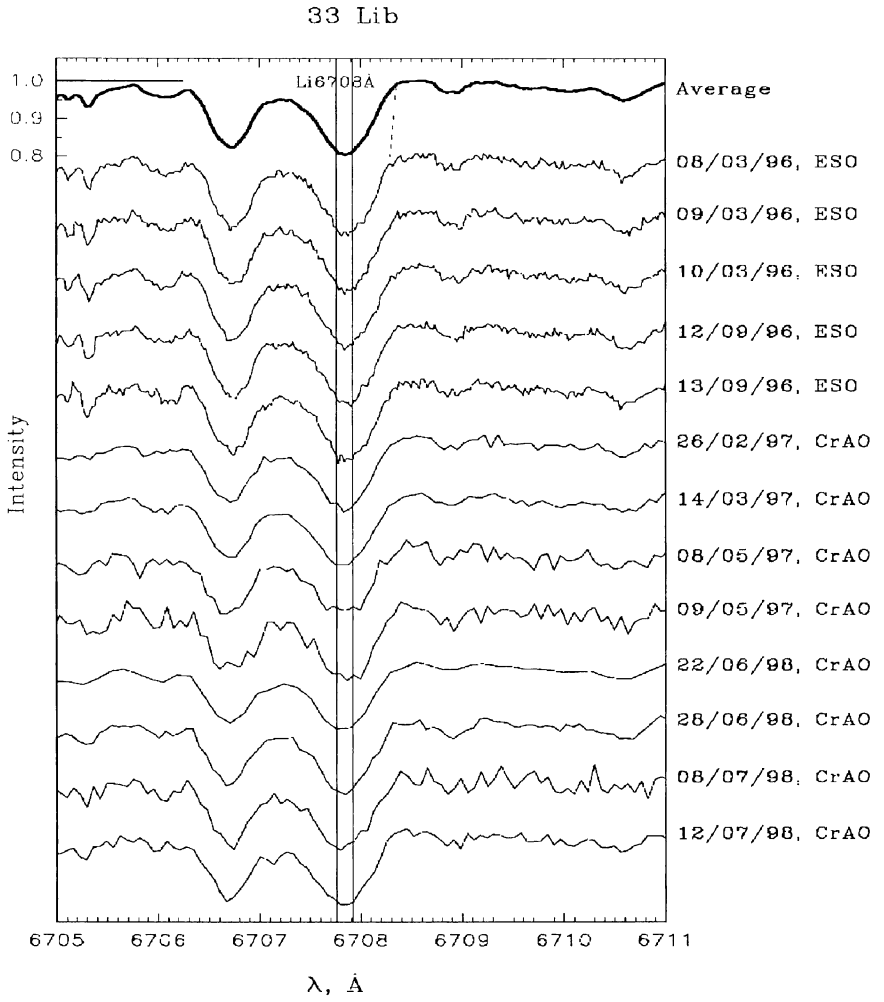


Figure 3. The spectra 33 Lib in LiI 6708 region in residnal intensity scale. Thick line is average spectrum. At the right side is indicated telescopes ESO(CAT) and CRAO(2.6m) are used for observations, and model oblique rotator for groupe 3 stars.

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A typical S/N ratio is better than 100. The wavelength range was 6690-9730 Å. The spectra were reduced by DS using the package of S.Sergeev. The observations with the Nordic Optical Telescope (NOT) on La Palma, Spain, were carried out with the SOFIN echelle spectrograph (Tuominen, 1992) and two CCD cameras, yielding R=3D 80000 and 160000 in the 5500 - 8500 Å range and the S/N ratio 90-300 per pixel. A detailed description of the observations and the discussion of the line identification problems may be found in Hack *et al.* (1997), North *et al.* (1998), and Zverko *et al.* (1998).

## 3. Results and Conclusion.

The resonance LiI 6708 Å line was observed in spectra of twelve program Ap-CP-stars. The behaviour of the line 6708 Å permits us to distingnish four groupes of stars:

* groupe 1 – the line shows great variability of profile Li line and "W", "RV" with rotation phase (Fig 1a,b). This behaviour can be explained by the presence of two Li spots on the star's surface.=20 (HD 83386, HD 60435) (Fig 2a,b)

* group 2 – the line is variable, but the observations are too sparse to make a conclusion about the variability nature. (HD 188041, $\beta$CrB)

* group 3 – the line is strong, but nonvariable. (33 Lib, HD 134214, HD 166473) (Fig 3a)

* group 4 – the line was not detected ( HD 42659, HD 80316, HD 118022 and HD 128898 )

- The discovery of LiI-spots in HD 83368 and in 60435 is the first indication of spottiness in lithium distribution on surface of some cool magnetic=20 CP-stars.

- A good correlation between the positions of the spots, magnetic poles, and oscillation phenomena (HD 83368) indicates possible connections between the magnetic fields configuration and the local structure of star's atmosphere. (Polosukhina N. et al, 1999)

- We explaned the behaviour of 6708 Å line using the model of the "spotted" oblique rotator, with different parameters for each star(Fig 2a,b). The anles "$i$" and "$\beta$" for different stars defermine the visibility of magnetic poles and spots, consequently, behaviour lithium line 6708 Å. HD 83368 - is unique star, the lithium are situated at the poles of the magnetic dipole. The magnetic dipole is placed hear equator's plane. The angles $i \simeq 90°$ and $\beta \simeq 90°$ too.=20 In the case of constancy of the line 6708 Å (group 3), observer sees spot near rotation pole $i \leq 30°$, $\beta \leq 30°$ (Fig 3b)

- The results of observations in Li I 6708 Å line and discovery Li spots on magnetic poles are good argee with prediction Babel theory, concern ambipolar diffusion of hydrogen in CP-stars with dipole structure of magnetic field (Babel J., Michaud G., 1991).

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