Bull. Spec. Astrophys. Obs., 2001, 51, 112-114

Back-and-forth magnetometry of some Hg-Mn stars

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Received May 7, 2001; accepted June 21, 2001.

Abstract. A search has been carried out for magnetic fields in 7 Hg-Mn stars by using a back-and-forth mode of observations. No magnetic fields were found accurate to 10–60 G.

Key words: stars: chemically peculiar — stars: magnetic fields — stars: individual: Hg-Mn

1. Introduction

Hg-Mn stars are chemically peculiar (CP3) stars (Schneider, 1981; Khokhlova, 1983) of late B spectral types which possibly appear to be the continuation of metallic stars to the region of higher temperatures. The presence of chemical anomalies led to attempts of finding a magnetic field (Conti, 1969, 1970a,b; Borra & Landstreet, 1973, 1980; Borra et al., 1973; Glagolevskij et al., 1985, 1989). Although in these papers no longitudinal magnetic field was detected, Mathys & Hubrig (1995), Hubrig et al. (1999) reported about the broadening of the spectral lines possibly caused by a field of complex structure. But this method is applicable only to stars with very narrow spectral lines. The presence of a magnetic field in Hg-Mn stars remains open to question.

2. Measuring techniques

We use the back-and-forth mode (Chountonov & Orlov, 1997; Chountonov et al., 2000) for high precision magnetometry of Hg-Mn stars. A schematic diagram of measurements with the BTA Main Stellar Spectrograph (MSS) (camera 2) is shown in Fig.1. The light from a star passes through the liquid crystal modulator, which can be in two states creating phase shifts of 180° and 0°, and is deflected by Mooney rhomb to the spectrograph slit. The Mooney rhomb is in the capacity of the flat diagonal mirror of the spectrograph and serves at the same time as the achromatic quarter-wave phase retarder. Behind the spectrograph slit there is a unit of two calcite plates which split the beam in two. The essence of the recording mode being discussed is that the charge pattern, accumulated in a given state of the modulator, which corresponds to the portion of the spectrum on the cassete part of the spectrograph, is not read after a short elementary exposure time but transferred to a specified number of lines. Then a synchronous switching of the electrooptical modulator state occurs, the signal is being accumulated during the elementary exposure time with further backward transfer to the same number of lines. The system recovers the original state and the process is repeated. After accumulation of the necessary number of charges the process is discontinued and the accumulated image pattern is digitized. The influence of light flux fluctuations on the spectrograph slit is reduced in this mode, and for recording of spectra in left and right circularly polarized light, the same pixels are used, i.e. the necessity for flat-fielding is ruled out.

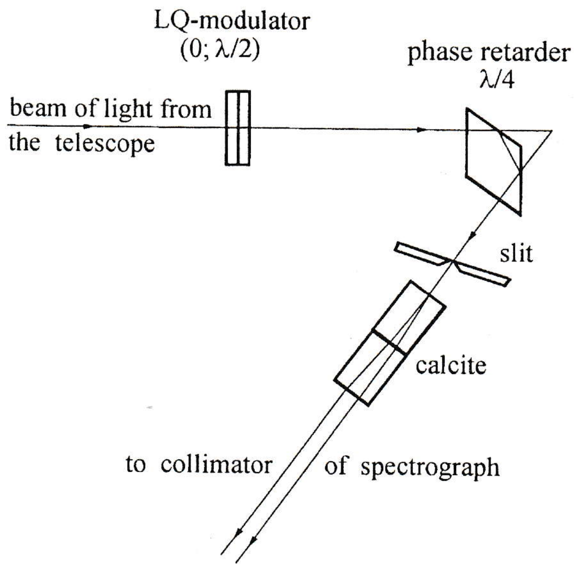

Figure 1: *A schematic diagram of measurements.*

3. Observations and discussion

We carried out measurements during either technical time or bad seeing, when it was impossible to run the main programme. SiII 6347 and 6371 ÅÅ lines with known Lande factors 1.17 and 1.33 (Romanyuk, 1984) were used, where the liquid crystal electroopti-

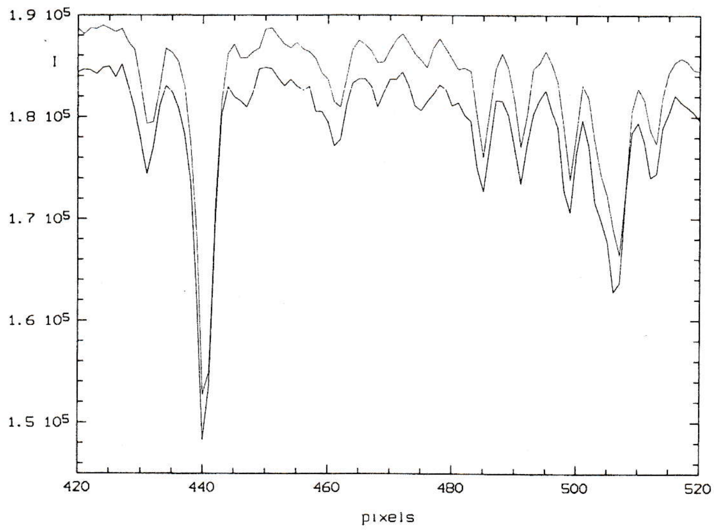

Figure 2: *a) Fragment of γ Equ spectra in 2 circular polarizations (solid and dashed lines) in 6400 Å region. The intensity is shown on the vertical axis, numbers of pixels - on the horizontal axis.*

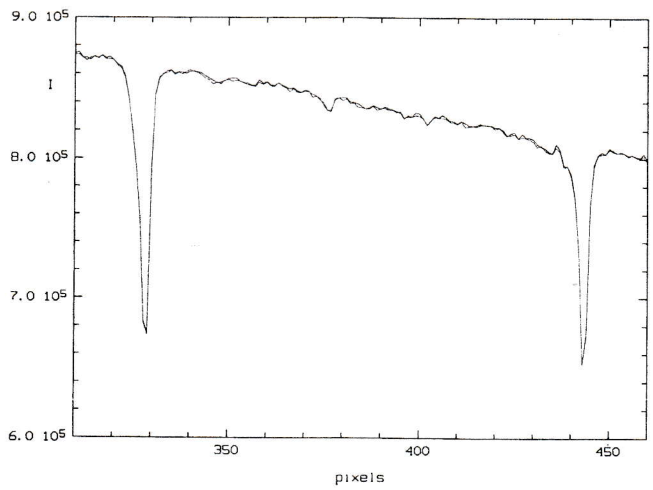

Figure 2: *b) Fragment of spectra of the programme star HD 143807 from SiII 6347 to SiII 6371 lines in 2 circular polarizations (solid and dashed lines). The designation is the same as in Fig. 2a.*

cal modulator was effective to the utmost. The modulator was switched on every 5 seconds. More than 10 accumulations for each star were produced in this mode and the mean value and the standard deviation of the shift were calculated. To illustrate the capacity for work, a fragment of γ Equ spectra in 2 circular polarizations (solid and dashed lines) is shown in Fig. 2a in the region of 6400 Å where the splitting is more significant. The magnetic field of the star changes slowly and was measured as -1100 G. Fig. 2b presents the spectra of the programme star HD 143807. There is no shift between two spectra in contrast to the previous case. Numbers of pixels are shown on the horizontal axis on both figures.

The results of the measurements are shown in Table 1. The precision of measurements for some stars as compared to the previous data was improved by a factor of three. From the table it can be seen that no magnetic field is found. The spectra were reduced using the MIDAS procedure and the programme of Kudryavtsev D.O. determining Zeeman splittings. In the aggregate, at present, the magnetic field was not found in any of 11 stars that were tested by the Zeeman method, and Preston's idea (Preston 1971) that Hg-Mn stars have magnetic fields which are substantially smaller than those of the classical magnetic Ap stars is neither rejected nor holds true. For this reason, it is necessary to move to the range of smaller

Table 1:

Name	Be,G	σ,G	v sin$i$	Date
α And.	+ 24	50	56.0	10.09.2000
	- 41	60	56.0	25.12.2000
33 Gem	+ 33	50	22.0	23.12.2000
	- 10	10	22.0	24.12.2000
53 Tau	+ 31	20	6.5	25.12.2000
HD 78316	+ 53	30	7.0	25.12. 2000
HD 89822	- 42	50	3.2	25.12.2000
HD 143807	- 64	30	1.0	16.06.2000
HD 145389	-22	40	7.0	11.02.2001

fields.

Acknowledgements. It is pleasure to thank V.V. Vlasyuk and Y.V. Glagolevskij for support of this work.

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