

POLARIMETRIC OBSERVATIONS OF HYDROGEN DEFICIENT STARS

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ABSTRACT. Polarimetric observations of HD 30353, SU Tau, XX Cam, R Cr B, UV Cas, BD+13 3224, BD+10 2179 and HD 124448 are presented. The linear polarization of HD 30353 is found to vary appreciably at $H\alpha$ over a time scale as short as one day. It is also found that SU Tau shows significant variation in polarisation even at light maximum.

1. INTRODUCTION

Hydrogen deficient stars are, generally, thought to be the remnants of red giants which have lost their hydrogen envelopes during their evolution along the asymptotic giant branch. Some of these objects are surrounded by circumstellar dust and polarimetric observations are very important for understanding the nature of the materials which constitute these dust shells. In this paper we present the results of linear polarisation measurements of a few hydrogen deficient stars belonging to the different subgroups. The observations were made with a view to detect and monitor the changes in the polarisation exhibited by them.

2. OBSERVATIONS

The programme stars were observed with a polarimeter attached to the 102-cm Telescope of Kavalur Observatory during the period from October 1984 to February 1985. The polarimeter, which works on rapid modulation principle, consists of a half-wave retarder rotated at 10.41 Hz acting as the polariser and a Wollaston prism as the analyser. For data acquisition and on-line processing a micro-computer system built around a Z-80 micro-processor was employed. A set of UBVRI broad band filters were used for the study of the wavelength dependence of linear polarisation. On some occasions an $H\alpha$ interference filter was also made use of. Depending on the faintness of the objects in each wavelength band, the integration times were increased and the observations repeated 3 to 5 times to bring down the errors in the measurement of polarisation. A detailed description

TABLE 1. POLARISATION (P% and θ°)

STAR	JULIAN DAY OF OBSERVATION	U	B	V	R	I	H α						
JD 2446000.+													
HD 30353	004.42	1.6±0.3	1.7±0.3	1.54	1.8±0.3	1.54	1.7±0.3	1.56	1.4±0.2	1.54	2.5±0.8	140	
	005.34	2.0±0.3	1.9	2.2±0.4	1.52	2.1±0.3	1.53	2.0±0.4	1.53	1.7±0.4	1.56	2.9±0.7	150
	007.32	1.6±0.1	1.49	1.7±0.1	1.47	1.8±0.1	1.47	1.7±0.1	1.46	1.5±0.1	1.48	1.5±0.2	139
	055.24	1.5±0.2	1.49	1.9±0.1	1.43	1.9±0.1	1.47	1.9±0.1	1.53	1.5±0.1	1.49	1.5±0.8	153
	115.23	1.8±0.1	1.42	1.9±0.1	1.49	2.0±0.1	1.47	1.7±0.1	1.41	1.5±0.1	1.46	-	-
SU Tau	054.24	1.7±0.5	1.60	2.0±0.2	1.48	2.2±0.1	1.63	2.1±0.1	1.63	1.8±0.1	1.48	-	-
	116.26	2.6±0.9	1.42	1.5±0.2	1.54	2.0±0.1	1.60	1.9±0.1	1.55	1.6±0.1	1.59	-	-
XX Cam	004.38	2.7±0.6	1.39	2.6±0.4	1.27	2.7±0.3	1.30	2.6±0.2	1.30	2.1±0.3	1.30	-	-
	117.10	2.8±0.5	1.26	2.8±0.1	1.14	2.7±0.1	1.21	2.4±0.1	1.26	2.1±0.1	1.17	-	-
R Cr B	115.38	0.2±0.1	1.36	0.2±0.0	0.99	0.2±0.0	1.03	0.1±0.0	1.02	0.1±0.0	0.94	-	-
UV Cas	055.18	-	-	5.0±0.6	5.2	4.2±0.2	4.8	3.9±0.2	4.8	3.9±0.2	5.3	-	-
BD+13° 3224	117.46	0.2±0.3	-	0.2±0.1	-	0.1±0.1	-	0.3±0.2	-	0.5±0.1	-	-	-
BD+10° 2179	115.32	0.4±0.2	-	0.1±0.1	-	0.1±0.1	-	0.2±0.2	-	0.4±0.2	-	-	-
HD 124448	116.38	0.4±0.2	57	0.5±0.1	45	0.6±0.1	69	0.6±0.2	53	0.5±0.2	52	-	-

of the polarimeter and the method of calibration are given in Deshpande et al.(1985).

3.RESULTS

In Table 1,the results of our polarimetric observations are summarised. It gives the name of the object,Julian day of observation, percentage of linear polarisation (P%) and position angle (θ°). The measured quantities are given for each of the filter used.

3.1. Hydrogen deficient binary HD 30353

HD 30353 (KS Per) is a single-lined spectroscopic binary with an orbital period of 360 days and exhibits light variations apparently unrelated to the orbital motion (Heard 1962,Osawa et al.1963). Bidelman (1950) has reported the presence of $H\alpha$ in emission in its spectrum. HD 30353 was observed on five different nights spanning an interval of about 110 days. In addition to the UBVRI filters,this object was observed through an $H\alpha$ interference filter also. Our observations indicate that the linear polarisation of HD 30353 is fairly constant at all wavelengths but there is large variation at $H\alpha$. In Fig.1,we have plotted the linear polarisation and the corresponding position angles obtained on two nights,namely,JD 246005.34 and 2446007.32 and it can be seen clearly that significant changes in polarisation occurred even on a time-scale as short as one day.

3.2 R Coronae Borealis stars

These objects are characterised by irregular and large drop in brightness, sometimes,by several magnitudes. Four well-known members of this group SU Tau,XX Cam,R Cr B and UV Cas - were observed polarimetrically at their light maxima.

The measurements of SU Tau, obtained on two nights separated by about 60 days show appreciable changes in the polarisation at all wavelengths. In Fig.2,we have plotted these two sets of observations along with those obtained by Coyne (1974) and we note that there is a slight indication of a change in the wavelength dependence. Unlike all the other members of its class, XX Cam shows no infrared excess and is a very inactive member of the R Cr B group (Kameswara Rao et al.1980). We observed XX Cam on two occasions separated by about 110 days and both sets of data agree well with each other and those obtained at earlier epochs (Zhilyaev et al.1978).

The other two objects, namely R Cr B and UV Cas, could be observed only on one occasion each. It is known already that R Cr B, polarimetrically a comparatively well studied object, shows less polarisation at the light maximum. The present measurements,which are also obtained near maximum, showed linear polarisation ranging from 0.2% in U to about 0.1% in I.

As far as we know there is no information in the literature on the wavelength dependence of polarisation shown by UV Cas. The few measurements obtained by Orlov and Rodriguez (1977) at an effective wavelength

$\lambda_{\text{eff}} = 4500 \text{ \AA}$ are less than the value which we obtained in B by about

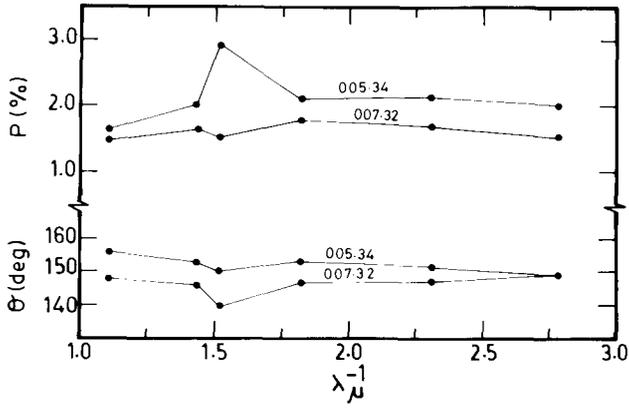


Fig.1. HD 30353

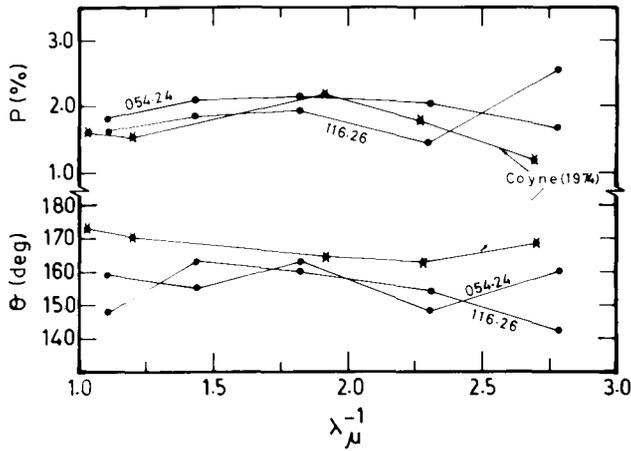


Fig.2. SU Tau

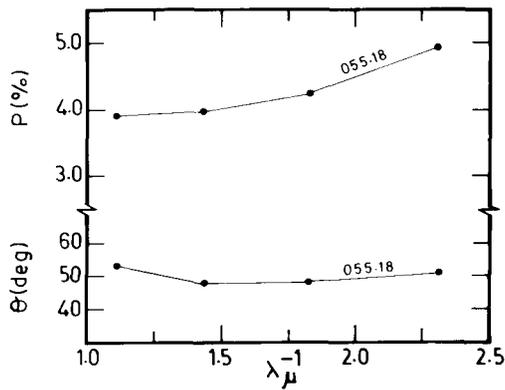


Fig.3. UV Cas

1% , indicating variability in linear polarisation. Our results are plotted in Fig.3.

3.3 Extreme helium stars BD + 10° 2179, HD 124448 and BD + 13° 3224

Schonberner and Wolf (1974) find that both BD + 10° 2179 and HD 124448 have similar physical characteristics; $T_{\text{eff}} \sim 16000$ K, $\log g \sim 2.2$, and $m \sim 1 M_{\odot}$ and Landolt (1973) has reported that both stars are light variables with a range of about 0.1 mag in V. These stars were observed only on one occasion each. BD+10 2179 did not show any significant polarisation, whereas, HD 124448 showed slightly significant linear polarisation. Further polarimetry and analysis are needed to know the contribution by the interstellar medium in the observed quantities. No significant polarization is seen in the pulsating extreme helium star BD+13 3224.

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