COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS

Number 2208

Konkoly Observatory
Budapest
1982 October 14

HU ISSN 0374-0676

PHOTOELECTRIC PHOTOMETRY OF Ap STARS IN THE ORION AND UPPER SCORPIUS ASSOCIATIONS: PRELIMINARY RESULTS

As part of a general programme for searching periods of magnetic stars in clusters, all magnetic stars of the Orion association listed in Joncas and Borra (1981) were examined for their variability. At least three measurements have been made for each star, each one consisting in the sequence C1-V-C2-V-C2-V-C1 or C1-C2-V-V-V-C2-C1, V being the supposed variable and C1 and C2 always being the stars HD 33647 and 35640. If no variation greater than $0^{m}.010$ was found either in V, [U-B] or [B-V] (brackets mean that Geneva UBV filters are involved) among these measures, the star was no longer monitored, while in the opposite case the star was measured twenty times or more. Among the 22 stars listed by Joncas and Borra in their tables 1 to 3, two had been measured in 1980-81: HD 37151, which was found more or less constant, and HD 36916, perhaps a non-member (Warren and Hesser 1977), whose period has already been published by Renson and Manfroid (1981). HD 35008 has 16 absolute measures in the Geneva system and does not seem to vary. Among the remaining ones, nine were found to vary in the sense specified above.

One of the comparison stars, HD 33647, is a MnHg star (Schneider 1981). The author was not aware of this at the time of the observations: the star had been chosen because it had been measured many times and had a small standard deviation. A period search carried out on 318 differential magnitudes C1-C2, with the aid of the discrete Fourier transform method of Deeming (1975), yielded an unambiguous period of 0.565 days in spite of the very small amplitude. This variation introduces a noise in the differential measurements of the other stars, whose peak-to-peak amplitude is only $0^{m}.0012$ and $0^{m}.0027$ in V and U respectively, which may be considered negligible.

Table I

Association	Peculiarity (as given in Joncas & Borra 1981 or Hartoog 1977)	HD	Period	Amplitudes [U-B]	[B-V]	V	No. of measurements	Remark
Ori OBl	MnHg	33647	0.565	~.002		~.003	318	Differential measures C1-C2
	He w.	35298	1.85	.03	.02	.03	26	
	Si	36313	.59	.03	.016	.026	34	
	SiSr, He w.	36526	1.54	.03	.012	.028	23	
	He w.	36540	2.18	.035	.02	.055	24	
	Si, He w.	36668	2.11	.037	.012	.023	20	
	SiSr, He w.	37140	2.70	.028	.022	.034	27	
	Si	37210	11.2(?)	.045	.024	.027	20	P=.92 not completely excluded, but less probable
	B9.5p	37633	1.56	.07	.055	.06	20	
	Si	37642	1.08	.06	.018	.035	25	
Upper Sco	SiCr	147010	3.92 or 1.34	<.01	.035	.045	63	Absolute, single measures

Some CP2 stars have been monitored in the Upper Scorpius complex too, but HD 147010 alone has been sufficiently measured to give a period: this was obtained from absolute measures. It was not possible from photometry alone to choose between two periods, but the low value of vsini (20 km/s, Wolff 1981) might exclude the 1.34 days period since it implies an inclination $i = 12^{\circ}$ only if $R = 2.5\ R_{\odot}$. Such a low inclination seems inconsistent with the large amplitude observed, but further measures are necessary.

The periods and peak-to-peak amplitudes are listed in Table I. The periods were obtained with the methods of Deeming (1975) and Stellingwerf (1978) from V, [U-B] and [V-B]data. For HD 37210, Renson's θ_1 test (Renson 1978) was used as well. HD 33647 was analysed with Deeming's and Renson's methods only.

Among these stars, all but HD 33647 (since HgMn stars are considered non-magnetic) and HD 37633 have had their magnetic field measured by Borra (1981), or by Brown and Landstreet (1981). The periods suggested by Borra (1981) for HD 35298 and 36526 are confirmed, while HD 36668 has a period nearer to 2.1 than to 2.7 or 3.0. HD 37642 has a period nearer to 1.08 than to 0.8 days, while HD 36313 has one of the shortest periods known among magnetic stars. HD 147010 is a spectrum variable according to Kameswara Rao and Rajamohan (1982): however, the 5.7 days period they suggest is not confirmed by the present work.

It is remarkable that the distribution of the periods found here for magnetic stars is not very much different, if any, from the distribution obtained for field Si stars, especially if the period of HD 37210 is really 11.2 days. Since field Si stars are about ten times older on the average (5×10^7 years, Wolff 1981), this may imply that magnetic braking during the main sequence lifetime is not sufficient to explain the small angular momentum of hot CP2 stars. Such a conclusion is strengthened by the fact that that the bias against long periods exists in the present work as well as in most published works on field Ap stars.

I thank C. Waelkens and P. Bartholdi for having observed the star HD 147010. I am also indebted to P. Bartholdi, who implemented a FORTH programme of period search on the HP 2100 computer of the Swiss telescope at La Silla. I thank H. Schneider (Göttingen) for having drawn my attention to the peculiarity of

HD 33647.

This work is based on observations collected at the European Southern Observatory (ESO) at La Silla, Chile.

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References:

Borra, E.F.: 1981, Astrophys. J. Letters 249, L39
Brown, D.N., Landstreet, J.D. et al.: 1981, in 23rd Liège Astrophysical Colloquium, Upper Main Sequence CP Stars, p. 195
Deeming, T.J.: 1975, Astrophys. Space Sci. 36, 137
Joncas, G., Borra, E.F.: 1981, Astron. Astrophys. 94, 134
Kameswara Rao, N., Rajamohan, R.: 1982, Inf. Bull. Var. Stars No. 2121
Renson, P.: 1978, Astron. Astrophys. 63, 125
Renson, P., Manfroid, J.: 1981, Astron. Astrophys. Suppl. 44, 23
Schneider H.: 1981, Astron. Astrophys. Suppl. 44, 137
Stellingwerf, R.F.: 1978, Astrophys. J. 224, 953
Warren, W.H. Jr., Hesser, J.E.: 1977, Astrophys. J. Suppl. 34, 115
Wolff, S.C.: 1981, Astrophys. J. 244, 221