The magnetic variable star HD 10783

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THE MAGNETIC VARIABLE STAR HD 10783

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Photo-electric observations with a red filter of the magnetic variable star HD 10783 show a regular light variation, with a range of about 0.030 mag. The new period of $4^d.1565$ gives a fairly good curve for the photo-electric observations as well as for the variations of the magnetic field and the radial velocity.

1. Introduction

This star is one of the magnetic stars mentioned in the catalogue of BABCOCK (1957). The spectral type is A2p. There are many strongly widened metallic lines, such as Si II, Sr II, Cr I, Cr II, Fe II and λ 4201, and many weaker lines of Fe I. Babcock found that the magnetic field was strong and that it showed rapid changes. He called this star irregular. STEINITZ (1965), however, suggested that possibly all the magnetic stars are regular. He found for HD 10783 a period of $4^d.134$, but the dispersion in the magnetic measures is still rather large.

Together with the photo-electric observations given here, a better and more accurate period of $4^d.1565$ could be derived.

2. Observations and reductions

The observations were made with the 45-cm Zunderman reflector of the Leiden Observatory. The telescope was equipped with an E.M.I. photomultiplier of type 6094. As a result of the low declination of HD 10783 and the comparison star we used a red filter to minimize the effect of extinction. The effective wavelength of the filter is 5960 A.

The "no-atmosphere" magnitude m_0, for the comparison star BD +8°258 (= c) (figure 1) resulted from measures made during several nights in which the ex-

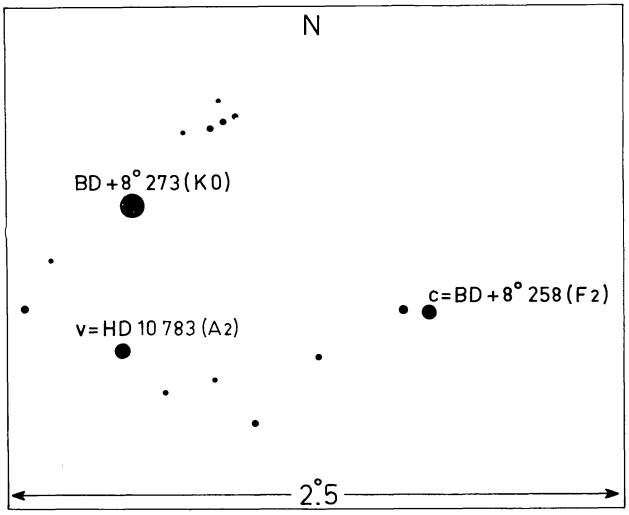

Figure 1. Identification chart.

TABLE 1

Data for the variable and the comparison stars

Star	α(1964)	δ(1964)	HD	BD	Sp.	m
HD 10783	$1^h43^m.8$	+8°22′	10783	+7°275	A2p	6.6
c	1 38.7	+8 34	10262	+8 258	F2	6.7
BD +8°273	1 43.5	+8 59	10761	+8 273	K0	4.5

TABLE 2

Normal points*

Date	J.D. - 2438000	$m_v - m_c$	m.e.	m.d.obs. ($0^m.001$)	Number of obs.	Phase
24/25 December 1963	388.48	$0^m.347$	± 7	± 17	6	0.159
15/16 January 1964	410.27	0.350	2	7	9	0.402
17/18 January	412.28	0.363	2	7	10	0.885
30/31 January	425.26	0.366	5	10	5	0.008
4/ 5 February	430.34	0.361	2	4	4	0.230
13/14 February	439.26	0.360	3	-	2	0.376
20/21 February	446.28	0.356	3	10	13	0.065
21/22 February	447.28	0.358	3	10	11	0.306
25/26 August	633.59	0.353	1	6	29	0.130
26/27 August	634.58	0.367	4	15	14	0.368
27/28 August	635.57	0.379	3	7	7	0.606
1/ 2 September	640.57	0.368	1	6	15	0.809
2/ 3 September	641.57	0.360	2	8	16	0.049
3/ 4 September	642.51	0.355	3	9	14	0.276
23/24 September	662.59	0.347	2	6	11	0.107
24/25 September	663.53	0.362	3	8	11	0.333
28/29 September	667.47	0.359	1	4	11	0.281
29/30 September	668.53	0.374	10	28	5	0.536
30 September/1 October	669.53	0.370	2	6	11	0.776
5/ 6 October	674.49	0.364	2	6	11	0.970
19/20 October	688.44	0.365	3	10	10	0.326
8/ 9 November	708.53	0.346	2	5	9	0.159
9/10 November	709.48	0.369	2	6	11	0.388
22/23 December	752.23	0.373	3	10	13	0.673

* The observations of 24/25 December 1963 were made by Dr. K. K. Kwee and Dr. R. Steinitz.

tinction seemed to be constant. The extinction coefficients resulted from the observed intensity changes of the comparison star during the night, with the assumption that the response of the electronic equipment to light-intensity is linear.

Taking into account the known decrease of the reflection power of the mirror during the whole period of observation, through which the m_0 of star c also decreased, we could derive the extinction coefficients for every observation. These coefficients varied from 0.100 mag for good nights to 0.350 mag for bad nights.

Only star c (spectral type F2) was used as comparison star, for it was the only one which is situated at a reasonable distance from HD 10783 and which, moreover, has about the same brightness. The corrections for differential extinction therefore were rarely greater than 0.007 mag.

Comparison of star c with the bright star BD +8°273 (spectral type K0) during 13 nights showed variations in the mean magnitude differences (BD +8°273 −c) of about 0.03 mag. These observations are not given here. The variations are possibly due to the K0 star.

The measurements were made as follows: sky −c− HD 10783 −sky −c, etc. The individual magnitude differences (HD 10783 −c) in three decimals and the Julian Day in four decimals are given in table 3.

3. Light-curve, magnetic curve and radial-velocity curve

The normal points of figure 2 and table 2 are the mean values of the individual magnitude differences made during one night. The fourth and the fifth column

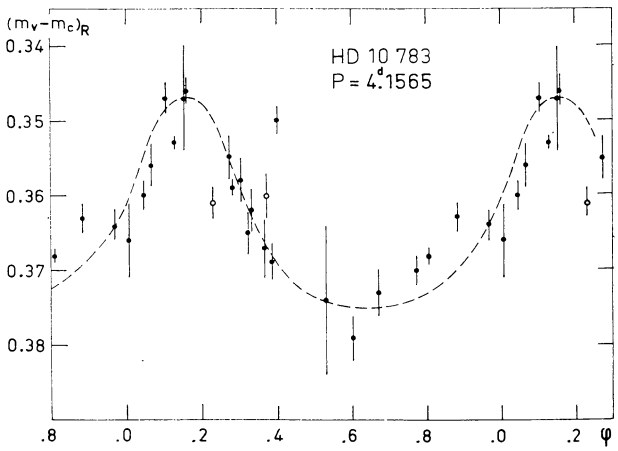

Figure 2. The light-curve of HD 10783 in red light (λ_{eff} = 5960 A). The mean errors are indicated by lines. Open circles are the mean values of less than five observations.

TABLE 3

Individual observations

J.D. − 2438000	$m_v - m_c$	J.D. − 2438000	$m_v - m_c$	J.D. − 2438000	$m_v - m_c$	J.D. − 2438000	$m_v - m_c$
388.4733	$0^m.358$	633.5683	$0^m.351$	641.5649	$0^m.355$	669.5251	$0^m.368$
388.4761	0.374	633.5699	0.353	641.5663	0.355	669.5264	0.368
388.4788	0.327	633.5717	0.366	641.5676	0.367	669.5277	0.374
388.4810	0.338	633.5732	0.357	641.5691	0.359	669.5289	0.369
388.4832	0.350	633.5747	0.344	641.5704	0.366	669.5301	0.370
388.4751	0.337	633.5763	0.350	641.5716	0.363	669.5315	0.371
		633.5780	0.357	641.5729	0.359	669.5327	0.362
410.2596	0.344	633.5795	0.360	641.5742	0.350	669.5339	0.369
410.2613	0.347	633.5812	0.358	641.5756	0.353		
410.2632	0.354	633.5828	0.354			674.4816	0.363
410.2651	0.362	633.5843	0.361	642.4895	0.368	674.4830	0.353
410.2672	0.355	633.5858	0.361	642.4910	0.364	674.4844	0.371
410.2691	0.346	633.5874	0.349	642.4925	0.359	674.4858	0.360
410.2711	0.356	633.5917	0.352	642.4940	0.353	674.4872	0.358
410.2829	0.347	633.5932	0.357	642.4956	0.366	674.4887	0.373
410.2846	0.340	633.5947	0.354	642.5007	0.345	674.4901	0.364
		633.6048	0.354	642.5019	0.342	674.4914	0.362
412.2757	0.356	633.6064	0.348	642.5034	0.350	674.4928	0.371
412.2774	0.369	633.6080	0.347	642.5047	0.352	674.4976	0.368
412.2788	0.356	633.6096	0.351	642.5060	0.345	674.4990	0.363
412.2806	0.372	633.6113	0.352	642.5139	0.370		
412.2820	0.360	633.6158	0.350	642.5154	0.352	688.4374	0.355
412.2837	0.370	633.6173	0.354	642.5168	0.352	688.4389	0.383
412.2851	0.359	633.6191	0.350	642.5182	0.358	688.4403	0.362
412.2865	0.356					688.4418	0.363
412.2881	0.372	634.5656	0.371	662.5753	0.347	688.4433	0.375
412.2898	0.360	634.5679	0.374	662.5775	0.349	688.4448	0.348
		634.5697	0.360	662.5794	0.344	688.4462	0.368
425.2528	0.364	634.5715	0.386	662.5817	0.357	688.4477	0.368
425.2545	0.385	634.5735	0.349	662.5836	0.348	688.4492	0.359
425.2559	0.363	634.5755	0.330	662.5857	0.349	688.4509	0.364
425.2573	0.357	634.5858	0.371	662.5879	0.345		
425.2587	0.362	634.5879	0.373	662.5903	0.351	708.5274	0.339
		634.5899	0.377	662.5989	0.333	708.5288	0.341
430.3402	0.366	634.5920	0.378	662.6013	0.345	708.5300	0.341
430.3416	0.361	634.5945	0.373	662.6035	0.349	708.5311	0.342
430.3431	0.359	634.5969	0.382			708.5324	0.352
430.3446	0.358	634.5989	0.355	663.5183	0.353	708.5337	0.347
		634.6014	0.354	663.5197	0.351	708.5349	0.353
446.2742	0.358			663.5211	0.356	708.5362	0.347
446.2756	0.351	635.5569	0.376	663.5228	0.361	708.5377	0.348
446.2770	0.369	635.5590	0.366	663.5241	0.367		
446.2783	0.364	635.5624	0.384	663.5259	0.357	709.4776	0.364
446.2799	0.368	635.5657	0.382	663.5273	0.374	709.4790	0.368
446.2815	0.338	635.5678	0.376	663.5287	0.370	709.4804	0.367
446.2832	0.346	635.5702	0.382	663.5302	0.369	709.4816	0.379
446.2847	0.338	635.5726	0.388	663.5317	0.361	709.4828	0.367
446.2881	0.347			663.5331	0.373	709.4841	0.370
446.2895	0.346	640.5567	0.377			709.4853	0.379
446.2909	0.349	640.5579	0.365	667.4651	0.363	709.4865	0.364
446.2923	0.356	640.5593	0.367	667.4665	0.358	709.4876	0.367
446.2938	0.359	640.5607	0.367	667.4679	0.358	709.4888	0.370
		640.5621	0.354	667.4690	0.359	709.4897	0.360
447.2601	0.377	640.5636	0.366	667.4701	0.357		
447.2618	0.353	640.5650	0.364	667.4712	0.349	752.2139	0.392
447.2633	0.346	640.5663	0.366	667.4727	0.358	752.2154	0.363
447.2649	0.364	640.5676	0.368	667.4736	0.362	752.2170	0.366
447.2665	0.372	640.5688	0.372	667.4748	0.362	752.2188	0.382
447.2831	0.359	640.5702	0.371	667.4759	0.357	752.2205	0.371
447.2845	0.348	640.5715	0.374	667.4772	0.364	752.2218	0.372
447.2884	0.353	640.5728	0.376			752.2232	0.367
447.2896	0.354	640.5741	0.364	668.5174	0.387	752.2246	0.384
447.2909	0.354	640.5754	0.375	668.5249	0.345	752.2261	0.375
447.2927	0.362			668.5261	0.357	752.2341	0.359
		641.5569	0.346	668.5280	0.388	752.2356	0.384
633.5602	0.354	641.5583	0.368	668.5294	0.391	752.2374	0.377
633.5619	0.347	641.5596	0.364			752.2388	0.363
633.5634	0.338	641.5611	0.352	669.5215	0.375		
633.5652	0.356	641.5624	0.378	669.5226	0.381		
633.5667	0.356	641.5638	0.365	669.5239	0.361		

give the mean errors of the normal points and the internal mean deviation of one observation. The former are also indicated in figure 2.

The phases of figures 2 and 3 have been computed with the formula

$$\text{phase} = (\text{J.D.} - 2430000) \times (0.240587\,\text{d}^{-1}).$$

This corresponds with a period of $4^{\text{d}}.1565$.

Only one point in figure 2, at phase $\varphi = 0.4$, differs strongly from the mean light-curve. We have no explanation for this; the correction for differential extinction in that night happened to be zero. The smooth curve has been drawn as a symmetric curve, but it might be that the bump in the ascending branch is real, just as that of α^2CVn at $\lambda_{\text{eff}} = 5500$ A (JARZEBOWSKI, 1962).

In figure 3 only the best values of Babcock's catalogue are plotted with their probable errors if present. Observations marked by a colon have not been used.

As no exact times of observation were given, we computed the phases of figure 3 with the Julian Day number for 0^{h} U.T. Consequently the two curves are not strictly comparable with figure 2. The magnetic curve shows a smaller dispersion if compared with the curve based on a period of $4^{\text{d}}.134$. The extremely sharp minimum is striking.

The radial-velocity curve does not seem to be in phase with the magnetic curve, but there are actually too few observations to draw definite conclusions.

It seems now definitely established that the phenomena observed in HD 10783 are of a periodic character. However, the period derived in this note should be considered as provisional and needs further confirmation.

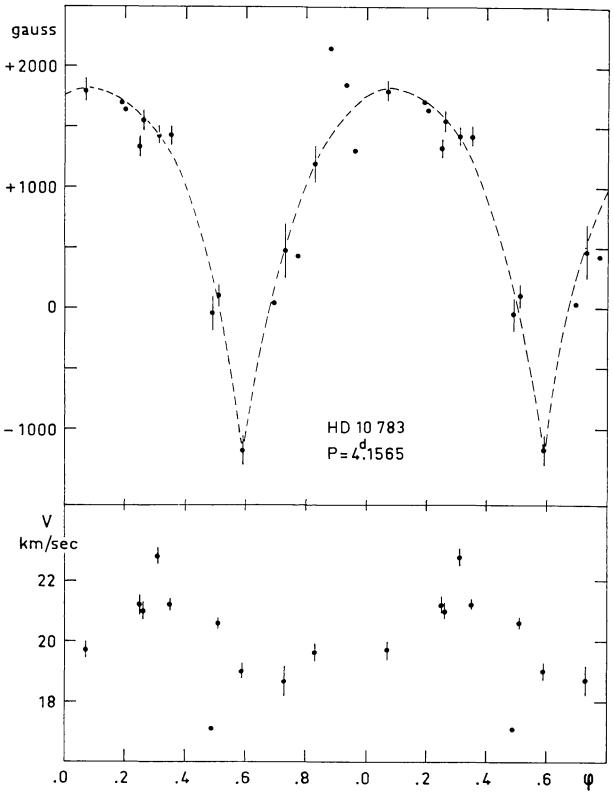

Figure 3. The magnetic and radial-velocity curve of HD 10783. Only the best magnetic measures of the catalogue of BABCOCK (1957) have been plotted, with their probable errors if given.

References

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