

Research Note

Low Amplitude Variable Stars

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Summary. One hundred and twenty one stars selected from the Bright Star Catalogue and statistically situated in the Cepheid instability strip have been observed photoelectrically to investigate their light stability. Fifteen of the stars show light variations from 0^m02 to 0^m17 and for five of them the periods and light-curves have been determined.

Key words: variable stars — instability strip — photo-electric photometry

A study is being undertaken in order to determine how many per cent of the stars in the Cepheid instability strip that are variable. For this purpose suitable objects were selected with the aid of the magnetic tape version of the Bright Star Catalogue. During 1972–76, 121 stars whose stability have not been tested before, have been observed in the UBV-system with the 40 cm photoelectric telescope at the Kvistaberg station of the Uppsala Observatory.

Because there is no luminosity classification for many stars in this catalogue a statistical criterion was used to locate the stars in the HR-diagram, namely the τ -components of the galactic motions of the stars relative to the sun. An upper limit of 15 km s⁻¹ was found to correspond to an absolute magnitude M_v brighter than -0.5 .

The criteria used to identify a star as falling in the instability strip were:

- 1) spectral range F2-G7, and
- 2) luminosity M_v brighter than -0.5 .

For practical reasons the investigation was limited to stars with a declination 0–90°. The list resulting from the computer analysis contained 159 stars that statistically should be situated in the instability strip. Among them were the following known Cepheids: Polaris, SU Cas, RT Aur, Zeta Gem. FF Aql, SU Cyg, Eta Aql, S Sge, X Cyg, T Vul, DT Cyg, Delta Cep. Only one Cepheid is missing in this list, T Mon. This star has a τ -component that is somewhat greater than 15 km s⁻¹. Thus, for the Cepheids the efficiency of the selection criterion is 12/13 = 92%.

Other variables among the selected stars are the supergiants Rho Cas, D Ser and V 441 Her (89 Her). According to Fernie and Hube (1971) the star BS 6536 is possibly variable.

One possible eclipsing binary, Epsilon UMi, is among the 159 stars. There are also 13 stars that have been considered as constant by Fernie and Hube (1971) and one star, BS 2134, used by Ljunggren as a standard (private communication) as well as two Johnson standards, 78 UMa and 44 Cyg. Finally, 6 stars, BS 330, 1309, 1676, 3811, 5011 and 5385, are suspected to be nonvariable dwarfs (M_v fainter than -0.5) from the MK classification and from good agreement between the V magnitudes of different observers.

To the 120 stars remaining from the original list BS 690 was added because it was a border case in the τ -component criterion and has the MK-class F7Ib. These 121 stars have been observed twice, and, if these measurements differed more than 0^m01, a third time. If the remaining deviations could not be explained by unstable weather conditions the star was considered as a possible variable and a comparison star was chosen for it. Up to date 15 stars have been found to be variables (Table 1) and have been observed several times for the determination of their periods and light-curves. Periods are now determined for 5 of the 15 stars. The results are given in Table 2. The probability of discovery has been computed a posteriori from the existing observations of the stars as the number of

Table 1. Determination of variability of the 121 stars

Number of observation before considered non- variable	Number of stars	%
2	72	60
3	25	21
4	5	4
5	4	3
Remaining variables	15	12

Table 2. Data for the new variables

BS No.	Number of observations	Amplitude ^a	Period	Probability of discover %	V	Sp	Remarks
642	8	0 ^m .075	—	86	4 ^m .95	G 5 III	Pulsating?
690	62	0.123	7 ^d .572	72	6.27	F 71 b	Cepheid
1287	129	0.104	0.1266	82	5.93	dF 3	Delta Sct
2024	37	0.082	—	37	5.96	G 0 + A 0	?
2630	35	0.086	0.7282	70	5.18	G 5 III	Pulsating
3144	20	0.033	—	59	6.28	F 5	Pulsating
3245	14	0.062	—	31	5.74	gG 5	Eclipsing? (SB)
3768	21	0.025	—	42	5.78	dF 6	Pulsating
3771	34	0.058	0.9202	70	4.56	G 2 IV	Pulsating
4716	9	0.067	—	75	4.79	G 7 III	Eclipsing? (SB)
6707	39	0.050	—	45	4.41	F 2 II	Pulsating
7508	18	0.076	—	63	6.31	gG 4	Eclipsing? Double: Mag diff = 3.5 Sep = 0 ^{''} .6
7811	31	0.040	—	62	5.66	gG 6	Pulsating
8157	43	0.169	3.337	93	5.89	F 2	Cepheid Double: Mag diff = 0.0 Sep = 0 ^{''} .3 SB
8750	7	0.018	—	40	6.21	gG 4	Pulsating?

^a Maximum difference between the observations

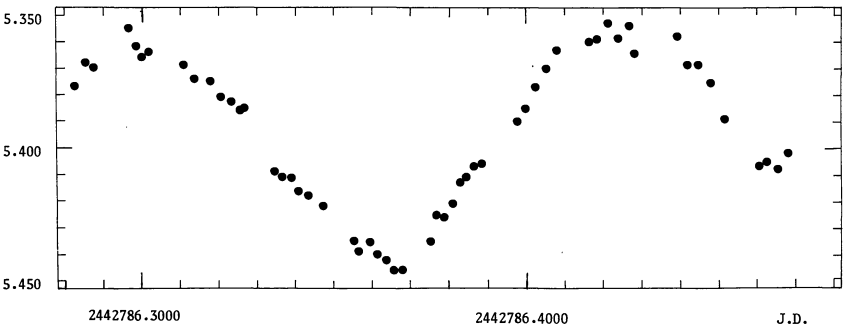


Fig. 1. Variation of the V magnitude of BS 1287 on January 8, 1976. The period is 0^d.1266, determined from six nights during three months. The star BD 26° 687 has been used as a comparison star

consecutive measurements with deviations greater than 0^m.01 divided by the total number of measurements. For stars with known light-curves it will be possible to determine the correlation between the probability of discovery and the amplitude and compute the total number of stars in a given amplitude interval. It will be difficult to separate the intrinsic variations of the stars from the uncertainty of the observations for amplitudes less than 0^m.02. The deviations of the first two measure-

ments of all stars were less than 0^m.01 for 70% and less than 0^m.005 for 45% of the stars. A typical observational series of a variable star is shown in Figure 1. The light curves for all periodic variables will be published when the final transformation to the UBV-system has been made and all the new data have been included.

Additional Variables

Two stars selected as comparison stars have been found to be variable and their light-curves have also been studied (Table 3). The total number of comparison stars is 27.

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References

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Table 3. Variable comparison stars

BD No.	Number of observations	Amplitude	Period	V	Sp	Remarks
21° 203	26	0.162	1 ^d .4175	7.09	B 9	Eclipsing
70° 567	110	0.056	0.0831	7.55	A 0	Delta Sct