NEW HIPPARCOS VARIABLES IN *THE BRIGHT STAR CATALOGUE*

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Abstract

The Hipparcos mission discovered 5665 new or previously suspected variable stars. Among these are 308 recently named variables common to *The Bright Star Catalogue*. The distributions of these HR stars according to types of variation and amplitude are discussed.

1. Introduction

The *74th Special Name List of Variable Stars* (Kazarovets *et al.* 1999) notes that the compilers of the *Hipparcos and Tycho Catalogues* (hereafter *Hipparcos*) (Perryman *et al.* 1997) designated 5665 stars as probably variable. Of these, 3157 objects were considered sufficiently reliable to be officially assigned variable star names, 248 of which are stars common to *The Bright Star Catalogue* (Warren and Hoffleit, 5th edition in progress), where the stars are designated by their HR numbers. The previous *Name List*, *No. 73* (Kazarovets and Samus 1997), and the following two, *Nos. 75* and *76* (Kazarovets *et al.* 2000, 2001), include 60 additional variables common to *Hipparcos* and the *Bright Star Catalogue*. The distributions of the types and amplitudes of variation of these 308 newly named *Hipparcos* variables are discussed. Figure 1 shows the distribution of the amplitudes of these stars without regard to their assigned types of variation. Surprisingly, the vast majority have amplitudes under 0.10 magnitude. This is obviously the reason why they were not previously discovered as variable.

Two types of variability—BE and LBV—occurring in relatively large numbers in the *Hipparcos* catalogue are newly assigned classes not used either in *Hipparcos* or in the latest edition of the *General Catalogue of Variable Stars* (GCVS) (Kholopov *et al.* 1985). The *74th Name List* has 185 stars classified BE, of which 28 are HR stars, and the *75th* and *76th Name Lists* add four more. Of fifteen stars now called type BE, *Hipparcos* called eleven GCAS, two L, and two I.

Before *Hipparcos* appeared, 29 stars had already been assigned the BE designation by Kholopov *et al.* in 1989. They stated:

Although the majority of the Be stars [B type spectra with emission lines] are photometrically variable, not all of them could be properly called

> GCAS variables.... By now we are not able to present an elaborate system of classification for Be variables, but we adopt a decision that in the cases when a Be variable cannot be readily described as a GCAS star we give simply BE as the type of variability.

Thus BE simply stands for a variable with emission B-type spectrum—stars needing further observations for assigning a more specific type of variation.

Similarly, LBV was introduced by Kazarovets and Samus in 1995, who defined stars thus designated as "comparatively long period B stars (periods exceeding one day)." *Hipparcos* called the vast majority of these stars type SBP (23 out of 31 sampled, one each called BCep and ACV, and 6 without assigned *Hipparcos* types). Thus SBP and LBV are synonyms.

2. The newly named *Hipparcos* variables in *The Bright Star Catalogue*

The 308 newly named bright variables in *Hipparcos* that are also HR stars are distributed in Table 1 according to the types of variation assigned in *Name Lists Nos.73–76*. The distribution of their amplitudes, from only 0.01 to 0.51 magnitude, was somewhat surprising, the most frequent amplitude being about 0.04 magnitude. The nine with amplitude 0.30 and larger are shown in Table 2. Except for the three with greatest amplitude, HR 3472, 4647, and 5953, new visual or old photographic observations would be hopeless for ascertaining periods or verifying types, and even these three would be difficult to verify except with photoelectric equipment.

The frequencies of amplitude of the types represented by more than 20 stars each are shown in Figure 2. They represent, successively, types E (E, EA, EB, and EW), ACYG, BE, L (LA, LB), LBV, and SR (SR, SRB, SRD, SRS). The subclass SRS was first introduced in the recent *76th Name List* (Kazarovets *et al.* 2001), where it was defined as "Semiregular pulsating giant stars with short period (several days to a month)." Only three stars have as yet been given this designation, only one of which is an HR star, AV Ari, 5.68–5.76*V*. The two fainter stars have somewhat greater, but still small, amplitudes (AU Ari, 8.45–8.69*V* and V643 Per, 7.68–7.80*V*).

Of the 308 *Bright Star Catalogue* variables found by Hipparcos to be variable, 130 had previously been suspected of variability by ground-based observers. The *Hipparcos* frequencies of their amplitudes are given in Figure 3, and the correlations between these and previous visual or photovisual magnitudes are plotted in Figure 4. Although the Hipparcos system of magnitudes is not specifically on the customary *V*-system, the two systems are reasonably in agreement. Even the largest discrepancies shown in Figure 4 are within the accuracies of the earlier ground-based magnitudes. However, there is one star with a much larger discrepancy, HR 8436 = OY Peg, for which the *NSV Catalogue* (Kholopov *et al.* 1982) gives a visual range 6.3–7.7: while *Hipparcos* gives only 6.26–6.47, an amplitude of only 0.21 magnitude. This star should be checked on Harvard College Observatory patrol plates to ascertain if the earlier visual amplitude is reasonable or the time span of the Hipparcos observations may be too short to have revealed the total amplitude.

For two other stars, HR 2173 = PU Gem and HR 2306 = IU CMa, *Hipparcos* indicates amplitudes of 0.05 magnitude, which are presumably for blended magnitudes for a triple and a double star, respectively. In each of these cases the earlier observations indicated that Component B is the variable, with amplitudes 7.0–10.0*V* for PU Gem and 7.5–9.0*V* for IU CMa.

3. The percentages of bright stars found to be variable

In the 4th edition of *The Bright Star Catalogue* (Hoffleit and Jaschek 1982) there are 2001 named and suspected variable stars, representing 22% of the total 9110 HR stars. The 5th edition (Warren and Hoffleit in preparation) now has 2410, or 26% of all HR stars as named or suspected variables. There being stellar evolution and increasingly higher precision in magnitude determinations, eventually all stars will be found to be variable. Hipparcos yielded a 3% increase of bright variables in its single contribution acquired over a time span of less than four years.

References

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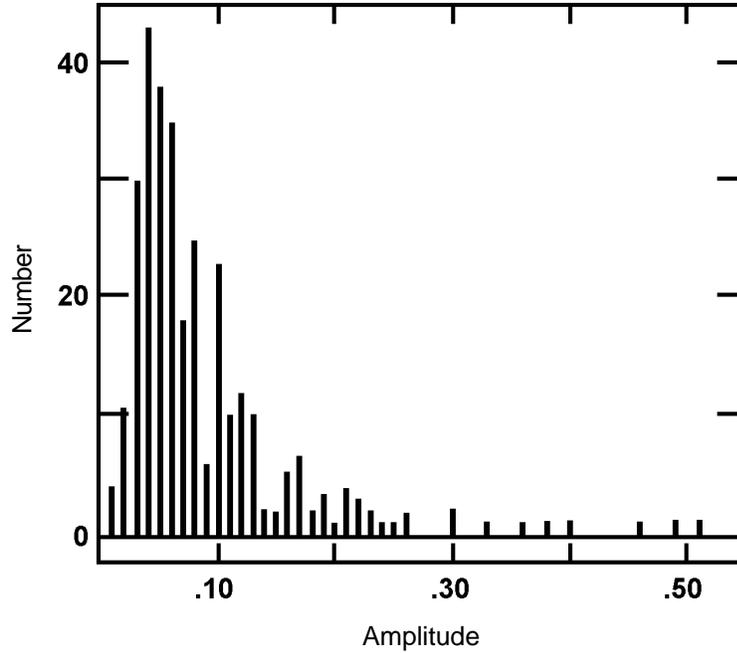
Figure 1. Distribution of amplitudes without regard to types of variation.

Table 1. Distribution by type of variability.

Type	No.	Amp.	Type	No.	Amp.
ACV	20	$0^{m}01$–$0^{m}06$	IA	1	$0^{m}13$
ACYG	27	0.03–0.10	LB	33	0.03–0.51
BE	33	0.02–0.21	LC	9	0.07–0.17
BY	6	0.03–0.10	LBV	38	0.02–0.06
GCAS	4	0.05–0.46	RR	1	0.06
CEP	1	0.03	RRAB	1	0.11
BCEP	3	0.04–0.10	RS	7	0.03–0.13
DSCTE	15	0.01–0.07	SR	1	0.08
GDOR	5	0.02–0.16	SRB	26	0.06–0.38
E	13	0.03–0.22	SRD	12	0.03–0.23
EA	17	0.04–0.49	SRS	1	0.08
EB	14	0.04–0.30	SXARI	3	0.02–0.05
EW	2	0.06–0.10	UV	1	0.36
Ell	14	0.01–0.08			

Table 2. The nine HR / HIP variables with largest amplitude.

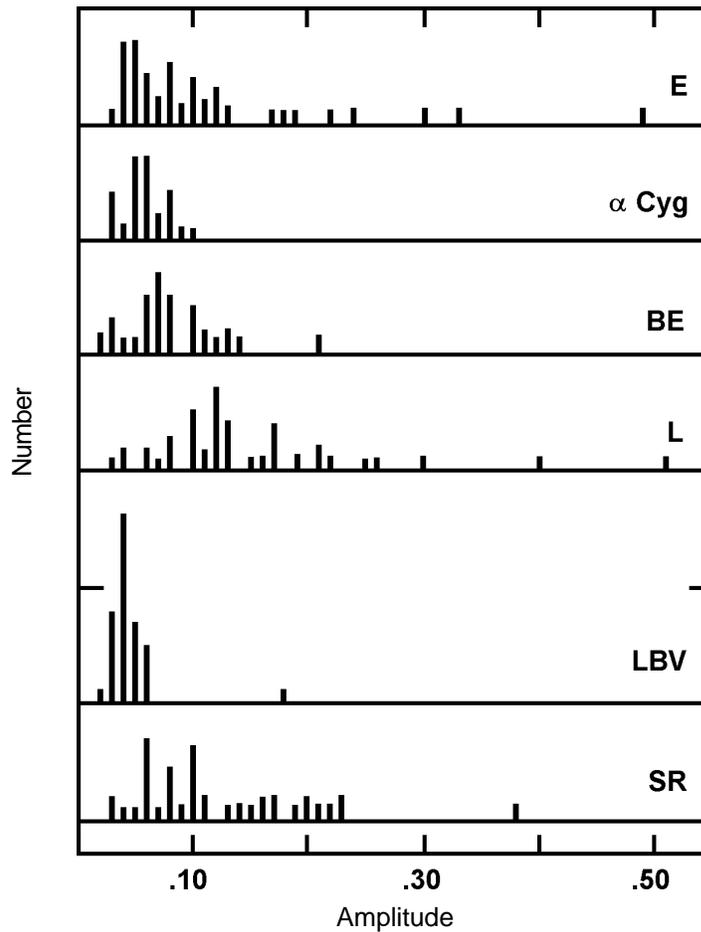| HR	HIP	Name	Type	Amp.	NSV
2567	33040	KX Cha	LB	0.$^{\mathrm{m}}$30	3259
3472	42951	MX Hya	EA	0.49	——
3846	47427	OW Hya	EA	0.33	——
4647	59588	V335 Hya	LB	0.51	5503
5512	72208	EK Boo	SRB	0.38	6796
5953	78401	δ Sco	GCAS	0.46	——
6676	87655	V2388 Oph	EB	0.30	9834
7568	97651	V2093 Cyg	LB	0.40	——
8344	107788	V373 Peg	UV:	0.36	13891

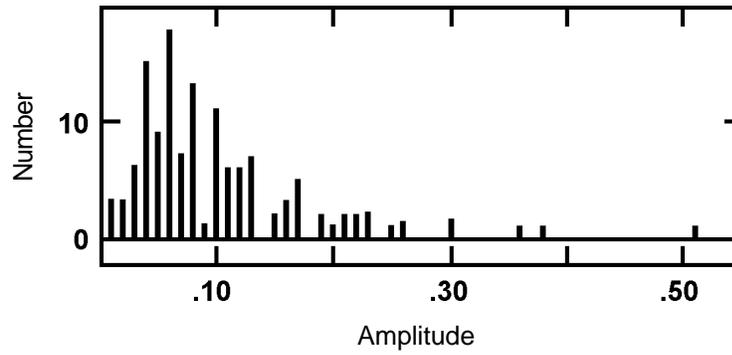Figure 2. Distribution of amplitudes of the most prevalent types of variation.

Figure 3. Distribution of *Hipparcos* amplitudes of 130 previously suspected variables.
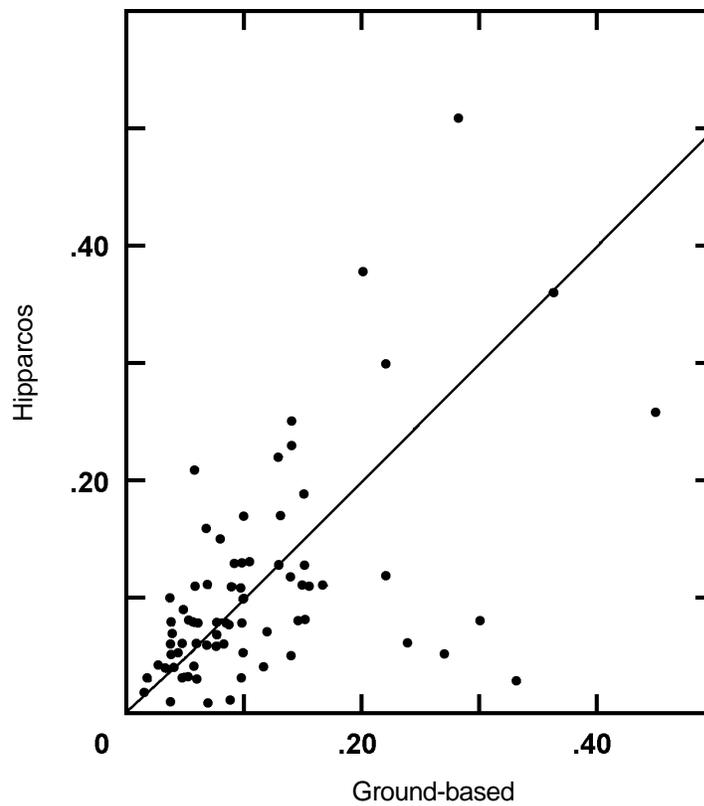

Figure 4. Correlation between ground-based visual or photovisual amplitudes and Hipparcos determinations.