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STARS WITH THE LARGEST HIPPARCOS PHOTOMETRIC AMPLITUDES

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Abstract. A list of the 2027 stars that have the largest photometric amplitudes in Hipparcos Photometry shows that most variable stars are all Miras. The percentage of variable types change as a function of amplitude. This compilation should also be of value to photometrists looking for relatively unstudied, but large amplitude stars.

Key words: stars: variability

1. INTRODUCTION

To find interesting relatively unstudied photometric variables for possible study, the distribution of photometric variables as a function of amplitude in Hipparcos photometry is investigated. The data was extracted from the stellar headers in the Hipparcos Catalogue: Epoch Photometry Annex (Vol. 17, ESA 1997). The variability types for the 2027 stars with the largest amplitudes ($\geq$ 0.36 mag.) are from Celestia 2000 (ESA 1998). 888 stars with amplitudes $\geq$ 0.64 mag. and 314 stars with amplitudes between 0.36-0.63 mag. were excluded as their variability is noted as spurious due to duplicity or as they have fewer than 20 accepted transits. The list of the 2027 stars is available from the author. The brightest of these stars are well-known variables while the fainter ones may not be.

For stars of 11, 12, and 13 magnitudes the noise in the data is at least 0.08, 0.14, and 0.42 mag., respectively (Adelman 2001). Thus for 11 and 12 mag stars with observed amplitudes of 0.36 mag, the true amplitudes, respectively, are approximately 0.35 and 0.33 mag, as noise adds quadrically with the amplitude. A 13th magnitude star

Table 1a. Variability information – Part 1

Amp. (mag)	CEP	CW	E	GCAS	I	L	RR	SR	SXPHE	U
0.36-0.37	4	1	21	0	6	11	1	15	0	42
0.37-0.39	4	0	13	0	12	11	0	14	2	44
0.39-0.41	1	1	28	1	6	10	2	15	0	37
0.41-0.43	9	0	25	2	6	9	2	22	2	24
0.43-0.46	6	0	27	2	7	16	2	17	1	21
0.46-0.48	6	1	24	0	6	9	6	22	1	22
0.48-0.52	5	1	32	0	3	6	6	25	0	21
0.52-0.55	9	0	34	0	5	11	8	17	4	12
0.55-0.59	12	2	31	0	2	12	7	21	2	11
0.59-0.63	21	0	22	0	5	9	5	18	3	14

There are also a few single types of stars:

1. An RS CVn star in the 0.36-0.37 and 0.43-0.46 mag groups.
2. A δ Sct star in the 0.37-0.39, 0.48-0.52 and 0.52-0.55 mag groups and three such stars in the 0.59-0.62 mag group.
3. A periodic variable and RV Tau star in the 0.37-0.39 mag group.
4. A recurrent novae in the 0.39-0.41 mag group.
5. A Z And star in the 0.41-0.43 and 0.55-0.59 mag groups.
6. A nova-like star in both the 0.43-0.46 and 0.46-0.48 mag groups.
7. A peculiar nova in the 0.43-0.46 and 0.48-0.52 mag groups.
8. A fast nova and a WN star in a binary system in the 0.46-0.48 mag group.
9. An rotating ellipsoidal variable in the 0.48-0.52 and the 0.52-0.55 mag groups.
10. An R CrB star in the 0.55-0.59 mag group.
11. An α Cyg and a S Dor variable in the 0.59-0.62 mag group.

with a true amplitude of 0.36 mag will have an observed amplitude of order 0.50 mag. Hence the few stars with observed magnitudes close to or less than this value are at best possibly variable. With a better noise model one could determine the true amplitudes of those stars fainter than 11th mag. and redistribute them to appropriate smaller categories.

Table 1b. Variability information – Part 2

Amp. (mag)	CEP	CW	DCEP	E	I	L	M	RCB	RR	RV	SR	U
0.64-0.68	4	2	17	0	2	15	0	1	9	0	19	10
0.67-0.73	26	1	23	0	1	12	1	0	10	0	14	11
0.73-0.79	34	2	13	0	5	9	0	1	7	1	19	7
0.79-0.87	27	4	16	0	2	4	0	0	9	3	22	12
0.87-0.99	27	1	10	0	2	2	1	1	28	1	23	3
0.99-1.15	18	4	9	0	4	3	2	0	32	3	15	9
1.15-1.47	7	5	5	1	5	2	3	0	41	2	20	9
1.47-2.23	0	2	13	1	7	0	38	3	5	1	13	17
2.23-3.27	0	0	4	0	1	2	78	3	0	0	3	9
3.28-5.19	0	0	0	0	0	0	107	0	0	0	0	0

There are also a few single types of stars:

1. A BY Dra variable in the 0.67-0.73 mag group.
2. One SX Phe star each in the 0.73-0.79 mag and in the 0.87-0.99 mag groups.
3. A UV Cet variable in the 0.79-0.87 mag group.
4. An X-ray pulsar in the 0.99-1.15 mag group.
5. A periodic variable in the 0.64-0.68 mag group.
6. A Z And star in the 0.99-1.15 mag group.

2. VARIABILITY AS A FUNCTION OF AMPLITUDE

Table 1a,b summarizes the variability by amplitude and by the types which are used by the Hipparcos Catalogue: BY = BY Draconis variables, CEP = Cepheids including CEP(B) and DCEP = δ Cepheids (Table 1a only), CW = W Virginis stars, GCAS = γ Cassiopeiae variables (Be stars), E = eclipsing binaries, I = irregular variables, L = slow irregular variables, M = Mira Ceti variables, P = undifferentiated periodic variables, RCB = R Coronae Borealis stars, RR = RR Lyrae variables, RV = RV Tauri stars, SR = semiregular variables, SXPHE = SX Phoenicis stars, U = unresolved variables including unknown types, UV = UV Ceti type variables, XP = X-ray pulsars, and ZAND = Z Andromedae cataclysmic variables. The unresolved variables need further study. Other stars need better observations to improve our knowledge of their periods and light curves. A fair number need to have their spectra classified.

The percentage of variables change with amplitude. Table 1a considers the 1020 stars with amplitudes between 0.36 and 0.63 mag in 10 groups, each with 102 stars. Table 1b has the 1007 stars with amplitudes $\geq$ 0.64 mag in 10 groups, the first nine of which have 100 stars and the last has 107 stars. Relatively rare types are listed in the notes.

The Cepheids increase in percentage with increasing amplitude in Table 1a. Their maximum percentage occurs in the 0.67-0.79 mag range. The eclipsing binaries average about one-quarter of the stars in Table 1a, but are almost absent in Table 1b. The percentage of unresolved types of variables increases with decreasing amplitudes in Table 1a, but in Table 1b the distribution is better described as constant with scatter. For amplitudes $\leq$ 0.52 mag, we probably are seeing the effects of noise moving faint stars into higher amplitude categories. Some of the less well observed irregular variables may be found to be periodic or multiperiodic once they are well observed. Some classes with many stars, e.g. the RR Lyrae stars, the Cepheids, the W Virginis stars, and the eclipsing binaries, show definite upper limits to their variability.

All of the very large variables are Miras. The first non-Mira is the R CrB variable UW Cen with an amplitude of 2.96 mag. Most of the Miras are M stars while a few are S and carbon stars. There are a few Miras which have far smaller amplitudes than the rest of the class and these might have evolved. Y Per, for example, has apparently changed from a monoperiodic Mira to a doubly-periodic SRb star (Kiss et al. 1999). Thus the other such stars should be checked. The largest amplitude semi-regular variables, some of whom might be related to the Miras (e. g., Kerschbaum & Hron 1992, Mennessier et al. 1997), have larger amplitudes than the smallest amplitude Miras.

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