Nearby Hipparcos Eclipsing Binaries
for Color – Surface Brightness Calibration

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ABSTRACT

This paper contains the list of Hipparcos eclipsing binaries that fulfill the following conditions: the star is classified in the Hipparcos Catalogue as EA-type eclipsing binary and its parallax is either larger than 5 mas or it is five times larger than its mean error. An eclipsing binary with known distance and with photometric and double-line spectroscopic orbits determined can be used in the process of calibrating the relation between the stellar surface brightness and the color that is crucial for the method of the distance determination by means of eclipsing binaries. This list is being published in order to draw attention of observers using small telescopes to these bright, potentially useful and in the most cases poorly observed objects. The advantages of the eclipsing binary method of the distance determination are discussed.

Key words: binaries: eclipsing – Stars: fundamental parameters – Stars: distances

1 Introduction

The double-line eclipsing binaries are now often considered to be one of the most promising distance indicators (e.g., Paczyński 1997). The method is largely geometrical with only a single relation that needs to be calibrated. This is the relation between the stellar surface brightness and whatever data that can be obtained to judge about the stellar temperature.

The method itself is pretty much obvious once the spectroscopic and photometric orbits of the binary system are at hand. Yet its origins are not commonly known so that it happens once and again that somebody rediscovers it, claiming that he has found an original method. That has motivated us to write Section 2 where we describe how this nearly hundred years old method was developed.
Section 3 is devoted to explaining why it is important to derive the calibration of the surface brightness – color relation exclusively from observations of eclipsing binaries with known distances.

Finally in Section 4 we present the list with a selection of nearby Hipparcos eclipsing binaries.

2 Historical Outlook

The photometric orbit of an eclipsing binary gives us relative radii of both stellar components expressed in terms of their separation and in addition an orbital inclination. The double-line spectroscopic orbit when combined with the orbital inclination that comes out from the photometric orbit results with masses of both components and metric value of the system dimension.

When the distance to the binary system is known then the angular sizes of both components are also known and knowing the apparent magnitudes of both components which come out from the photometric solution makes it possible to calculate surface brightness for each of components. So, known parallax of an eclipsing binary can be used to obtain direct measurement of the surface brightness.

On the other hand if one knows the value of surface brightness of an eclipsing binary component and if also the photometric and double-line spectroscopic orbits for that eclipsing binary are available then it is possible to calculate distance to the binary system.

First applications of this two-way inference were made in the "distance to surface brightness" direction. The necessary observational data started to be available about hundred years ago. Vogel (1890) was first to determine radial velocity orbital variations for Algol and thus he obtained the first single-line spectroscopic orbit for any eclipsing variable. He is also credited with the first determination of the stellar radius, expressed in that case in miles. Stebbins (1910), starting observations with his newly developed selenium cell photometer, obtained the first accurate photometric light curve of Algol. Combining the photometric orbit based on his observations and the single-line spectroscopic orbit of Schlesinger and Curtiss (1908) and using average of three then existing determinations of trigonometric parallax (70 mas as compared with the Hipparcos value of 35 mas) he was able to estimate values of surface brightness for both components expressed in units of the solar surface brightness. With a single-line spectroscopic orbit these estimates depended on an assumed mass ratio of Algol components. For two plausible assumptions about mass ratio the resulting surface brightness differed by a factor of three.
\(\beta\) Aur was the first eclipsing binary with double-line spectroscopic orbit (Baker 1910) and with good photometric light curve (Stebbins 1911). The only thing that marred this otherwise excellent situation was low accuracy of the available data on the trigonometric parallax. Stebbins (1911) was analyzing this set of data under the assumption that the parallax is smaller than 30 mas and therefore he was able to determine only lower limits for surface brightness of both components. This limitation was overcome by Russell, Dugan and Steward (1927) who used parallax equal to 34 mas and obtained surface brightness of both components expressed in units of an equivalent effective temperature. It is worth mentioning here that the Hipparcos parallax for \(\beta\) Aur is equal to 40 mas.

Gaposchkin (1933) made an attempt to determine effective temperatures for 30 eclipsing binaries with measured parallaxes even though in most cases these parallaxes were smaller than corresponding measurements errors. This work was criticized (Woolley 1934, Pilowski 1936) on obvious reason of using nonuniform and largely unreliable data. Kopal (1939) repeated the work of Gaposchkin using data on radial velocities and proper motions available for 39 systems and resorting to the statistical parallax method after he had divided his data into three groups depending on spectral types. He also used two binary systems with trigonometric parallaxes and two with group parallaxes. Thus before the year 1940 there already existed a crude independent calibration of the surface brightness expressed in terms of temperature as a function of spectral type, based exclusively on the eclipsing binaries.

Up to now we presented the "distance to surface brightness" inference. It is difficult to imagine that all the involved individuals were not aware of the possibilities and potentials of the reverse inference "surface brightness to distance". In any case, we have not encountered any reference to that possibility prior to the papers by Gaposchkin (1938, 1940) but even in that case the problem of the distance determination was not stated openly. The luminosities of eclipsing binary components were calculated with the help of system dimensions and with temperatures judged from the spectral types. A trivial step of calculating distances by comparing luminosities with apparent magnitudes was not done – as it was not done in much newer and much more accurate analysis by Andersen (1991). Gaposchkin stressed the fact that the calibration he had applied was based exclusively on the eclipsing binaries data.

For nearby Galactic stars the quantities that are interesting are masses, sizes, luminosities and temperatures. Once we know these quantities it is not really relevant, if a star is 100 or 200 pc away. The situation is much
different when we have to do with eclipsing variables in extragalactic nebulæ. In that case it provides opportunity to determine the distance of the host external galaxy. Gaposchkin (1962) determined distance to an eclipsing variable in the M31 nebula. He did it using very crude form of the method but undoubtedly the distance determination was the main aim of that paper and certainly that was the "surface brightness to distance" inference. Several papers with the determination of distances of eclipsing variables in M31, LMC, and SMC followed (Gaposchkin 1968, 1970, Dworak 1974, de Vaucouleurs 1978). Attention was also directed to the Galactic eclipsing binary systems. Dworak (1975) and Brancewicz and Dworak (1980) prepared a catalog of more than 1000 eclipsing variables for which they made crude determination of parallaxes.

It was a common property of both Gaposchkin and Dworak determinations of the distance that they did not stick to the clean case with a good photometric orbit and a good double-line spectroscopic orbit supplemented with information about temperatures of components. Eclipsing binaries offer plenty of opportunities for estimating the mass ratio of components in the case of single-line spectrum and even for estimating masses without any spectroscopic data. This kind of mixed accuracy data could be useful e.g., for selecting candidates for parallax observations by Hipparcos (Dworak and Oblak 1987, 1989) but it has not helped to the method’s reputation.

Originally it was the stellar spectral type that was used for estimating the temperature and consequently the surface brightness what needed also the knowledge of bolometric correction. Barnes and Evans (1976) found that the $V - R$ color can serve as an excellent tool in that context without any need to know the spectral types, effective temperatures or bolometric corrections. All the relevant informations are compressed into so called surface brightness parameter $F_V$ that can be directly determined from observations. In particular, for stars later than the spectral type A0 the plot of surface brightness parameter $F_V$ vs. the $V - R$ color index is parallel to the reddening line what obviates the need for precise reddening determination. The Barnes–Evans finding was soon applied by Lacy (1977, 1979) to the eclipsing binary distance determination.

In an early calibration Barnes, Evans and Moffett (1978) could only use three eclipsing binaries as calibrators, namely $\beta$ Aur, YY Gem and CM Dra so that the calibration was based mainly on stars with interferometrically determined angular sizes supplemented with data from lunar occultations. Popper (1980) has modified slightly the calibration of Barnes, Evans and Moffett. He allowed deviations from linearity in the relation between the
surface brightness parameter and the color index and beside the recommended by Barnes and Evans $V - R$ index he also calibrated $B - V$ and Strömgren $b - y$ indices. Also separate calibrations for dwarfs and giants were given. Recent calibrations of the Barnes–Evans relation concerned late type stars (Fouqué and Gieren 1997, Beuermann et al. 1999) or stars later than A0 (Di Benedetto 1998).

The new Hipparcos data were used by Popper (1998) for comparison with his old (Popper 1980) calibration of the relation between the surface brightness parameter and the $B - V$ color index. He selected 14 detached eclipsing binaries closer than 125 pc with the mean errors of the Hipparcos parallax of 10% or less and with good photometric and spectroscopic data. The outcome of the comparison is that the majority of objects lie on or slightly above the calibration curve but 5 binary systems are situated clearly below it. Popper suggested that these 5 outliers may have depressed surface brightness due to spotted character of their surfaces. Ribas et al. (1998) made another selection of eclipsing binaries with Hipparcos parallaxes. As compared to the Popper selection they relaxed the distance accuracy requirement (relative errors in the trigonometric parallax smaller than 20%) but stuck to the high accuracy of the object dimension determination. The resulting sample of 20 stars contains only 5 objects common with Popper sample. Ribas et al. stopped at the calculation of the effective temperatures for all components of these 20 binaries and did not proceeded with collecting the color indices and constructing the surface brightness parameter vs. color index diagram. These two papers give an idea what kind of photometric and spectroscopic data is available right now. About ten times larger number of eclipsing variables have trigonometric parallaxes measured by Hipparcos with accuracy better than 20%, many of them discovered as eclipsing variables by Hipparcos as well, but majority of them lacking sufficiently good photometric and spectroscopic data.

3 Motivation for Using More Eclipsing Binaries as Calibrators

When one aims to determine accurate distances with the help of eclipsing binaries then the calibration of the surface brightness parameter vs. color index should be as good as possible and free as much as possible from any systematic errors.

Angular sizes determined with the help of interferometry (Hanbury Brown et al. 1974, Davis 1997), lunar occultations (Ridgway et al. 1980, Richichi
1977) or infrared flux method (Blackwell and Shallis 1977, Blackwell and Lynas-Gray 1994) are plagued by the presence of limb darkening. They are effective sizes corresponding to some effective surface brightness. One can correct such effective sizes having some idea about the degree of limb darkening either from theoretical models of stellar atmospheres or from observations of limb darkening in eclipsing binaries. In any case the need to correct for the limb darkening makes the calibration less direct. When analyzing light curve of an eclipsing binary astronomer can determine also limb darkenings of the components so that the component sizes should be free from limb darkening uncertainty. Recent progress in the interferometric techniques opens the possibility to determine limb-darkened angular diameters of stars (Benson et al. 1997, Hummel et al. 1998, Pauls et al. 1998, Armstrong et al. 1998, Hajian et al. 1998) also by means of interferometry. A comparison of limb-darkening resulting from these two techniques can be seen as an additional cross-check of the calibration.

Surface brightness dependence on gravity and metallicity is not particularly strong but striving for the best accuracy the corresponding corrections should be calibrated and applied. As these corrections are not expected to be large it should be enough to determine the shape of the functional dependence of corrections on gravity and metallicity with the help of atmospheric models but the zero point, or more precisely the dependence of the surface brightness parameter on color for solar metallicity main sequence stars, should be determined by comparison with the calibrating data. One of advantages of the eclipsing binary data is that surface gravity is also accurately known in that case.

We think that the optimal case is when the eclipsing binary method of distance determination is calibrated exclusively with the use of eclipsing binaries with geometrically determined distances. This has been made feasible by publication of the Hipparcos trigonometric parallaxes for many nearby eclipsing binaries.

Beside the use for distance determination such calibration can serve as an independent check for the data on fundamental stellar parameters resulting from other methods of stellar angular size determination including model calculations.

In the following Section we present the list of nearby Hipparcos eclipsing binaries. For most of them there are only scanty observational data available. Some of them are not good for being reliable calibrators because of the light curve characteristics, RS CVn type variability, small depths of eclipses or because of being semi-detached system but rejections based on
| HIP Number | Name        | Type  | Spectral type | Max [mag] | Min [mag] | $P$ [days] | $E$ | $\pi$ [mas] | $\sigma_\pi$ [mas] | RA 2000.0 | Dec  |
|------------|-------------|-------|---------------|-----------|-----------|------------|-----|-------------|------------------|------------|------|
| 270        | V397 Cep    | EA    | A2            | 7.393     | 7.811     | 2.08684    | 2448501.180 | ! | 4.70        | 0.63             | 00h03m24.0   | +73°10'36"    |
| 817        | V342 And    | EA    | A3+...        | 7.578     | 7.723     | 2.63934    | 2448500.693 | ! | 7.21        | 1.55             | 00h10m03.2   | +46°23'25"    |
| 1233       | V348 And    | EA    | B9            | 6.750     | 6.900     | 5.5392     | 2448504.070 | ! | 4.05        | 0.76             | 00h15m17.8   | +44°12'12"    |
| 1550       | TV Cas      | EA/SD | B9V           | 7.264     | 7.827     | 1.81257    | 2448501.350 | 3.93 | 0.76        | 00h19m18.7   | +59°08'21"    |
| 3454       | V355 And    | EA    | F5            | 7.585     | 7.624     | !           |               | 8.22 | 1.74        | 00h44m11.2   | +46°14'08"    |
| 3572       | YZ Cas      | EA/DM | A2IV          | 5.673     | 6.060     | 4.4673     | 2448500.883 | ! | 11.24       | 0.55             | 00h45m39.1   | +74°59'17"    |
| 4157       | CF Tuc      | EA/RS | G2/SV + F0    | 7.660     | 8.020     | 2.79765    | 2448502.560 | ! | 11.60       | 0.65             | 00h53m07.2   | +74°39'06"    |
| 4843       | U Cep       | EA/SD | G8III         | 6.855     | 9.400     | 2.49307    | 2448502.598 | 4.84 | 0.54        | 01h02m18.3   | +81°52'32"    |
| 5348       | B Psc       | EA/DM | B6V + B0V     | 3.910     | 4.390     | 1.66974    | 2448501.433 | 11.66 | 0.77        | 01h08m23.1   | +55°14'45"    |
| 5980       | UV Psc      | EA/D  | G2            | 9.050     | 9.900     | 0.86105    | 2448500.480 | 15.87 | 1.32        | 01h16m55.1   | +06°48'42"    |
| 7323       | * BH Sct    | EA    | A5V           | 7.921     | 8.150     | 2.04507    | 2448500.45 | ! | 5.33        | 0.94             | 01h34m18.4   | +27°21'47"    |
| 7372       | * BB Sct    | EA    | K3V           | 7.233     | 7.437     | 0.47653    | 2448500.102 | 42.29 | 1.47        | 01h35m01.0   | +29°54'38"    |
| 8115       | * V73 Cas   | EA    | A3V           | 6.212     | 6.304     | 1.29366    | 2448500.931 | 12.63 | 0.77        | 01h44m17.9   | +57°32'12"    |
| 9230       | CI Eri      | EA/SD | F8V           | 9.750     | 10.900    | 1.23819    | 2448500.828 | 9.49  | 1.99        | 01h58m38.5   | +53°31'39"    |
| 9383       | X Tri       | EA/SD | A7V           | 8.850     | 11.150    | 0.97154    | 2448500.966 | 6.03  | 1.27        | 02h00m33.7   | +27°53'19"    |
| 10099      | * DP Cet    | EA    | A2            | 6.850     | 7.050     | 3.17480    | 2448502.600 | ! | 11.31       | 0.92             | 02h09m51.3   | +03°46'10"    |
| 10579      | * DS Cet    | EA    | G3V           | 8.970     | 9.340     | !           |               | 7.23  | 3.71        | 02h16m00.9   | -21°00'30"    |
| 10961      | * V505 Per  | EA    | F5            | 6.950     | 7.500     | 4.22202    | 2448501.012 | 15.00 | 0.84        | 02h21m12.9   | +54°30'36"    |
| 12657      | * AL Ari    | EA    | F8            | 9.308     | 9.656     | !           |               | 9.54  | 1.76        | 02h42m36.4   | +12°44'08"    |
| 12805      | * V405 Cep  | EA    | A2            | 8.753     | 8.958     | 1.37374    | 2448500.968 | 4.36  | 0.87        | 02h44m34.2   | +79°11'56"    |
| 13133      | RZ Cas      | EA/SD | A3V           | 6.280     | 7.870     | 1.19525    | 2448500.037 | 15.99 | 0.62        | 02h48m55.5   | +69°38'03"    |
| 14273      | CW Eri      | EA/DM | F2V           | 8.430     | 8.900     | 2.72837    | 2448500.602 | 5.95  | 1.25        | 03h03m9.9    | +17°44'16"    |
| 14568      | AE For      | EA    | K4            | 10.323    | 10.895    | 0.91824    | 2448500.658 | 32.10 | 1.78        | 03h08m06.5   | -24°45'36"    |
| 14576      | $\beta$ Per | EA/SD | B8V           | 2.080     | 3.220     | 2.86730    | 2448500.290 | 35.14 | 0.90        | 03h08m10.1   | +40°57'20"    |
| 15003      | LX Per      | EA/AR | G5IV + G5IV   | 8.320     | 9.150     | 8.03821    | 2448503.140 | 10.00 | 1.03        | 03h13m22.3   | +48°06'32"    |
| HIP Number | Name   | Type   | Spectral Type | Max $P$ | Min $P$ | $E$ | $\pi$ | $\alpha\pi$ | RA 2000.0 | Dec 2000.0 |
|------------|--------|--------|---------------|---------|---------|-----|------|----------|------------|------------|
| 13092      | TZ For | EA/GS  | G2V           | 6.998   | 7.040   | 75.66750 | 2445032.61 | 5.86 | 0.96      | 03$^h$14$^m$40$^s$   | $-35^\circ$33'28"   |
| 15193      | V572 Per | *EA  | A0           | 6.504   | >6.790  | 1.21317  | 2448500.5700 | 7.90 | 1.03      | 03$^h$15$^m$48$^s$   | $+50^\circ$57'22"   |
| 15811      | RT Per  | EA/SD  | F0V          | 10.600  | >12.000 | 0.84940  | 2448500.509  | 5.56 | 2.17      | 03$^h$23$^m$40$^s$   | $+46^\circ$34'36"   |
| 16083      | $\xi$ Tau | EA:  | B9Vn         | 3.701   | 3.786   |        |        | 14.68 | 1.01      | 03$^h$27$^m$10$^s$   | $+09^\circ$43'58"   |
| 17024      | V1125 Tau | G0   |              | 8.774   | 9.033   |        |        | 20.54 | 1.15      | 03$^h$38$^m$58$^s$   | $+00^\circ$47'48"   |
| 17333      | CU Cam  | EA    | A0           | 7.940   | 8.180   | 3.3637  | 2448502.523 | 6.99 | 0.78      | 03$^h$42$^m$36$^s$   | $+77^\circ$10'13"   |
| 17441      | GH Eri  | *EA   | F2V          | 9.016   | 9.605   | 0.72238 | 2448500.450 | 7.52 | 0.93      | 03$^h$44$^m$13$^s$   | $-41^\circ$16'46"   |
| 17962      | V471 Tau | EA    | KOv/DA       | 9.561   | 9.633   | 0.52118 | 2445612.38 | 21.37 | 1.62      | 03$^h$50$^m$24$^s$   | $+17^\circ$14'48"   |
| 18724      | $\lambda$ Tau | EA/DM | B3V + A      | 3.340   | >3.500  | 3.95295 | 2448501.550 | 8.81 | 0.99      | 04$^h$00$^m$40$^s$   | $+12^\circ$29'25"   |
| 19062      | GT Eri  | EA    | F0V          | 8.621   | 9.121   | 0.90138 | 2448500.8140 | 6.79 | 1.08      | 04$^h$05$^m$06$^s$   | $-31^\circ$10'11"   |
| 19571      | GW Eri  | EA    | A1V + (F/G)  | 5.840   | >6.130  | 3.6586  | 2448502.817 | 13.06 | 0.72      | 04$^h$11$^m$36$^s$   | $-20^\circ$21'23"   |
| 20657      | VW Ret  | EA    | F0V          | 8.762   | 9.286   | 2.08470 | 2448500.6460 | 3.67 | 0.70      | 04$^h$25$^m$35$^s$   | $-60^\circ$45'25"   |
| 20806      | HH Eri  | EA    | G8/K0V + F/G | 8.502   | 8.847   |        |        | 20.90 | 2.04      | 04$^h$27$^m$31$^s$   | $-17^\circ$06'31"   |
| 20896      | DI Cam  | EA    | F8           | 7.850   | 8.090   | 4.1659  | 2448501.040 | 10.14 | 0.67      | 04$^h$28$^m$42$^s$   | $+79^\circ$42'07"   |
| 21213      | RZ Cae  | *EA   | A4V          | 7.680   | 7.820   |        |        | 7.45  | 0.97      | 04$^h$33$^m$01$^s$   | $-38^\circ$17'00"   |
| 21334      | TY Tau  | EA    | K0V          | 11.953  | 12.563  | 1.07736 | 2448500.860 | 6.01 | 0.62      | 03$^h$34$^m$43$^s$   | $+15^\circ$15'54"   |
| 21604      | FU Tauri | EA/SD | B8V          | 5.857   | 6.708   | 2.05631 | 2448501.1857 | 9.03 | 0.84      | 03$^h$38$^m$15$^s$   | $+20^\circ$41'05"   |
| 22000      | RZ Eri  | EA/DS  | Am comp SB   | 7.880   | 9.110   | 39.28238 | 2448523.56 | 5.40 | 1.29      | 04$^h$43$^m$45$^s$   | $+10^\circ$40'56"   |
| 22229      | AL Dor  | EA    | F8V          | 7.800   | 8.120   | 1.20696 | 2448500.0360 | 15.34 | 0.61      | 04$^h$46$^m$52$^s$   | $-60^\circ$36'14"   |
| 22498      | DP Cam  | *EA   | K7           | 9.905   | 10.438  |        |        | 42.59 | 17.78     | 04$^h$50$^m$24$^s$   | $+63^\circ$20'00"   |
| 23453      | $\zeta$ Aur | EA/GS | K4II comp    | 3.842   | 3.876   | 972.16000 | 2427692.83 | 4.14 | 0.81      | 05$^h$02$^m$28$^s$   | $+41^\circ$04'33"   |
| 24552      | V1366 Ori | EA   | A0           | 9.872   | 10.644  |        |        | 6.10  | 1.63      | 05$^h$16$^m$00$^s$   | $-09^\circ$48'35"   |
| 24663      | CD Tau  | EA/D  | F7V          | 6.790   | 7.310   | 3.43514 | 2448503.401 | 13.66 | 1.64      | 05$^h$17$^m$31$^s$   | $+20^\circ$07'56"   |
| 24710      | VW Col  | EA    | K3V          | 9.240   | 10.330  |        |        | 19.09 | 3.25      | 05$^h$18$^m$00$^s$   | $-27^\circ$29'26"   |
| 24740      | AR Aur  | EA    | B9.5V        | 6.110   | 6.780   | 4.13470 | 2448503.180 | 8.20  | 0.78      | 05$^h$18$^m$18$^s$   | $+33^\circ$46'03"   |
| HIP Number | Name | Var type | Spectral type | Max [mag] | Min [mag] | $P$ [days] | $E$ [mas] | $\pi$ [mas] | $\sigma_\pi$ | RA 2000.0 | Dec |
|------------|------|----------|---------------|-----------|-----------|-----------|-----------|------------|------------|-----------|-----|
| 24836 *    | DV Cam | EA       | B5V           | 6.100     | 6.300     | 1.52950   | 2448501.0860 | !         | 3.71 0.73  | 05°19'27.8 | -58°07'03'' |
| 25760      | UX Men | EA/DM    | F8V           | 8.320     | 8.970     | 4.18110   | 2448500.880  | 9.93 0.62  | 05°30'03.1 | -76°14'55'' |
| 25776      | TZ Men | EA/D     | A1V           | 6.180     | 6.700     | 8.5702    | 2439190.34   | 9.35 0.50  | 05°30'13.9 | -84°47'07'' |
| 26760 *    | AV Dor | EA       | F0V           | 9.670     | 10.090    | 1.9480    | 2448500.4260 | !         | 4.90 0.88  | 05°41'04.9 | -61°51'28'' |
| 27309      | V1380 Ori | * EA     | B5           | 9.760     | 10.610    | 5.8130    | 2448501.920  | !         | 5.70 4.95  | 05°47'07.9 | +00°17'56'' |
| 28360      | $\beta$ Aur | EA       | A2V           | 1.890     | 1.980     | 3.96004   | 2448500.910  | 39.72 0.78 | 05°59'31.8 | +44°56'51'' |
| 28537      | RW Gem | EA/SD:   | B6V comp SB   | 9.610     | 11.840    | 2.86550   | 2448502.160  | 10.53 2.47 | 06°01'28.1 | +23°08'28'' |
| 29455 *    | IO CMa | EA       | A1m A5-F2     | 8.460     | 8.707     | 2.87211   | 2448500.9091 | !         | 6.47 0.77  | 06°12'22.4 | -30°28'54'' |
| 30270 *    | V454 Aur | EA       | F8            | 7.740     | 8.170     | 3.20570   | 2448502.200  | !         | 14.39 0.94 | 06°22'03.1 | +34°35'51'' |
| 30651      | RR Lyn | EA/DM    | A3m           | 5.950     | 5.980     | 9.9451    | 2448509.050  | 12.01 0.97 | 06°26'25.9 | +56°17'06'' |
| 30806 *    | V722 Mon | EA       | F5            | 7.838     | 7.994     | !         | !         | !         | !         | 06°28'20.4 | -00°43'46'' |
| 30878      | V455 Aur | EA       | F2            | 7.328     | 7.590     | !         | !         | !         | !         | 06°28'55.0 | +52°07'33'' |
| 31017 *    | KL CMa | EA       | B8V           | 6.730     | 6.970     | 1.76220   | 2448501.5700 | !         | 4.51 0.76  | 06°30'29.8 | -14°57'16'' |
| 31173      | WW Aur | EA/DM    | A3m + A3m     | 5.820     | > 6.300   | 2.52502   | 2448500.9150 | 11.86 1.06 | 06°32'27.2 | +32°27'18'' |
| 32015      | SV Cam | EA/DW    | G5V           | 9.352     | 10.084    | 0.59308   | 2448500.4320 | 11.77 1.07 | 06°41'18.9 | +82°16'04'' |
| 32374 *    | EA:    | M2III    | !             | 7.202     | 7.287     | !         | !         | 2.83 0.52  | 06°45'25.3 | -65°02'39'' |
| 32900      | HS Aur | EA/DM    | G8V+...       | 10.231    | 10.318    | 9.81538   | 2427397.53   | 10.05 2.21 | 06°51'18.5 | +47°40'24'' |
| 33487      | * V358 Pup | EA       | G5V           | 9.304     | 9.540     | !         | !         | 12.21 2.45 | 06°57'39.1 | -41°17'40'' |
| 34003      | VV Mon | EA/RS    | K0IV + G2     | 9.510     | > 10.250  | 6.05083   | 2448503.390  | 5.59 1.46  | 07°03'18.3 | -05°44'16'' |
| 34659 *    | V362 Pup | EA:    | A2Vs          | 7.516     | 7.626     | !         | !         | 5.42 1.02  | 07°10'39.6 | +41°15'54'' |
| 35447      | V365 Pup | * EA    | A0V           | 7.977     | 7.912     | !         | !         | 3.80 0.68  | 07°19'06.6 | -35°11'03'' |
| 35487      | R CMA | EA/SD    | F2III/IV      | 5.780     | 6.417     | 1.13569   | 2448500.3328 | 22.71 0.80 | 07°19'28.1 | -16°23'42'' |
| 36608      | PS Pup | EA       | B8V           | 6.550     | 6.710     | 1.32110   | 2448500.5680 | 3.69 0.68  | 07°31'42.7 | -35°53'16'' |
| 38167      | V397 Pup | * EA    | B9V           | 5.910     | 6.090     | 3.00455   | 2448502.1900 | 6.82 0.53  | 07°49'14.6 | -35°14'36'' |
| 41361      | NO Pup | EA/KE:  | B9IV/V        | 6.050     | 6.610     | 1.25689   | 2448500.930  | 5.32 0.87  | 08°26'17.7 | -39°03'32'' |
### Table 1

Continued

| HIP Number | Name       | Var type | Spectral type | Max [mag] | Min [mag] | $P$ [days] | $E$ [mag] | $\pi$ [mas] | $\sigma_\pi$ [mas] | RA 2000.0 | Dec  |
|------------|------------|----------|---------------|-----------|-----------|-----------|-----------|-------------|----------------|-----------|------|
| 41564      | LO Hya     | EA       | A5m           | 6.479     | 6.605     |           | 11.73     | 0.94        | 08°28'29''2  | -02°31'02''  |
| 41834      | VZ Hya     | EA/DM    | F5V + F5V     | 9.030     | 9.770     | 2.90430   | 2448500.174| 5.03        | 1.34          | 08°31'41''4  | -06°19'08''  |
| 42794      | RS Cha     | EA+DSC   | A7V           | 6.090     | 6.750     | 1.66987   | 2448501.650| 10.23       | 0.46          | 08°43'12''3  | -79°04'12''  |
| 42951      | * MX Hya   | EA       | F2+           | 6.520     | 7.010     |           |           | 11.50       | 2.71          | 08°45'20''8  | -02°36'04''  |
| 44164      | TY Pyx     | EA/D/R   | G5V           | 6.960     | 7.590     | 3.19858   | 2448500.048| 17.91       | 0.74          | 08°59'42''8  | -27°48'58''  |
| 44349      | WY Cnc     | EA/SD    | G8V           | 9.540     | 10.230    | 0.82937   | 2448500.738| 11.76       | 1.72          | 09°01'55''5  | +26°41'23''  |
| 45079      | PT Vel     | *EA      | A0V           | 7.046     | > 7.600   | 1.80201   | 2448500.715| !           | 6.20          | 09°10'57''7  | -43°16'03''  |
| 45887      | * NY Hya   | EA       | G5           | 8.650     | 9.020     | 1.59140   | 2448500.032| !           | 10.15         | 09°21'22''8  | -06°40'20''  |
| 46002      | * NZ Hya   | EA       | F7/F8V       | 8.280     | 8.780     |           |           | !           | 12.47         | 09°22'56''6  | -15°29'44''  |
| 46881      | S Vel      | EA/SD    | A5Ve comp SB  | 7.790     | > 9.650   | 5.93365   | 2448504.480| 6.61        | 0.78          | 09°33'13''2  | -45°12'31''  |
| 48054      | KN Vel     | *EA      | A21V(m)       | 6.560     | 6.720     | 2.72290   | 2448501.250| !           | 8.07          | 09°47'44''0  | -49°56'36''  |
| 50966      | HS Hya     | EA/D     | F5V           | 8.160     | 8.500     | 1.56804   | 2448501.330| 11.04       | 0.88          | 10°24'36''8  | -19°05'33''  |
| 51683      | * PX Hya   | EA:      | F2V           | 8.473     | 8.572     |           |           | 5.00        | 1.12          | 10°33'30''7  | -20°10'52''  |
| 52066      | UV Leo     | EA/DW    | G0V           | 9.020     | 9.680     | 0.60009   | 2448500.560| 10.85       | 1.16          | 10°38'20''8  | +14°16'04''  |
| 52381      | RZ Cha     | EA/DM    | F5V + F5      | 8.100     | 8.560     | 2.83208   | 2448501.810| 5.43        | 0.63          | 10°42'24''2  | -82°02'14''  |
| 52465      | * UW LMi   | EA       | G0V           | 8.446     | 8.674     | 3.8750    | 2448501.163| !           | 7.73          | 10°43'30''2  | +28°41'10''  |
| 53487      | * QR Hya   | EA       | G1V           | 8.508     | 8.690     |           |           | 10.58       | 0.96          | 10°56'31''2  | -34°33'50''  |
| 53806      | * V359 Vel | EA/B     | B9V           | 7.580     | 7.840     | 4.5350    | 2448500.360| !           | 3.65          | 11°00'33''4  | -51°56'50''  |
| 53905      | * TW Crt   | EA       | F5V           | 8.390     | 8.720     | 0.94430   | 2448500.718| !           | 11.35         | 1.34          | 11°01'48''0  | -21°50'31''  |
| 54766      | * FM Leo   | EA       | F8            | 8.542     | 8.857     |           |           | 8.35        | 1.17          | 11°12'45''2  | +00°20'53''  |
| 54807      | TT Hya     | EA/SD    | A1III         | 7.298     | > 9.100   | 6.9534    | 2448500.466| 6.50        | 0.95          | 11°13'12''5  | -26°27'54''  |
| 56379      | * KR Mus   | EA/BV     | B9Vne         | 6.678     | 6.873     |           |           | !           | 9.67          | 11°33'25''5  | -70°11'41''  |
| 58579      | * TX Crv   | EA:      | G0           | 8.080     | 8.600     |           |           | !           | 10.83         | 12°00'47''6  | -12°09'27''  |
| 59229      | V788 Cen   | EA       | A3III         | 5.812     | 6.011     | 4.9664    | 2448502.225| !           | 9.99          | 12°08'53''8  | -44°19'33''  |
Table 1

| HIP Number | Name       | Var type | Spectral type | Max Type [mag] | Min Type [mag] | $P$ [days] | $E$ | $\pi$ [mas] | $\sigma_\pi$ [mas] | RA 2000.0    | Dec  |
|------------|------------|----------|---------------|----------------|----------------|------------|----|------------|------------------|--------------|------|
| 60812      | * KP Vir   | EA       | A2            | 8.420          | 8.790          | 2.2720     | 2448501.940 | 5.49          | 1.61                   | 12°27'51.0" | -10°10'02" |
| 61006      | * FK Dra   | EA       | K0            | 9.300          | 9.790          | 2.00072    | 2448501.630 | 9.00          | 0.96                   | 12°30'11.6" | +63°53'21" |
| 61882      | * LL Mus   | EA       | A0V           | 8.930          | 9.340          | 1.36584    | 2448501.020 | 4.82          | 0.94                   | 12°40'51.0" | -67°44'24" |
| 61910      | VV Crv     | * EA     | F3IV          | 5.190          | 5.340          | 3.14500    | 2448502.170 | 11.72         | 1.90                   | 12°41'16.0" | -13°00'50" |
| 62801      | * LQ Mus   | EA       | F5V           | 9.140 > 9.750  | 4.0070         | 2448503    | !             | 7.10          | 1.03                   | 12°52'08.2" | -68°54'01" |
| 63592      | UY Vir     | EA/DM    | A9IV          | 8.020          | 8.920          | 1.99451    | 2448501.260 | 7.58          | 0.92                   | 13°01'53.4" | -19°46'28" |
| 64120      | HY Vir     | EA       | F2            | 7.880          | 8.200          | 2.73233    | 2448500.570 | 6.13          | 0.87                   | 13°08'29.9" | -02°40'45" |
| 64293      | RS CVn     | EA/AR    | K2III         | 8.140          | 9.410          | 4.79789    | 2448503.960 | 9.25          | 1.06                   | 13°10'36.9" | +35°56'05" |
| 64607      | LN Vir     | EA:      | M0III         | 5.752          | 5.799          | !            | 2448501.312 | 6.43          | 0.80                   | 13°14'51.2" | +11°19'54" |
| 64661      | η Mus      | * EA     | B8V           | 4.750          | 4.860          | 2.39630    | 2448501.730 | 8.04          | 0.59                   | 13°15'15.0" | -67°53'40" |
| 66683      | * LX Mus   | EA:      | F5V           | 3.852          | 9.030          | !            | 2448501.116 | 7.53          | 0.80                   | 13°40'11.6" | -74°04'45" |
| 68064      | ZZ Boo     | EA/DM    | F2V           | 6.860          | 6.895          | 4.99174    | 2438565.92  | 8.88          | 0.78                   | 13°56'09.6" | +25°55'07" |
| 68258      | BH Vir     | EA/DW    | F8V           | 9.630 > 10.300 | 0.81687       | 2448500.2450 | 7.94       | 1.50                   | 13°58'24.9" | -01°39'39" |
| 68384      | * CX CVn   | EA       | F8            | 9.440          | 9.690          | 1.64096    | 2448502    | 8.43          | 2.30                   | 13°59'55.7" | +28°09'40" |
| 68992      | AT Cir     | EA/DM    | A5IV/Vs       | 7.669 > 8.200  | 3.25728       | 2448503.105 | 5.95        | 0.88                   | 14°03'38.3" | -66°44'07" |
| 69211      | V353 Hya   | * EA     | F5V           | 7.515          | 7.649          | !            | 2448501.056 | 8.29          | 1.05                   | 14°10'12.4" | -25°24'02" |
| 69781      | V636 Cen   | EA/DM:   | F8/G0V        | 8.790          | 9.000          | 4.2839    | 2448501.692 | 15.36         | 1.12                   | 14°16'57.9" | -49°56'42" |
| 70287      | * DV Boo   | EA       | A2            | 7.600          | 7.840          | 1.26086    | 2448500.400 | 7.38          | 0.92                   | 14°22'49.7" | +14°56'20" |
| 71487      | BW Boo     | EA/DM    | F0V           | 7.140          | 7.420          | 3.32822    | 2448501.620 | 7.80          | 0.76                   | 14°37'08.8" | +35°55'47" |
| 73473      | δ Lib      | EA/SD    | B9.5V         | 4.924          | 5.933          | 2.32737    | 2448502.1655 | 10.72         | 0.91                   | 15°06'58.4" | -08°31'08" |
| 74127      | * IL Lib   | EA       | F2            | 7.639          | 7.764          | !            | 15°08'56.7" | 9.32         | 1.22                   | 15°17'57.5" | +83°51'34" |
| 74866      | TY UMi     | * EA     | F0            | 7.790          | 8.236          | 1.72480    | 2448500.2764 | 9.10         | 0.59                   | 15°17'56.4" | -40°47'17" |
| 74950      | GG Lup     | EA       | B9V           | 5.552          | 6.070          | 1.84962    | 2448500.5500 | 6.34         | 0.72                   | 15°18'56.4" | -60°47'17" |
| 76196      | TW Dra     | EA/SD    | A5 comp SB    | 7.406          | 8.963          | 2.80689    | 2448501.9687 | 8.21         | 1.03                   | 15°33'51.0" | +63°54'26" |
| 76267      | α CrB      | EA       | A0V           | 2.213          | 2.290          | 17.35991   | 2423163.77  | 43.65         | 0.79                   | 15°34'41.2" | +26°42'54" |
| HIP Number | Name | Var type | Spectral type | Max | Min | P | E | π | σ | RA | Dec |
|------------|------|----------|---------------|-----|-----|---|---|---|---|----|-----|
| 76658      | RW CrB | EA/SD: A8V SB | 10.130 | 10.900 | 0.72641 | 2448500.3490 | 5.11 | 1.65 | 15°39'35.2'' | +29°37'20'' |
| 78523      | V1041 Sco | EA | F6V | 8.937 | 9.258 | 2.18694 | 2448500.5500 | 11.61 | 2.95 | 16°01'51.5'' | -28°22'26'' |
| 81519      | WW Dra | *EA/AR G2IV + K0IV | 8.330 | 8.980 | 4.62962 | 2448502.010 | 8.67 | 1.24 | 16°39'04.0'' | +60°41'59'' |
| 81530      | OT Aps | *EA | B9.5IV | 7.980 | 8.340 | 2.42660 | 2448501.6000 | 4.54 | 0.79 | 16°39'09.3'' | -75°29'19'' |
| 81589      | R Ara | EA/DM: B9IV/V | 6.560 | 7.200 | 4.42507 | 2448501.290 | 12.44 | 2.03 | 16°39'44.7'' | -56°59'40'' |
| 82080      | ξ UMi | EA | G5IIIvar | 4.350 | 4.410 | 39.48090 | 2448514.28 | 9.41 | 0.67 | 16°45'58.2'' | +82°02'14'' |
| 82977      | UU Oph | EA/SD | A1IV | 10.350 | >10.540 | 4.39680 | 2420750.49 | 7.18 | 1.93 | 16°57'22.6'' | -25°47'58'' |
| 83491      | V923 Sco | EA/D | F3V | 5.989 | 6.013 | 34.82690 | 2441903.69 | 15.61 | 0.80 | 17°03'50.9'' | -38°09'09'' |
| 83719      | WZ Oph | EA/DM | F8V | 9.179 | >9.800 | 4.18351 | 2435648.78 | 7.99 | 1.37 | 17°06'39.0'' | +07°46'58'' |
| 84479      | V2368 Oph | *EA | A2V | 6.220 | 6.420 | 7.7010 | 2448506.350 | ! | 5.54 | 0.86 | 17°16'14.2'' | +02°11'10'' |
| 84500      | U Oph | EA/DM | B5Vn | 5.906 | 6.606 | 1.67734 | 2448500.7312 | 5.38 | 0.83 | 17°16'31.7'' | +01°12'38'' |
| 84670      | TX Her | EA/DM | A9V | 8.150 | 8.950 | 2.05981 | 2448500.980 | 5.55 | 0.84 | 17°18'36.4'' | +41°53'17'' |
| 84870      | V819 Her | EA | F9Vn... | 5.670 | 5.770 | 2.22970 | 2448502.010 | ! | 15.53 | 1.16 | 17°21'43.6'' | +39°58'29'' |
| 85057      | V948 Her | EA | F2 | 9.015 | 9.306 | 1.27519 | 2448510.107 | ! | 8.31 | 1.10 | 17°22'57.7'' | +29°20'42'' |
| 86809      | V624 Her | EA | A3m | 6.240 | 6.400 | 3.89498 | 2448502.410 | 6.93 | 0.74 | 17°44'17.2'' | +14°24'36'' |
| 87965      | Z Her | *EA/AR | F6v | 7.363 | >8.180 | 3.3928 | 2448502.500 | 10.17 | 0.84 | 17°58'07.0'' | +15°08'21'' |
| 88008      | MM Her | EA/AR | G3 | 9.660 | 10.640 | 7.96032 | 2448504.620 | 5.42 | 1.56 | 17°58'38.5'' | +22°08'47'' |
| 88069      | V1647 Sgr | EA/DM | A3III | 6.960 | >7.550 | 3.28279 | 2448129.70 | 8.70 | 1.40 | 17°59'13.5'' | -36°56'20'' |
| 89816      | QS Ser | EA | G0+... | 7.690 | 8.250 | ! | 16.40 | 1.83 | 18°19'48.1'' | -04°57'42'' |
| 90313      | V2291 Oph | EA | G8III-IV+... | 5.783 | 5.810 | 385.000000 | 2447018.18 | 4.04 | 0.69 | 18°25'38.8'' | +08°01'55'' |
| 92330      | V362 Pav | EA | A2mA5-A9 | 7.436 | 7.644 | ! | 6.10 | 0.82 | 18°49'03.5'' | -63°16'10'' |
| 92537      | V539 Lyr | EA | A0 | 7.264 | 7.310 | ! | 3.91 | 0.55 | 18°51'26.8'' | +39°19'14'' |
| 92835      | HP Dra | EA | G5 | 8.060 | >8.360 | 6.6930 | 2448500.330 | 12.45 | 0.72 | 18°54'53.5'' | +51°18'29'' |
| 93104      | V542 Lyr | EA | B7IV | 5.860 | 5.950 | 5.8230 | 2448502 | 6.32 | 0.54 | 18°58'01.9'' | +38°15'58'' |
| 93595      | BH Dra | EA/SD: A2Vp+... | 8.430 | >8.900 | 1.81724 | 2448500.850 | 5.63 | 1.45 | 19°03'39.5'' | +57°27'26'' |
| HIP Number | Name      | Var type | Spectral type | Max  | Min   | $P$  | $E$   | $\pi$ | $\sigma_\pi$ | RA    | Dec   |
|-----------|-----------|----------|---------------|------|-------|------|-------|-------|-------------|-------|-------|
| 93809     | V085 Aql  | EA/DM    | A2 + A7       | 7.620| 8.000 | 2.40823 | 2448500.190 | 5.80 | 0.87        | 19°06'18"2 | -11°38'57" |
| 94335     | FL Lyr    | EA/DM    | G0V           | 9.466| 10.061| 2.17809 | 2448500.2673 | 7.69 | 0.89        | 19°12'04"9 | +46°19'26" |
| 95588     | * V1455 Aql | EA:   | F0           | 8.081| 8.272 | !      | 9.17  | 1.14    | 19°26'33"2 | -08°09'42" |
| 95611     | V2080 Cyg | EA        | F5            | 7.460| 7.870 | 2.46680 | 2448500.6200 | 12.60 | 0.58        | 19°26'47"9 | +50°08'43" |
| 96011     | V2083 Cyg | EA        | A3            | 6.938| >7.180| 2.16742 | 2448501.1262 | 3.98 | 0.79        | 19°31'16"4 | +47°28'53" |
| 96234     | V4089 Sgr | EA        | A5IV-III      | 5.910| 6.130 | 4.6271  | 2448503.102 | 7.49 | 0.88        | 19°34'08"5 | -40°02'05" |
| 96620     | V1143 Cyg | EA/DM    | F6Vasc        | 5.980| 6.430 | 7.64076 | 2448501.110 | 25.12 | 0.56        | 19°38'41"2 | +54°58'24" |
| 96739     | V4090 Sgr | EA        | A1mA6-F0      | 6.660| 6.910 | 11.41507| 2448503.40  | 11.84 | 0.97        | 19°39'45"5 | +39°25'58" |
| 97263     | HZ Dra    | EA        | A0            | 8.160| 8.320 | 0.77294 | 2448500.7650 | 5.96 | 0.62        | 19°46'02"5 | +69°55'09" |
| 97649     | * Aql     | EA        | A7IV-V        | 0.820| 0.869 | 7.9450  | 2448502.54  | 194.44| 0.94        | 19°50'46"7 | +08°52'03" |
| 97849     | V505 Sgr  | EA/SD    | A1V           | 6.508| <7.510| 1.18287 | 2448501.1079 | 8.58 | 1.38        | 19°53'06"4 | -14°36'11" |
| 98118     | BS Dra    | EA/DM    | F5V + F5V     | 9.190| 9.950 | 3.36401 | 2448502.320 | 4.80 | 0.74        | 19°56'28"8 | +73°36'58" |
| 98539     | V4428 Sgr | * EA     | F3V           | 8.260| 8.530 | 2.78350 | 2448502.2300 | 5.49 | 1.15        | 20°01'04"7 | -42°10'12" |
| 98955     | V477 Cyg  | EA/DM    | A3V           | 8.566| 9.320 | 2.34962 | 2448500.6622 | 5.22 | 1.05        | 20°05'27"7 | +31°58'18" |
| 100981    | * MP Del  | EA        | A3            | 7.624| 7.890 | !      | 6.09  | 0.99        | 20°28'26"6 | +11°43'14" |
| 101236    | * MR Del  | EA        | K0            | 8.850| 9.160 | 0.52169 | 2448500.5160 | 22.53| 5.13        | 20°31'13"3 | +05°13'06" |
| 102037    | * V400 Vul | EA:   | A0            | 6.756| 6.823 | !      | 5.82  | 0.73        | 20°40'42"3 | +26°04'45" |
| 102041    | * IO Aqr  | EA        | G0            | 8.924| 9.344 | 2.36816 | 2448502.3278 | 5.42 | 1.26        | 20°40'45"5 | +00°56'21" |
| 102545    | * NN Del  | EA        | F8            | 8.490| 8.917 | !      | 5.71  | 1.14        | 20°46'49"2 | +07°33'11" |
| 102827    | * V2136 Cyg | EA:   | B4V           | 6.300| 6.378 | !      | 3.55  | 0.59        | 20°49'54"6 | +46°39'41" |
| 103505    | CG Cyg    | EA/SD    | G9.5V +K3V    | 10.120| 10.770| 0.63114 | 2448500.330 | 9.25 | 4.95        | 20°58'13"3 | +35°10'30" |
| 103542    | KZ Pav    | EA/SD    | F6V           | 7.262| 7.962 | 0.94987 | 2448500.1013 | 10.12| 5.66        | 20°58'40"1 | -70°25'20" |
| 104263    | V1061 Cyg | EA/D     | F8            | 9.360| >9.700| 2.34664 | 2448500.6056 | 6.25 | 1.06        | 21°07'20"5 | +52°02'58" |
| 104604    | * BR Ind  | EA        | F8V           | 7.075| 7.220 | 0.89277 | 2448500.4820 | 20.47| 2.08        | 21°11'22"8 | +52°20'22" |
| 105515    | * Cap     | EA        | G8III         | 4.428| 4.464 | !      | 15.13| 0.80        | 21°22'14"8 | -16°50'04" |
| HIP Number | Name | Var type | Spectral type | Max [mag] | Min [mag] | $P$ [days] | $E$ | $\pi$ [mas] | $\sigma_\pi$ [mas] | RA 2000.0 | Dec |
|------------|------|----------|---------------|----------|---------|-----------|-----|----------|---------------|-----------|-----|
| 105584     | *V2154 Cyg | EA | F0 | 7.851 | 8.237 | 2.63060 | 2448502.160 | 11.40 | 0.97 | 21$^h$23$^m$08$^s$2 | +48$^\circ$31$'$.08$''$ |
| 106024     | El Cep | EA/DM | F2V | 7.650 | 8.160 | 8.43933 | 2448500.550 | 5.03 | 0.56 | 21$^h$28$^m$28$^s$2 | +76$^\circ$24$'$.13$''$ |
| 106981     | EE Peg | EA/DM | A7V var | 6.997 | 7.607 | 2.62817 | 2448502.2388 | 7.61 | 0.91 | 21$^h$40$^m$01$^s$9 | +09$^\circ$11$'$.05$''$ |
| 107083     | EK Cep | EA/DM | A1V | 7.880 | 9.060 | 4.42779 | 2448500.330 | 6.53 | 0.58 | 21$^h$41$^m$21$^s$5 | +69$^\circ$41$'$.34$''$ |
| 107960     | AW Peg | EA/DS | A3V | 7.630 | 8.690 | 1.062259 | 2448500.37 | 6.25 | 0.94 | 21$^h$52$^m$20$^s$7 | +24$^\circ$00$'$.44$''$ |
| 108606     | CM Lac | EA/DM | A2V | 8.220 | 8.800 | 1.60469 | 2448500.260 | 4.40 | 0.84 | 22$^h$00$^m$04$^s$4 | +44$^\circ$33$'$.08$''$ |
| 108644     | FF Aqr | EA/RS: | G5III-IV | 9.397 | 9.679 | 9.20775 | 2442752.96 | 7.91 | 1.50 | 22$^h$00$^m$36$^s$4 | +02$^\circ$44$'$.27$''$ |
| 108646     | *V441 Cep | EA | A0 | 8.740 | 9.223 | 1.64900 | 2448500.330 | 3.57 | 0.67 | 22$^h$00$^m$36$^s$6 | +75$^\circ$04$'$.22$''$ |
| 108797     | DX Aqr | EA/KE: | A0/1V + K1/2 | 6.430 | 6.880 | 0.94501 | 2448500.4630 | 6.92 | 2.17 | 22$^h$02$^m$26$^s$2 | +16$^\circ$57$'$.53$''$ |
| 109354     | *V402 Lac | EA | B9 | 6.699 | 6.993 | 3.7820 | 2448500.980 | 4.18 | 0.70 | 22$^h$09$^m$15$^s$2 | +44$^\circ$50$'$.47$''$ |
| 111162     | KX Aqr | *EA | G8/G0V | 8.232 | 8.697 | 2.07441 | 2448501.5469 | 6.25 | 1.07 | 22$^h$31$^m$13$^s$4 | -22$^\circ$59$'$.48$''$ |
| 111454     | * LL Aqr | EA | G0 | 9.327 | 9.719 | 3.4707 | 2448500.4459 | 7.16 | 1.46 | 22$^h$34$^m$42$^s$1 | -03$^\circ$35$'$.58$''$ |
| 111809     | *VZ PsA | EA | A0V | 5.675 | 5.723 | 0.0549 | 2448500.4459 | 7.50 | 0.76 | 22$^h$38$^m$51$^s$5 | -33$^\circ$04$'$.53$''$ |
| 112317     | ZZ Cep | EA/DM | A2p | 8.540 | 9.540 | 2.14180 | 2427928.45 | 5.95 | 2.57 | 22$^h$45$^m$02$^s$6 | +68$^\circ$07$'$.58$''$ |
| 113442     | *DF Gru | EA | F3/F5V | 10.352 | 10.785 | 1.40159 | 2448501.660 | 6.02 | 2.79 | 22$^h$58$^m$32$^s$0 | -42$^\circ$17$'$.17$''$ |
| 114206     | *BN ScI | EA | F7V | 8.963 | 9.331 | 3.6506 | 2448500.690 | 5.85 | 1.16 | 23$^h$07$^m$42$^s$8 | -30$^\circ$13$'$.60$''$ |
| 114305     | V381 And | EA: | A0 | 7.352 | 7.417 | 0.7775 | 2448500.4459 | 4.79 | 0.90 | 23$^h$08$^m$57$^s$1 | +38$^\circ$54$'$.55$''$ |
| 114484     | RT And | EA/DW | F8V var | 8.998 | 9.800 | 0.62894 | 2448500.3671 | 13.26 | 1.13 | 23$^h$11$^m$10$^s$1 | +53$^\circ$01$'$.33$''$ |
| 114639     | SZ Psc | *EA/DS | K1IIIv comp | 7.380 | 7.870 | 3.96579 | 2448503.170 | 11.34 | 0.92 | 23$^h$33$^m$28$^s$8 | +02$^\circ$40$'$.31$''$ |
| 115200     | OT And | EA | A0 | 7.398 | 7.530 | 0.0575 | 2448500.4459 | 4.63 | 0.86 | 23$^h$20$^m$01$^s$2 | +41$^\circ$45$'$.17$''$ |
| 115990     | AR Cas | EA | B3IV | 4.840 | 4.960 | 6.0663 | 2448501.820 | 5.67 | 0.56 | 23$^h$30$^m$01$^s$9 | +58$^\circ$32$'$.56$''$ |
| 116167     | DI Peg | EA/SD | F4IV | 9.530 | 10.680 | 0.71182 | 2448500.280 | 5.17 | 1.72 | 23$^h$32$^m$14$^s$7 | +14$^\circ$58$'$.09$''$ |
| 118223     | *V821 Cas | EA | A0 | 8.273 | 8.700 | 1.76975 | 2448500.4459 | 5.38 | 0.91 | 23$^h$58$^m$49$^s$2 | +53$^\circ$40$'$.20$''$ |
such arguments could be done for well observed systems only. For the sake of using clearly defined selection criteria we have left in the Table all the objects that fulfill our primary criteria.

4 Table Description

Table 1 contains all Hipparcos eclipsing binaries that have their variability types denoted as EA or EA: and that fulfill the following distance condition: the binary must be either nearer than 200 pc or the standard error of its parallax must be five times smaller than the parallax value. In the *Hipparcos Catalogue* we have found 198 eclipsing binaries that fulfill these conditions. 156 of these stars are comprised in the Section ”Periodic Variables” of the *Hipparcos Variability Annex* (ESA 1997, Vol. 11) and 42 in the Section ”Unsolved Variables” of this Annex. The latter Section contains the stars with generally unknown periods. All of them are listed in Table 1 in order of increasing Hipparcos numbers. The columns of Table 1 are generally self-explanatory. Comments must only be given to some of them. The asterisk between the Hipparcos number and the name of the star indicates that the object has been newly-classified in the *Hipparcos Catalogue* on the basis of the Hipparcos observations and the preliminary variability analysis. The asterisk preceding variability type in column 3 denotes that this type was newly classified by Hipparcos. The maximum and minimum magnitudes in columns 5 and 6 of the Table are taken as determined by Hipparcos. Columns 9 and 10 give the parallax value and its standard error in milliarcseconds (mas).

We have also selected a set of poorly observed stars that have neither spectroscopic nor photometric orbit solutions what has been validated by search in the SIMBAD database. Such objects have been marked by exclamation marks between columns 8 and 9.

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REFERENCES

Andersen, J. 1991, Astron. Astrophys. Rev., 3, 91.
Armstrong, J.T., Mozurkewich, D., Pauls, T.A., and Hajian, A.R. 1998, Proc. SPIE, 3350, 461.
Baker, R.H. 1910, Publ. Allegheny Obs., 1, 163.
Barnes, T.G., and Evans, D.S. 1976, MNRAS, 174, 489.
Barnes, T.G., Evans, D.S. and Moffett, T.J. 1978, MNRAS, 183, 285.
Benson, J.A., et al. 1997, Astron. J., 114, 1221.
Beuermann, K., Baraffe, I., and Hauschildt, P. 1999, Astron. Astrophys., 348, 524.
Blackwell, D.E., and Shallis, M.J. 1977, MNRAS, 180, 177.
Blackwell, D.E., and Lynas-Gray, A.E. 1994, Astron. Astrophys., 282, 899.
Brancewicz, H.K., and Dworak, T.Z. 1987, Acta Astron., 30, 501.
Davis, J. 1977, "Fundamental Stellar Properties: The Interaction Between Observation and Theory", IAU Symposium No. 189, Ed. T.R. Bedding, A.J. Booth and J. Davis, (Kluwer Academic Publishers), 31.
de Vaucouleurs, G. 1978, Astrophys. J., 223, 730.
Di Benedetto, G.P. 1998, Astron. Astrophys., 339, 858.
Dworak, T.Z. 1974, Acta Cosmologica, 2, 13.
Dworak, T.Z. 1975, Acta Astron., 25, 383.
Dworak, T.Z., and Oblak, E. 1987, IBVS, No. 2991.
Dworak, T.Z., and Oblak, E. 1989, IBVS, No. 3399.
ESA 1997, The Hipparcos and Tycho Catalogues, ESA-SP1200.
Fouquê, P., and Gieren, W.P. 1997, Astron. Astrophys., 320, 799.
Gaposchkin, S.I. 1933, Astron. Nachr., 248, 213.
Gaposchkin, S.I. 1938, Harvard Reprint, No. 151.
Gaposchkin, S.I. 1940, Harvard Reprint, No. 201.
Gaposchkin, S.I. 1962, Astron. J., 67, 358.
Gaposchkin, S.I. 1968, P.A.S.P., 80, 558.
Gaposchkin, S.I. 1970, IBVS, No. 496.
Hajian, A.R., et al. 1998, Astrophys. J., 496, 484.
Hummel, C.A., Mozurkewich, D., Armstrong, T.J., Hajian, A.R., and Elias II, N.M., and Hutter, D.J. 1998, Astron. J., 116, 2536.
Hanbury Brown, R., Davis, J., and Allen, L.R. 1974, MNRAS, 167, 121.
Kopal, Z. 1939, Astrophys. J., 90, 281.
Lacy, C.H. 1977, Astrophys. J., 213, 458.
Lacy, C.H. 1979, Astrophys. J., 228, 817.
Paczyński, B. 1997, "The Extragalactic Distance Scale", STScI Symp. Ser. 10, Ed. M. Livio, M. Donahue and N. Panagia (Cambridge University Press), 273.
Pauls, T.A., Mozurkewich, D., Armstrong, J.T., Hummel, C.A., Benson, J.A., and Hajian, A.R., 1998, Proc. SPIE, 3350, 467.
Piórowski, K. 1936, Zeitschr. Astrophys., 11, 267.
Popper, D.M. 1980, Ann. Rev. Astron. Astrophys., 18, 115.
Popper, D.M. 1998, P.A.S.P., 110, 919.
Ribas, I., Giménez, A., Torra, J., Jordi, C., and Oblak, E. 1998, Astron. Astrophys., 330, 600.
Richichi, R. 1977, "Fundamental Stellar Properties: The Interaction Between Observation and Theory", IAU Symposium No. 189, Ed. T.R. Bedding, A.J. Booth and J. Davis,
Ridgway, S.T., Joyce, R.R., White, N.M., and Wing, R.F. 1980, *Astrophys. J.*, 235, 126.
Russell, H.N., Dugan, R.S., and Stewart, J.Q. 1927, "Astronomy" II, (Ginn and Company), 750.
Schlesinger, F. and Curtiss, R.H. 1908, *Publ. Allegheny Obs.*, 1, 25.
Stebbins, J. 1910, *Astrophys. J.*, 32, 185.
Stebbins, J. 1911, *Astrophys. J.*, 34, 112.
Vogel, H.C. 1890, *Astron. Nachr.*, 123, 289.
Woolley, R.v.d.R. 1934, *MNRAS*, 94, 713.