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# PHOTOELECTRIC MINIMA OF 30 ECLIPSING BINARY SYSTEMS

We present 70 minima observations of 30 eclipsing binary systems, not yet published anywhere. Most of the observed systems are apsidal motion stars (or at least eccentric or candidate stars) selected from the listing of Hegedüs (1988). Some minima observations are part of complete light curve coverages.

One part of the observations was carried out at Piszkéstető Mountain Observing Station of the Konkoly Observatory of the Hungarian Academy of Sciences with a 20 in. f/15 Cassegrain telescope. The photometer used was equipped with an unrefrigerated EMI9058QB photomultiplier tube and Schott UG2 (for U), BG12+GG13 (for B) and GG11 (for V) filters. This system is referred to as Pi50 in Table 1. Another part of the observations was made at Konkoly Observatory (Budapest Szabadsághegy). The photometer was equipped with an unrefrigerated EMI9502B tube, Schott UG1 (for U), BG12+GG13 (for B) and GG11 (for V) filters, and mounted in the f/6 Newtonian focus of the 24 in. telescope (see eg. Szeidl et al. 1992). This system is marked as Bp60 in Table 1. Most of the measurements were made at Baja Astronomical Observatory with a Starlight-I photometer, equipped with an unrefrigerated EMI9924A multiplier tube and Schott filters UG1 (matching Johnsonian U), GG400+BG25 (matching B) and OG515 (matching V), mounted on the 16 in. Cassegrain f/14 telescope of JATE (Szeged) and later on the 20 in. f/8.4 Ritchey-Chrétien telescope (Ba40 and Ba50 in Table 1, respectively). The system signed as Ba40 was described by Hegedüs (1987). The XZ And and CC Her minima were measured with an ST-5 unfiltered CCD camera installed on the 20 in. RC telescope.

The observations were made between 1987-1996. Reduction of the photoelectric data was made by standard procedures. For the reduction of the CCD frames we used the IMAGINE-32 software. All the minima times were computed using the parabolic fitting method. The times are heliocentric-corrected ones.

Table 1 presents the derived minima times. The content of the first two columns is self-explaining. In the third column the types of minima are marked (I for primary, and II for secondary ones), while in the fourth column the number of individual data involved in the parabolic fit is given. The columns from fifth to seventh describe the filters used, the first three letters of the observers' names and the codes of the instrumentation. The last column contains the comparisons (and occasional check stars) used, identified by their BD or GSC numbers. This work was partly supported by the National Grants OTKA-T4330 and OTKA-F007318 and the Local Government of Bács-Kiskun County.

Table 1

| Star | Min. HJD +2400000 | Min. type | Points used | Filter | Obs.'s name | Instr. | Comp. | Check |
|---|---|---|---|---|---|---|---|---|
| XZ And | 49651.4992 | I | 22 | - | Bor | Ba50 (ST5) | 2824+1544 | |
| | 49655.5713 | I | 16 | - | Bor | Ba50 (ST5) | | |
| V889 Aql | 48755.4814 | II | 74 | V | Heg | Pi50 | BD+15°3754 | |
| | 48755.4849 | II | 74 | B | Heg | Pi50 | | |
| | 48755.4793 | II | 74 | U | Heg | Pi50 | | |
| SS Ari | 50043.2785 | I | 21 | V | Bor | Pi50 | BD+23°284 | BD+23°277 |
| | 50043.2774 | I | 21 | B | Bor | Pi50 | | |
| | 50043.4792 | II | 34 | V | Bor | Pi50 | | |
| | 50043.4812 | II | 34 | B | Bor | Pi50 | | |
| | 50045.5112 | II | 29 | V | Bor+Bir | Pi50 | | |
| | 50045.5113 | II | 34 | B | Bor+Bir | Pi50 | | |
| AS Cam | 47524.2763 | II | 32 | V | Heg | Ba40 | BD+69°317 | |
| | 47524.2753 | II | 32 | B | Heg | Ba40 | | |
| | 48639.3418 | II | 50 | V | Heg | Pi50 | | |
| | 48639.3421 | II | 50 | B | Heg | Pi50 | | |
| | 49749.4581 | I | 59 | V | Bor | Pi50 | | |
| | 49749.4586 | I | 54 | B | Bor | Pi50 | | |
| | 49749.4576 | I | 54 | U | Bor | Pi50 | | |
| | 50001.4341: | II | 72 | V | Bor | Ba50 | | |
| | 50001.4337: | II | 72 | B | Bor | Ba50 | | |
| | 50003.3399 | I | 72 | V | Bor | Ba50 | | |
| | 50003.3406 | I | 72 | B | Bor | Ba50 | | |
| RZ Cas | 48854.4354 | II | 97 | V | Heg+Bor | Pi50 | BD+67°215 | |
| | 48854.4270 | II | 97 | B | Heg+Bor | Pi50 | | |
| | 48857.4195 | I | 24 | V | Heg+Bor | Pi50 | | |
| | 48857.4197 | I | 25 | B | Heg+Bor | Pi50 | | |
| | 49956.4592 | II | 50 | V | Bor | Ba50 | | |
| | 49956.4609 | II | 112 | B | Bor | Ba50 | | |
| | 49956.4622 | II | 112 | U | Bor | Ba50 | | |
| | 49968.4105 | II | 47 | V | Bor | Ba50 | | |
| | 49968.4038 | II | 47 | B | Bor | Ba50 | | |
| | 49968.4127 | II | 47 | U | Bor | Ba50 | | |
| | 49984.5487 | I | 40 | V | Bir | Ba50 | | |
| | 49984.5485 | I | 40 | B | Bir | Ba50 | | |
| | 49990.5260 | I | 32 | V | Bor | Ba50 | | |
| | 49990.5259 | I | 31 | B | Bor | Ba50 | | |
| | 50142.3223 | I | 40 | V | Bir | Ba50 | | |
| | 50142.3224 | I | 41 | B | Bir | Ba50 | | |
| TV Cas | 50096.4287: | I | 45 | V | Bor | Ba50 | BD+58°024 | |
| | 50096.4238: | I | 46 | B | Bor | Ba50 | | |
| TW Cas | 50088.4010 | I | 61 | V | Bir | Ba50 | BD+64°337 | |
| | 50088.3987 | I | 108 | B | Bir | Ba50 | | |
| | 50095.5448 | I | 65 | V | Bir | Ba50 | | |
| | 50095.5454 | I | 63 | B | Bir | Ba50 | | |
| VW Cep | 47153.2969 | II | 88 | V,B | Heg | Ba40 | BD+75°765 | |
| | 47153.4303 | I | 33 | V,B | Heg | Ba40 | | |
| | 47263.3656 | I | 81 | V,B | Heg | Ba40 | | |
| | 47263.5057 | II | 97 | V,B | Heg | Ba40 | | |
| | 47293.4235 | I | 33 | V,B | Heg | Ba40 | | |
| | 47352.4255 | I | 52 | V,B | Heg | Ba40 | | |
| | 47353.3999 | II | 57 | V,B | Heg | Ba40 | | |

Table 1 (cont.)

| Star | Min. HJD +2400000 | Min. type | Points used | Filter | Obs.'s name | Instr. | Comp. | Check |
|---|---|---|---|---|---|---|---|---|
| XX Cep | 50047.3571 | I | 56 | V | Bir | Pi50 | BD+63°2030 | |
| | 50047.3559 | I | 56 | B | Bir | Pi50 | | |
| EK Cep | 47393.3960 | I | 30 | V | Heg | Ba40 | BD+68°1239 | |
| | 47393.3959 | I | 30 | B | Heg | Ba40 | | |
| | 47444.5074 | II | 91 | V | Heg | Ba40 | | |
| | 47444.5087 | II | 92 | B | Heg | Ba40 | | |
| | 47911.4469 | I | 24 | V | Heg | Ba40 | | |
| | 47911.4467 | I | 24 | B | Heg | Ba40 | | |
| | 48429.4992 | I | 30 | V | Heg | Ba40 | | |
| | 48429.4975 | I | 30 | B | Heg | Ba40 | | |
| | 48500.3451 | I | 28 | B | Heg | Ba40 | | |
| | 48500.3453 | I | 28 | V | Heg | Ba40 | | |
| | 48511.5957 | II | 30 | V | Heg | Ba40 | | |
| | 50138.6288 | I | 27 | V | Bor | Ba50 | | |
| | 50138.6285 | I | 27 | B | Bor | Ba50 | | |
| GK Cep | 50033.5048: | I | 26 | V | Bir | Ba50 | BD+70°1182 | |
| | 50033.5055: | I | 26 | B | Bir | Ba50 | | |
| CG Cyg | 48840.5135 | I | 24 | V | Par | Bp60 | BD+34°4224 | BD+34°4232 |
| | 48840.5139 | I | 21 | B | Par | Bp60 | | |
| | 48840.5153 | I | 17 | U | Par | Bp60 | | |
| DK Cyg | 48841.5024 | I | 30 | V | Par | Bp60 | BD+34°4465 | |
| | 48841.5028 | I | 35 | B | Par | Bp60 | | |
| MR Cyg | 50044.3227: | I | 27 | B | Bir | Ba50 | BD+47°3622 | |
| | 50044.3258: | I | 18 | B | Bor | Pi50 | | |
| V836 Cyg | 48833.4300 | I | 42 | V | Par | Bp60 | BD+35°4461 | BD+35°4460 |
| | 48833.4291 | I | 42 | B | Par | Bp60 | | |
| V1143 Cyg | 48409.4176 | I | 41 | V | Heg | Ba40 | BD+55°2213 | |
| | 48409.4175 | I | 42 | B | Heg | Ba40 | | |
| | 48430.3590 | II | 54 | B | Heg | Ba40 | | |
| | 48537.2846 | II | 53 | V | Heg | Ba40 | | |
| | 48537.2885 | II | 52 | B | Heg | Ba40 | | |
| TZ Dra | 49120.5168 | I | 31 | V | Par | Bp60 | BD+47°2626 | BD+47° 2624 |
| | 49120.5169 | I | 32 | B | Par | Bp60 | | |
| | 49120.5189 | I | 16 | U | Par | Bp60 | | |
| RW Gem | 50046.6214 | I | 32 | V | Bir | Pi50 | BD+23°1161 | BD+23° 1154 |
| AK Her | 49818.5410 | I | 31 | V | Bor | Pi50 | BD+16°3123 | |
| | 49818.5424 | I | 31 | B | Bor | Pi50 | | |
| | 49818.5425 | I | 31 | U | Bor | Pi50 | | |
| | 49867.4375 | I | 32 | V | Bor | Ba50 | | |
| | 49867.4383 | I | 32 | B | Bor | Ba50 | | |
| | 49886.4069 | I | 29 | V | Bor | Ba50 | | |
| | 49886.4063 | I | 26 | B | Bor | Ba50 | | |
| CC Her | 49876.5413 | I | 38 | - | Par | Ba50 (ST5) | 0956+1166 | |
| DI Her | 48128.4574 | II | 31 | V | Heg | Ba40 | BD+24°3555 | |
| | 48128.4555 | II | 32 | B | Heg | Ba40 | | |
| | 48856.4202 | II | 15 | V | Heg+Bor | Pi50 | | |
| | 48856.4201 | II | 15 | B | Heg+Bor | Pi50 | | |
| | 48856.4132 | II | 31 | U | Heg+Bor | Pi50 | | |
| HS Her | 49811.5528 | II | 72 | V | Bor | Ba50 | BD+24°3545 | |
| | 49811.5456: | II | 74 | B | Bor | Ba50 | | |
| | 49861.5015 | I | 64 | V | Bor | Ba50 | | |
| | 49861.5004 | I | 64 | B | Bor | Ba50 | | |

Table 1 (cont.)

| Star | Min. HJD +2400000 | Min. type | Points used | Filter | Obs.'s name | Instr. | Comp. | Check |
|---|---|---|---|---|---|---|---|---|
| AR Lac | 49998.4063: | I | 110 | V | Bor | Ba50 | BD+47°3711 | |
| | 49998.4084: | I | 111 | B | Bor | Ba50 | | |
| UV Leo | 50080.5871 | I | 32 | V | Bor | Ba50 | BD+14°2277 | |
| | 50080.5872 | I | 32 | B | Bor | Ba50 | | |
| | 50139.3935 | I | 51 | V | Bir | Ba50 | | |
| | 50139.3932 | I | 46 | B | Bir | Ba50 | | |
| FT Ori | 47482.5449 | I | 22 | V | Heg | Ba40 | BD+22°1250 | |
| | 47482.5451 | I | 22 | B | Heg | Ba40 | | |
| | 50138.3534: | I | 29 | V | Bor | Ba50 | | |
| | 50138.3508: | I | 29 | B | Bor | Ba50 | | |
| U Peg | 49979.5645 | II | 38 | V | Bor | Pi50 | BD+15°4903 | |
| | 49979.5653 | II | 38 | B | Bor | Pi50 | | |
| AG Per | 47118.4536 | I | 34 | V | Heg | Ba40 | BD+32°714 | |
| | 47529.3656 | II | 41 | V | Heg | Ba40 | | |
| | 47529.3666 | II | 55 | B | Heg | Ba40 | | |
| | 47530.2869 | I | 36 | V | Heg | Ba40 | | |
| | 47530.2860 | I | 37 | B | Heg | Ba40 | | |
| | 47897.4892 | I | 38 | V | Heg | Ba40 | | |
| | 47897.4858 | I | 38 | B | Heg | Ba40 | | |
| | 50018.6111 | II | 72 | V | Bor | Ba50 | | |
| | 50018.6088 | II | 72 | B | Bor | Ba50 | | |
| | 50080.4111 | I | 80 | V | Bor | Ba50 | | |
| | 50080.4086 | I | 80 | B | Bor | Ba50 | | |
| IQ Per | 50047.6185 | I | 64 | V | Bir | Pi50 | BD+47°0923 | |
| | 50047.6172 | I | 64 | B | Bir | Pi50 | | |
| | 50061.5687 | I | 62 | V | Bir | Ba50 | | |
| | 50061.5687 | I | 52 | B | Bir | Ba50 | | |
| | 50061.5685 | I | 54 | U | Bir | Ba50 | | |
| b Per | 50022.5429: | I | 53 | V | Bir | Ba50 | BD+49°1155 | BD+49°1154 |
| TX UMa | 50141.4519 | I | 68 | V | Bir | Ba50 | BD+47°1797 | |
| | 50141.4515 | I | 73 | B | Bir | Ba50 | | |

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