# CCD MINIMA OF ECLIPSING BINARY STARS

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We present 76 CCD minimum times of eclipsing binaries collected during a campaign of Unione Astrofili Italiani (UAI). The data cover time span from May 2003 to October 2009.

All the observations were made by private observatories. 25 light curves were remotely obtained (via Internet) by using the Italian and Australian telescopes of the Skylive-UAI Project, that are publicly available on the web site `www.skylive.it`.

All moments of minimum presented in Table are heliocentric.

Both geocentric and heliocentric photometric data can be requested via e-mail to Giuseppe Marino (`giumar69@gmail.com`).

| Observatory and telescope: |
| --- |
| 40-cm Ritchey–Chrétien telescope (RC40) of Lumezzane Observatory (Italy) |
| 30-cm Schmidt–Cassegrain, 20-cm Newton–Cassegrain and 9-cm apochromatic refractor telescopes (SC30, NC20, Rfr9, respectively) of the Skylive-UAI Project (Italy) |
| 13-cm and 9-cm apochromatic refractor telescopes (AP13 and AP9, respectively) |
| 25-cm and 23-cm Schmidt–Cassegrain telescopes (SC25 and SC23, respectively) |
| 20-cm Newton telescope (NW20) |
| 8-cm semi-apochromatic refractor telescope (ED8) |

| Detector: | |
| --- | --- |
| | Kaf400e CCD camera (Kaf) |
| | SBIG ST-10XME CCD camera (ST10) |
| | Starlight XPress HX916 CCD camera (HX916) |
| | HiSis23 CCD camera (HiS23) |
| | SBIG ST-7XME CCD Camera (ST7) |
| | Meade DSI Pro II Monochromatic CCD camera (DSI) |

**Method of data reduction:**

Data reduction, consisting in differential photometry on each CCD image, was made by means of the softwares Maxim DL, Iris (occasionally) and, in one case, AIP. When dark and flat field corrections were not been performed, the flatness of the interested detector's area and/or the stability of the comparison–check stars were accurately checked. No reduction to photometric standard system was performed.

**Method of minimum determination:**

The minimum times (in days) reported in Table were computed by KvW method (Kwee & van Woerden, 1956) and, occasionally, by Avalon neuronal networks fitting program (Gaspani, 1995). For the KvW method we used a DOS program available at AAVSO, whose results were found to be consistent with those produced by the AVE (Barberá, 1996) and Peranso (`www.peranso.com`) softwares.

The error in the timing of each minimum was determined following Arlot's method (Arlot *et al.*, 2009): we calculated the noise on magnitudes from their standard deviation $\sigma_m$ within a stable range of the light curve (at the deepest part of the minimum or at the maximum) and transformed it into an error time, through the value of the speed of decrease in magnitude $\frac{\Delta m}{\Delta t}$, by adopting the formula $\sigma_{ToM} = \frac{\sigma_m}{\Delta m}\Delta t$.

The effects of different data sampling/selection and of asymmetry of some minima were evaluated in a sample of light curves and found within the reported errors.

We note that the errors in Table do *not* include systematic errors, depending on the time synchronization accuracy (estimated within ±0.5 s), the shutter latency time (measured between −0.2 to −0.5 s) and the difference between the heliocentric and the barycentric light time (up to ∼ 5 s).

The type of each minimum is assumed according to the updated elements of Kreiner (2004).

**Times of minima:**

| Star name | Time of min. HJD 2400000+ | Error | Type | Filter | Rem. |
|---|---|---|---|---|---|
| AB And | 55111.3770 | 0.0007 | I | | Sal-Los/SC23/ST7 |
| OO Aql | 52784.5735 | 0.0005 | I | *V* | Fog-Cre/RC40/Kaf |
| | 53184.4335 | 0.0006 | I | *V* | Pap/SC25/HX916 |
| | 53218.3895 | 0.0008 | I | *V* | Pap/SC25/HX916 |
| | 53220.4148 | 0.0005 | I | | Ben *et al.*/AP13/ST10 |
| | 53258.4244 | 0.0006 | I | *V* | Pap/SC25/HX916 |
| | 53591.387 | 0.001 | I | *V* | Pap/SC25/HX916 |
| | 53966.4152 | 0.0006 | I | *RG9* | Mil/NW20/HiS23 |
| | 53967.429 | 0.001 | I | *-IR* | Bel/AP9/ST7 |
| | 53968.4424 | 0.0005 | I | *-IR* | Bel/AP9/ST7 |
| | 54000.3692 | 0.0002 | I | *V* | Pap/SC25/HX916 |
| | 54978.4790 | 0.0004 | I | | Sal/SC23/ST7 |
| ZZ Aur | :54529.3864 | 0.0003 | I | | Sal/SC30/ST10 |
| TY Boo | 54639.3687 | 0.0001 | I | *R* | Mar/SC30/ST10 |
| TZ Boo | :54642.422 | 0.001 | I | *R* | Mar/SC30/ST10 |
| VW Boo | 54610.3792 | 0.0007 | I | *-IR* | Sal/AP9/ST7 |
| AC Boo | 54938.3649 | 0.0005 | II | *R* | Sal-Los/SC23/ST7 |
| CW Cas | 55023.4699 | 0.0007 | I | | Are/NW20/DSI |
| V523 Cas | 55022.5079 | 0.0003 | II | | Are/NW20/DSI |
| BE Cep | 55009.4351 | 0.0009 | I | | Are/NW20/DSI |
| CW Cep | 53972.542 | 0.003 | I | | Mar-Los/SC25/ST7 |
| GK Cep | 53971.513 | 0.004 | II | | Mar-Los/SC25/ST7 |
| | 54001.470 | 0.004 | II | | Mar-Sal/SC23/ST7 |

**Times of minima:**

| Star name | Time of min. HJD 2400000+ | Error | Type | Filter | Rem. |
|---|---|---|---|---|---|
| RW CrB | 54572.431 | 0.001 | I | | Sal/SC30/ST10 |
| VZ CVn | 54191.4775 | 0.0009 | I | | Mar/NC20/ST10 |
| GM Cyg | 54974.579 | 0.001 | I | | Mar/NW20/ST7 |
| GO Cyg | 54715.475 | 0.001 | I | | Are/NW20/ST7 |
| V548 Cyg | 54318.498 | 0.001 | I | | Mar/SC23/ST7 |
| | 54652.4695 | 0.0007 | I | $R$ | Are/SC30/ST10 |
| V836 Cyg | 54319.4897 | 0.0008 | I | | Mar/SC23/ST7 |
| | 55006.554 | 0.002 | II | | Are/NW20/DSI |
| RZ Dra | 54641.4491 | 0.0003 | I | $R$ | Mar/SC30/ST10 |
| UX Eri | 54791.2726 | 0.0009 | II | | Sal/SC23/ST7 |
| QW Gem | 54544.3746 | 0.0009 | I | | Sal-Mar/SC30/ST10 |
| SZ Her | 54905.5884 | 0.0004 | I | | Are/NW20/DSI |
| AK Her | 54198.5863 | 0.0009 | I | $-IR$ | Mar/AP9/ST7 |
| V829 Her | 54938.476 | 0.002 | I | $R$ | Sal-Los-Mar/SC23/ST7 |
| SW Lac | 54327.4341 | 0.0004 | II | | Mar/SC23/ST7 |
| | 54327.5955 | 0.0003 | I | | Mar/SC23/ST7 |
| | 54718.3917 | 0.0008 | II | | Are/NW20/ST7 |
| XY Leo | 54954.429 | 0.001 | I | | Are/NW20/DSI |
| DU Leo | 54157.3373 | 0.0009 | I | | Mar/NC20/ST10 |
| | 54201.3100 | 0.0007 | I | | Mar/NC20/ST10 |
| VZ Lib | 54667.3531 | 0.0007 | II | | Sal/SC23/ST7 |
| VW LMi | 54192.352 | 0.001 | II | | Mar/NC20/ST10 |
| UV Lyn | 54164.293 | 0.003 | I | $-IR$ | Mar/AP9/ST7 |
| V400 Lyr | 55014.433 | 0.001 | II | | Are/NW20/DSI |
| | 55014.559 | 0.001 | I | | Are/NW20/DSI |
| | 55015.446 | 0.001 | II | | Are/NW20/DSI |
| | 55015.573 | 0.002 | I | | Are/NW20/DSI |
| V576 Lyr | 54978.4373 | 0.002 | I | | Sal-Los/SC23/ST7 |
| V508 Oph | 54721.3643 | 0.0007 | II | $R$ | Sal-Are/NW20/ST7 |
| V839 Oph | 54938.536 | 0.001 | I | $R$ | Sal-Los-Mar/SC/ST7 |
| ER Ori | 54791.4350 | 0.0002 | II | | Sal/SC23/ST7 |
| AQ Peg | 54001.365 | 0.001 | I | $V$ | Pap/SC25/HX916 |
| AT Peg | 54379.3224 | 0.001 | I | | Zar/NC20/ST10 |
| IP Peg | 54413.4150 | 0.0001 | I | | Sal-Mar/SC23/ST7 |
| V357 Peg | 54373.326 | 0.003 | I | | Sal/SC23/ST7 |
| | 54375.353 | 0.002 | II | | Sal/SC23/ST7 |
| AZ Pup | 54542.026 | 0.004 | I | | Sal/SC30/ST10 |
| AU Ser | 54978.3680 | 0.0006 | II | | Sal-Los/SC23/ST7 |
| AH Tau | 54513.3391 | 0.0004 | I | | Sal/SC30/ST10 |
| AN Tau | 54447.403 | 0.001 | I | | Sal/SC30/ST10 |
| RV Tri | 53746.3086 | 0.0002 | I | $V$ | Pap/SC25/HX916 |
| | 54018.3813 | 0.0005 | I | $V$ | Pap/SC25/HX916 |
| W UMa | 54200.3725 | 0.0005 | I | $-IR$ | Mar/AP9/ST7 |
| | 54952.3869 | 0.001 | I | | Mar *et al.*/ED8/HX916 |
| XZ UMa | 54174.5341 | 0.0009 | I | | Bel/NC20/ST10 |
| RU UMi | 54173.5540 | 0.0007 | I | $R$ | Bel/NC20/ST10 |
| AG Vir | 54620.386 | 0.004 | I | | Sal-Mar-Los/SC23/ST7 |
| AH Vir | 54161.6242 | 0.0006 | II | $-IR$ | Mar/AP9/ST7 |
| AX Vir | 54571.3490 | 0.0009 | I | | Sal/SC30/ST10 |
| HT Vir | 54974.418 | 0.002 | I | | Mar/NW20/ST7 |
| NN Vir[a] | 54159.636 | 0.003 | I | | Mar/NC20/ST10 |
| Z Vul | 53945.5753 | 0.0004 | I | | Mar/SC25/ST7 |
| | 54662.4148 | 0.0007 | I | $R$ | Are/SC30/ST10 |

**Explanation of the remarks in the table:**
Observer[s] (as the first letters of authors' surname)/Telescope/Detector
$^a$ + TYC 323.830.1
: uncertain

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