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Minima of eclipsing binary stars

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Type(s): Binaries: eclipsing

Keyword(s): CCD photometry, eclipsing binaries, times of minima

Abstract: We present several CCD minima observations of eclipsing binaries.

The list below contains 98 times of minima for 59 eclipsing binary stars calculated from CCD observations made by participants in the SSV-UAI Eclipsing Binaries Program. Except for two (Univ. College London Obs. and Univ. Siena Obs.) all the observatories are privately operated. Some light curves were remotely obtained (via Internet) using the UAI Remote Telescope, that is publicly available on the web site www.skylive.it.

The observations were reduced following standard procedures (see next section) and the light curves were analyzed using the Kwee-van Woerden algorithm (Kwee & van Woerden, 1956) to determine the times of minima. All the times of minima listed in this paper are heliocentric. It is worth noting that most of the observed stars are neglected objects.

Observatory and telescope: 36-cm Schmidt-Cassegrain (SC36)

30-cm Schmidt-Cassegrain (SC30)

25-cm Schmidt-Cassegrain (SC25)

25-cm Newton (N25)

23-cm Schmidt-Cassegrain (SC23)

20-cm Schmidt-Cassegrain (SC20)

20-cm Newton (N20)
13-cm Maksutov-Cassegrain (MC13)

Detector:

Meade DSI Pro II Monochromatic CCD camera (DSI) QSI 516wsg CCD camera (QSI)
SBIG ST-7 CCD camera (ST7)
SBIG ST-8XME CCD camera (ST8)
SBIG ST-9 CCD camera (ST9)
SBIG STL-6303 CCD camera (STL)
Sony ICX429ALL based CCD camera (UAI)
Canon Eos 1100D DSLR (Eos)

Method of data reduction: Frame calibration (dark subtraction and flat field correction) and photometric analysis (differential photometry on each image) were performed using MaxIm DL or Mira Pro software packages.

Method of minimum determination: Times of minima, expressed as Heliocentric Julian Day (see the attached Table), were computed adopting the KW method (Kwee & van Woerden, 1956) using AVE (Barberá, 1996). This algorithm also provides an error estimate, that is the formal internal error of the KW method, which can be considered as a lower limit of the actual uncertainty on times of minima. Together with that error we provide, as upper limit of the uncertainty, an alternative estimate error according to the Arlot's (modified) method (Arlot et al., 2009) by adopting the formula $\{\sigma\}_{\text{ToM}} = 1/\sqrt{2}\{\sigma\}_m/\{\Delta\}_m\{\Delta\}_t$, where $\{\sigma\}_m$ is the average error in magnitude and $\{\Delta\}_m$ is the magnitude drop during a time range $\{\Delta\}_t$ delimiting the part of the light curve where the speed of decrease in magnitude is the highest.

Times of minima

Name	Time of min. (24...)	Error	Type	Filter	Rem.
V473 And	56185.5181	0.0004 ^a 0.0001 ^b	I	c	Banfi/SC25/ST7
V473 And	56186.3198	0.0007 0.0004	I	V	Corfini/N20/UAI
V473 And	56553.3065	0.0010 0.0002	II	c	Cervoni/SC36/ST8
V473 And	56644.4018	0.0015 0.0003	II	V	Barbieri/SC30/ST9
V608 Aur	56280.3285	0.0001 0.0001	i	c	Ruocco/SC25/ST7
V609 Aur	56280.3732	0.0003 0.0002	I	c	Ruocco/SC25/ST7
V609 Aur	56280.6120	0.0015 0.0005	II	c	Ruocco/SC25/ST7
V618 Aur	56290.3306	0.0006 0.0004	i	c	Ruocco/SC25/ST7
AQ Boo	56474.3809	0.0004 0.0004	ii	c	Salvaggio/SC23/ST8
IW Boo	56416.4280	0.0022 0.0005	I	V	Banfi/SC25/ST7
IW Boo	56416.5582	0.0009 0.0003	II	V	Banfi/SC25/ST7
LY Boo	56426.4597	0.0010 0.0007	i	c	Ruocco/SC25/ST7

MT Boo	56433.3348	0.0013 0.0010	ii	c	Ruocco/SC25/ST7
OQ Cam	56371.3541	0.0005 0.0001	i	c	Salvaggio/SC23/ST8
GO Cnc	56348.3574	0.0011 0.0002	i	V	Marino/N25/ST7
EX CVn	56395.4009	0.0012 0.0004	ii	c	Ruocco/SC25/ST7
SU Cep	56633.2807	0.0002 0.0001	I	R	Marino et al./N25/ST7
VW Cep	56451.4689	0.0033 0.0002	i	c	Bonaventura/MC13/Eos
V737 Cep	56141.4078	0.0010 0.0006	ii	V	Aceti et al./SC20/ST8
UCAC4 737-078030	56633.2715	0.0036 0.0006	I	R	Marino/N25/ST7
UCAC4 737-078030	56637.3727	0.0067 0.0005	II	R	Marino/N25/ST7
UCAC4 737-078030	56639.3136	0.0076 0.0003	I	R	Marino/N25/ST7
UCAC4 737-078030	56644.2780	0.0060 0.0006	II	R	Marino/N25/ST7
AS CrB	56446.3428	0.0004 0.0006	i	c	Ruocco/SC25/ST7
LN Cyg	56521.3706	0.0004 0.0003	I	c	Ruocco/SC25/ST7

Times of minima

Name	Time of min. (24...)	Error	Type	Filter	Rem.
PY Cyg	56498.4447	0.0027 0.0004	i	c	Ruocco/SC25/ST7
V447 Cyg	56136.4345	0.0007 0.0002	i	c	Ruocco/SC25/ST7
V456 Cyg	56153.3446	0.0004 0.0007	ii	V	Salvaggio/SC23/ST7
V869 Cyg	56471.4078	0.0014 0.0004	i	c	Ruocco/SC25/ST7
V884 Cyg	56455.3963	0.0006 0.0004	ii	c	Salvaggio/SC23/ST8
V931 Cyg	56456.4112	0.0002 0.0001	i	c	Salvaggio/SC23/ST8
V979 Cyg	56454.4075	0.0003 0.0003	ii	c	Salvaggio/SC23/ST8
V1044 Cyg	56185.3528	0.0012 0.0006	i	V	Martinengo/SC20/QSI
V1045 Cyg	56185.4878	0.0005 0.0005	ii	V	Martinengo/SC20/QSI
V1187 Cyg	56138.3541	0.0010 0.0003	i	c	Corfini/N20/UAI
V1187 Cyg	56523.3895	0.0017 0.0005	ii	V	Marino/N25/ST7
V1191 Cyg	56523.3831	0.0009 0.0003	ii	V	Marino/N25/ST7
V1457 Cyg	56137.4737	0.0004 0.0003	i	c	Ruocco/SC25/ST7
V1665 Cyg	56189.3146	0.0013 0.0002	i	c	Ruocco/SC25/ST7
V1870 Cyg	56508.5757	0.0014 0.0004	II	c	Ruocco/SC25/ST7
V1870 Cyg	56509.3678	0.0010 0.0008	II	c	Ruocco/SC25/ST7
V1870 Cyg	56512.5247	0.0015 0.0007	II	c	Ruocco/SC25/ST7
V1870 Cyg	56516.4742	0.0023 0.0006	II	c	Ruocco/SC25/ST7
V1870 Cyg	56518.4483	0.0002 0.0002	I	c	Ruocco/SC25/ST7
KIC 1061825	56451.5009	0.0004 0.0003	ii	c	Marino/N20/ST7
GSC 03089-01273	56129.5241	0.0002 0.0003	ii	c	Marino/N20/ST7
GSC 03089-01273	56129.5258	0.0013 0.0003	ii	c	Arena/N20/DSI
V1072 Her	56522.4967	0.0005 0.0001	I	V	Cervoni/SC36/ST8

V1072 Her	56533.3736	0.0025 0.0003 II	V	Cervoni/SC36/ST8
V1092 Her	56461.4064	0.0005 0.0003 i	V	Marino/N25/ST7
V1106 Her	56119.4252	0.0004 0.0002 ii	c	Corfini/N20/UAI
V1106 Her	56124.3921	0.0004 0.0003 i	c	Corfini/N20/UAI
V1106 Her	56126.4282	0.0014 0.0012 i	c	Banfi/SC25/ST7
V1106 Her	56126.5551	0.0006 0.0002 ii	c	Banfi/SC25/ST7
V1106 Her	56127.4476	0.0002 0.0002 i	c	Corfini/N20/UAI
V1106 Her	56157.3617	0.0005 0.0003 ii	c	Corfini/N20/UAI
V1106 Her	56180.4048	0.0005 0.0002 i	c	Banfi/SC25/ST7
V1106 Her	56185.3682	0.0000 0.0001 ii	V	Corfini/N20/UAI
V1106 Her	56191.3523	0.0010 0.0003 i	V	Corfini/N20/UAI
V1106 Her	56203.3183	0.0005 0.0002 i	c	Corfini/N20/UAI
V1106 Her	56224.3210	0.0001 0.0003 ii	c	Zambelli/RC40/STL
V1106 Her	56459.4460	0.0005 0.0001 i	c	Marino/N25/ST7
V1106 Her	56499.4151	0.0028 0.0003 i	c	Barbieri/SC30/ST9
V1106 Her	56499.5518	0.0038 0.0005 ii	c	Barbieri/SC30/ST9
V1106 Her	56516.3489	0.0009 0.0001 ii	c	Barbieri/SC30/ST9
V1106 Her	56516.4762	0.0019 0.0003 i	c	Barbieri/SC30/ST9
V1106 Her	56528.4420	0.0015 0.0007 i	V	Cervoni/SC36/ST8
V1175 Her	56135.4275	0.0009 0.0002 I	V	Aceti et al./SC20/ST8
V1175 Her	56158.3929	0.0006 0.0002 II	c	Corfini/N20/UAI
UCAC4 638-056476	56129.5617	0.0013 0.0003 i	c	Marino/N20/ST7
VX Lac	56584.2572	0.0031 0.0011 ii	c	Ruocco/SC25/ST7
VY Lac	56269.2665	0.0004 0.0001 i	c	Salvaggio/SC23/ST8
UCAC4 708-102815	56598.4890	0.0037 0.0010 i	V	Marino/N25/ST7
UCAC4 708-102876	56598.5124	0.0048 0.0013 ii	V	Marino/N25/ST7
UCAC4 708-102942	56598.4101	0.0059 0.0016 i	V	Marino/N25/ST7
IW Lyr	56446.4314	0.0009 0.0007 II	c	Ruocco/SC25/ST7
IW Lyr	56448.4215	0.0003 0.0001 I	c	Ruocco/SC25/ST7
NS Lyr	56092.5440	0.0008 0.0005 i	c	Ruocco/SC25/ST7

Times of minima

Name	Time of min. (24...)	Error	Type	Filter	Rem.
QQ Lyr	56184.4009	0.0054 0.0017 II	c	Banfi/SC25/ST7	
QQ Lyr	56550.3634	0.0048 0.0003 I	c	Cervoni/SC36/ST8	
V417 Lyr	56459.4393	0.0003 0.0003 ii	c	Ruocco/SC25/ST7	
V417 Lyr	56459.5887	0.0003 0.0005 i	c	Ruocco/SC25/ST7	
V431 Lyr	56450.4307	0.0018 0.0005 ii	c	Ruocco/SC25/ST7	
V556 Lyr	56452.4622	0.0079 0.0003 i	c	Bonaventura/MC13/Eos	

V556 Lyr	56593.3241	0.0242 0.0002 ii	V	Marino/N25/ST7
V864 Mon	56354.3415	0.0004 0.0000 ii	V	Marino/N25/ST7
KN Per	56293.2412	0.0011 0.0008 ii	c	Ruocco/SC25/ST7
V880 Per	56274.2808	0.0009 0.0003 i	c	Ruocco/SC25/ST7
V912 Per	56265.3465	0.0005 0.0003 i	c	Ruocco/SC25/ST7
AH Tau	56322.4137	0.0006 0.0002 i	c	Salvaggio/SC23/ST8
EQ Tau	56290.4697	0.0004 0.0001 i	V	Marino/N20/ST7
IV Tau	56291.3029	0.0020 0.0004 i	c	Ruocco/SC25/ST7
V423 Tau	56281.4846	0.0021 0.0009 i	V	Corfini/N20/UAI
V423 Tau	56290.3501	0.0029 0.0002 i	c	Marino/N20/ST7
ES UMa	56342.4839	0.0007 0.0002 i	V	Arena, Fossey/SC36/STL
HW Vir	56417.3374	0.0003 0.0001 II	V	Banfi/SC25/ST7
HW Vir	56417.3957	0.0001 0.0000 I	V	Banfi/SC25/ST7
HW Vir	56417.4538	0.0004 0.0002 II	V	Banfi/SC25/ST7

Explanation of the remarks: Error:

^a Arlot's modified method, ^b as given by KW method

Type:

I [II] the deeper [shallower] minimum

i [ii] the type of minimum simply assumed at 0 [0.5] phase according to the ephemeris provided by Kreiner's (2004) web site or by B.R.N.O. - *O-C Gateway* web site

(<http://var.astro.cz/ocgate>), because:

- the two minima observed during one night had the same depth (for V1106 Her)
- only one minimum was observed or
- the minima were not covered enough to allow to deduce the relative depth.

Remark:

Observer[s]/Telescope/Detector

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