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Times of Minima of Selected Eclipsing Binaries Obtained in 2023-2024

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Abstract

We present 66 times of minima of 35 eclipsing binaries obtained with the IST40 telescope of the Istanbul University Observatory between May 2023 - May 2024.

Özet

Bu çalışmada İstanbul Üniversitesi Gözlemevinin İST40 teleskobuyla Mayıs 2023 -Mayıs 2024 tarihleri arasında 35 farklı örten çift yıldız için elde edilen 66 minimum zamanı sunulmaktadır.

Key words: binaries: eclipsing – methods: observational – techniques: photometric

1 Introduction

In the framework of monitoring variable stars from Istanbul University Observatory, we obtained minima times of various eclipsing binaries. Monitoring eclipse timings can be very useful as due to various mechanisms such binary systems show orbital period variations. These mechanisms can be caused by mass transfer between companions, magnetic activity, mass loss from the system or orbital period modulation due to an unseen companion. In the latter case, eclipse timings variation (ETV) is used as a fundamental tool to detect exoplanets or stellar third bodies.

Target systems were selected based on their brightness ($V<15$) and orbital period ($P< 1^{\rm d}$). Targets were selected from the General Catalogue of Variable Stars (GCVS) (Samus' et al. 2017) and The Zwicky Transient Facility Catalog of Periodic Variable Stars (Chen et al. 2020). As the transparency of the sky at the Beyazit Campus is very variable, we focus mainly on short period binaries displaying W UMa (EW) and Algol-type (EA) light variations in order to obtain their entire light curves or only minima profiles for the measurements of light minima of a given eclipsing binary in a single observation.

The variable star monitoring program is conducted as a training for the undergraduate students of the Astronomy and Space Sciences Department of Istanbul University. The program is performed mainly by the 2nd, 3rd and 4th-year students with an increasing interest from the junior and MSc students as well.

2 Observations and Data Reduction

All observations presented in this study were carried out with the 0.4m Schmidt-Cassegrain telescope (aka. IST40) of the Istanbul University Observatory. The telescope is located in the university campus at Beyazit, Istanbul (N 41°.01167, E 28°.96528, altitude 65 m).

Observations were performed with a thermoelectrically cooled CCD consisting a KAF-8300 chip which has 3358×2536 pixels. Pixel size of 5.4 μm yields 0″.27 pixel^{-1} resolution at the focal plane and this resolution allows to capture16″×12″ field of view.

All frames were bias, dark and flat-field corrected in a standard manner. Several bias and dark frames were combined in order to create a master calibration frame. Flat-fielding was performed using sky flats obtained at dusk. Calibration images were taken each observing night. The log of observations is given in Table 1.

Instrumental magnitudes were determined with aperture photometry using *Muniwin* software of the `C-Munipack` package (Hroch 2014). Photometry procedures of the `C-Munipack` package are based on the well-known `DAOPHOT` (Stetson 1987) package. To give an impression to the reader, we provide an example light curve of the V2822 Ori system in Fig. 1.

Minimum times of eclipsing binaries were computed with the help of Peranso software (Paunzen & Vanmunster 2016) which uses Kwee and van Woerden method (Kwee & van Woerden 1956). This method requires a homogeneous temporal coverage of the minimum light with an odd number of data points forming a symmetrical profile. Thus, we use the data halfway from the eclipse center at each side. In result, we omit eclipses when the descending or the ascending portion of the light curve is not complete. In this way, we ensure the precision of the minima times given in Table 2. All times in the table were converted into Heliocentric Julian Date (HJD).

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Table 1. Log of observations. Star name <ZTF> represents "ZTF J200814.08+173019.2". Observers are as follows; YD: Yasin Dalkılıç, CB: Canday Beyaz, MTS: Mustafa Turan Sağlam, EA: Esat Akkaşoğlu, ZT: Zafer Toy, MIE: Melike İlayda Eryılmaz, ANO: Aleyna Nur Öztürk, FIK: Fatmanur İlayda Keleş, ANA: Asuman Nura Altınöz, SE: Sedanur Eroğlu, HE: Hilal Erişti, MBB: Muhammed Baki Bayram, EC: Elif Çolak, OU: Özkan Utuş, SB: Safahan Başara, EG: Elanur Güler, SOT,SO: Sibel Ötken, SOZ: Sezer Özel, MI: Mehmet İçen, MA: Mübin Atmaca, SF: Sajed Fateh, IZK: İrem Zeynep Kelkitli, EED: Elif Ece Devecioğlu, YEC: Yunus Emre Çetinkaya, EbS: Ebubekir Şark, HK: Hasan Kalay, ES: Elif Şafak, BE: Burak Erdoğan, MuO: Muhammet Özcan, ZE: Zeynep Erol, EG: Ege Gültekin, RIC: Rabia İrem Çevik, IK: İrem Kişmir, AK: Ada Köken, VU: Volkan Uzuğ, BD: Batıkan Demirel, YAL: Yağız Altıkulaç, YA,YAV: Yusuf Avcıoğlu, LFT: Latife Fatıma Türkoğlu, SA: Samet Ayhan, ST: Sudenur Tırak, IE: Ilgın Ertekin, AK: Ayşenur Köse, OD: Özge Deveci, SK: Selin Kedik, SC: Sevgi Çulpan, AI: Aykut Işıktaş, II: İrem İlhan, KNK: Kifayet Nur Kın

Date (y-m-d)	JD Interval 2460000+	Duration (h)	Star	Variable Type	Number of Frames	Filter	Exp. Time (s)	Observers
2023-05-24	89.267537 - 89.471495	4.89	XY Boo	EW	268	I	50	EA,ES
2023-05-25	90.292382 - 90.465600	4.16	AR Boo	EW	200	V	60	MTS
2023-07-03	129.334238 - 129.462309	3.07	V2477 Cyg	EW	345	V	20	YD,SB,MIE,EED
2023-07-21	147.310103 - 147.547973	5.71	V626 Peg	EW	232	R	60	YEC,ANO,HE,CB
2023-07-22	148.328587 - 148.547849	5.26	V1828 Aql	EA	170	V	90	YD,SB,II
2023-07-30	156.295769 - 156.568038	6.53	V365 Sge	EW	210	V	90	YD,EG,IZK,SE,ZT,RIC,HE
2023-07-30	156.295769 - 156.568038	6.53	<ZTF>	EW	194	V	90	YD,EG,IZK,SE,ZT,RIC,HE
2023-08-02	159.321029 - 159.595254	6.58	V1918 Cyg	EW	640	V	30	MTS,MBB
2023-08-03	160.334471 - 160.564981	5.53	V1918 Cyg	EW	306	V	30	SO,OU,ES
2023-08-04	161.298646 - 161.462322	3.93	V417 Aql	EW	345	V	30	YEC,ANO,HE,CB
2023-08-05	162.306789 - 162.528817	5.33	V700 Cyg	EW	278	V	60	SB,EG,YD
2023-08-06	163.294888 - 163.434074	3.34	V417 Aql	EW	134	V	45	YD
2023-08-12	169.347704 - 169.489241	3.40	MR Del	EA	291	V	30	SB
2023-08-23	180.269493 - 180.475019	4.93	MR Del	EA	1508	V	5	EED,EG,MIE
2023-08-24	181.279073 - 181.573072	7.06	V373 Del	EW	427	V	45	SO,OU,ES,EA
2023-08-25	182.365582 - 182.524145	3.81	V1918 Cyg	EW	261	V	45	HE,YEC,CB
2023-08-26	183.296302 - 183.475707	4.31	RY Aqr	EA	330	V	30	YD,SE
2023-08-29	186.264085 - 186.476750	5.10	MR Del	EA	1154	R	7	ZT,FIK
2023-09-09	197.366730 - 197.473908	2.57	V700 Cyg	EW	202	V	40	SE,YD,SB
2023-09-10	198.251516 - 198.439920	4.52	MR Del	EA	501	V	20	YD
2023-09-12	200.252219 - 200.544554	7.02	V685 Peg	EW	359	V	60	ZT,FIK,IZK
2023-09-14	202.269720 - 202.537979	6.44	V685 Peg	EW	420	I	45	SO,OU,ES
2023-09-15	203.275040 - 203.484989	5.04	V626 Peg	EW	314	V	45	YEC
2023-09-16	204.301507 - 204.449676	3.56	V1918 Cyg	EW	165	V	40	SB,YD,SE,ANO
2023-09-19	207.329420 - 207.599784	6.49	V685 Peg	EW	335	R	60	FIK,ANA,ZT,IZK
2023-09-22	210.332206 - 210.541575	5.02	V485 Peg	EW	222	R	70	CB,ANO,HE,YEC,SO
2023-10-07	225.256579 - 225.485306	5.49	BB Peg	EW	346	V	45	YD,SB
2023-10-12	230.320822 - 230.486218	3.97	V485 Peg	EW	158	R	70	OU,BD,YA,SOZ,SOT
2023-10-20	238.260998 - 238.526268	6.37	V685 Peg	EW	251	V	60	YEC,HE,ANO,CB
2023-10-22	240.232639 - 240.452794	5.28	V685 Peg	EW	261	V	60	EA,EbS,MA
2023-10-28	246.320147 - 246.451835	3.16	V909 Cep	EW	155	V	60	SE,YD,SB
2023-11-07	256.239954 - 256.475844	5.66	V685 Peg	EW	253	R	60	ZT,AI,SK,SC
2023-11-09	258.311010 - 258.546206	5.64	AP Tau	EA	185	V	100	OD,CB
2023-12-25	304.279804 - 304.380008	2.40	RZ Tau	EW	231	V	15	MIE,EED,SF,EG
2023-12-26	305.178512 - 305.411297	5.59	V1377 Tau	EW	423	R	40	ZT
2024-02-01	342.216207 - 342.416838	4.82	V1332 Tau	EW	236	V	60	HE,LFT,CB
2024-02-03	344.253071 - 344.423142	4.08	KV Gem	EW	213	V	60	YD,SB,SE,EC,IE
2024-02-03	344.253071 - 344.423142	4.08	V404 Gem	EW	213	V	60	YD,SB,SE,EC,IE
2024-02-05	346.462836 - 346.563362	2.41	NY Leo	EW	130	V	50	EED,YEC,ZE,MuO
2024-02-06	347.195482 - 347.445882	6.01	V2822 Ori	EW	303	R	60	ZT,ANO
2024-02-08	349.316426 - 349.501800	4.45	EX CMi	EW	182	R	60	ST,CB
2024-02-22	363.350559 - 363.502411	3.64	TY UMa	EW	195	R	60	LFT,HE,IZK,SA,CB
2024-02-24	365.230559 - 365.492686	6.29	HN Cnc	EW	332	V	60	YD,SE,SB
2024-03-10	380.365493 - 380.452065	2.08	BS UMa	EA	86	V	70	SB,IK,AK,VU,BD
2024-03-18	388.317932 - 388.389850	1.73	XY Leo	EW	173	V	20	MIE,EED,SF,EG
2024-04-05	406.317813 - 406.553819	5.66	V356 Leo	EW	270	V	60	MBB,SOZ,SO
2024-04-11	412.325413 - 412.451930	3.04	XY Leo	EW	348	V	20	CB
2024-04-11	412.469409 - 412.582438	2.71	BI CVn	EW	372	V	20	CB
2024-04-13	414.319036 - 414.612145	7.03	VW Cep	EW	176	B	50	YD,SE
2024-04-14	415.265752 - 415.544458	6.69	MM Com	EW	1636	V	52	SB,HK
2024-04-15	416.265537 - 416.392806	3.05	XY Leo	EW	336	V	20	ZE,YEC,MuO,MIE,MI
2024-04-26	427.279966 - 427.579730	7.19	RZ Com	EW	358	V	60	MBB,SOZ,SO

Table 2. List of minimum times. Table lists UT date, minimum time (HJD), uncertainty of the minimum, filter of observation, and the type of the minimum. Star name <ZTF> represents "ZTF J200814.08+173019.2".

Star	UT Date (y-m-d)	T_{min} (HJD 2400000+)	Uncertainty (days)	Filter	Min. Type
V417 Aql	2023-08-04	60161.3336	0.0003	V	II
V417 Aql	2023-08-06	60163.3796	0.0036	V	I
V1828 Aql	2023-07-22	60148.3722	0.0001	V	II
V1828 Aql	2023-07-22	60148.4280	0.0002	V	I
V1828 Aql	2023-07-22	60148.4834	0.0007	V	II
V1828 Aql	2023-07-22	60148.5385	0.0002	V	I
RY Aqr	2023-08-26	60183.3955	0.0002	V	I
AR Boo	2023-05-25	60090.3740	0.0021	V	I
XY Boo	2023-05-24	60089.4098	0.0008	I	I
VW Cep	2024-04-13	60414.4419	0.0006	B	II
VW Cep	2024-04-13	60414.5839	0.0021	B	I
V909 Cep	2023-10-28	60246.4128	0.0006	V	I
EX CMi	2024-02-08	60349.3668	0.0004	R	I
HN Cnc	2024-02-24	60365.2673	0.0002	V	I
MM Com	2024-04-14	60415.3051	0.0003	V	II
MM Com	2024-04-14	60415.4589	0.0003	V	I
RZ Com	2024-04-26	60427.3587	0.0001	V	II
RZ Com	2024-04-26	60427.5276	0.0005	V	I
BI CVn	2024-04-11	60412.5103	0.0001	V	I
V700 Cyg	2023-08-05	60162.4441	0.0001	V	I
V700 Cyg	2023-09-09	60197.4646	0.0001	V	II
V1918 Cyg	2023-08-02	60159.5323	0.0002	V	II
V1918 Cyg	2023-08-03	60160.3583	0.0019	V	II
V1918 Cyg	2023-08-25	60182.4632	0.0003	V	I
V1918 Cyg	2023-09-16	60204.3610	0.0006	V	I
V2477 Cyg	2023-07-03	60129.4037	0.0001	V	I
MR Del	2023-08-12	60169.4035	0.0009	V	II
MR Del	2023-08-23	60180.3581	0.0005	V	II
MR Del	2023-08-29	60186.3588	0.0034	R	I
MR Del	2023-09-10	60198.3593	0.0026	V	I
V373 Del	2023-08-24	60181.3294	0.0002	V	I

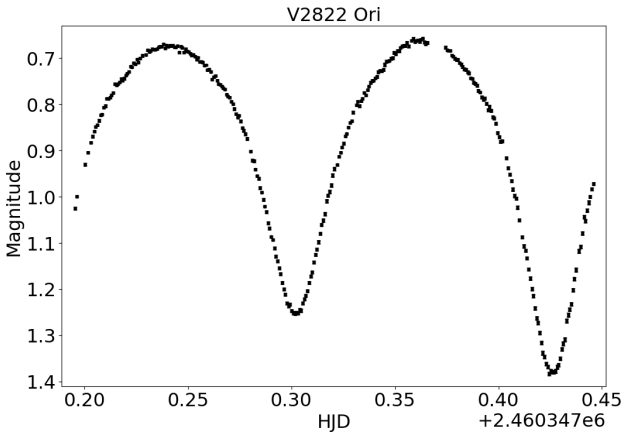

Figure 1. An example light curve of V2822 Ori obtained with IST40 telescope. Light curve is given in instrumental magnitudes and Julian Day fraction. Details can be seen in Table 2.

Table 2 – *continued.*

Star	UT Date (y-m-d)	T_{min} (HJD 2400000+)	Uncertainty (days)	Filter	Min. Type
V373 Del	2023-08-24	60181.5071	0.0003	V	II
KV Gem	2024-02-03	60344.2693	0.0001	V	II
V404 Gem	2024-02-03	60344.2972	0.0003	V	I
NY Leo	2024-02-05	60346.5084	0.0002	V	I
XY Leo	2024-03-18	60388.3643	0.0002	V	II
XY Leo	2024-04-11	60412.3707	0.0002	V	I
XY Leo	2024-04-15	60416.3470	0.0001	V	I
V356 Leo	2024-04-05	60406.4612	0.0002	V	I
V2822 Ori	2024-02-06	60347.3020	0.0001	R	II
V2822 Ori	2024-02-06	60347.4260	0.0001	R	I
BB Peg	2023-10-07	60225.2911	0.0001	V	I
BB Peg	2023-10-07	60225.4730	0.0010	V	II
V485 Peg	2023-09-22	60210.4089	0.0016	R	II
V485 Peg	2023-10-12	60230.3965	0.0034	R	II
V626 Peg	2023-07-21	60147.4166	0.0001	R	II
V626 Peg	2023-07-21	60147.5359	0.0001	R	I
V626 Peg	2023-09-15	60203.2875	0.0003	V	II
V626 Peg	2023-09-15	60203.4074	0.0015	V	I
V685 Peg	2023-09-12	60200.3587	0.0004	V	II
V685 Peg	2023-09-12	60200.5184	0.0004	V	I
V685 Peg	2023-09-14	60202.4217	0.0003	I	I
V685 Peg	2023-09-19	60207.4972	0.0002	R	II
V685 Peg	2023-10-20	60238.2710	0.0005	V	I
V685 Peg	2023-10-20	60238.4300	0.0008	V	II
V685 Peg	2023-10-22	60240.3340	0.0004	V	II
V685 Peg	2023-11-07	60256.3551	0.0010	R	I
V365 Sge	2023-07-30	60156.4914	0.0002	V	II
AP Tau	2023-11-09	60258.4329	0.0002	V	I
RZ Tau	2023-12-25	60304.3495	0.0001	V	I
V1332 Tau	2024-02-01	60342.3540	0.0033	V	I
V1377 Tau	2023-12-26	60305.2307	0.0001	R	II
V1377 Tau	2023-12-26	60305.3720	0.0002	R	I
BS UMa	2024-03-10	60380.4067	0.0003	V	I
TY UMa	2024-02-22	60363.3987	0.0001	R	I
<ZTF>	2023-07-30	60156.4640	0.0008	V	I

3 Results

Table 2 lists the minima times that we obtained in this study. Date (UT), minimum time and its uncertainty, filter used in the acquisition of the light curve (B, V, R and I are standard Johnson filters), and the type of the minimum are given in the table as well as the star name. Min. I refers the deeper minimum, while the Min. II is when the fainter star is eclipsed. Some stars were observed extensively and has many times of minimum.

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