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Report of the Section of Observation of Positions and Occultations of the Polish Amateur Astronomers Society for the year 2017

Introduction

In 2017 three kinds of occultation phenomena were observed by the members of the Section of Observation of Positions and Occultations. These were: total lunar occultations, grazing lunar occultations and asteroidal occultations. The results of the observations are presented below.

1. Total lunar occultations

The observations of total lunar occultations (mainly of double stars, apart from the Hyades open cluster on August 16)) have been made at five stations (see the Tables below). In 2017 a comparison of observed and calculated moments were possible thanks to the fact that the used Occult software was able to take into consideration the new dataset of the lunar limb profile obtained during the Kaguya lunar probe mission. This dataset makes it possible to calculate the predicted moments of phenomena with the precision of 0.1 sec instead of 1 sec. for the old photographic Watts dataset of the lunar limb profile (elaborated in 1960s).

Observation results show a small delay of recorded moments in relation to the Occult predictions, usually less than 1 second, apart from an unexpected large difference for the Aldebaran phenomena (both dis- and reappearance) on August 16; at two independent stations the difference was recorded of about 2 sec or even more. The last occultation of Aldebaran on November 6 also shows relatively large difference greater than 1 second. Therefore, next lunar phenomena should be observed in forthcoming years in order to obtain more results and to study these trends.

All observed oocultations of double stars made with the time resolution of 0.04 sec. revealed substantial differences in relation to the Occult predictions, especially regarding the angular separation (and in consequence the time separation) of the stars' components. These effects are visible on separate video frames as well as in the presented selected light curve plots.

No.	Location	Abbr	Geogr. coord. WGS84		Height	Telescope[#]
			Longitude ° ′ ″	Latitude ° ′ ″	m a.s.l.	aperture/focal length [mm]
1	Łódź Pomorska	Ld-1	19 27 33.4	51 46 41.3	225	Cass. 150/2250
2	Łódź Julianowska	Ld-2	19 27 04.8	51 47 55.2	235	Cass. 90/1250
3	Tobolice	Tb	19 03 22.3	51 54 48.2	140	Cass. 200/2032
4	Królik Polski	KP	21 49 02.6	49 30 34.0	450	Newton 200/1000
5	Lublin	Lb	22 35 47.5	51 14 35.4	201	Cass. 150/1800

Tab. 1. Stations and telescopes, (*) - all telescopes with electrical driving

No.	Location	Abbr	Observer	Timekeeping
1	Łódź Pomorska	Ld-1	Marek Zawilski, Remigiusz Jabłoński	Time inserter IOTA, CCD camera
2	Łódź Julianowska	Ld-2	Marek Zawilski	Time inserter IOTA, CCD camera
3	Tobolice	Tb	Marek Zawilski	Time inserter IOTA, CCD camera
4	Królik Polski	KP	Wiesław Słotwiński	Time inserter DCF GaPa Jawil, CCD camera
5	Lublin	Lb	Zbigniew Rzepka	DCF receiver, synchronised time registrator using the Mera-Poltik analog clock, camera Canon Power Shot A630[#]

Tab. 2. Stations, observers, timekeeping and methods of recording

[#] the eyepiece projection applied.

Date 2017	Ph.[#]	Star					Station	Weather conditions	Observed time UT	Predicted time UT*	Difference obs-pred
		No	Name	Mag.	Double	Sep. ["]			h m s	s	s
March 8	DD	1238		6.0	6.9/6.9	0.009	Ld-2	good	19 31 44.63[1]	44.3	+0.3
April 1	DD	94220		7.3	8.2/8.2	0.10	Ld-1	good	18 08 27.86[2] 27.90	27.7	+0.2
April 1	DD	0741		5.5	6.5/6.5	0.08	Ld-1	good	18 13 10.39[2] 10.43	09.8	+0.6
May 1	DD	97168		7.8	8.8/8.8	0.10	Tb	good	19 06 45.49[2] 45.53	45.1	+0.4
June 2	DD	1732		6.8	7.6/7.6	0.10	Tb	good	22 55 22.72[2] 22.76	22.8	0.0
June 3	DD	1825		5.9			Lb	good	20 55 37.74	37.7	0.0
July 4	DD	2223	γ Lib	2.9	4.0/4.2	0.10	Tb	good	18 41 50.93[3] 18 41 51.05	50.9	-0.1
July 6	DD	2497		6.5	7.8/7.8	1.3	Tb	good	23 32 04.46[4] 04.54	03.8	+0.7
July 29	DD	1978	88 Vir	6.6	7.4/7.4	0.10	Tb	good	20 18 43.22[4] 43.30	42.7	+0.4
August 16	RD	93928		7.5			Tb	good	02 26 19.50[1] 19.54	19.1	+0.4
August 16	RD	0659		6.6			Tb	good	02 28 27.78[5] 27.82	27.3	+0.5
August 16	RD	0661	71 Tau	4.5			Tb	good	02 44 49.22[6] 49.30	48.2	+0.9
August 16	RD	93944		7.5			Tb	good	03 02 08.09[6] 08.17	07.5	+0.7
August 16	RD	0671	θ^2 Tau	3.4			Tb	good	04 06 26.11[5] 26.15	25.4	+0.7
August 16	RD	0669	θ^1 Tau	3.8			Tb	good	04 07 29.99	29.2	+0.8

Tab. 3. Total lunar occultation observations results

August 16	DB	0692	α Tau (Aldebaran)	0.9			Tb	good (by day)	07 07 14.08	12.1	+2.0
August 16	DB	0692	α Tau (Aldebaran)	0.9			KP	good (by day)	07 08 53.86	51.9	+2.0
August 16	RD	0692	α Tau (Aldebaran)	0.9			Tb	good (by day)	08 05 25.02[5] 25.06	22.9	+2.2
August 16	RD	0692	α Tau (Aldebaran)	0.9			KP	good (by day)	08 13 03.73	01.6	+2.1
September 29	DD	2886	56 Sgr				Tb	good	19 43 10.05[2] 10.09	08.7	+1.4
November 6	DB	0692	α Tau (Aldebaran)	0.9			KP	air turbulences, strong wind	03 12 02.60[7]	01.0	+1.6
November 6	DB	0692	α Tau (Aldebaran)	0.9			KP	through thin clouds	03 46 43.23	41.9	+1.3

Tab. 3. Total lunar occultation observations results

phenomenon; DD – disappearance at dark limb, DB – disappearance at bright limb, RD – reappearance at dark limb, RB – reappearance at bright limb

* according to the Occult v.4.2.5.0 software

[1] no duplicity of the star detected;

[2] a decrease of brightness on two video frames recorded;

[3] a gradual decrease of brightness on four video frames recorded

[4] a gradual decrease of brightness on three video frames recorded

[5] an increase of brightness on two video frames recorded

[6] an increase of brightness on three video frames recorded; last moment not sure

[7] not sure

Below some examples of the lightcurves are presented. All of them have been obtained using TANGRA software that analyses the magnitude of the star in each video frame. The magnitude is equivalent to the number of pixels of the star image.

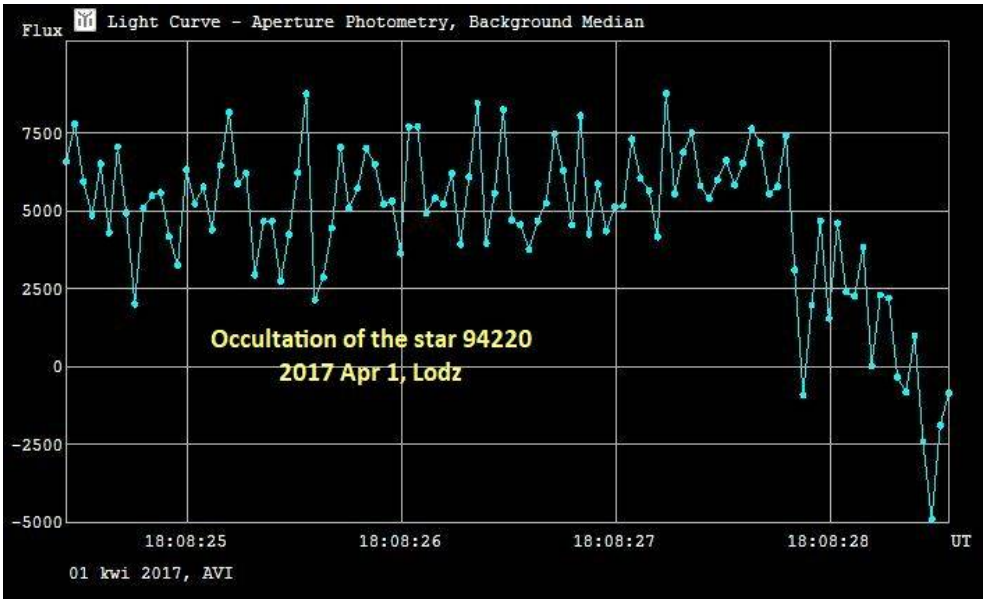


Fig. 1. Total lunar occultation of SAO 94220.

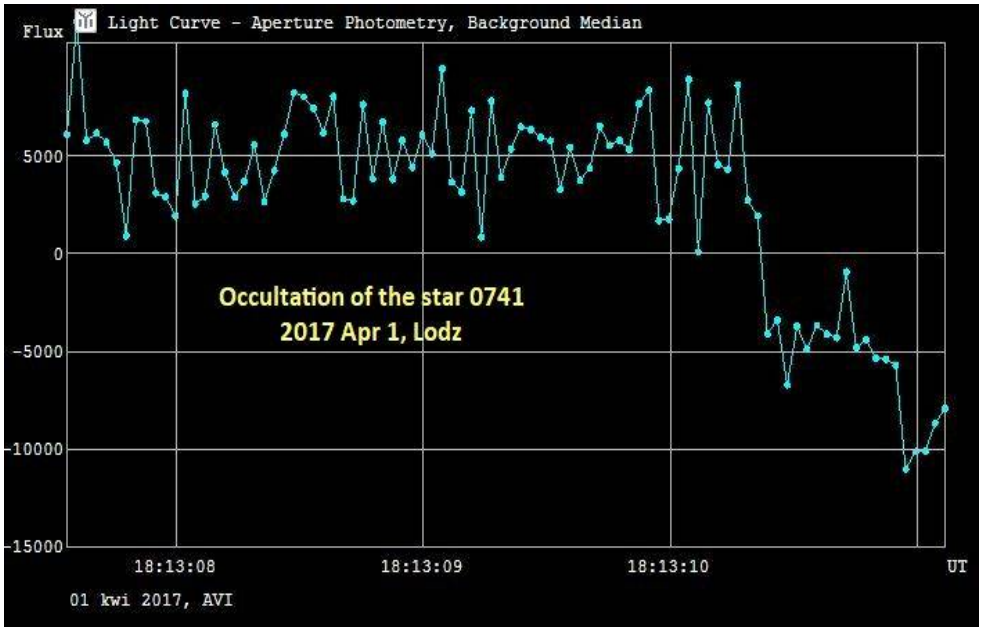


Fig. 2. Total lunar occultation of ZC 741.

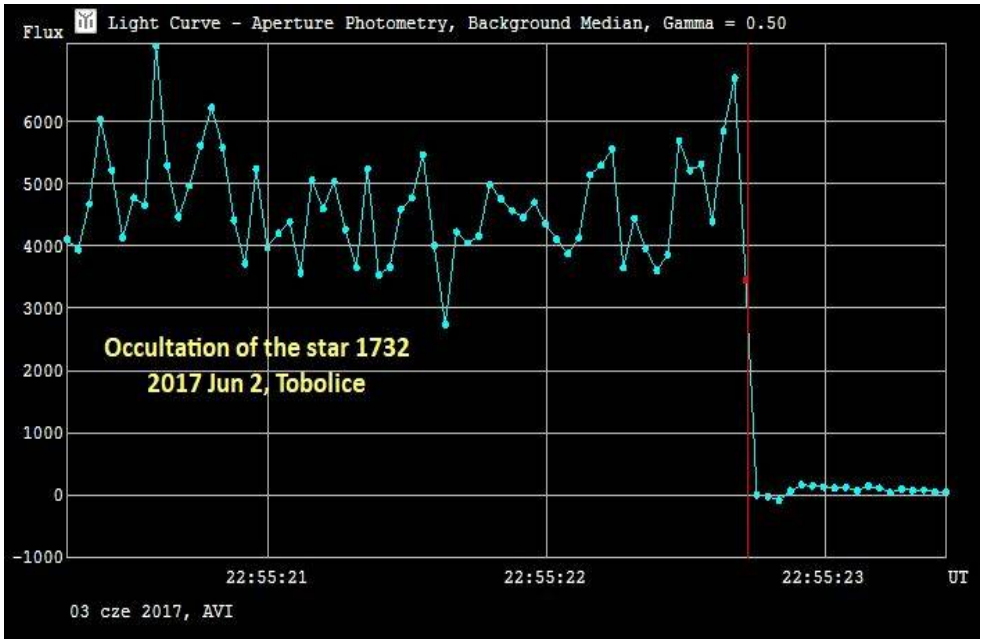


Fig. 3. Total lunar occultation of ZC 1732.

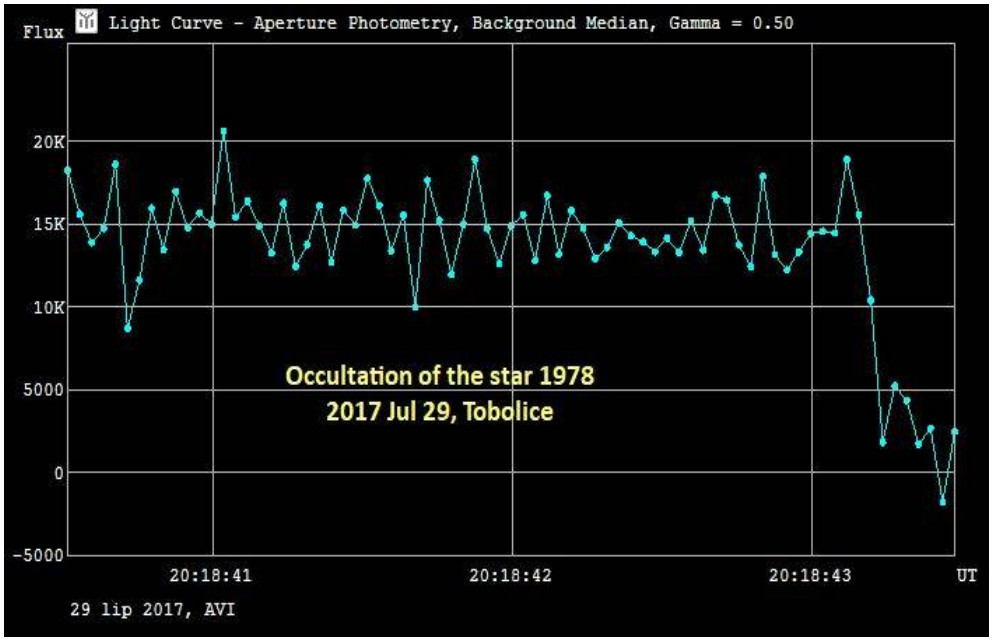


Fig. 4. Total lunar occultation of ZC 1978.

2. Grazing lunar occultations

In last year 3 of 18 reported global grazing occultation were observed in Poland. Two of the graze occured on 15th August with an interval of 23 hours. One of them, the graze of ZC 635 led by **Leszek Benedyktowicz**, was recorded by 6 observers with 58 events in total. Because of the doubleness of the stars, some of the phenomena were partial - the star's shield did not hide completely behind the Moon's peaks. The observations very well coincide with the Moon's profile obtained by the Kaguya probe, the average residuum of a single phenomenon estimated at 0.007" which gives 15 m on the surface of the Moon.

3. Asteroidal occultations

In 2017, 3 out of 13 attempts to observe asteroidal occultation were successful. The most active observer was **Dariusz Miller** from Warsaw who have done nearly half of all observations. It is worth mentioning that **Gabriel Murawski** and **Wojciech Burzyński** have observed their first positive asteroidal occultation ever. The figure no 7 is an example of positive asteroidal occultation event with time chord no 1 observed by G. Murawski.

Accurate timings of asteroidal occultations can help refine the exact size and orbit of an asteroid, and even the exact position of the occulted star itself. Also, stars have been discovered to be members of previously unknown double star systems using these techniques, and in a few cases a satellite of the asteroid has been found or, if previously known, its size and orbit around the asteroid have been refined.

If several observers record disappearance and reappearance times, chords of timings can be combined to determine the shape of the asteroid such as show in Fig.7. Such information cannot be found using the largest telescopes in the world. Those telescopes lack the resolving capability to see details of asteroids of a few dozen kilometres in diameter only. So, the only way to find these details is timing asteroidal occultations.

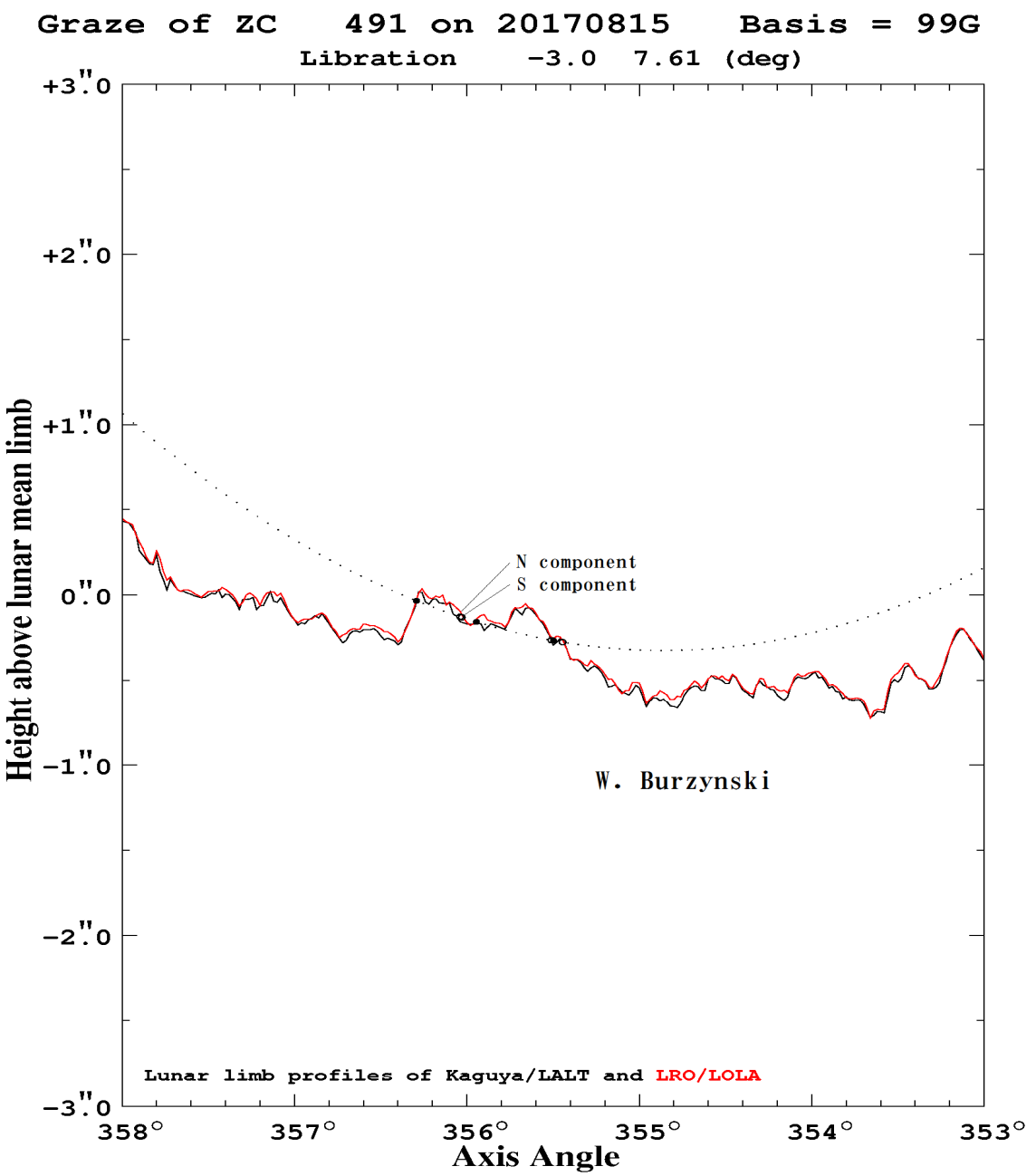


Fig. 5. Grazing lunar occultation results of ZC 491.

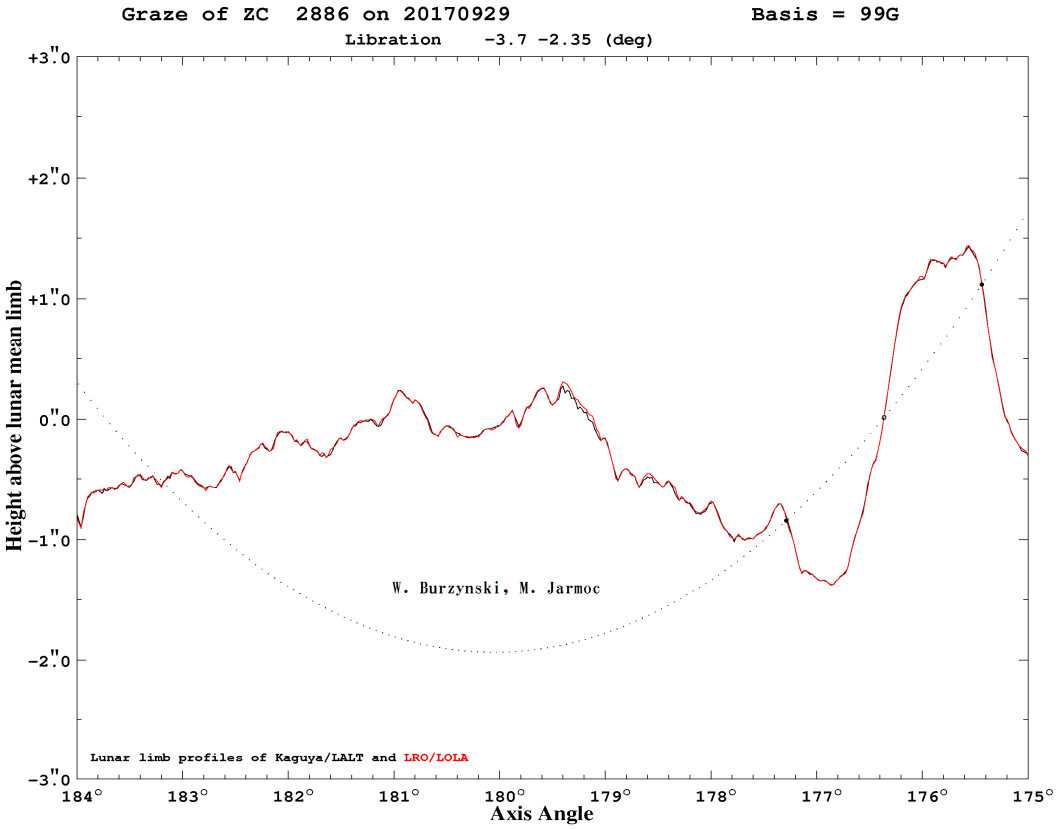


Fig. 6. Grazing lunar occultation results of ZC 2886.

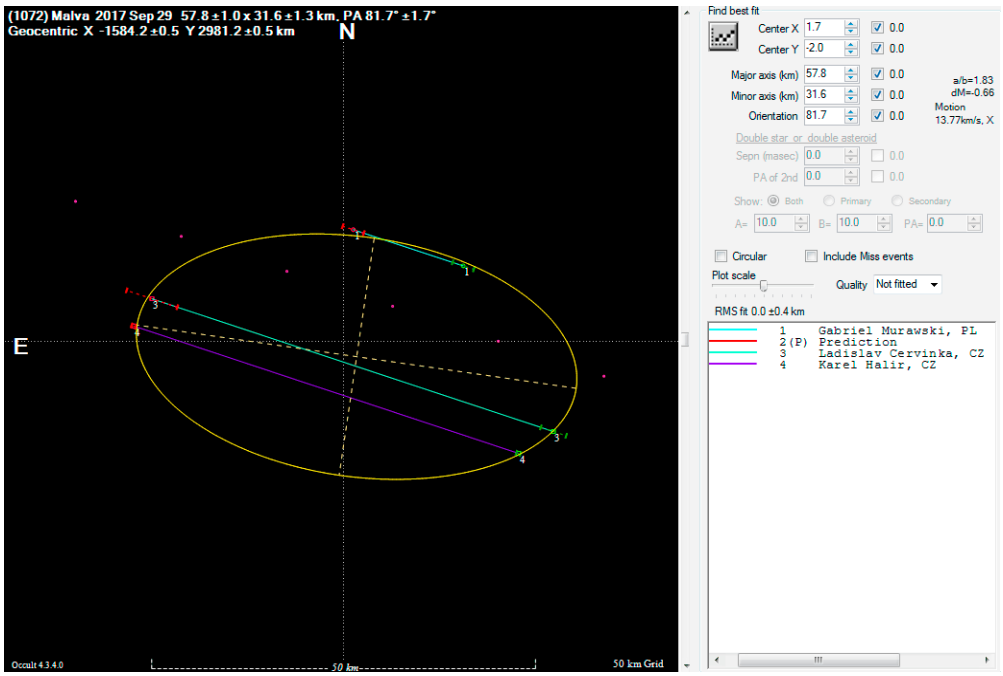
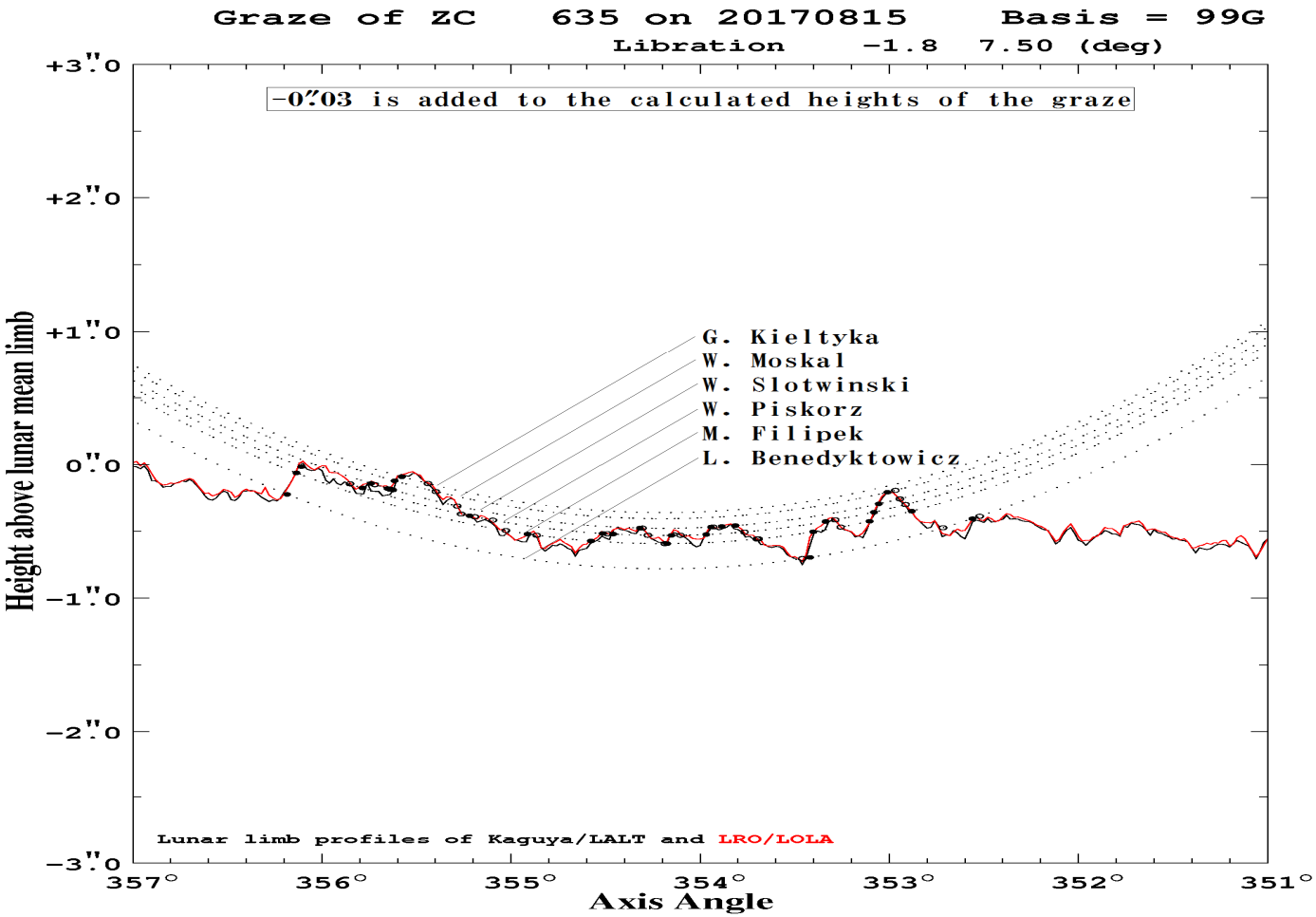


Fig. 7. Asteroidal occultation results of (1072) Malva.


Graze of ZC 635 on 20170815 Basis = 99G
Libration −1.8 7.50 (deg)
−0″.03 is added to the calculated heights of the graze
G. Kieltyka
W. Moskal
W. Slotwinski
W. Piskorz
M. Filipek
L. Benedyktowicz
Lunar limb profiles of Kaguya/LALT and LRO/LOLA
Height above lunar mean limb
+3″.0
+2″.0
+1″.0
0″.0
−1″.0
−2″.0
−3″.0
357°
356°
355°
354°
353°
352°
351°
Axis Angle

Lp	Date	Star no	Asteroid no	Observer	Location	Results and remarks
1	2017/01/06	4UC665-044532	(6174) Polybius	Wojciech Burzyński	Ignatki	no occultation
2	2017/03/14	TYC 2404-00176-1	(68) Leto	Dariusz Miller	Warszawa	no occultation
3	**2017/03/14**	**TYC 2427-00775-1**	**(22) Kalliope**	**Wojciech Burzyński**	**Ignatki**	**POSITIVE, duration 8.07 s**
4	2017/03/15	TYC 1913-00243-1	(936) Kunigunde	M. Filipek, L. Benedyktowicz	Jerzmanowice	no occultation
5	2017/05/16	TYC 0832-00644-1	(386) Siegena	Dariusz Miller	Warszawa	no occultation
6	2017/05/31	TYC 6184-00776-1	(534) Nassovia	Marcin Filipek	Jerzmanowice	no occultation
7	2017/06/07	4UC322-074639	(90568) 2004 GV9	W. Burzyński, M. Jarmoc	Pomigacze	no occultation, TNO object
8	2017/09/09	HIP 21673	(692) Susumu	Dariusz Miller	Warszawa	no occultation
9	**2017/09/29**	**TYC 1870-01460-1**	**(1072) Malva**	**Gabriel Murawski**	**Suwalki**	**POSITIVE, duration 1.04 s**
10	2017/09/30	2UCAC 35887778	(217) Eudora	Dariusz Miller	Warszawa	no occultation
11	**2017/09/30**	**2UCAC 35887778**	**(217) Eudora**	**Marcin Filipek**	**Jerzmanowice**	**POSITIVE, duration 3,4 s**
12	2017/10/08	TYC 5632-00827-1	(173) Ino	Dariusz Miller	Warszawa	no occultation
13	2017/10/12	TYC 5830-00820-1	(1755 Lorbach	Dariusz Miller	Warszawa	no occultation

Tab. 4. Asteroidal occultation observations results obtained in 2018 in Poland.

References:

[1] www.euraster.net - European asteroidal occultations results

[2] www2.nao.ac.jp/~mitsurusoma/grazes.html - reduction of worldwide lunar graze observations

[3] www.sopiz.ptma.pl - the website of the Section of Observation of Positions and Occultations of the Polish Amateur Astronomers Society

[4] www.iota-es.de - European Section of International Occultation Timing Association

[5] www.occultations.org - International Occultation Timing Association