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The PHEMU03 catalogue of observations of the mutual phenomena of the Galilean satellites of Jupiter

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ABSTRACT

Context. In 2003 the Sun and the Earth passed through the equatorial plane of Jupiter and therefore through the orbital planes of its main satellites.
Aims. During this period, phenomena of mutual eclipses and occultations occurred and have been observed and we now present the catalogue of the data gathered.
Methods. Light curves of mutual eclipses and occultations were recorded by the observers of the international campaign PHEMU03 organized by the Institut de mécanique céleste, Paris, France.
Results. We made 361 observations of 116 mutual events from 42 sites. The corresponding data are given in this paper. For each observation, information is given about the telescope, the receptor, the site and the observational conditions.
Conclusions. This paper gathers together all these data and gives a first estimate of the precision. The catalogue of these rare events published in this paper intends to be an improved basis of accurate astrometric data useful for the development of dynamical models.

Key words. Jupiter – Galilean satellites – Mutual events – Eclipses – Occultations – Astrometry

Table 1. Results of the past campaigns of observations

	1985	1991	1997	2003
number of sites	28	56	42	42
number of light curves	166	374	275	361
number of observed events	64	111	148	116

1. Introduction

Observations of mutual events of the natural satellites are performed intensively since 1973 and they had been proved to be a very accurate way to get astrometric measurements of the natural satellites. As we did in the past, we encouraged the observers to make as many observations as possible and we organized and coordinated an international campaign in order to catch these rare events. This campaign named PHEMU03 allowed us to collect 361 lightcurves of 116 mutual events thanks to the observers of our international network made of 42 sites. [1]

We provide in this paper all the data collected. Another paper (Emelianov et al., 2008) will provide the astrometric data extracted from the lightcurves thanks to a sophisticated photometric model of the lightcurves including the albedoes map deduced from the space probes images. The aim of the present paper is to provide the photometric data and the observational parameters useful to future works on the improvement of the dynamical models as well as of models of the surfaces of the satellites. These data will be available through the data center NSDC dedicated to the natural satellites (http://www.imcce.fr/nsdc).

2. The mutual events

The Earth and the Sun cross the equatorial plane of Jupiter every six years. Then the Jovian declinations of the Earth and the Sun become zero and since the orbital plane of the Galilean satellites is very close to the equatorial plane of Jupiter, the satellites occult and eclipse each other.

The 2003 period was favorable since the equatorial plane crossing happened during the opposition of Jupiter and the Sun.

Arlot (2002) made predictions of all the 2003 events using the G5 ephemerides based upon the Lieske's theory (Lieske, 1977) and the newer L1 ephemerides from Lainey et al. (2004a, 2004b) of the motion of the Galilean satellites. 581 mutual events, even not observable, were computed. Before 2003, several campaigns of observations took place during the previous occurrences (Arlot et al. 1997 , 2006). Table 1 shows the results obtained during each campaign until the present one. Our goal is to observe as much events as possible. At least, two observations of each event are desirable in order to eliminate biases in the observations.

Since there is no thick atmosphere around the Galilean satellites the photometric observations of such phenomena are very accurate for astrometric purposes . The results previously obtained after similar observations of the Galilean satellites, show that a high astrometric accuracy may be obtained: an accuracy better than 30 mas is expected (Lainey et al. 2004).

Such a fact allows us to provide data necessary to the improvement of the theoretical models of the orbital motions and to the determination of the tidal effects in the dynamics of the Galilean satellites.

3. The PHEMU03 campaign

We made a coordinated international PHEMU03 campaign in order to get a significant amount of data. These events occur in a short span of time, so, numerous observers located in several sites were necessary in order to avoid meteorological problems and observe from different longitudes to get different events. This is the reason why observers previously involved in the PHEMU campaigns of observations of the mutual events of the Galilean satellites were invited to join the new campaign.

3.1. Receptors

For the observations of the mutual events only relative photometry is generally possible. Since the elevation of Jupiter above the horizon may be very small, the air mass is often too large and absolute photometry is then not possible. Telescopes were equipped with the receptors listed in Table 2. Three kinds of receptors were used, the photoelectric photometric single channel receptors, the video cameras and the two-dimensional CCD receptors. Visual observations are reported only for comparison. The codes for each receptors is the ones provided in the tables for each observation.

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[1] tables 4 and figures are available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html. They are also available on the following ftp server together with the digitized lightcurves available under the form of ascii files at ftp://ftp.imcce.fr/ pub/NSDC/ jupiter/raw_data/ phenomena/ mutual/2003/

Table 2. Receptors used for the observations

Code as given in the tables	Description
CCT	intensified camera of T120-OHP
CCD	unknown
CCD1	CCD SONY ICX021CL
CCD2	Video Watec 902H
CCD3	Video B/W CCD KC381
CCD5	same as CCT
CCD4	Sony ICX098BQ
CCD6	WebCam Toucam
CCD7	KAF3200E
CCD8	Johnson I-type filter
CCD9	ST-6V
CCD10	Hi Sys 22
CCD11	Audine400
CCD12	Sony ICX083AL
CCD13	Sony ICX027BL
CCD14	camera SBIG ST-8
CCD15	TH7852
CCD16	Imaintel intensified camera
CCD17	Kaf400E with V-Filter
CCD18	TC245-40
CCD19	OS45D
CCD20	Sony ICX 039 BLA (Camera OS45D)
CCD21	Starlight Xpress SX
CCD22	Pictor 416
CCD23	KAF-6300
CCD24	KAF-0400
CCD25	ST7
CCD26	CCD SBIG ST-6
CCD27	Sony HAD ICX38DLA
CCD28	Tektronics CCD
VIDEO	Astrovid 2000 video camera with a SONY ICX038 detector chip
WAT	WATEK 902H Camera
PM	unknown
PM1	EMI-9789QA
PM2	one-channel 1 P21
PM3	Hamamatsu Johnson system V-mag (PCPA-R647-04)
PM4	EMI9502B
PM5	WBVR
PM6	one Channel electro-photometer (Filter V)
PMTF	FEU-136 (S-20 (Cs)Na2K Sb photocathode)
NOCT	Nocticon Vidicon camera
VISU	visual

3.2. Sites of observation

This campaign, coordinated by the IMCCE, involved the different locations given in Table 3. This table gives the names, longitudes, latitudes and elevations of these sites and the telescopes used (L=refractor; T=reflector, followed by the aperture in cm).

Table 3. Sites of observation of the PHEMU03 campaign

Sites	Telescope	Longitude °	′	″		Latitude °	′	″		elevation meters
Alma-Ata (Kazakhstan)	T 60	76	57	15	E	76	57	25	N	1450
Antony (France)	T 13	2	17	12	E	48	45	00	N	50
Armagh (Northern Ireland)	T 25	6	38	59	W	54	21	11	N	67
Bordeaux (France)	T 60	0	31	36	W	44	50	06	N	73
Brescia (Italia)	T 20	9	59	30	E	45	26	12	N	94
Bucharest (Romania)	T 15	26	05	48	E	44	24	48	N	267
Catania (Italia)	T 20	15	03	19	E	37	32	54	N	300
Chateaugiron (France)	T 21	1	30	12	W	48	2	41	N	70
Chemnitz (Germany)	L 6	12	51	10	E	50	49	25	N	344
Cluj-Napoca (Romania)	T 41	23	35	37	E	46	42	36	N	750
Dax (France)	T 32	1	01	43	E	43	41	35	N	35
Dolberg (Germany)	T 20	7	54	53	E	51	42	45	N	68
Ekaterinenburg (Russia)	T 45	50	00	00	E	56	48	00	N	237
Elgin (USA)	T 20	117	55	16	W	45	34	22	N	1252
Gieres (France)	T 20	5	44	00	E	45	11	00	N	210
Kavalur (India)	T 234	78	49	15	E	12	34	38	N	725
Lanester (France)	T 20	3	21	15	W	47	45	00	N	0
La Palma (Spain)	T 35	17	53	00	W	28	45	26	N	2300
Lille (France)	L 32	3	4	15	E	50	36	57	N	32
Lisbonne (Portugal)	T 20	8	23	02	W	39	31	23	N	90
Lumezzane (Italia)	T 40	10	12	27	E	45	39	59	N	830
Massa (Italia)	T 18	10	6	11	E	44	2	31	N	40
Mainz (Germany)	T 25	8	14	56	E	49	55	05	N	205
Meudon (France)	T 100	2	13	54	E	48	48	18	N	162
Monterrey (Mexico)	T 18	100	22	26	W	25	38	36	N	661
Mundolsheim (France)	T 15	7	42	50	E	48	38	50	N	135
Naucsny (Ukraine)	T 60	34	01	00	E	44	37	37	N	600
Novara (Italia)	L 6	8	37	30	E	45	28	30	N	160
Nyrola (Finland)	T 41	25	30	47	E	62	20	32	N	210
Odessa (Ukraine)	T 80	57	53	00	E	37	55	27	N	2020
OHP (France)	L 15	5	42	36	E	43	53	36	N	665
OHP (France)	T 80	5	42	36	E	43	53	36	N	665
OHP (France)	T 120	5	42	36	E	43	53	36	N	665
Prague (Czech Republic)	T 15	14	23	57	E	50	03	58	N	327
Pulkovo (Russia)	T 65	45	19	30	E	59	46	18	N	75
Pulokvo (Russia)	T 32	45	19	30	E	59	46	18	N	75
Rozhen (Bulgaria)	T 60	24	44	30	E	41	41	35	N	1750
Sabadell (Spain)	T 80	2	05	29	E	41	33	04	N	224
Saragosse (Spain)	T 41	0	24	43	E	41	38	38	N	425
Sendai (Japan)	T 36	140	52	30	E	38	16	36	N	55
Sobota (Slovakia)	T 15	20	02	00	E	48	39	00	N	225
Terskol (Russia)	T 60	42	30	03	E	43	16	36	N	3100
Ukkel (Belgium)	T 85	4	21	29	E	50	47	55	N	105
Vienna (Austria)	T 10	16	24	00	E	48	12	00	N	190
Yunnan Obs. (China)	T 100	102	47	15	E	25	01	45	N	1940

4. Lightcurves reduction procedure

Lightcurves have been deduced from photometric measurements either with relative photometry performed with photoelectric photometers or with CCD cameras.

For observations made with CCD cameras in video mode the signal was digitized with digitizing boards. The lightcurves were obtained by aperture photometry as well as for the observations for which a value of the diaphragm is provided. For video observations made in Meudon or OHP, images have been measured with the facility of Gaussian photometry of the AVIA software (Arlot et al., 1989). Two dimensional measurements allow us generally to calibrate the signal of the involved satellite to the signal of a nearby satellite and eventually to get data under very difficult conditions (see for example Arlot and Stavinschi, 2007).

The determination of the time of the minimum of light and of the value of the magnitude drop was based on a fit of the lightcurve with a sample polynomial. The errors in these determinations are also given. The error on the timing of the minimum is determinated as follows: we calculate the noise in magnitude and transform it into time error through the highest value of the decreasing speed in magnitude during the event. The largest errors occur for faint noisy events and the smallest for the fast ones. The errors are comparable only if the integration time is the same.

5. The catalogue

5.1. The data

The Tables 4 provide for each event, the following data for each observed event (all dates are in UTC):

- first, the predictions of the time of the event:

1. the date of the event (year, month, day) and the nature of the event (4O1 means that sat. 4 occults sat. 1; 3E2 means that sat. 3 eclipses sat. 2; P means partial event, A annular, T total, and blank, an eclipse by the penumbra only);
2. the beginning of the event;
3. the maximum of ther event;
4. the end of the event;
5. the calculated magnitude drop;
6. the phase angle in degrees;
7. the apparent distance satellite-planet in planetary radii.

-second, for each observation of the above event:

1. the site of observation;
2. -
3. the observed time of the maximum of magnitude drop and observational error;
4. -
5. the observed magnitude drop and observational error;
6. -
7. -
8. the (C-O) of the observation in seconds of time; these quantities take into account a phase effect by means of the Aksnes et al. (1986) method;
9. the aperture of the telescope in centimeters (T= reflector; L= refractor);
10. the code of the used receptor in column "Recept." (cf Table 2);
11. the elevation of Jupiter upon the horizon in degrees;
12. the elevation of the Sun upon the horizon in degrees;
13. the observational conditions in column "Obs. cond." : [0] means no information, [1] means very good conditions, [2] means acceptable and [3] very difficult conditions;
14. the filter used, if any, during the observations in column "Filter"; no filter used is denoted by "-";
15. the integration time of the measurements in seconds; a variable integration time is denoted "v";
16. the size of the diaphragm when used;
17. the satellites inside the diaphragm, i.e. taken into account in the light curve (if nothing indicated, only the eclipsed satellite for the eclipses and both implied satellites for the occultations)

For each observation described in these tables corresponds a lightcurve provided in the figures 1 to 41 where is shown the magnitude drop versus UTC time scale.

These data and light-curves are available for anyone who is interested through the electronic database of the Natural Satellite Data Center (NSDC) server on the WEB server (http://www.imcce.fr/ nsdc) or on the ftp server at ftp://ftp.imcce.fr/ pub/NSDC/ jupiter/raw_data/ phenomena/ mutual/2003/.

5.2. Discussion

This catalogue intends to provide observational information and reduced data issued from the PHEMU03 campaign. Another paper (Emelianov 2008) provides the astrometric data extracted from the lightcurves.

The quality of each lightcurve may be judged either with the value of the errors on the determined parameters (time of the minimum of light and magnitude drop) or with the appearance of the lightcurve itself.

We have to say that as for the previous catalogues of such events we computed the errors on the determined parameter as follows. The error on the lightflux drop is deduced from the standard deviation from the fit to the model light curve. The error on the date of the minimum is deduced from the error on the magnitude drop combined with the speed of the decrease of the lightflux during the event. This explains that this error depends on the number of points, on the integrating time and on the depth of the light curve. Because of that, the error bars may be compared only between events made with the same time constants and, preferably, with the same equipment in order to get an observational error and a measurement of the quality of the observation.

6. Conclusion

We give in this paper the results of the PHEMU03 campaign. The present catalogue gives the results obtained by all the participants of this campaign who obtained significant results. In order to catch the maximum of events, it was necessary to organize such an international campaign. These phenomena occur every 6 years and they lead to very accurate astrometric measurements which are very difficult to get with other ground-based techniques. Furthermore they may allow us to determine surface parameters by comparison of lightcurves with synthetic models. Our experience shows that the past campaigns provided catalogues of data which were used for astrometric purpose. Accurate astrometric data were published thanks to the published observations and were used for dynamical purpose. Mixed with other types of observations, it is clear that mutual events data have the smallest residuals (Lainey et al. 2004).

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Table 4. Observational data

Dates Phenomena Locations	**Begins h m s**	**Maxi. h m s**	**Ends h m s**	**Magn. drop**	**Ph. (s)**	**Dist. (Rs)**	**O-C (s)**	**Ap. (cm)**	**Rec.**	**El. Sat. (°)**	**El. Sun (°)**	**Cd.**	**Filt.**	**T. int. (s)**	**Dia. (")**	**Sat. in dia.**
2/10/28 2 O1(P)	1 8 8	1 10 59	1 13 50	.410	10.6	5.2										
PULKOVO		1 10 53 ± 3		1.111 ± .125			6	T 32.	CCD9	32	-30	0	-	-	-	-
2/11/11 2 O1(P)	5 47 54	5 50 58	5 54 3	.291	10.8	5.5										
CHATEAUGIRON-F		5 50 44 ± 6		.396 ± .027			14	T 21.	CCD1	54	2	1	-	0.02	-	-
CHATEAUGIRON-V		5 51 56 ± 21		.353 ± .113			-58	T 21.	CCD1	54	2	1	-	-	-	-
2/11/12 4 O2(P)	23 5 20	23 8 26	23 11 32	.158	10.8	6.4										
CLUJ-NAPOCA		23 8 13 ± 6		.468 ± .029			13	T 41.	CCD22	20	-59	0	V	1.	-	-
2/11/18 2 E1( )	6 2 35	6 5 4	6 7 34	.059	10.7	4.8										
LA PALMA-V		6 4 46 ± 13		.054 ± .018			18	T 35.	CCD14	76	-19	2	G	0.2	-	-
2/11/18 2 O1(P)	8 7 43	8 10 43	8 13 45	.188	10.7	5.6										
MONTERREY		8 10 50 ± 18		.254 ± .044			-7	T 18.	VIDEO	33	-65	1	-	0.5	-	-
2/11/25 2 E1(P)	8 21 46	8 24 57	8 28 10	.193	10.4	5.0										
MONTERREY		8 24 58 ± 14		.169 ± .033			-1	T 18.	VIDEO	42	-63	1	-	0.5	-	-
2/11/25 2 O1(P)	10 27 44	10 30 34	10 33 25	.110	10.4	5.7										
MONTERREY		10 30 37 ± 28		.113 ± .028			-3	T 18.	VIDEO	70	-34	2	-	0.5	-	-
2/11/28 2 E1(P)	21 31 51	21 35 18	21 38 49	.275	10.2	5.1										
CLUJ-NAPOCA		21 35 26 ± 4		.336 ± .022			-8	T 41.	CCD22	15	-64	0	V	3.	-	-
KAVALUR		21 35 21 ± 2		.303 ± .006			-3	T 234.	CCD28	61	-45	0	-	-	-	-
2/11/28 2 O1(P)	23 37 37	23 40 20	23 43 3	.080	10.2	5.8										
CLUJ-NAPOCA		23 40 11 ± 12		.065 ± .011			9	T 41.	CCD22	36	-59	0	V	1.5	-	-
2/12/ 5 2 E1(P)	23 53 49	23 57 52	0 1 57	.453	9.7	5.4										
EKATERINBOURG		23 58 7 ± 8		.477 ± .034			-15	T 45.	PM6	49	-35	2	V	1.0	-	-
OHP		23 57 43 ± 10		1.675 ± .227			9	L 15.	CCD16	32	-68	0	-	0.04	-	-
OHP		23 57 53 ± 16		.031 ± .005			-1	T 80.	CCD2	32	-68	0	-	-	-	-
2/12/ 7 1 O4(P)	22 10 51	22 17 31	22 24 1	.343	9.5	5.9										
ALMA-ATA		22 12 54 ± 13		.190 ± .014			277	T 60.	CCD9	61	-41	0	-	-	-	-
PULKOVO		22 16 26 ± 31		.326 ± .048			65	T 32.	CCD9	29	-53	0	-	-	-	-
2/12/13 2 E1(A)	2 18 19	2 22 57	2 27 38	.624	8.9	5.5										
OHP		2 2 9 ± 43		.297 ± .132			-2	L 15.	CCD2	59	-49	0	-	-	-	-
PULKOVO		2 22 56 ± 5		.999 ± .062			1	T 32.	CCD9	46	-31	0	-	-	-	-
BUCHAREST		2 22 58 ± 3		1.174 ± .038			-1	T 15.	CCD9	62	-35	0	V	-	-	-
CHEMNITZ		2 23 30 ± 7		2.585 ± .166			-33	L 6.	VISU	54	-42	0	-	-	-	-

Dates Phenomena Locations	**Begins h m s**	**Maxi. h m s**	**Ends h m s**	**Magn. drop**	**Ph. (s)**	**Dist. (Rs)**	**O-C (s)**	**Ap. (cm)**	**Rec.**	**El. Sat. (°)**	**El. Sun (°)**	**Cd.**	**Filt.**	**T. int. (s)**	**Dia. (")**	**Sat. in dia.**
2/12/15 4 O3(P)	10 30 12	10 33 56	10 37 40	.171	8.7	2.7										
MONTERREY		10 33 30 ± 10		.271 ± .023			26	T 18.	VIDEO	80	-36	1	-	0.5	-	-
2/12/15 4 O2(T)	11 36 11	11 39 14	11 42 16	.295	8.7	2.3										
MONTERREY		11 39 2 ± 5		1.141 ± .059			12	T 18.	VIDEO	71	-22	1	-	0.5	-	-
2/12/16 4 O1(T)	2 7 13	2 10 31	2 13 47	.361	8.6	3.8										
OHP		2 10 13 ± 9		.466 ± .063			18	L 15.	CCD2	59	-52	0	-	-	-	-
CLUJ-NAPOCA		2 10 12 ± 3		1.218 ± .030			19	T 41.	CCD22	59	-39	0	V	0.9	-	-
2/12/20 2 E1(A)	4 46 13	4 51 27	4 56 45	.711	8.1	5.7										
CHATEAUGIRON		4 51 27 ± 5		1.618 ± .109			0	T 21.	CCD1	42	-13	0	-	-	-	-
OHP		4 51 27 ± 4		1.557 ± .070			0	L 15.	CCD16	54	-23	0	-	0.04	-	-
CLUJ-NAPOCA		4 51 27 ± 1		1.668 ± .016			0	T 41.	CCD22	42	-12	0	V	0.9	-	-
VIENNA		4 51 9 ± 3		.650 ± .016			18	T 10.	VISU	46	-17	1	-	-	-	-
MASSA		4 51 21 ± 6		1.756 ± .126			6	T 18.	CCD3	-25	-9	1	-	0.04	2	-
CHEMNITZ		4 51 37 ± 8		4.733 ± .283			-10	L 6.	VISU	46	-20	0	-	-	-	-
GIERES		4 51 37 ± 7		2.904 ± .286			-10	T 20.	CCD6	53	-24	0	-	-	-	-
2/12/20 2 O1(P)	21 1 3	22 56 11	23 33 1	.245	8.0	3.3										
CLUJ-NAPOCA		21 41 32 ± 151		.346 ± .027			-146	T 41.	CCD22	31	-65	0	V	0.8	5	-
2/12/23 2 O3(A)	0 14 35	0 48 37	1 17 34	.480	7.7	8.3										
OHP		0 59 10 ± 144		.852 ± .217			-93	T 80.	CCD16	52	-65	0	-	0.04	-	-
ROZHEN		0 50 31 ± 76		.203 ± .013			-114	T 60.	PM1	63	-54	1	-	1.	-	-
ZARAGOZA		0 48 9 ± 41		.309 ± .015			28	T 41.	CCD21	49	-69	0	-	-	-	-
2/12/24 1 O4(P)	3 53 23	3 56 9	3 58 55	.332	7.6	1.7										
SABADELL		3 55 23 ± 0		.199 ± .000			46	T 80.	CCD26	77	-52	0	-	-	-	-
2/12/30 2 O3(P)	5 54 46	6 9 14	6 23 10	.237	6.7	9.0										
SABADELL		6 9 47 ± 19		.170 ± .009			-33	T 80.	CCD26	56	-23	0	-	-	-	-
OHP		6 8 54 ± 261		.154 ± .195			19	T 80.	CCD16	35	-11	0	-	0.04	-	-
2/12/30 2 E1(P)	20 38 29	20 44 54	20 51 28	.584	6.6	5.9										
PULKOVO		20 45 3 ± 13		.804 ± .075			-9	T 32.	CCD9	30	-51	0	-	-	-	-
BUCHAREST		20 44 56 ± 7		1.096 ± .057			-2	T 30.	CCD7	31	-52	1	-	0.3	-	-
NYROLA		20 44 54 ± 4		1.023 ± .027			0	T 41.	CCD14	30	-49	0	V	-	-	-
KAVALUR		20 44 55 ± 1		1.055 ± .010			-1	T 234.	CCD	79	-60	0	-	-	-	-
2/12/30 4 O3(P)	21 12 46	21 19 27	21 26 10	.205	6.5	13.9										
NYROLA		21 19 18 ± 17		.330 ± .028			9	T 41.	CCD14	30	-49	0	V	-	-	-
ROZHEN		21 18 27 ± 10		.388 ± .013			60	T 60.	PM1	36	-67	1	-	1.	-	-
KAVALUR		21 19 25 ± 4		.356 ± .005			2	T 234.	CCD	86	-52	0	-	-	-	-
PULKOVO		21 19 26 ± 9		.481 ± .025			1	T 32.	CCD9	34	-53	0	-	-	-	-
BUCHAREST		21 19 23 ± 22		.365 ± .040			4	T 30.	CCD9	37	-66	1	-	0.3	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (”)	Sat. in dia.
3/ 1/ 6 2 E1(P)	23 24 57	23 32 47	23 40 53	.449	5.3	5.8										
BORDEAUX		23 32 53 ± 4		.730 ± .016			-6	T 60.	CCD15	46	-67	2	-	2.6	5	-
CATANIA		23 32 49 ± 38		.892 ± .165			-2	T 20.	CCD6	60	-74	1	-	0.5	-	-
CHATEAUGIRON		23 32 46 ± 114		.354 ± .174			1	T 21.	CCD1	56	-62	0	-	-	-	-
NYROLA		23 32 48 ± 4		.650 ± .014			-1	T 41.	CCD14	43	-48	0	C	-	-	-
PULKOVO		23 32 52 ± 25		.452 ± .061			-5	T 32.	CCD9	46	-50	0	-	-	-	-
PULKOVO		23 32 49 ± 6		.668 ± .021			-2	T 65.	CCD9	46	-50	0	-	-	-	-
ZARAGOZA		23 32 51 ± 9		.662 ± .027			-4	T 41.	CCD21	47	-69	0	-	-	-	-
3/ 1/ 7 2 O1(P)	19 0 15	19 4 37	19 8 55	.063	5.2	5.8										
KAVALUR		19 4 57 ± 8		.039 ± .003			-20	T 234.	CCD	64	-80	0	-	-	-	-
3/ 1/ 8 3 O1(P)	18 46 29	18 54 29	19 2 55	.069	5.0	5.7										
EKATERINBOURG		18 55 19 ± 55		.088 ± .019			-50	T 45.	PM6	36	-53	0	R	1.	-	-
ALMA-ATA		18 55 20 ± 23		.080 ± .008			-51	T 60.	CCD9	53	-69	0	-	-	-	-
KAVALUR		18 55 40 ± 12		.079 ± .004			-71	T 234.	CCD	62	-80	0	-	-	-	-
3/ 1/ 9 3 O1(P)	0 33 8	0 43 25	0 53 19	.064	5.0	2.5										
SABADELL		0 42 47 ± 181		.056 ± .033			38	T 80.	CCD26	55	-81	0	-	-	-	-
UKKEL		0 41 22 ± 144		.087 ± .054			123	T 85.	CCD23	54	-59	0	-	-	-	-
3/ 1/14 2 E1(P)	2 34 14	2 45 57	2 58 41	.329	4.0	5.6										
NYROLA		2 46 18 ± 13		.425 ± .014			-21	T 41.	CCD14	52	-30	0	C	-	-	-
OHP		2 46 0 ± 71		.212 ± .045			-3	T 120.	CCD5	57	-46	0	-	0.04	-	-
PULKOVO		2 46 4 ± 78		.276 ± .056			-7	T 32.	CCD9	35	-28	0	-	-	-	-
ZARAGOZA		2 46 12 ± 24		.202 ± .017			-15	T 41.	CCD21	65	-64	0	-	-	-	-
3/ 1/14 2 O1(P)	21 24 6	21 27 37	21 31 6	.056	3.8	5.9										
BUCHAREST		21 27 15 ± 35		.052 ± .040			22	T 30.	CCD7	49	-64	0	-	-	-	-
OHP		21 28 7 ± 86		.019 ± .037			-30	L 15.	CCD2	36	-54	0	-	-	-	-
3/ 1/17 4 O2(P)	0 38 16	0 43 51	0 49 29	.238	3.4	9.1										
MEUDON		0 43 24 ± 9		.742 ± .058			27	T 100.	NOCT	58	-61	0	-	0.04	-	-
NYROLA		0 43 34 ± 3		.781 ± .013			17	T 41.	CCD14	44	-42	0	V	-	-	-
OHP		0 43 6 ± 18		.074 ± .009			45	T 120.	CCD5	63	-64	0	-	0.04	-	-
LA PALMA-V		0 43 39 ± 3		.824 ± .015			12	T 35.	CCD14	62	-80	0	-	-	-	-
ROZHEN		0 43 35 ± 2		.805 ± .010			16	T 60.	PM1	63	-55	1	V	1.	-	-
ZARAGOZA		0 43 36 ± 5		.777 ± .024			15	T 20.	CCD21	63	-68	0	-	-	-	-
3/ 1/17 2 E1(P)	16 33 25	16 54 36	17 23 31	.296	3.3	5.1										
KAVALUR		16 56 9 ± 58		.187 ± .018			-93	T 234.	CCD	43	-60	0	-	-	-	-
3/ 1/17 2 E1(P)	19 20 45	19 55 17	20 21 13	.423	3.2	3.4										
CLUJ-NAPOCA		19 52 47 ± 90		.261 ± .032			150	T 41.	CCD22	34	-49	0	-	0.8	-	-

Dates Phenomena Locations	**Begins h m s**	**Maxi. h m s**	**Ends h m s**	**Magn. drop**	**Ph. (s)**	**Dist. (Rs)**	**O-C (s)**	**Ap. (cm)**	**Rec.**	**El. Sat. (°)**	**El. Sun (°)**	**Cd.**	**Filt.**	**T. int. (s)**	**Dia. (")**	**Sat. in dia.**
3/ 1/18 4 O2(P)	4 48 44	5 0 11	5 11 44	.161	3.2	2.6										
SABADELL		5 0 48 ± 9		.402 ± .011			-37	T 80.	CCD26	54	-39	0	-	-	-	-
LA PALMA-V		5 0 32 ± 13		.266 ± .009			-21	T 35.	CCD14	54	-39	0	-	-	-	-
LA PALMA-R		5 0 9 ± 28		.318 ± .035			2	T 35.	CCD14	54	-39	0	-	-	-	-
3/ 1/18 4 O1(P)	12 31 14	12 36 35	12 41 52	.361	3.1	5.6										
SENDAI		12 36 19 ± 8		.969 ± .060			16	T 36.	PM3	42	-58	1	V	0.1	-	-
3/ 1/19 4 O3(P)	1 1 19	1 5 51	1 10 24	.160	3.0	10.5										
LUMEZZANE		1 5 39 ± 39		.272 ± .060			12	T 40.	PM2	61	-58	0	-	-	-	-
OHP		1 6 2 ± 26		.326 ± .050			-11	L 15.	CCD2	63	-61	0	-	-	-	-
CHATEAUGIRON		1 6 7 ± 48		.271 ± .067			-16	T 21.	CCD1	55	-50	0	-	-	-	-
3/ 1/20 2 E3(P)	15 45 22	15 54 48	16 4 6	.250	2.7	8.8										
ALMA-ATA		15 54 20 ± 23		.258 ± .030			28	T 60.	CCD9	32	-45	0	-	-	-	-
3/ 1/20 2 O3(P)	17 5 19	17 12 48	17 20 13	.218	2.7	9.4										
ALMA-ATA		17 14 13 ± 33		.305 ± .039			-85	T 60.	CCD9	46	-58	0	-	-	-	-
TERSKOL		17 12 16 ± 49		.240 ± .068			32	T 60.	CCD9	22	-35	1	-	-	-	-
3/ 1/21 2 O1(P)	23 40 58	23 43 53	23 46 46	.046	2.4	5.9										
TERSKOL		23 44 4 ± 18		.042 ± .008			-11	T 60.	CCD9	57	-51	1	-	-	-	-
3/ 1/24 3 O4(P)	18 28 32	18 35 22	18 42 14	.328	1.8	13.4										
TERSKOL		18 35 1 ± 21		.234 ± .028			21	T 60.	CCD9	40	-48	1	-	-	-	-
3/ 1/25 2 O4(A)	13 29 37	13 33 14	13 36 50	.405	1.7	6.2										
SENDAI		13 33 34 ± 74		.076 ± .067			-20	T 36.	PM3	58	-65	3	-	-	-	-
3/ 1/25 1 E4( )	18 9 12	18 22 58	18 35 53	.129	1.6	4.3										
NOVARA		18 24 39 ± 3		.208 ± .010			-101	T 60.	VISU	16	-23	0	-	-	-	-
3/ 1/27 2 E3(A)	19 44 8	19 52 29	20 0 44	.288	1.2	9.1										
BRESCIA		19 53 21 ± 8		.573 ± .033			-52	T 20.	VISU	32	-37	0	-	-	-	-
MEUDON		19 52 19 ± 29		.251 ± .041			10	T 100.	NOCT	27	-32	3	-	0.04	-	-
NOVARA		19 52 33 ± 12		.385 ± .035			-4	T 60.	VISU	33	-38	0	-	-	-	-
SABADELL		19 46 46 ± 41		.141 ± .049			343	T 50.	CCD26	27	-32	0	-	-	-	-
KALAVUR		19 52 17 ± 6		.222 ± .007			12	T 102.	CCD28	81	-75	1	-	-	-	-
3/ 1/27 2 O3(P)	20 17 54	20 24 47	20 31 36	.241	1.2	9.4										
KAVALUR		20 25 0 ± 7		.258 ± .010			-13	T 102.	CCD28	74	-68	1	-	-	-	-
BRESCIA		20 26 17 ± 11		.581 ± .039			-90	T 20.	VISU	38	-43	0	-	-	-	-
MEUDON		20 24 54 ± 35		.297 ± .062			-7	T 100.	NOCT	32	-37	0	-	0.04	-	-
OHP		20 24 54 ± 71		.257 ± .123			-7	L 15.	CCD2	35	-40	0	-	-	-	-
SABADELL		20 20 17 ± 79		.166 ± .054			270	T 50.	CCD26	33	-38	0	-	-	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (")	Sat. in dia.
3/ 2/ 3 4 O2(T)	5 5 51	5 8 58	5 12 6	.294	.2	3.3										
SABADELL		5 8 50 ± 3		.978 ± .038			8	T 80.	CCD26	36	-36	0	-	-	-	-
3/ 2/ 3 4 O1(T)	17 9 18	17 12 8	17 14 58	.361	.3	1.7										
ALMA-ATA		17 11 53 ± 3		1.298 ± .054			15	T 60.	CCD9	56	-54	0	-	-	-	-
PULKOVO		17 11 54 ± 5		.767 ± .075			14	T 32.	CCD9	24	-22	0	-	-	-	-
CLUJ-NAPOCA		17 12 1 ± 2		.884 ± .022			7	T 41.	CCD24	19	-18	0	-	-	-	-
PULKOVO		17 12 11 ± 3		.598 ± .020			-3	T 65.	CCD9	24	-22	0	-	-	-	-
3/ 2/ 3 2 O3(A)	23 24 25	23 30 52	23 37 16	.479	.4	9.3										
LILLE		23 30 35 ± 10		.181 ± .014			17	L 32.	CCD10	57	-55	1	-	0.5	-	-
LA PALMA-R		23 30 44 ± 14		.289 ± .014			8	T 35.	CCD14	64	-62	0	-	-	-	-
LA PALMA-V		23 30 56 ± 14		.209 ± .013			-4	T 35.	CCD14	64	-62	0	-	-	-	-
UKKEL		23 30 57 ± 16		.275 ± .023			-5	T 85.	CCD23	57	-55	1	-	0.1	-	-
PULKOVO		23 31 21 ± 7		.281 ± .008			-29	T 32.	CCD9	45	-44	0	-	-	-	-
CLUJ-NAPOCA		23 31 3 ± 11		.341 ± .018			-11	T 41.	CCD24	59	-58	0	-	-	-	-
3/ 2/ 3 2 E3(A)	23 32 0	23 39 36	23 47 9	.320	.4	9.3										
LA PALMA-V		23 38 53 ± 14		.167 ± .012			43	T 35.	CCD14	66	-64	0	-	-	-	-
LA PALMA-R		23 39 6 ± 21		.255 ± .021			30	T 35.	CCD14	66	-64	0	-	-	-	-
UKKEL		23 39 29 ± 16		.243 ± .020			7	T 85.	CCD23	57	-55	1	-	0.1	-	-
PULKOVO		23 39 42 ± 4		.254 ± .005			-6	T 32.	CCD9	45	-44	0	-	-	-	-
CLUJ-NAPOCA		23 39 26 ± 10		.285 ± .012			10	T 41.	CCD24	58	-57	0	-	-	-	-
NAUCSNY		23 39 50 ± 10		.161 ± .009			-14	T 60.	PM5	55	-55	0	V	1.	-	-
3/ 2/11 2 O3(A)	2 27 33	2 33 39	2 39 42	.479	1.9	9.2										
LA PALMA-V		2 33 45 ± 19		.163 ± .017			-6	T 35.	CCD14	63	-68	0	-	-	-	-
LA PALMA-R		2 33 43 ± 17		.279 ± .031			-4	T 35.	CCD14	63	-68	0	-	-	-	-
ARMAGH		2 33 57 ± 136		.255 ± .368			-18	T 25.	CCD27	37	-38	0	-	-	-	-
OHP		2 33 38 ± 28		.323 ± .052			1	T 80.	CCD16	41	-44	0	-	0.04	-	-
3/ 2/11 2 E3(A)	3 12 54	3 19 57	3 26 59	.346	1.9	9.5										
ARMAGH		3 19 45 ± 51		.461 ± .169			12	T 25.	CCD27	79	-32	0	-	-	-	-
OHP		3 19 59 ± 22		.656 ± .109			-2	T 80.	CCD16	32	-37	0	-	0.04	-	-
LA PALMA-V		3 19 39 ± 14		.119 ± .010			18	T 35.	CCD14	32	-37	0	-	-	-	-
LA PALMA-R		3 19 44 ± 14		.273 ± .025			13	T 35.	CCD14	32	-37	0	-	-	-	-
3/ 2/15 2 O1(P)	19 15 42	19 16 25	19 17 8	.002	2.8	5.7										
PULKOVO		19 15 44 ± 131		.040 ± .034			41	T 65.	CCD9	44	-33	0	-	-	-	-
3/ 2/18 2 O3(A)	5 28 53	5 34 39	5 40 22	.479	3.3	9.1										
MONTERREY		5 34 46 ± 19		.283 ± .027			-7	T 18.	VIDEO	82	-67	1	-	0.5	-	-
3/ 2/18 2 E3(A)	6 48 44	6 55 22	7 1 58	.365	3.3	9.6										
MONTERREY		6 55 7 ± 11		.348 ± .023			15	T 18.	VIDEO	72	-76	1	-	0.5	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (")	Sat. in dia.
3/ 2/18 4 O3(P)	17 46 56	17 53 40	18 0 26	.335	3.4	13.3										
MEUDON		17 54 14 ± 25		.241 ± .038			-34	T 100.	NOCT	24	-7	0	-	0.04	-	-
OHP		17 53 31 ± 17		.800 ± .085			9	T 80.	CCD2	26	-9	0	-	-	-	-
YUNNAN OBS.		17 53 17 ± 4		.738 ± .018			23	T 100.	CCD8	65	-75	0	-	-	-	-
TERSKOL		17 53 47 ± 7		.664 ± .028			-7	T 60.	CCD9	59	-40	1	-	-	1	-
CLUJ-NAPOCA		17 53 44 ± 9		.744 ± .041			-4	T 41.	CCD24	38	-21	0	-	0.7	5	-
3/ 2/18 4 E3(P)	20 39 31	20 48 49	20 58 7	.384	3.4	13.9										
PULKOVO		20 48 32 ± 12		.557 ± .029			17	T 65.	CCD9	49	-39	3	-	-	-	-
ARMAGH		20 46 44 ± 26		.389 ± .111			125	T 25.	CCD27	49	-35	0	-	-	-	-
BORDEAUX		20 48 38 ± 9		.588 ± .026			11	T 60.	CCD15	52	-35	1	-	-	-	-
CHATEAUGIRON		20 48 39 ± 36		.845 ± .209			10	T 21.	CCD1	59	-46	0	-	-	-	-
LANESTER		20 48 29 ± 100		.541 ± .334			20	T 20.	CCD6	52	-36	2	-	-	-	-
LILLE		20 48 18 ± 25		.528 ± .063			31	L 32.	CCD10	50	-35	2	-	1.0	-	-
MEUDON		20 48 24 ± 21		.179 ± .022			25	T 100.	NOCT	51	-35	0	-	0.04	-	-
NAUCSNY		20 48 33 ± 3		.359 ± .005			16	T 60.	PM5	62	-51	0	-	-	-	-
MAINZ		20 48 18 ± 28		.501 ± .077			31	T 25.	CCD25	53	-38	0	-	-	-	-
NOVARA		20 48 54 ± 9		2.254 ± .229			-5	T 6.	VISU	57	-41	0	-	0.1	-	-
OHP		20 48 35 ± 35		.346 ± .069			14	T 80.	CCD2	56	-39	0	-	-	-	-
YUNNAN OBS.		20 48 25 ± 12		.570 ± .032			24	T 100.	CCD8	25	-39	0	-	-	-	-
TERSKOL		20 48 43 ± 8		.522 ± .022			6	T 60.	CCD9	64	-58	1	-	-	1	-
UKKEL		20 48 35 ± 15		.696 ± .059			14	T 85.	CCD23	50	-35	0	-	-	-	-
MUNDOLSHEIM		20 48 35 ± 57		.536 ± .172			14	T 15.	CCD4	54	-38	2	-	-	-	-
CLUJ-NAPOCA		20 48 26 ± 13		.567 ± .019			23	T 41.	CCD24	61	-48	0	-	0.6	5	-
3/ 2/19 4 O1(P)	20 28 22	20 31 16	20 34 9	.299	3.6	2.9										
ANTONY		20 31 3 ± 17		.990 ± .244			13	T 22.	CCD6	46	-30	1	-	-	-	-
BRESCIA		20 31 39 ± 7		.496 ± .035			-23	T 20.	VISU	55	-38	0	-	0.1	-	-
LILLE		20 31 1 ± 5		.787 ± .060			15	L 32.	CCD10	48	-32	1	-	0.1	-	-
NOVARA		20 31 31 ± 5		.725 ± .063			-15	T 6.	VISU	55	-38	0	-	0.1	-	-
NYROLA		20 31 1 ± 2		.855 ± .023			15	T 41.	CCD14	45	-35	0	V	-	-	-
TERSKOL		20 30 57 ± 6		.837 ± .054			19	T 60.	CCD9	64	-56	1	-	-	1	-
UKKEL		20 31 1 ± 3		1.146 ± .065			15	T 85.	CCD23	49	-33	1	-	0.1	-	-
MUNDOLSHEIM		20 31 0 ± 11		.916 ± .174			16	T 15.	CCD4	52	-36	0	-	-	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (")	Sat. in dia.
3/ 2/19 4 E1( )	22 11 19	22 15 42	22 20 6	.419	3.6	4.1										
CATANIA		22 15 26 ± 20		.407 ± .090			16	T 20.	CCD6	70	-61	1	-	0.5	-	-
LILLE		22 15 24 ± 5		.524 ± .028			18	L 32.	CCD10	57	-45	0	-	1.0	-	-
MEUDON		22 15 21 ± 18		.597 ± .109			21	T 100.	NOCT	59	-46	0	-	-	-	-
NYROLA		22 15 21 ± 3		.535 ± .017			21	T 41.	CCD14	45	-39	0	V	-	-	-
LA PALMA-V		22 15 25 ± 7		.522 ± .047			17	T 35.	CCD14	64	-44	0	-	-	-	-
LA PALMA-R		22 15 8 ± 13		.528 ± .064			34	T 35.	CCD14	64	-44	0	-	-	-	-
UKKEL		22 15 21 ± 7		.727 ± .060			21	T 85.	CCD23	57	-45	1	-	0.1	-	-
VIENNA		22 15 59 ± 12		.223 ± .018			-17	T 10.	VISU	60	-51	2	-	-	-	-
3/ 2/20 4 O2(T)	1 30 21	12 18 30	12 21 40	.295	3.8	3.7										
YUNNAN OBS.		12 18 24 ± 4		1.059 ± .048			6	T 100.	CCD8	26	-46	1	-	-	-	-
3/ 2/20 4 E2(P)	14 22 54	14 27 29	14 32 4	.543	3.8	2.3										
YUNNAN OBS.		14 27 14 ± 3		.824 ± .025			14	T 100.	CCD8	63	-46	1	-	-	-	-
3/ 2/20 1 O2(P)	15 47 28	15 49 17	15 51 5	.381	3.8	1.3										
YUNNAN OBS.		15 49 3 ± 1		.534 ± .011			14	T 100.	CCD8	76	-66	1	-	-	-	-
3/ 2/25 2 E3(A)	10 21 17	10 27 34	10 33 48	.380	4.7	9.7										
SENDAI		10 27 21 ± 19		.442 ± .067			13	T 36.	PM3	51	-26	1	-	0.1		-
3/ 2/27 1 O2(P)	17 46 8	17 47 56	17 49 43	.334	5.8	1.5										
NAUCSNY		17 47 44 ± 3		.426 ± .025			12	T 60.	PM5	49	-23	0	V	1.	-	-
YUNNAN OBS.		17 47 44 ± 1		.420 ± .008			12	T 100.	CCD8	54	-83	1	-	-	-	-
ROZHEN		17 47 30 ± 6		.189 ± .029			26	T 60.	PM1	46	620	1	V	1.	-	-
MUNDOLSHEIM		17 47 41 ± 15		.273 ± .080			15	L 49.	CCD4	33	-7	1	-	-	-	-
CLUJ-NAPOCA		17 47 41 ± 1		.467 ± .013			15	T 41.	CCD24	44	-18	0	-	0.8	5	-
3/ 2/27 1 O4(P)	21 59 30	22 2 56	22 6 24	.254	5.2	4.6										
ROZHEN		22 2 42 ± 3		.201 ± .007			14	T 60.	PM1	61	-56	1	V	1.	-	-
ZARAGOZA		22 2 40 ± 10		.146 ± .018			16	T 41.	CCD21	67	-46	0	-	-	-	-
SOBOTA		22 2 35 ± 18		.120 ± .028			21	T 15.	CCD14	58	-49	0	-	0.1	1	-
UKKEL		22 2 42 ± 19		.154 ± .036			14	T 85.	CCD23	58	-42	1	-	0.2	-	-
MUNDOLSHEIM		22 2 9 ± 29		.131 ± .069			47	L 49.	CCD4	60	-45	2	-	-	-	-
NAUCSNY		22 2 37 ± 4		.154 ± .006			19	T 60.	PM5	55	-52	0	V	1.	-	-
CLUJ-NAPOCA		22 2 28 ± 3		.173 ± .006			28	T 41.	CCD24	58	-51	0	V	0.8	-	-
LA PALMA-V		22 2 40 ± 5		.156 ± .009			16	T 35.	CCD14	68	-40	0	-	-	-	-
LA PALMA-R		22 2 33 ± 10		.155 ± .012			23	T 35.	CCD14	68	-40	0	-	-	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (”)	Sat. in dia.
3/ 2/28 1 E4(A)	1 8 33	1 16 8	1 23 55	.483	5.2	3.3										
ZARAGOZA		1 15 34 ± 7		.659 ± .034			34	T 41.	CCD21	46	-54	0	-	-	-	-
BORDEAUX		1 15 36 ± 6		.706 ± .026			32	T 60.	CCD15	45	-51	1	-	-	-	-
SOBOTA		1 15 34 ± 20		.166 ± .021			34	T 15.	CCD14	31	-40	0	-	0.1	1	-
CLUJ-NAPOCA		1 15 35 ± 6		.710 ± .027			33	T 41.	CCD24	29	-39	0	V	0.9	-	-
3/ 2/28 1 E4(A)	12 30 5	12 40 26	12 50 41	.534	5.3	1.4										
YUNNAN OBS.		12 40 59 ± 6		.707 ± .024			-33	T 100.	CCD8	47	-20	1	-	-	-	-
3/ 2/28 1 O4(P)	23 37 40	23 45 9	23 52 21	.137	5.4	5.9										
NAUCSNY		23 44 54 ± 22		.082 ± .008			15	T 60.	PM5	39	-46	0	V	1.	-	-
ZARAGOZA		23 44 47 ± 26		.884 ± .012			22	T 20.	CCD21	61	-56	0	-	-	-	-
TERSKOL		23 44 8 ± 115		.705 ± .036			61	T 60.	CCD9	30	-42	1	-	-	1	-
ARMAGH		23 44 45 ± 254		.134 ± .137			24	T 25.	CCD27	48	-43	0	-	-	-	-
CLUJ-NAPOCA		23 44 52 ± 34		.081 ± .013			17	T 41.	CCD24	43	-48	0	V	0.5	-	-
3/ 3/ 1 2 O4(A)	2 58 10	3 2 4	3 5 58	.405	5.4	7.2										
SABADELL		3 1 51 ± 15		.445 ± .061			13	T 80.	CCD26	27	-41	0	-	-	-	-
3/ 3/ 6 1 O2(P)	19 46 8	19 47 53	19 49 39	.290	6.4	1.7										
LISBOA		19 47 54 ± 5		.107 ± .011			-1	T 20.	CCD12	51	-16	1	-	0.1	-	-
ZARAGOZA		19 47 40 ± 3		.350 ± .021			13	T 41.	CCD21	55	-21	0	-	-	-	-
PULKOVO		19 47 40 ± 9		.305 ± .060			13	T 65.	CCD9	49	-30	3	-	-	-	-
3/ 3/ 9 4 O2(P)	16 30 40	16 37 10	16 43 36	.293	6.8	9.2										
PULKOVO		16 37 8 ± 14		.769 ± .061			2	T 32.	CCD9	38	-8	0	-	-	-	-
TERSKOL		16 37 12 ± 4		.817 ± .022			-2	T 60.	CCD9	54	-18	1	-	-	1	-
3/ 3/ 9 4 E2( )	21 59 35	22 5 19	22 11 4	.232	6.9	7.8										
ARMAGH		22 5 48 ± 51		.266 ± .166			-29	T 25.	CCD27	53	-36	0	-	-	-	-
BORDEAUX		22 5 0 ± 14		.251 ± .026			19	T 60.	CCD15	63	-41	1	-	-	-	-
SABADELL		22 5 13 ± 11		.242 ± .019			6	T 80.	CCD26	66	-45	0	-	-	-	-
LILLE		22 5 6 ± 19		.288 ± .039			13	L 32.	CCD10	57	-38	2	-	0.8	-	-
OHP		22 4 49 ± 53		.315 ± .120			30	T 80.	CCD16	63	-45	1	-	0.2	5	-
LA PALMA-V		22 4 49 ± 3		.153 ± .004			30	T 35.	CCD14	77	-39	0	-	-	-	-
MUNDOSLHEIM		22 5 14 ± 57		.299 ± .133			5	T 15.	CCD4	58	-41	1	-	-	-	-
ZARAGOZA		22 4 54 ± 8		.236 ± .015			25	T 20.	CCD21	67	-43	0	V	-	-	-
3/ 3/11 2 O3(P)	14 34 22	14 38 50	14 43 16	.217	7.1	8.6										
KAVALUR		14 38 46 ± 4		.224 ± .009			4	T 102.	CCD28	66	-26	1	-	-	-	-
3/ 3/11 2 E3(A)	17 17 5	17 22 43	17 28 20	.377	7.2	9.8										
KAVALUR		17 22 30 ± 3		.488 ± .009			30	T 102.	CCD28	72	-66	1	-	-	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (")	Sat. in dia.
3/ 3/13 1 O2(P)	21 47 40	21 49 23	21 51 7	.253	7.5	1.9										
ARMAGH		21 49 13 ± 20		.221 ± .167			10	T 25.	CCD27	53	-33	0	-	-	-	-
SABADELL		21 49 0 ± 8		1.992 ± .411			23	T 50.	CCD26	66	-41	0	-	-	-	-
MUNDOLSHEIM		21 49 6 ± 14		.335 ± .083			17	T 15.	CCD4	58	-39	1	-	-	-	-
3/ 3/15 3 E4(A)	22 5 7	22 14 49	22 24 33	.649	7.8	10.4										
ANTONY		22 14 38 ± 79		1.054 ± .532			11	T 22.	CCD6	52	-34	1	-	-	-	-
ARMAGH		22 14 42 ± 37		.939 ± .190			7	T 25.	CCD27	50	-35	0	-	-	-	-
BORDEAUX		22 14 42 ± 6		1.128 ± .033			7	T 60.	CCD15	61	-40	0	-	1.5	-	-
CHATEAUGIRON		22 14 44 ± 46		1.131 ± .278			5	T 21.	CCD1	48	-44	0	-	-	-	-
DAX		22 14 34 ± 5		1.033 ± .030			15	T 32.	CCD11	63	-41	0	-	-	-	-
DOLBERG OBS.		22 14 27 ± 28		.642 ± .220			22	T 20.	WAT	52	-37	0	-	-	-	-
GIERES		22 14 40 ± 18		1.129 ± .121			9	T 20.	CCD6	68	-66	2	-	-	-	-
LILLE		22 14 27 ± 18		1.114 ± .100			22	L 32.	CCD10	55	-37	1	-	0.5	-	-
MEUDON		22 14 34 ± 31		1.270 ± .240			15	T 100.	NOCT	57	-38	0	-	0.04	-	-
NYROLA		22 14 39 ± 3		1.008 ± .020			10	T 41.	CCD14	38	-30	0	R	-	-	-
PULKOVO		22 14 44 ± 6		.798 ± .028			5	T 32.	CCD9	38	-32	0	-	-	-	-
PULKOVO		22 14 44 ± 3		.994 ± .019			5	T 65.	CCD9	38	-32	0	-	-	-	-
UKKEL		22 14 42 ± 11		1.282 ± .066			7	T 85.	CCD23	54	-37	1	-	0.1	-	-
MUNDOLSHEIM		22 14 14 ± 41		.899 ± .348			35	T 15.	CCD4	55	-40	2	-	-	-	-
3/ 3/17 1 E3( )	18 18 8	18 22 36	18 27 8	.061	8.0	3.8										
ALMA-ATA		18 22 49 ± 20		.047 ± .009			-13	T 60.	CCD9	51	-47	0	R	0.5	-	-
NAUCSNY		18 22 32 ± 7		.052 ± .004			4	T 60.	PM5	61	-24	0	V	1.	-	-
NYROLA		18 22 36 ± 34		.052 ± .018			0	T 41.	CCD14	45	-14	0	V	-	-	-
MUNDOLSHEIM		18 22 4 ± 100		.083 ± .118			32	T 15.	CCD4	50	-9	1	-	-	-	-
3/ 3/18 2 E3(A)	20 41 34	20 46 53	20 52 12	.353	8.2	9.7										
ARMAGH		20 46 44 ± 26		.389 ± .111			9	T 25.	CCD27	54	-26	0	-	-	-	-
BORDEAUX		20 46 41 ± 4		.502 ± .014			12	T 60.	CCD15	64	-27	0	-	1.	-	-
CATANIA		20 46 42 ± 11		.399 ± .034			11	T 20.	CCD6	69	-41	1	-	0.2	-	-
CHATEAUGIRON		20 46 50 ± 23		.665 ± .147			3	T 21.	CCD1	57	-37	0	-	-	-	-
LILLE		20 46 50 ± 7		.456 ± .028			3	L 32.	CCD10	58	-26	1	-	0.5	-	-
OHP		20 46 46 ± 13		.665 ± .071			7	T 80.	CCD16	65	-32	0	-	0.04	-	-
LA PALMA-V		20 46 44 ± 5		.472 ± .019			9	T 35.	CCD14	69	-21	0	-	-	-	-
LA PALMA-R		20 46 56 ± 9		.486 ± .040			-3	T 35.	CCD14	69	-21	0	-	-	-	-
ZARAGOZA		20 46 46 ± 6		.454 ± .025			7	T 20.	CCD21	67	-29	0	V	-	-	-
UKKEL		20 46 44 ± 8		.578 ± .035			9	T 85.	CCD23	58	-27	1	-	0.1	-	-
MUNDOLSHEIM		20 46 41 ± 16		.387 ± .065			12	T 15.	CCD4	60	-30	1	-	-	-	-
3/ 3/19 2 E1( )	18 20 50	18 23 12	18 25 35	.091	8.3	4.4										
MUNDOLSHEIM		18 23 5 ± 111		.048 ± .081			7	T 15.	CCD4	52	-8	1	-	-	-	-
3/ 3/20 1 O2(P)	23 50 52	23 52 34	23 54 16	.225	8.4	2.2										
CATANIA		23 52 26 ± 35		.296 ± .196			8	T 14.	CCD6	35	-51	1	-	-	-	-
NYROLA		23 52 20 ± 3		.296 ± .023			14	T 41.	CCD14	26	-25	0	V	-	-	-
SABADELL		23 52 26 ± 13		.162 ± .029			8	T 50.	CCD26	44	-48	0	-	-	-	-
PULKOVO		23 52 21 ± 4		.149 ± .016			13	T 65.	CCD9	24	-27	0	-	-	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (")	Sat. in dia.
3/ 3/24 1 E3(P)	21 54 20	22 1 32	22 8 57	.136	8.9	3.7										
BORDEAUX		22 1 19 ± 13		.142 ± .010			13	T 60.	CCD15	59	-36	1	-	-	-	-
BUCHAREST		22 1 8 ± 8		.147 ± .006			24	T 50.	PM4	43	-44	0	V	-	-	-
CATANIA		22 1 44 ± 115		.123 ± .097			-12	T 20.	CCD6	53	-48	0	-	-	-	-
LILLE		22 1 31 ± 24		.149 ± .017			1	L 32.	CCD10	53	-33	1	-	0.5	-	-
MEUDON		22 1 34 ± 40		.060 ± .017			-2	T 100.	NOCT	54	-34	0	-	0.04	-	-
NAUCSNY		22 1 29 ± 12		.132 ± .010			3	T 60.	PM5	39	-42	0	V	1.	-	-
OHP		22 1 54 ± 70		.113 ± .038			-22	L 15.	CCD	56	-39	0	-	-	-	-
PRAGUE		22 1 0 ± 206		.140 ± .127			32	T 18.	CCD19	48	-36	0	-	-	-	-
PULKOVO		22 1 30 ± 29		.159 ± .029			2	T 32.	CCD9	35	-29	0	-	-	-	-
ZARAGOZA		22 1 35 ± 18		.144 ± .015			-3	T 20.	CCD21	61	-38	0	V	-	-	-
UKKEL		22 1 32 ± 32		.169 ± .029			0	T 85.	CCD23	52	-33	1	-	0.1	-	-
MUNDOLSHEIM		22 1 11 ± 74		.126 ± .103			21	T 15.	CCD4	52	-36	1	-	-	-	-
3/ 3/25 4 E3( )	13 32 19	13 38 59	13 45 39	.523	9.0	4.7										
KAVALUR		13 38 52 ± 8		.390 ± .022			7	T 102.	CCD28	66	-12	2	-	-	-	-
3/ 3/25 1 E3(P)	20 2 45	20 8 28	20 14 5	.118	9.0	7.9										
BORDEAUX		20 8 1 ± 15		.155 ± .015			27	T 60.	CCD15	64	-20	1	-	1.	-	-
BRESCIA		20 9 33 ± 5		.145 ± .015			-65	T 20.	VISU	63	-26	0	-	0.1	-	-
CATANIA		20 8 34 ± 84		.149 ± .081			-6	T 25.	CCD6	70	-33	1	-	0.2	-	-
LILLE		20 8 49 ± 51		.113 ± .045			-21	L 32.	CCD10	58	-19	2	-	0.5	-	-
MEUDON		20 8 22 ± 33		.152 ± .047			6	T 100.	NOCT	60	-20	0	-	0.04	-	-
NAUCSNY		20 8 15 ± 6		.857 ± .004			13	T 60.	PM5	56	-36	0	V	1.	-	2-3
NYROLA		20 8 19 ± 15		.081 ± .010			9	T 41.	CCD14	45	-21	0	V	-	-	2-3
OHP		20 7 50 ± 49		.182 ± .052			38	L 15.	CCD2	65	-24	0	-	-	-	2-3
PULKOVO		20 8 24 ± 37		.091 ± .026			4	T 32.	CCD9	46	-24	0	-	-	-	2-3
ZARAGOZA		20 8 20 ± 22		.076 ± .013			8	T 20.	CCD21	67	-21	0	V	-	-	2-3
3/ 3/25 2 O3(P)	20 44 50	20 48 10	20 51 30	.102	9.0	8.2										
BRESCIA		20 49 20 ± 9		.108 ± .014			-70	T 20.	VISU	61	-31	0	-	0.1	-	-
SABADELL		20 48 23 ± 8		.107 ± .008			-13	T 80.	CCD26	75	-20	0	-	-	-	-
CATANIA		20 48 0 ± 45		.052 ± .067			10	T 25.	CCD26	67	-29	1	-	0.2	-	-
LILLE		20 49 10 ± 65		.435 ± .161			-60	L 32.	CCD10	58	-24	2	-	0.5	-	-
MEUDON		20 48 13 ± 31		.057 ± .019			-3	T 100.	NOCT	60	-25	0	-	0.04	-	-
NAUCSNY		20 47 57 ± 5		.120 ± .005			13	T 60.	PM5	50	-39	0	V	1.	-	-
NYROLA		20 48 9 ± 10		.104 ± .011			1	T 41.	CCD14	42	-23	0	V	-	-	-
OHP		20 48 48 ± 51		.074 ± .057			-38	L 15.	CCD2	64	-30	0	-	-	-	-
LA PALMA-V		20 48 9 ± 14		.104 ± .012			1	T 35.	CCD14	75	-20	0	-	-	-	-
PULKOVO		20 48 6 ± 20		.124 ± .028			4	T 32.	CDD9	42	-27	0	-	-	-	-
ZARAGOZA		20 48 7 ± 20		.122 ± .020			3	T 20.	CCD21	67	-27	0	V	-	-	-
BORDEAUX		20 48 0 ± 24		.100 ± .019			10	T 60.	CCD15	64	-26	1	-	-	-	-

Dates Phenomena Locations	**Begins h m s**	**Maxi. h m s**	**Ends h m s**	**Magn. drop**	**Ph. (s)**	**Dist. (Rs)**	**O-C (s)**	**Ap. (cm)**	**Rec.**	**El. Sat. (°)**	**El. Sun (°)**	**Cd.**	**Filt.**	**T. int. (s)**	**Dia. (")**	**Sat. in dia.**
3/ 3/26 2 E3(A)	0 4 26	0 9 26	0 14 27	.314	9.0	9.6										
ARMAGH		0 9 33 ± 45		.345 ± .126			-7	T 25.	CCD27	32	-33	0	-	-	-	-
CATANIA		0 9 18 ± 26		.376 ± .096			8	T 25.	CCD6	27	-48	0	-	-	-	-
LILLE		0 9 15 ± 8		.403 ± .030			11	L 32.	CCD10	35	-37	1	-	1.	-	-
NYROLA		0 9 18 ± 7		.390 ± .019			8	T 41.	CCD14	21	-23	0	V	-	-	-
OHP		0 9 30 ± 14		.335 ± .047			-4	L 15.	CCD2	34	-44	0	-	0.04	-	-
LA PALMA-V		0 9 13 ± 8		.412 ± .030			13	T 35.	CCD14	54	-56	0	-	-	-	-
PULKOVO		0 9 12 ± 11		.540 ± .046			14	T 32.	CCD9	19	-24	0	-	-	-	-
3/ 3/26 2 E1(P)	20 38 23	20 40 56	20 43 30	.181	9.1	4.2										
PULKOVO		20 40 34 ± 13		.199 ± .037			22	T 32.	CCD9	43	-26	0	-	-	-	-
UKKEL		20 40 28 ± 41		.197 ± .121			28	T 85.	CCD23	58	-24	3	-	0.2	-	-
VIENNA		20 40 58 ± 13		.317 ± .019			-2	T 10.	VISU	70	-53	1	-	-	-	-
BRESCIA		20 40 58 ± 5		.087 ± .020			-2	T 20.	VISU	61	-30	0	-	0.1	-	-
SABADELL		20 40 44 ± 5		.118 ± .008			12	T 80.	CCD26	75	-18	0	-	-	-	-
CATANIA		20 40 34 ± 28		.148 ± .054			22	T 25.	CCD6	65	-38	1	-	0.2	-	-
LILLE		20 40 32 ± 12		.149 ± .028			24	L 32.	CCD10	58	-23	1	-	0.5	-	-
OHP		20 41 5 ± 27		.097 ± .049			-9	T 80.	CCD2	64	-29	0	-	-	-	-
LA PALMA-V		20 40 38 ± 7		.158 ± .018			18	T 35.	CCD14	75	-18	0	-	-	-	-
LA PALMA-R		20 40 35 ± 6		.170 ± .019			21	T 35.	CCD14	75	-18	0	-	-	-	-
PULKOVO		20 40 35 ± 15		.175 ± .049			21	T 65.	CCD9	43	-26	2	-	-	-	-
3/ 3/28 1 O2(P)	1 55 50	1 57 32	1 59 14	.208	9.2	2.4										
ARMAGH		1 57 29 ± 33		.211 ± .173			3	T 25.	CCD27	15	-26	0	-	-	-	-
SABADELL		1 57 14 ± 1		.213 ± .003			18	T 80.	CCD26	15	-38	0	-	-	-	-
MONTERREY		1 57 18 ± 6		.254 ± .026			14	T 18.	VIDEO	73	-15	1	-	0.5	-	-
3/ 3/28 1 E2(P)	3 30 2	3 32 15	3 34 29	.404	9.2	1.3										
MONTERREY		3 31 57 ± 8		.392 ± .054			18	T 18.	VIDEO	81	-35	1	-	0.5	-	-
3/ 4/ 1 1 E3(P)	23 25 49	23 30 41	23 35 29	.193	9.7	7.7										
VIENNA		23 31 16 ± 7		.242 ± .014			-35	T 10.	VISU	24	-71	1	-	-	-	-
PULKOVO		23 31 5 ± 63		.222 ± .105			-24	T 65.	CCD9	20	-23	0	-	-	-	-
3/ 4/ 2 2 E4( )	20 12 18	20 16 29	20 20 39	.124	9.8	1.6										
MUNDOLSHEIM		20 16 39 ± 60		.104 ± .067			-10	T 15.	CCD4	59	-22	1	-	-	-	-
3/ 4/ 2 2 E1(P)	22 55 20	22 58 1	23 0 40	.296	9.8	3.9										
BORDEAUX		22 57 42 ± 3		.339 ± .020			19	T 60.	CCD15	45	-38	1	-	-	-	-
PULKOVO		22 57 50 ± 15		.553 ± .166			11	T 32.	CCD9	24	-24	0	-	-	-	-
MUNDOLSHEIM		22 57 35 ± 25		.302 ± .127			26	T 15.	CCD4	39	-36	1	-	-	-	-
PULKOVO		22 57 21 ± 16		.327 ± .072			40	T 65.	CCD9	24	-24	0	-	-	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (")	Sat. in dia.
3/ 4/ 3 1 E4(P)	17 15 44	17 22 54	17 29 57	.233	9.8	9.9										
ALMA-ATA		17 21 47 ± 12		.367 ± .033			67	T 60.	CCD9	50	-37	1	R	1.	-	-
3/ 4/ 5 3 E1(P)	0 48 59	0 52 3	0 55 7	.465	9.9	2.2										
BORDEAUX		0 52 6 ± 3		.675 ± .030			-3	T 60.	CCD15	24	-38	1	-	-	-	-
3/ 4/ 7 1 O2(P)	17 6 40	17 8 24	17 10 7	.205	10.1	2.7										
KAVALUR		17 8 8 ± 2		.234 ± .009			16	T 102.	CCD28	50	-59	0	-	-	-	-
3/ 4/ 7 1 E2( )	18 50 58	18 52 54	18 54 52	.144	10.1	1.5										
NOVARA		18 53 31 ± 5		1.594 ± .177			-37	T 6.	VISU	63	-10	0	-	0.1	-	-
MUNDOLSHEIM		18 52 30 ± 25		.146 ± .096			24	T 15.	CCD4	60	-8	1	-	-	-	-
3/ 4/11 3 E2( )	20 58 57	21 1 59	21 5 1	.116	10.4	6.6										
NYROLA		21 2 11 ± 34		.069 ± .029			-12	T 41.	CCD14	35	-18	0	-	-	-	-
ZARAGOZA		21 2 9 ± 15		.085 ± .035			-10	T 20.	CCD21	60	-25	0	V	-	-	-
UKKEL		21 2 6 ± 46		.078 ± .057			-7	T 85.	CCD23	51	-21	1	-	0.1	-	-
CATANIA		21 2 0 ± 48		.064 ± .058			-1	T 25.	CCD6	51	-36	0	-	-	-	-
PULKOVO		21 1 59 ± 5		.080 ± .007			0	T 65.	CCD9	34	-21	0	-	-	-	-
3/ 4/11 4 E1( )	21 22 26	21 25 41	21 28 56	.085	10.4	2.3										
UKKEL		21 25 18 ± 52		.075 ± .048			23	T 85.	CCD23	48	-24	1	-	0.1	-	-
CATANIA		21 25 12 ± 87		.088 ± .081			29	T 25.	CCD6	46	-39	1	-	0.2	-	-
3/ 4/13 2 E1(P)	14 19 46	14 22 32	14 25 17	.498	10.5	3.5										
KAVALUR		14 22 11 ± 1		.693 ± .018			21	T 102.	CCD28	82	-22	1	-	-	-	-
3/ 4/14 1 O2(P)	19 16 12	19 17 59	19 19 46	.219	10.5	2.9										
EKATERINBOURG		19 17 44 ± 2		.249 ± .009			15	T 45.	PM6	32	-23	0	V	1.	-	-
NAUCSNY		19 17 44 ± 2		.248 ± .009			15	T 60.	PM5	52	-24	0	V	1.	-	-
NOVARA		19 18 31 ± 4		.471 ± .039			-32	T 6.	VISU	62	-12	0	-	0.1	-	-
PRAGUE		19 17 43 ± 30		.251 ± .136			16	T 18.	CCD19	57	-13	0	-	-	-	-
MUNDOLSHEIM		19 18 1 ± 18		.245 ± .075			-2	T 15.	CCD4	59	-10	1	-	-	-	-
3/ 4/16 1 E3(A)	5 31 38	5 35 48	5 39 59	.378	10.6	7.0										
ELGIN		5 35 37 ± 15		.479 ± .086			11	T 20.	CCD18	48	-26	2	-	0.1	-	-
3/ 4/16 2 E3( )	10 6 43	10 10 40	10 14 35	.121	10.6	9.1										
SENDAI		10 10 33 ± 30		.080 ± .033			7	T 36.	PM3	70	-12	1	-	0.1	-	-
3/ 4/19 3 E2( )	0 14 19	0 17 46	0 21 13	.221	10.7	7.0										
LILLE		0 17 45 ± 30		.192 ± .078			1	L 32.	CCD10	19	-28	2	-	0.5	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (")	Sat. in dia.
3/ 4/21 1 O2(P)	21 27 31	21 29 23	21 31 15	.247	10.8	3.1										
SABADELL		21 29 16 ± 4		.420 ± .036			7	T 80.	CCD26	47	-28	0	-	-	-	-
CHATEAUGIRON		21 29 14 ± 27		.254 ± .175			9	T 21.	CCD1	32	-29	0	-	-	-	-
GIERES		21 29 14 ± 10		.273 ± .036			9	T 20.	CCD6	44	-51	2	-	-	-	-
NAUCSNY		21 29 9 ± 2		.286 ± .010			14	T 60.	PM5	26	-31	0	V	1.	-	-
OHP		21 29 24 ± 6		.634 ± .175			-1	L 15.	CCD16	44	-27	0	-	0.04	-	-
LA PALMA-R		21 29 10 ± 2		.289 ± .013			13	T 35.	CCD14	66	-24	0	-	-	-	-
ZARAGOZA		21 29 10 ± 3		.314 ± .017			13	T 20.	CCD21	49	-26	0	V	-	-	-
PULKOVO		21 29 10 ± 5		.211 ± .022			13	T 65.	CCD9	26	-18	0	-	-	-	-
3/ 4/27 2 E1(A)	18 50 57	18 53 40	18 56 23	.662	10.9	2.9										
CATANIA		18 53 20 ± 4		1.516 ± .109			20	T 20.	CCD6	63	-13	1	-	0.2	-	-
NAUCSNY		18 53 20 ± 1		.973 ± .029			20	T 60.	PM5	48	-17	0	V	1.	-	-
PULKOVO		18 53 18 ± 4		1.607 ± .193			22	T 32.	CCD9	41	-8	0	-	-	-	-
TERSKOL		18 53 17 ± 5		.917 ± .101			23	T 60.	CCD9	41	-26	1	-	-	1	-
3/ 4/28 4 O2(P)	14 56 5	15 0 5	15 4 4	.213	10.9	7.9										
ALMA-ATA		15 0 1 ± 2		.633 ± .013			4	T 60.	CCD9	17	-33	1	-	1.	-	-
3/ 5/ 2 1 O2(P)	12 47 47	12 49 48	12 51 49	.315	10.9	3.5										
SENDAI		12 49 23 ± 10		.292 ± .057			25	T 36.	PM3	33	-32	1	-	0.1	-	-
3/ 5/ 4 2 E1(A)	21 5 59	21 8 37	21 11 15	.608	10.8	2.7										
SABADELL		21 8 23 ± 2		1.119 ± .046			14	T 80.	CCD26	42	-22	0	-	-	-	-
CATANIA		21 8 17 ± 5		1.657 ± .261			20	T 25.	CCD6	33	-31	1	-	0.2	-	-
NAUCSNY		21 8 15 ± 1		.801 ± .026			22	T 60.	PM5	21	-27	0	V	1.	-	-
NOVARA		21 8 36 ± 2		.700 ± .052			1	T 6.	VISU	37	-22	0	-	0.1	-	-
PRAGUE		21 8 19 ± 3		.947 ± .059			18	T 18.	CCD19	32	-20	0	-	-	-	-
TERSKOL		21 8 9 ± 6		.934 ± .139			28	T 60.	CCD9	12	-31	1	-	0.1	-	-
MUNDOLSHEIM		21 8 16 ± 7		1.050 ± .127			21	T 15.	CCD4	76	-19	1	-	-	-	-
3/ 5/ 7 2 O4(A)	2 27 25	2 39 58	2 52 4	.406	10.8	9.4										
MONTERREY		2 39 52 ± 83		.150 ± .029			6	T 18.	VIDEO	60	-18	1	-	0.5	-	-
3/ 5/ 7 1 E3(A)	14 1 10	14 4 46	14 8 20	.441	10.8	5.4										
KAVALUR		14 4 31 ± 3		.640 ± .025			15	T 102.	CCD28	67	-16	0	-	-	-	-
3/ 5/ 9 1 O2(P)	15 3 26	15 5 33	15 7 41	.377	10.8	3.7										
ALMA-ATA		15 5 17 ± 2		.389 ± .013			16	T 60.	CCD9	50	-11	1	R	0.5	-	-
KAVALUR		15 5 16 ± 2		.481 ± .018			17	T 102.	CCD28	51	-29	0	-	-	-	-
3/ 5/10 3 E1(P)	14 44 40	14 48 50	14 53 3	.868	10.8	5.0										
KAVALUR		14 48 56 ± 2		2.556 ± .063			-6	T 102.	CCD28	52	-8	0	-	-	-	-

Dates Phenomena Locations	Begins h m s	Maxi. h m s	Ends h m s	Magn. drop	Ph. (s)	Dist. (Rs)	O-C (s)	Ap. (cm)	Rec.	El. Sat. (°)	El. Sun (°)	Cd.	Filt.	T. int. (s)	Dia. (”)	Sat. in dia.
3/ 5/14 4 O1(P)	21 53 12	22 2 54	22 13 0	.173	10.6	3.5										
ARMAGH		22 2 7 ± 107		.400 ± .173			47	T 25.	CCD27	23	-14	0	-	-	-	-
CHATEAUGIRON		22 2 51 ± 55		.432 ± .168			3	T 21.	CCD1	12	-23	0	-	-	-	-
3/ 5/21 1 E3(P)	19 30 41	19 33 45	19 36 50	.230	10.3	4.0										
NOVARA		19 34 0 ± 2		.153 ± .020			-15	T 6.	VISU	42	-7	0	-	0.1	-	-
OHP		19 33 29 ± 30		.223 ± .107			16	L 15.	CCD2	45	-6	0	-	-	-	-
3/ 5/23 1 O2(P)	19 39 43	19 42 1	19 44 18	.422	10.2	4.1										
OHP		19 41 49 ± 8		.393 ± .055			12	L 15.	CCD2	42	-7	0	-	-	-	-
TERSKOL		19 41 38 ± 13		.524 ± .141			23	T 60.	CCD9	15	-24	1	-	-	1	-
3/ 5/24 3 E1(P)	20 46 1	20 51 4	20 56 12	.694	10.2	5.7										
CATANIA		20 51 22 ± 17		1.846 ± .301			-18	T 25.	CCD6	22	-25	1	-	0.2	-	-
OHP		20 51 19 ± 9		.451 ± .062			-15	L 15.	CCD2	29	-15	0	-	-	-	-
SOBOTA		20 51 15 ± 8		.987 ± .079			-11	T 15.	CCD14	20	-17	0	-	1.	-	-
VIENNA		20 51 46 ± 7		1.512 ± .105			-42	T 10.	VISU	22	-16	1	-	-	-	-
3/ 5/31 3 E2(P)	20 5 40	20 10 45	20 15 50	.940	9.7	8.5										
CATANIA		20 10 49 ± 12		3.987 ± .465			-4	T 25.	CCD6	25	-19	1	-	0.2	-	-
LUMEZZANE		20 10 53 ± 3		2.388 ± .079			-8	T 40.	CCD17	29	-10	0	-	0.1	-	-
SOBOTA		20 10 50 ± 2		1.455 ± .018			-5	T 15.	CCD14	22	-12	0	-	1.	-	-
MUNDOLSHEIM		20 10 49 ± 9		2.499 ± .303			-4	T 15.	CCD4	30	-7	1	-	-	-	-
3/ 6/10 1 O2(P)	13 34 28	13 36 40	13 38 52	.192	8.9	4.7										
KAVALUR		13 36 30 ± 1		.218 ± .005			10	T 102.	CCD28	47	-7	1	-	-	-	-
3/ 6/16 4 O1(P)	17 43 49	17 47 7	17 50 25	.248	8.4	4.4										
ODESSA		17 47 8 ± 11		.415 ± .044			-1	T 80.	PMTF	9	-20	1	V	0.1	-	-
3/ 6/17 4 O2(P)	16 9 41	16 11 52	16 14 3	.063	8.3	4.8										
ODESSA		16 11 53 ± 10		.051 ± .011			-1	T 80.	PMTF	27	-7	2	V	0.1	-	-
3/ 7/17 1 O3(A)	16 8 27	16 11 28	16 14 30	.356	4.9	3.5										
ODESSA		16 11 57 ± 18		.309 ± .074			-29	T 80.	PMTF	8	-8	2	V	0.1	-	-

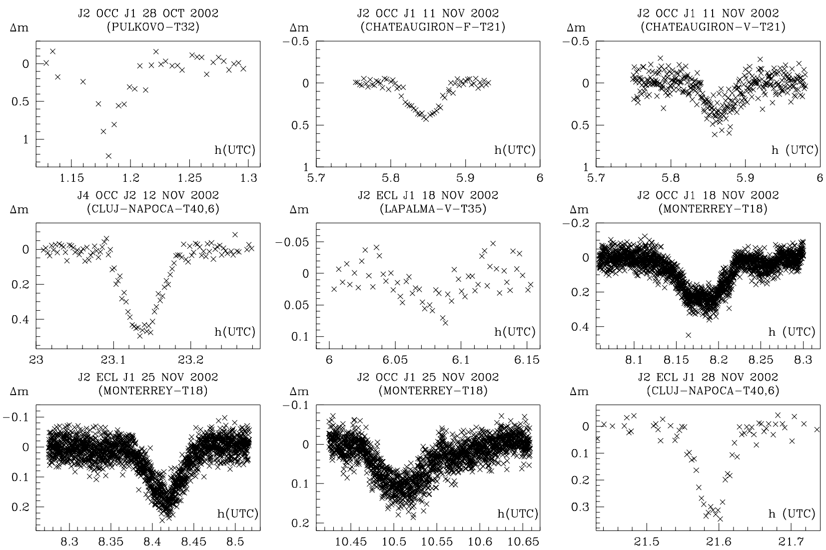

Fig. 1. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

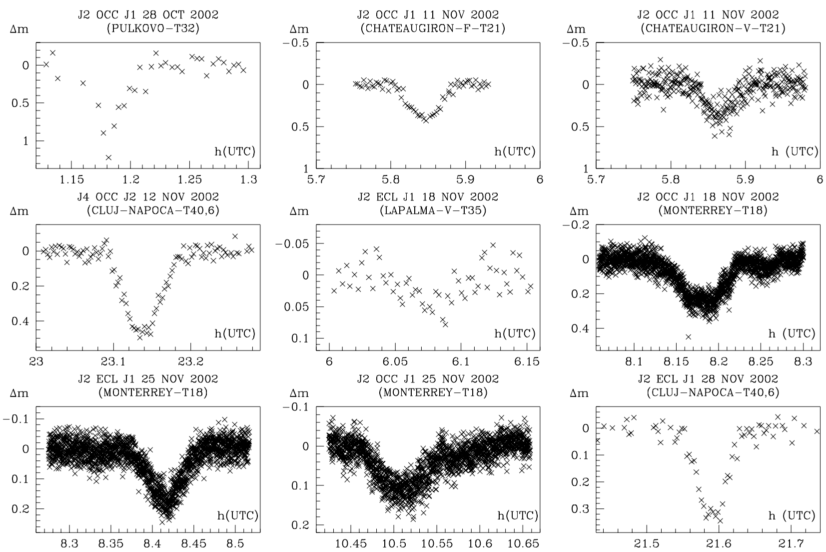

Fig. 2. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

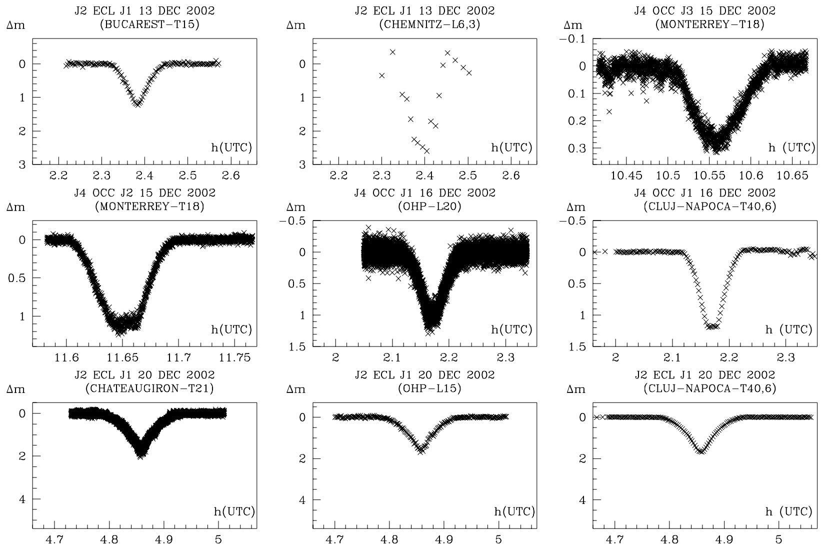

Fig. 3. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

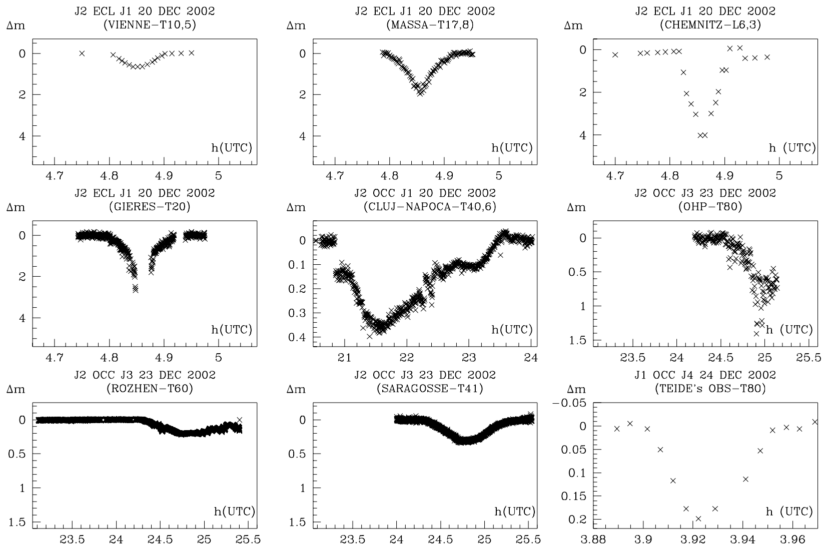

Fig. 4. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

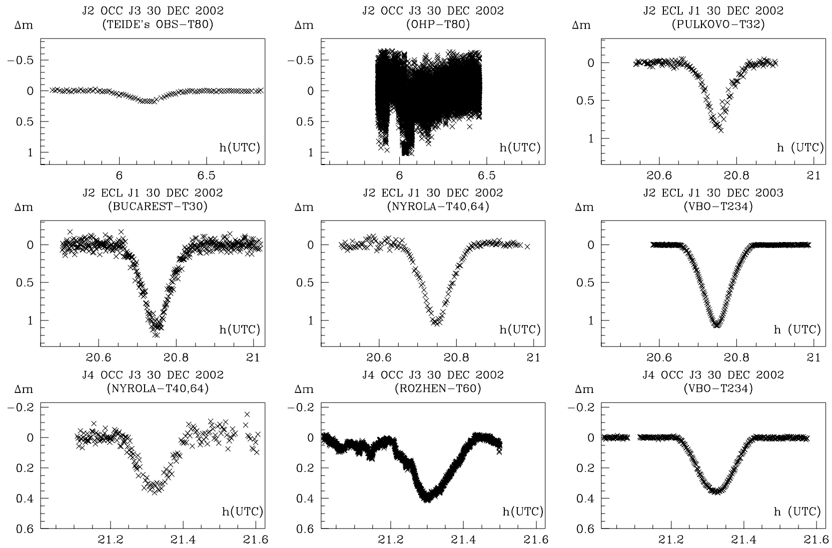

Fig. 5. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

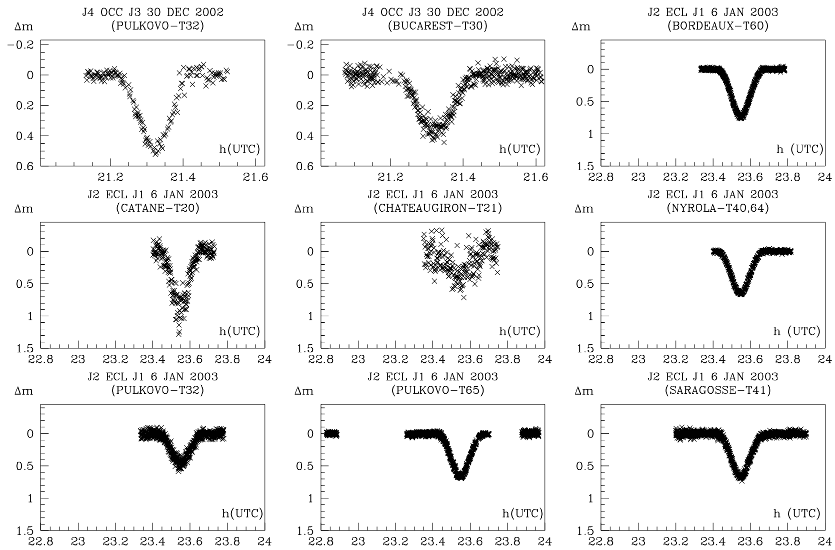

Fig. 6. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

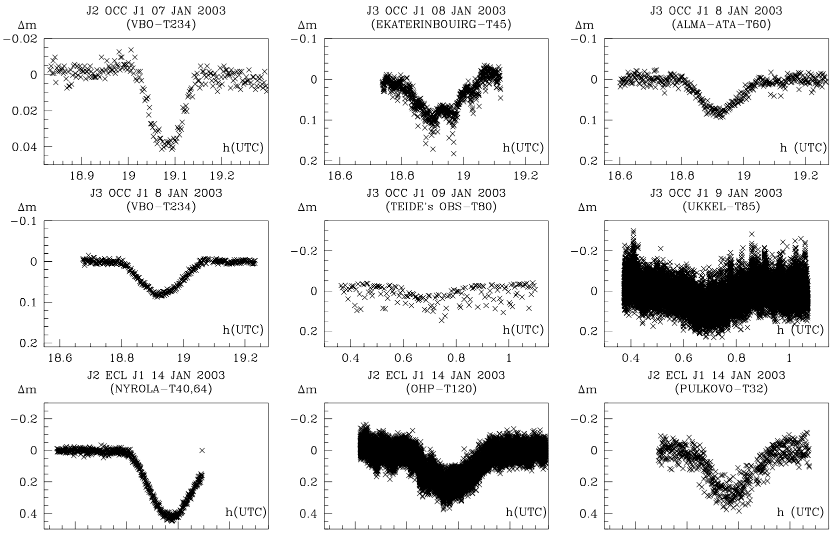

Fig. 7. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

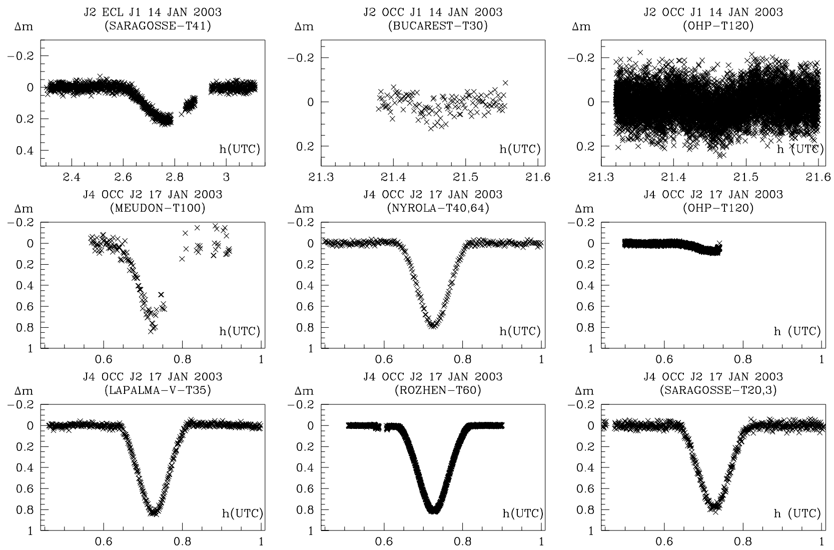

Fig. 8. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

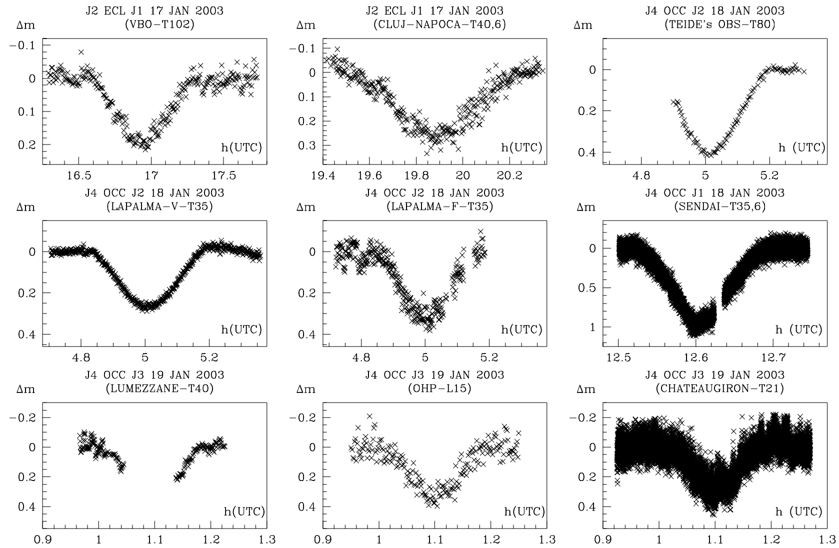

Fig. 9. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

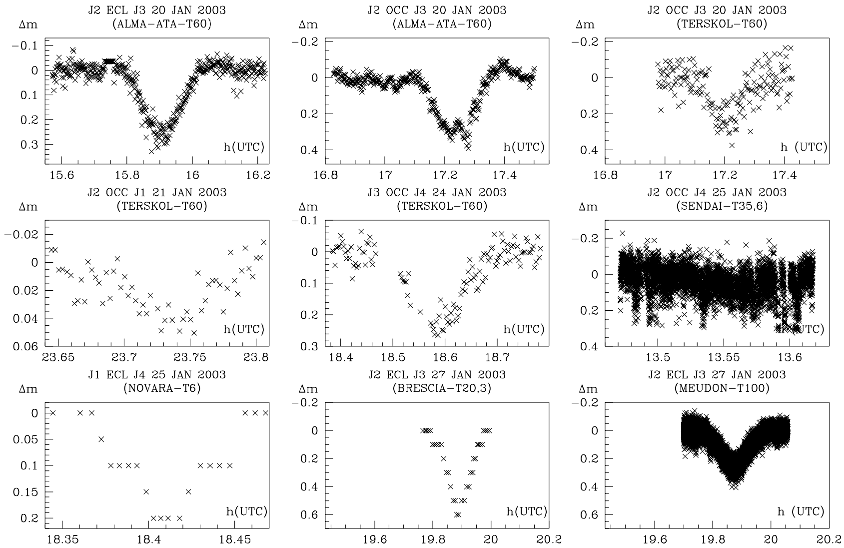

Fig. 10. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

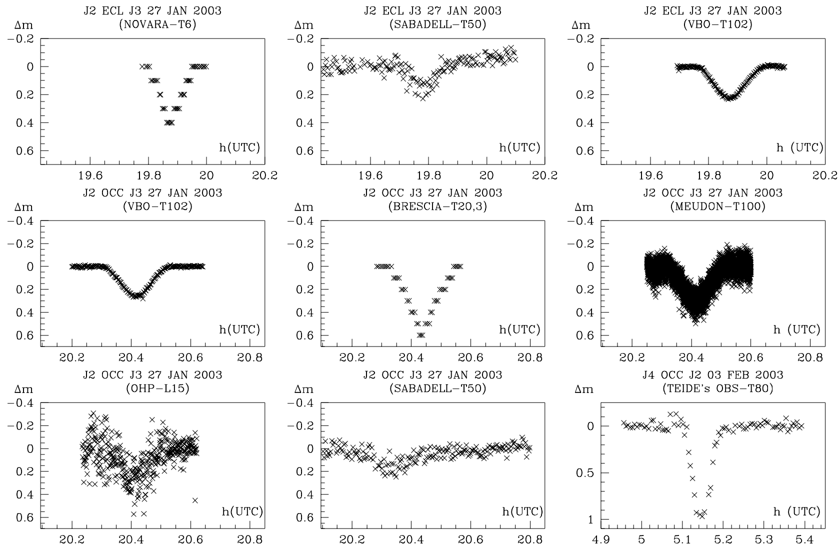

Fig. 11. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

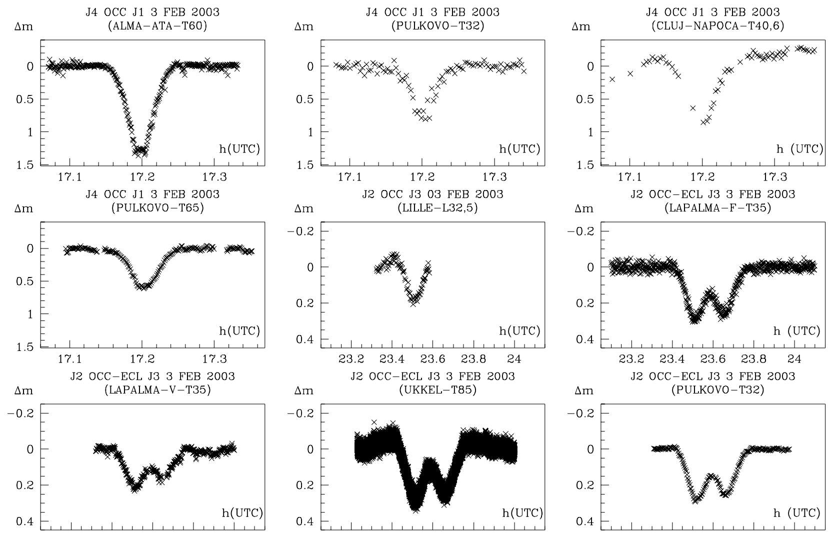

Fig. 12. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

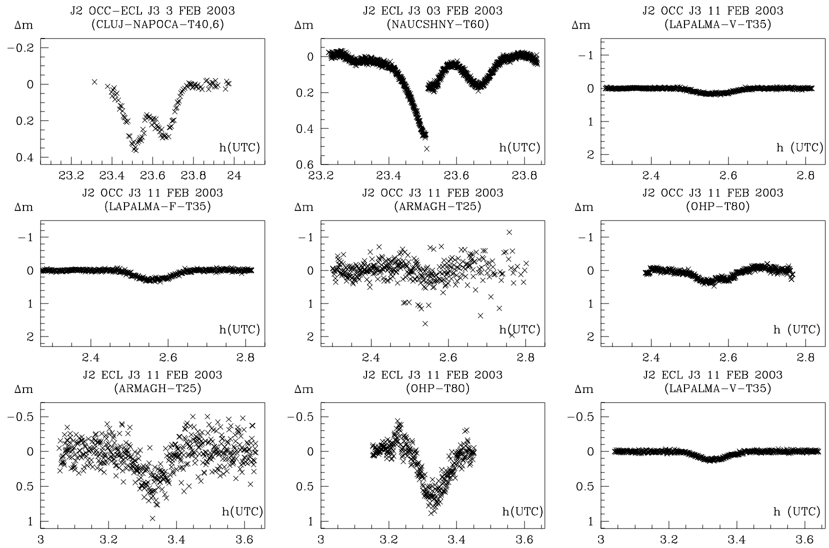

Fig. 13. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

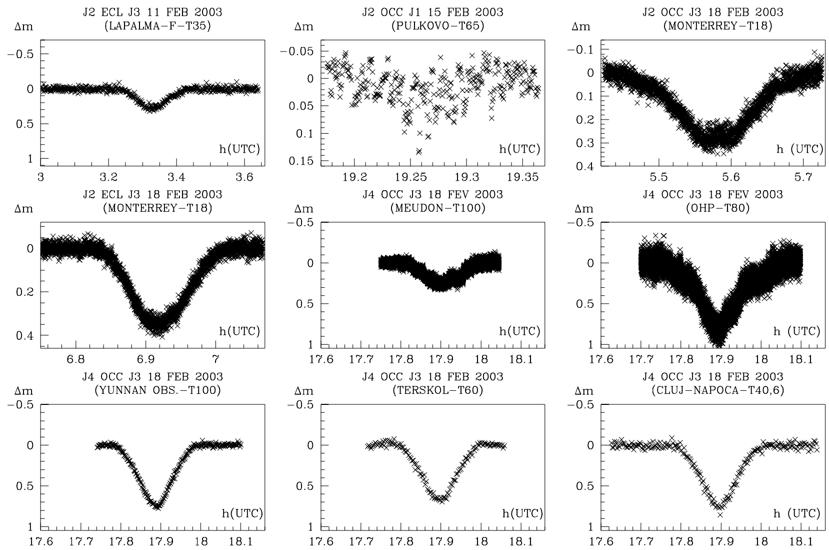

Fig. 14. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

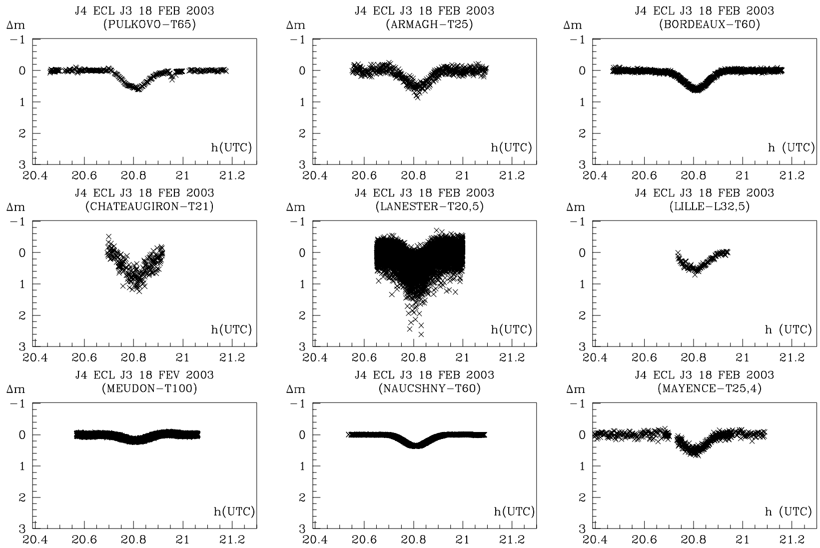

Fig. 15. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

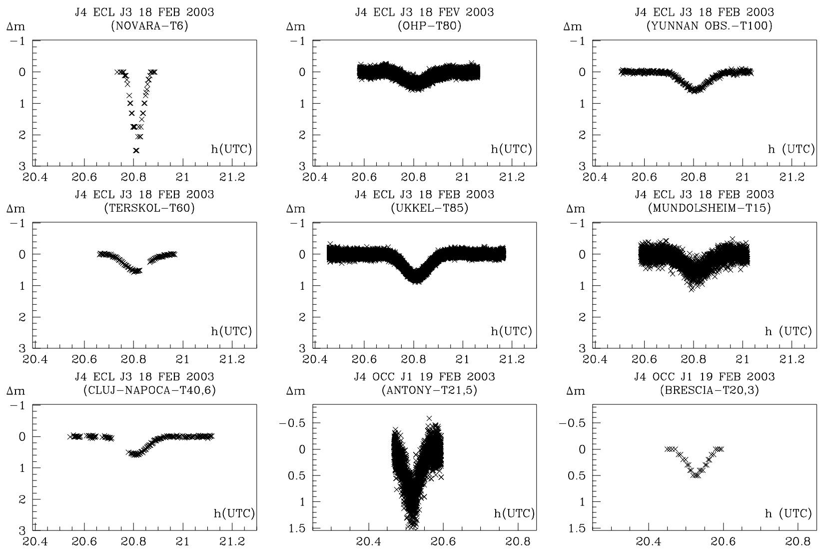

Fig. 16. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

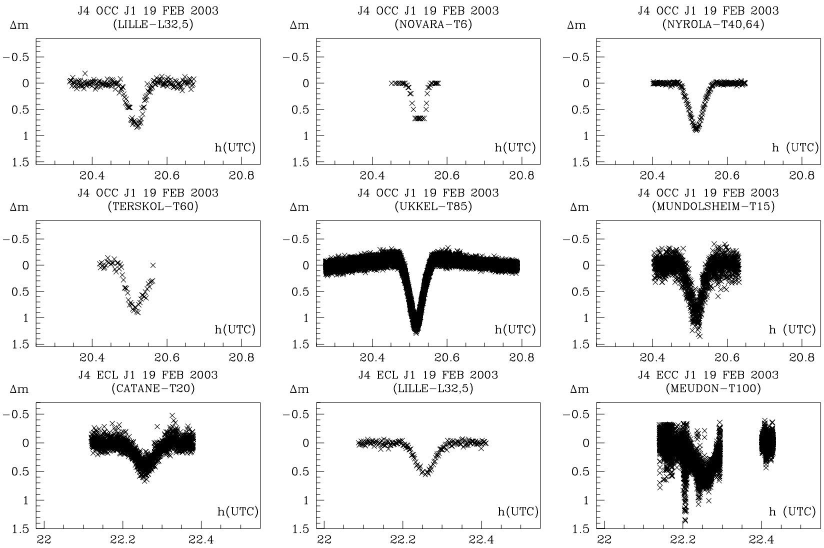

Fig. 17. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

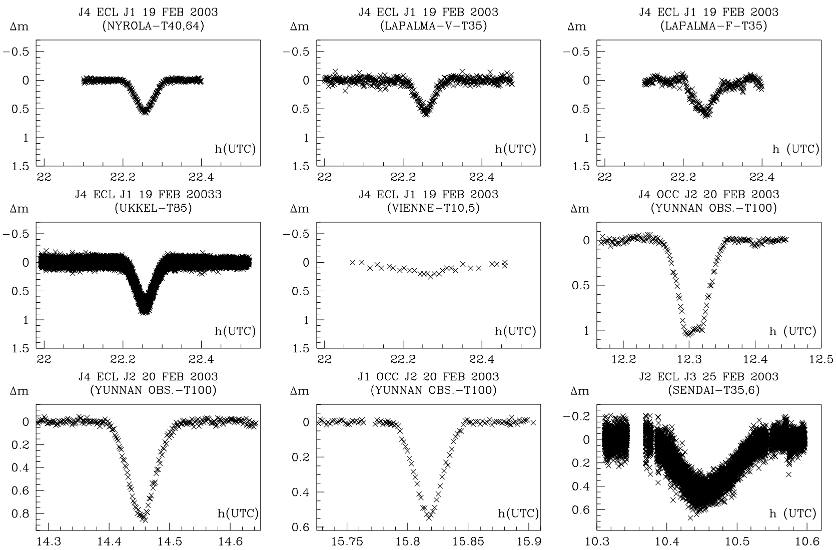

Fig. 18. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

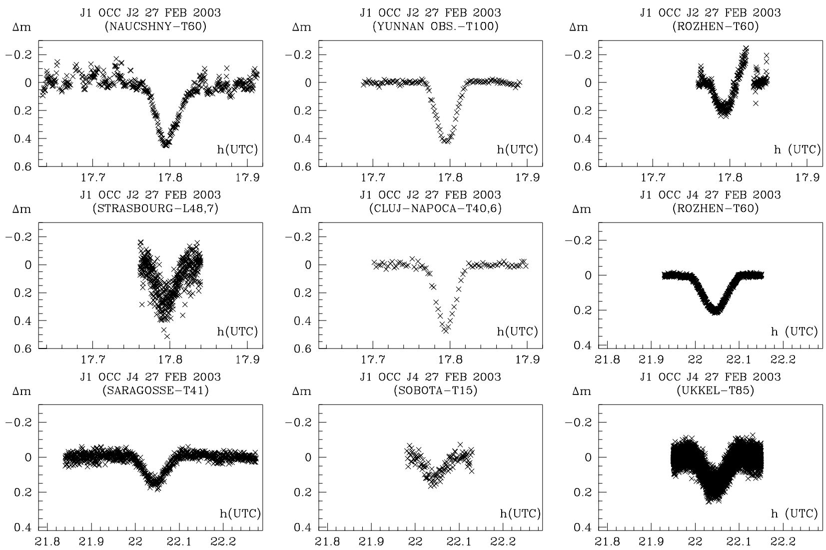

Fig. 19. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

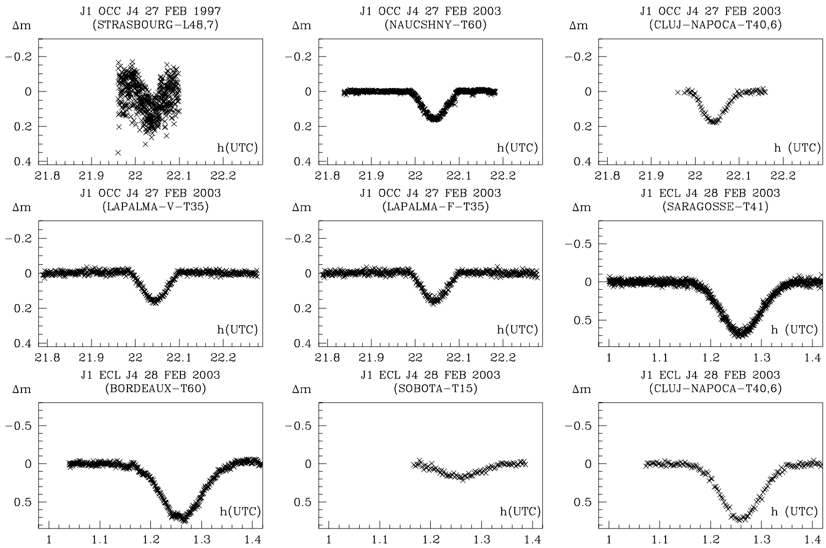

Fig. 20. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

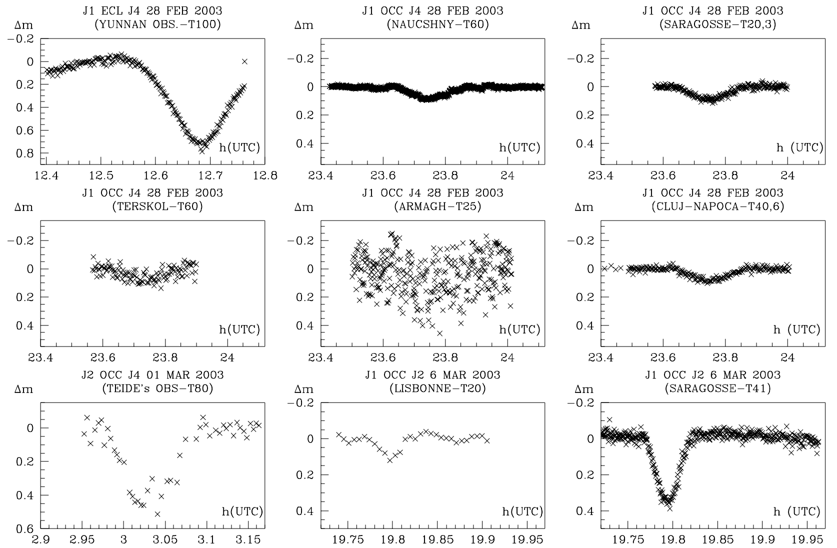

Fig. 21. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

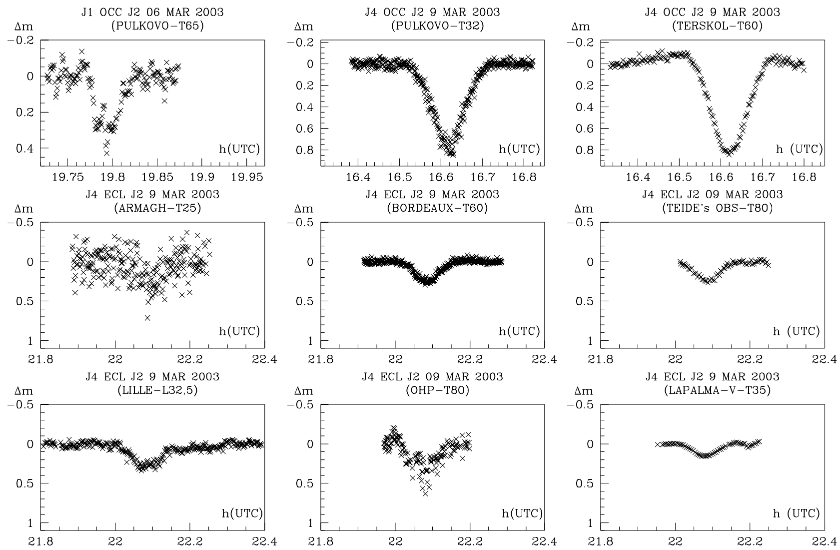

Fig. 22. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

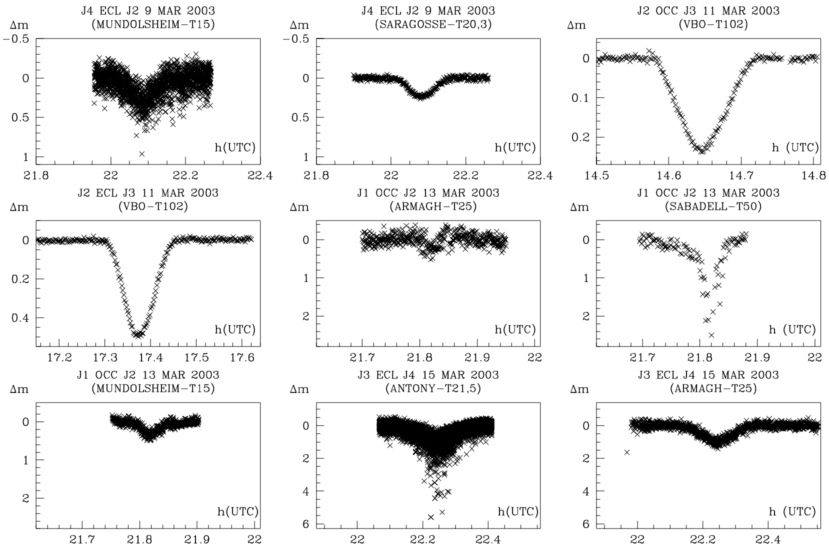

Fig. 23. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

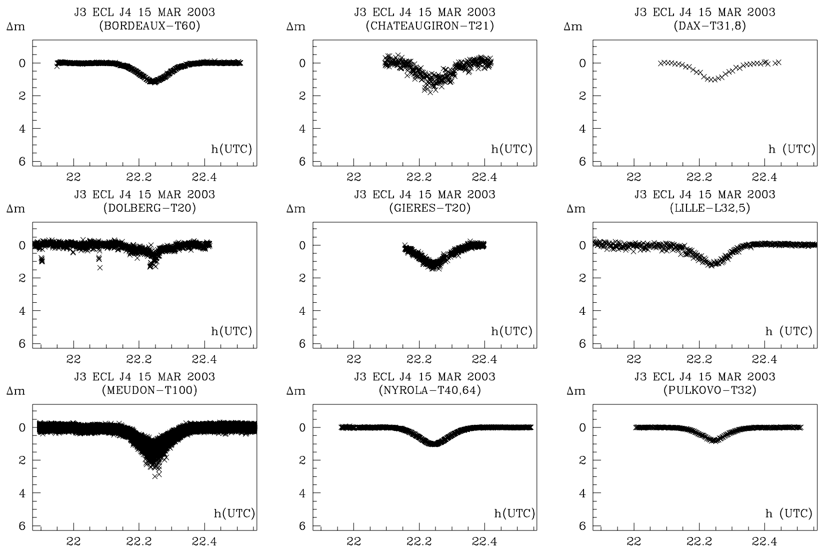

Fig. 24. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

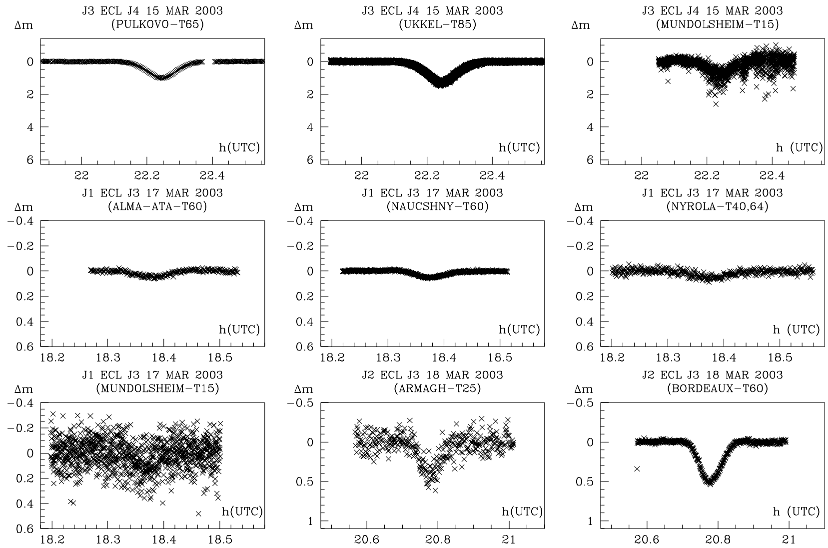

Fig. 25. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

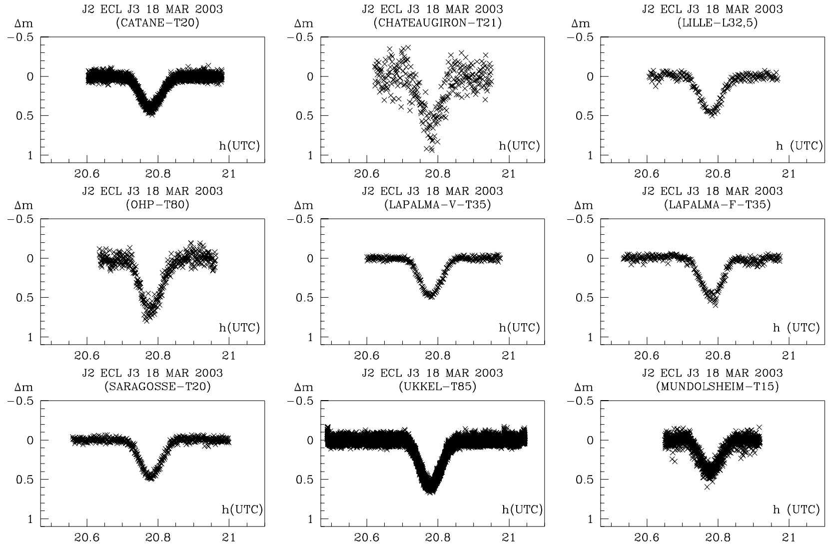

Fig. 26. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

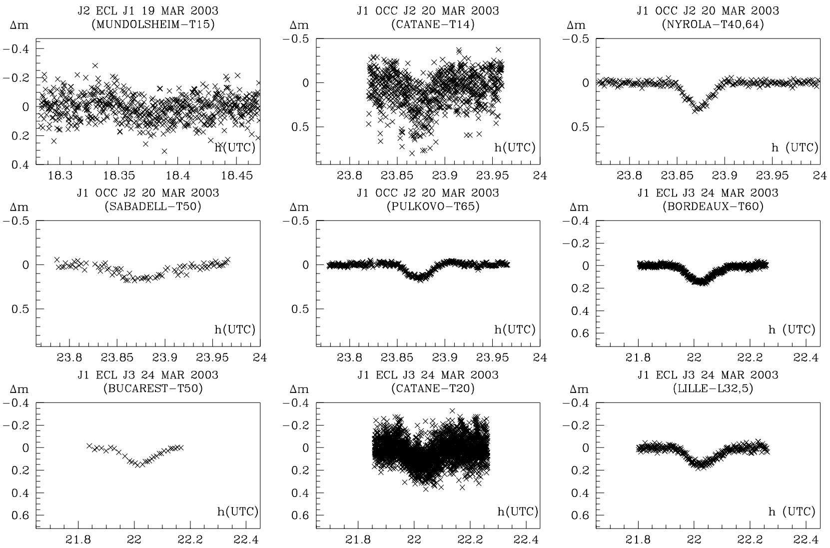

Fig. 27. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

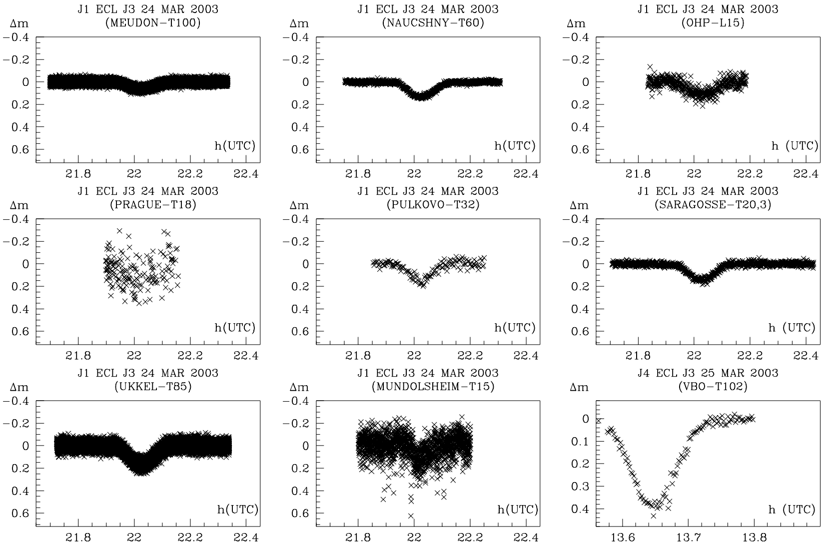

Fig. 28. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

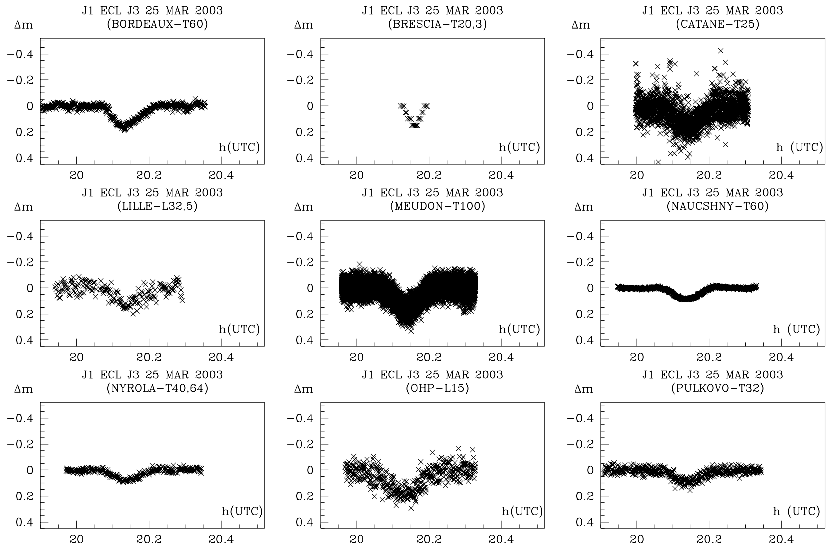

Fig. 29. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

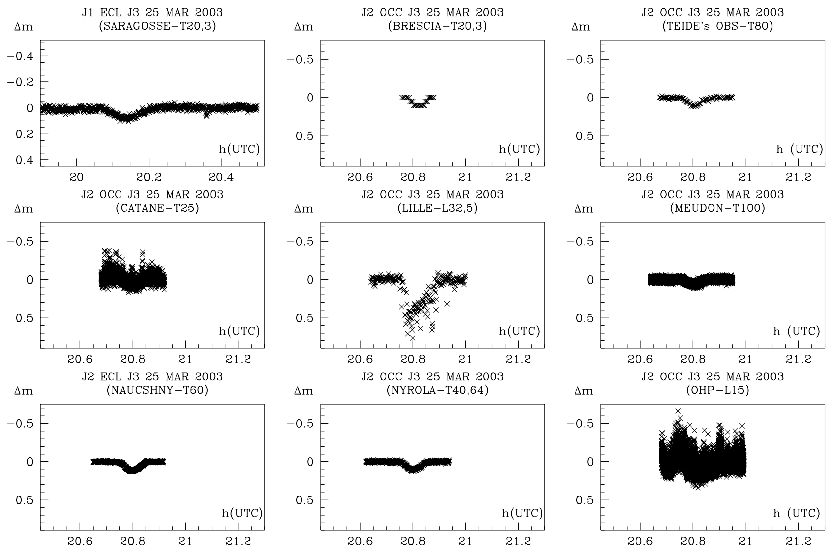

Fig. 30. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

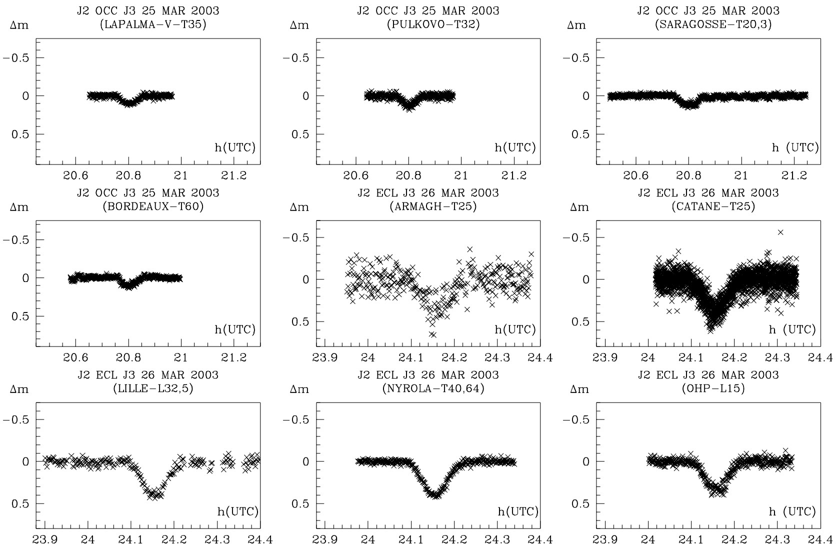

Fig. 31. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

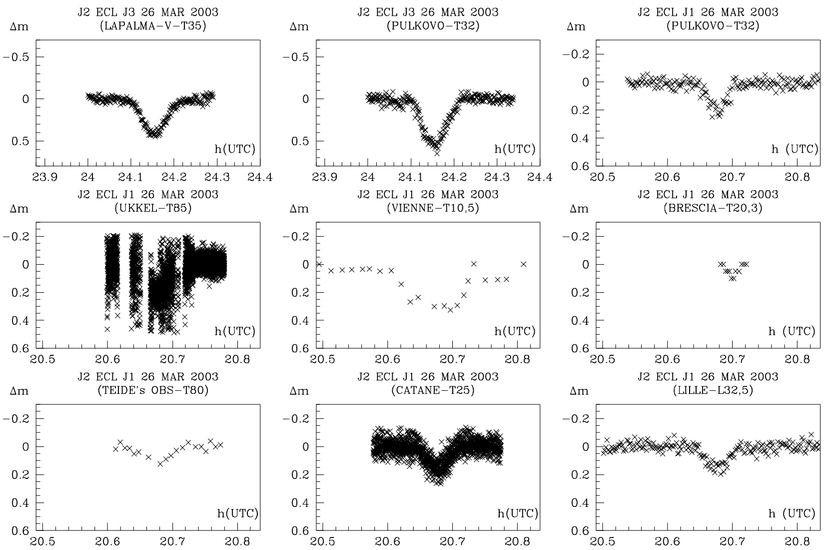

Fig. 32. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

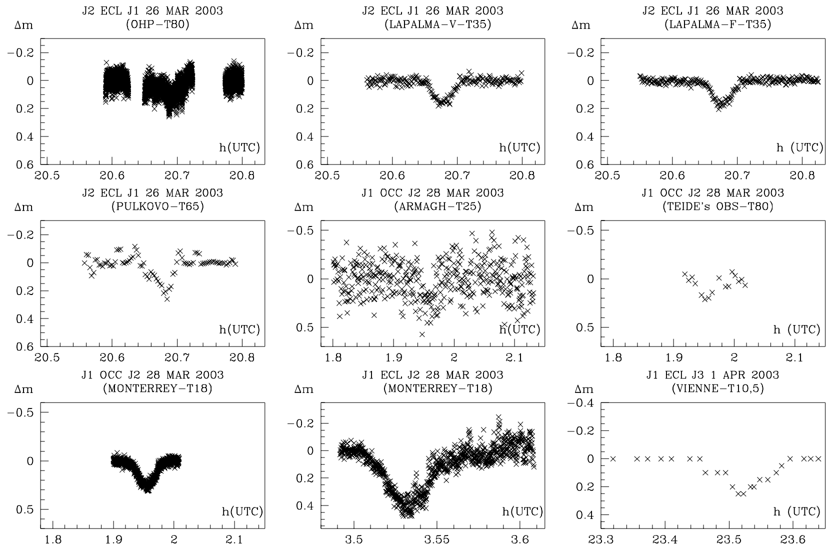

Fig. 33. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

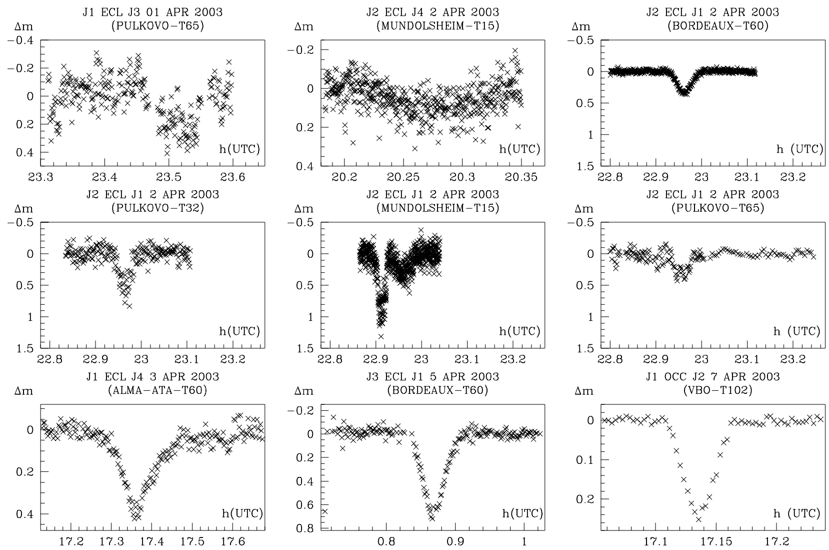

Fig. 34. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

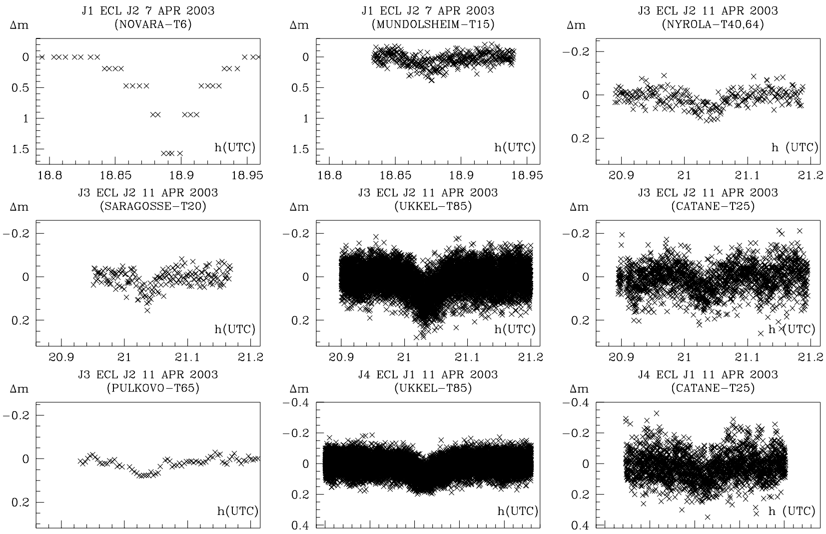

Fig. 35. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

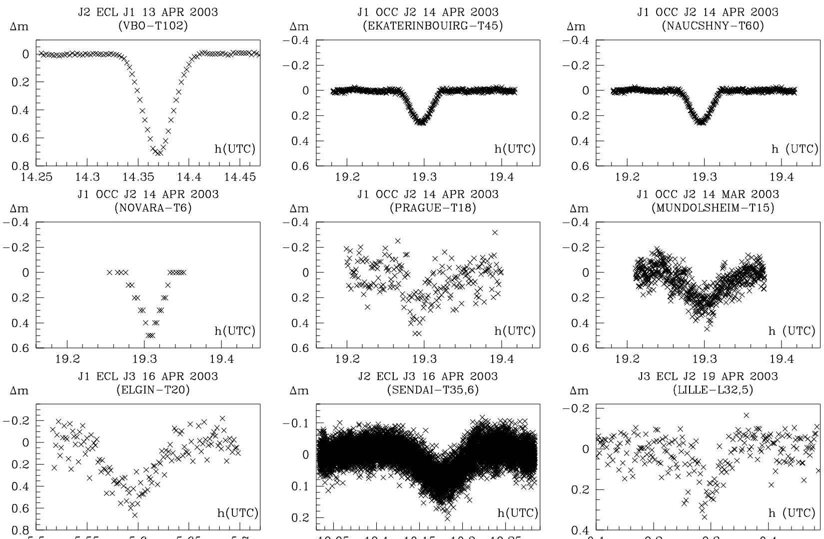

Fig. 36. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

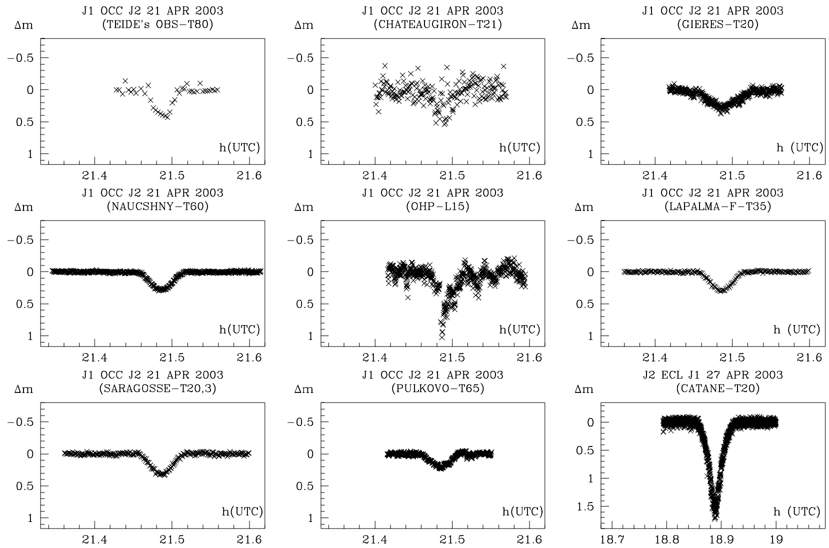

Fig. 37. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

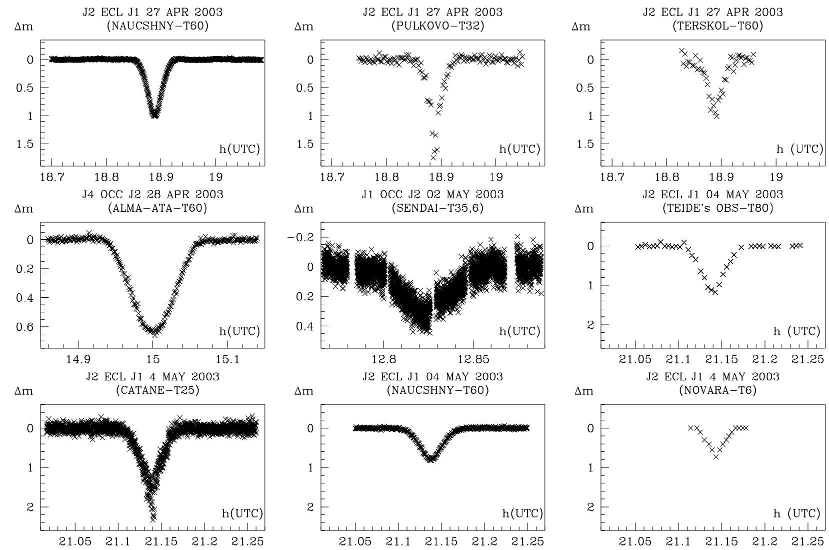

Fig. 38. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

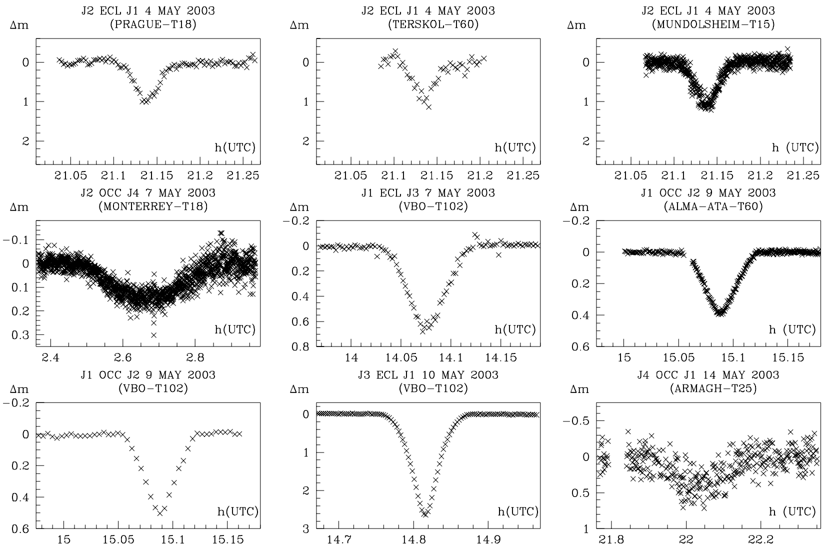

Fig. 39. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

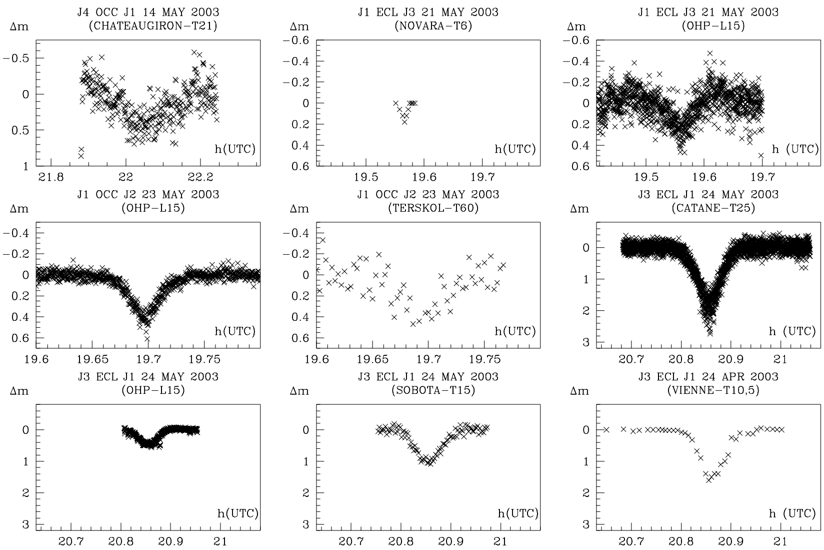

Fig. 40. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003

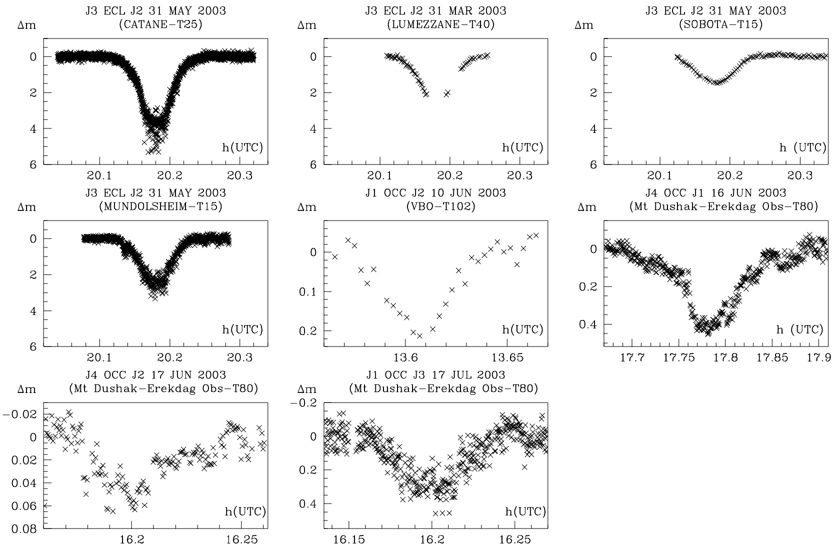

Fig. 41. Lightcurves issued from the observations of the mutual events of the Galilean satellites in 2002-2003