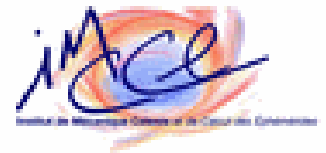


ISON participation in GAIA-FUN-SSO campaigns

Yurij Krugly, I. Molotov, V. Voropaev, L. Elenin, R. Inasaridze, V. Rumyantsev,
A. Baransky, V. Kouprianov, I. Belskaya, A. Sergeev, V. Shevchenko, I.
Slyusarev, N. Gaftonyuk, O. Burkhonov, Sh. Ehgamberdiev, K. Ergashev, A.
Aliev, E. Litvinenko, Yu. Ivashchenko, D. Varda, E. Sinyakov, T. Namkhai, T.
Kokina, N. Minikulov, S. Abdulloev, V. Nevsky, A. Matkin, A. Ivanov, M. Krugov,
A. Kusakin, V. Kudak



Gaia-FUN-SSO-3
Paris Observatory,
24-26 November 2014



ISON PARTICIPANTS

- **Chuguev Observatory, Kharkiv National University, Ukraine**
- **Keldysh Institute of Applied Mathematics, Moscow, Russia**
- **Abastumani Astrophysical Observatory, Georgia**
- **Crimean Astrophysical Observatory, Crimea**
- **Lisnyky Observatory, Kyiv University, Ukraine**
- **Pulkovo Observatory, St.-Petersburg, Russia**
- **Maidanak Observatory, Tashkent, Uzbekistan**
- **Andrushivka Observatory, Ukraine**
- **Blagoveschensk Station, Russia**
- **Huraltogoot Observatory, Ulan-Bator, Mongolia**
- **Cosala, Sinaloa University, Culiacan, Mexico**
- **Gissar Observatory, Dushanbe, Tajikistan**
- **ISON-Kislovodsk Observatory, Russia**
- **ISON-Ussuriysk Observatory, Russia**
- **Kuban Observatory, Krasnodar, Russia**
- **Tien-Shan Observatory, Alma-Ata, Kazakhstan**
- **Uzhhorod Observatory, Ukraine**

ISON PARTICIPANTS

MPC Code	Observatory	Telescope m	FOV arcmin	Scale arcsec/pix	Coordinates	Altitude m
K99	ISON-Uzhgorod	0.4	72	1.4	E22.453, N48.563	235
A50	Andrushivka	0.5	150	4.4	E28.997, N50.001	240
585	Lisnyky	0.7 0.48	16.9 x16.4 6x4	0.96 0.24	E30.524, N50.298	156
094	Simeiz	1.0	9.5	0.19	E33.996, N44.403	350
095	Crimea-Nauchnij	2.6 0.64	9.3 140.8	0.27 2.06	E34.016, N44.728	596
121	Chuguev	0.7	16.9 x16.4	0.96	E36.934, N49.641	151
C40	Kuban	0.5	92	1.35	E39.030, N45.020	60
119	Abastumani	0.7 1.25	45 x 30 10. 5	0.9 0.3	E42.820, N41.754	1595
D00	ISON- Kislovodsk	0.4	100	2.0	E42.654, N43.740	2107
188	Maidanak	1.5 0.6	18.3 11.7	0.27 0.69	E66.896, N38.673	2593
190	Gissar	0.7	30	1.8	E68.68, N38.49	730
193	Sanglok	0.6	60	1.2	E69.218, N38.261	2286
N42	Tien-Shan	1.0	20	0.3	E76.971, N	2100
O75	ISON-Hureltogoot	0.4	138	2.7	E107.051, N47.865	1604
D54	Blagoveschensk	0.5	74	1.45	E127.482, N50.318	226
C15	ISON-Ussuriysk	0.65 0.5	132 72	3.9 4.2	E132.166, N43.698	277
-	Cosala, Sinaloa	0.4	78	1.5	W106,609, N24,401	631
H15	ISON-NM	0.4	100	1.5	E254.472, N32.744	2225

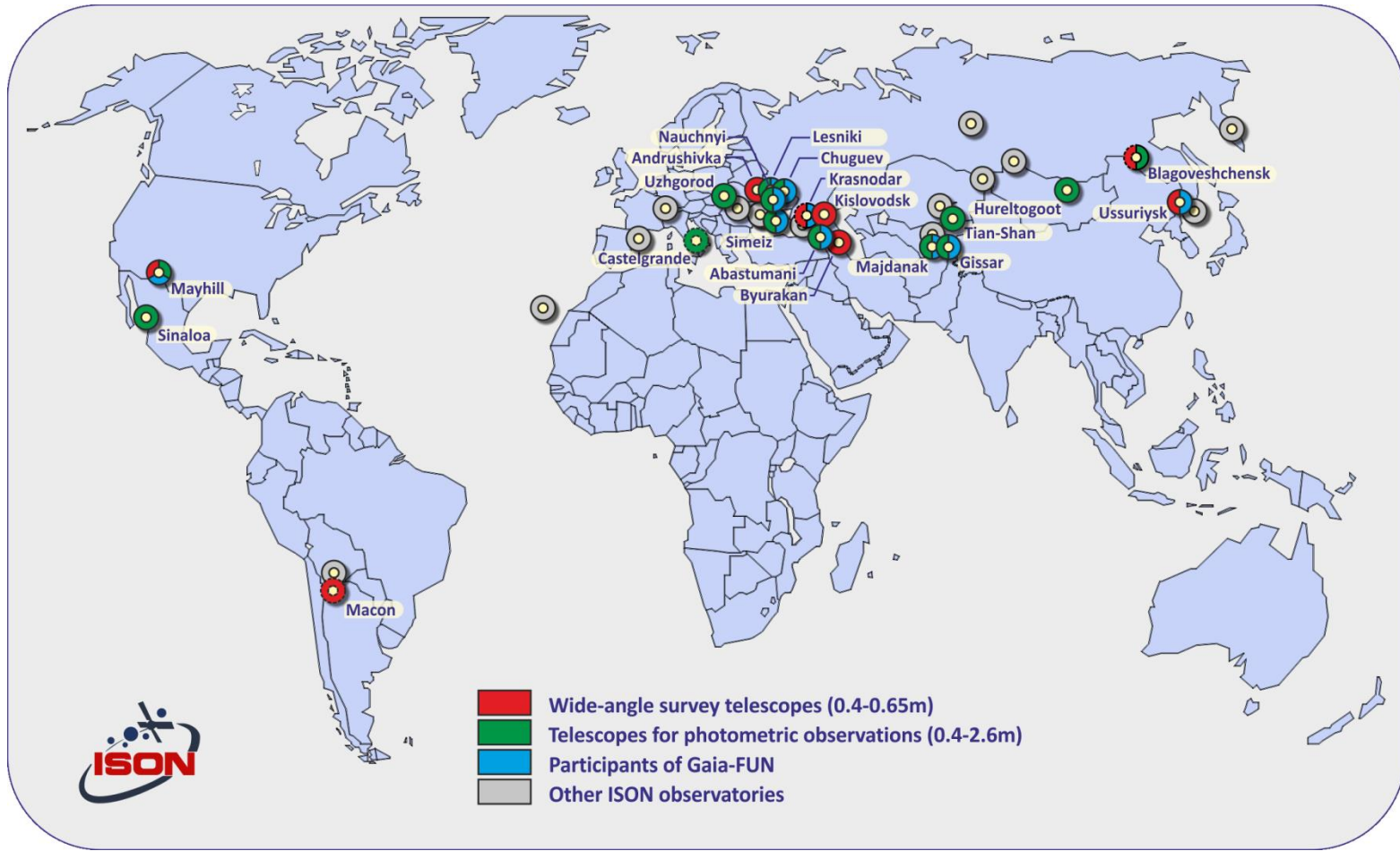
INTERNATIONAL SCIENTIFIC OPTICAL NETWORK



Started in 2004, currently the project involves more than 30 observatories and scientific institutions in **15 countries**: *Russia, Ukraine, Moldova, Georgia, Uzbekistan, Tajikistan, Kazakhstan, Italy, USA, Bolivia, Armenia, Switzerland, Spain, Mongolia, Mexico*. There are more than **70 telescopes** in the network.

The work is a part of long-term agreements on a scientific-technical cooperation between the *Keldysh Institute of Applied Mathematics* (KIAM, Moscow) and scientific or scientific-educational organizations, using both their own instruments (telescopes) in the possession of the organization, as well as instruments that provided by the ISON project.

INTERNATIONAL SCIENTIFIC OPTICAL NETWORK



THE NETWORK AIMS

- Monitoring of man-made space debris (primarily high-geostationary orbits, high-elliptical, circular type of GLONASS and GPS) by means of carrying out astrometric and photometric observations of orbiting objects
- Tracking of near-Earth asteroids (NEAs): to do the discovery, refinement of orbital parameters and to study their physical properties
- GRB optical afterglow observations

TELESCOPES

- ISON telescopes for asteroid and GRB observations includes:
 - (I) Five wide-field telescopes [with apertures 40 - 65 cm] used for searching asteroids. The main objects of our interest are NEAs.
 - (II) Several telescopes with apertures 0.6 – 2.6 m involved in carrying out photometry of asteroids.
 - (III) Observations of GRB optical afterglow are doing on different telescopes of the network in alert regime.

MANY OF NETWORK TELESCOPES WERE CREATED IN FRAME OF ISON



D = 19.5 cm



D = 40 cm



D = 65 cm



D = 25 cm



D = 50 cm

SEARCHING ASTEROIDS

- 60-cm A50: Andrushivka Observatory
- 40-cm H15: ISON-NM Observatory
- 40-cm D00: ISON-Kislovodsk
- 65-cm C15: ISON-Ussurijsk
- 40-cm O75: ISON-Hureltogoot



60-cm reflector (f/4, 72'x72')



40-cm reflectors (f/3, 106'x106')



65-cm reflector (f/2, 132'x132')

ASTEROID PHOTOMETRY

The telescopes with diameters from 60 cm up to 2.6 m have been modernized and using in the network for carrying out photometry of asteroids. Most of these telescopes have been equipped with modern CCD cameras, mainly manufactured by firm Finger Lakes Instrument (USA).



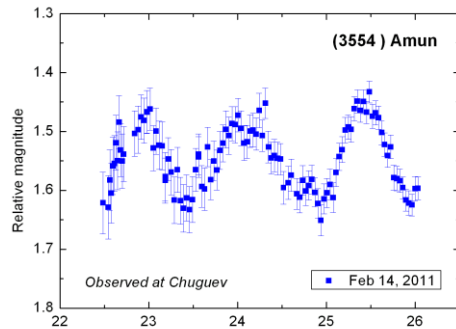
GOALS OF ASTEROID PHOTOMETRY

- Physical characteristics of the Near-Earth Asteroids
- Observations of Potentially Hazardous Asteroids (PHAs) and newly discovered NEAs foremost
- Searching for binary asteroids and determining parameters of the binary systems
- Investigation of YORP-effect (Yarkovsky-O'Keefe-Radzievskii-Paddack) – detection of the influence on asteroid's rotation
- Support radar observations of NEAs by optical observations

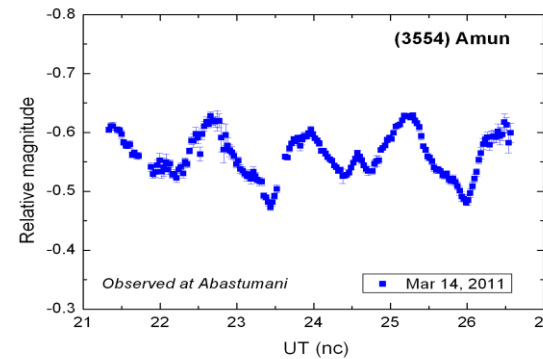
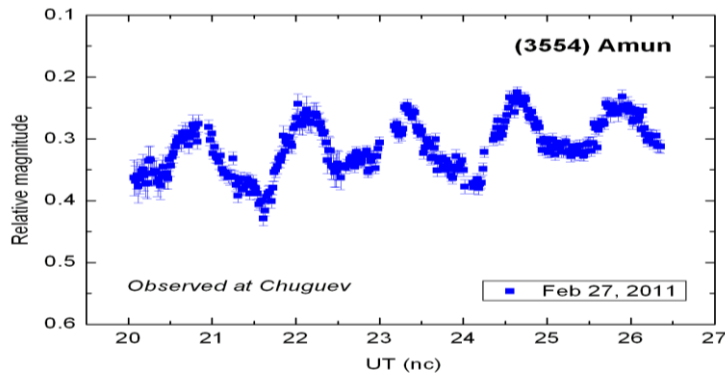
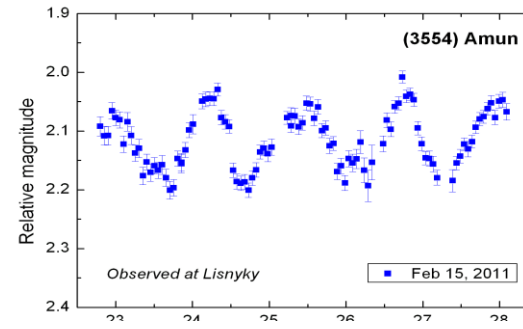
ACCURACY OF PHOTOMETRY

The lightcurves example:
NEA (3554) Amun observed in the network

V=16 mag, RMS = 0.03 mag



V=16 mag, RMS = 0.02 mag



V= 15 mag, RMS = 0.01 mag

V= 14 mag, RMS = 0.007 mag

The typical accuracy is 0.01-0.02 mag and no worse than 0.03-0.04 mag.

RESULTS OF PHOTOMETRY

- Photometry carried out of **30-50 NEAs per year**, and tens of rotation periods determined
- Discovered **7 binary NEAs**
- Registered YORP effect for **3 NEAs** (5 known)
- Calibrated photometry obtained for about **25%** of investigated asteroids
- Observed many of Hazardous Asteroids and in support of radar NEA observations

GAIA-FUN-SSO CAMPAIGNS

ASTEROID	TIME RANGE	ISON OBSERVATORY	OBSERVING NIGHTS
2005 YU55	Nov-Dec 2011	Abastumani, Lisnyky, Chuguev	2011 Nov 17-19, 23-24, 26, 28; Dec 17
1996 FG3	Feb-Mar 2012	NM-ISON, Abastumani	2011 Nov 22,25; Dec 1, 17-18, 30; 2012 Jan 21; Feb 24, 25
2012 DA14	Feb-Mar 2013	Abastumani, ISON-NM	2012 Feb 15, 20
99942 Apophis	Feb-Mar 2012	Chuguev, Abastumani	2012 Feb 18, 24 – asteroid not found
99942 Apophis	Dec 2012-Mar 2013	Maidanak, Lisnyky, Abastumani	2012 Dec 2,13; 2013 Jan 28, 30, Feb 2-3, 11, 13-14, 28; Mar 5-6; Apr 1
2002 GT	Jun-Aug 2013	Lisnyky, Nauchny, Simeiz, Abastumani, Gissar, Maidanak	2013 Jun 10-13, 19-20, 24-25, 30; Jul 4-5, 12
2013 QW1 (artificial object!)	Aug-Sep 2013	Chuguev	Aug 24
2013 TV135	Oct 2013-Jan 2014	ISON-NM, Abastumani, Chuguev	2013 Oct 17, 19, 21-25, 27; Dec 4
2014 HQ124	8-11 June 2014	Chuguev, Abastumani, Lisnyky	2014 Jun 10

(308635) 2005 YU55 campaign

15 Nov.- 15 Dec. 2011

- 119 Abstumani, Georgia: 2011 Nov 17-19, Dec 17
- 121 Chuguev, Kharkiv, Ukraine: 2011 Nov 18, 23, 24
- 585 Kiev, Lisnyky, Ukraine: 2011 Nov 17, 26, 28

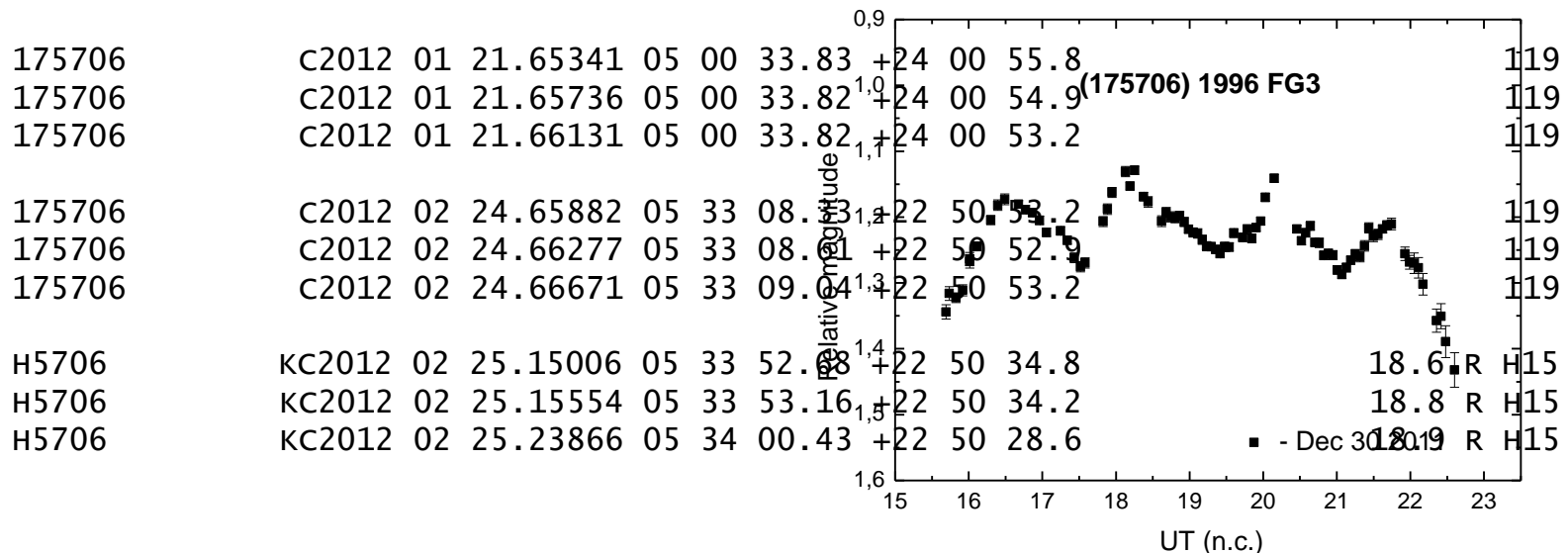
20111128 585 0.6+ 0.3-
20111128 585 0.1- 0.1-
20111128 585 0.9- 0.2-

Star	GSC id	x	y	RA (deg,2000)	DEC(deg,2000)	res RA	res DEC
1	0191-00010	763.80	403.24	39.57058	16.59156	-0.321	-0.545
2	0145-00010	547.31	385.71	39.51120	16.59435	0.157	0.475
3	0073-00010	241.39	480.80	39.42838	16.56631	0.412	0.421
4	0070-00010	238.06	391.11	39.42639	16.58964	-0.221	-0.391
5	0157-00010	589.68	519.63	39.52410	16.55943	0.029	0.105
6	0180-00010	689.94	538.67	39.55174	16.55536	-0.054	-0.030
7	0171-00010	663.73	692.39	39.54618	16.51475	0.314	0.271
8	0077-00010	241.28	779.04	39.43112	16.48765	-0.316	-0.308

(175706) 1996 FG3 campaign

Feb. - March 2012

- 121 Abastumani: 2011 Nov 22, 25; Dec 1, 17, 18, 30; 2012 Jan 21, Feb 24
- H15 ISON-NM, USA/Russia: 2011 Feb 25

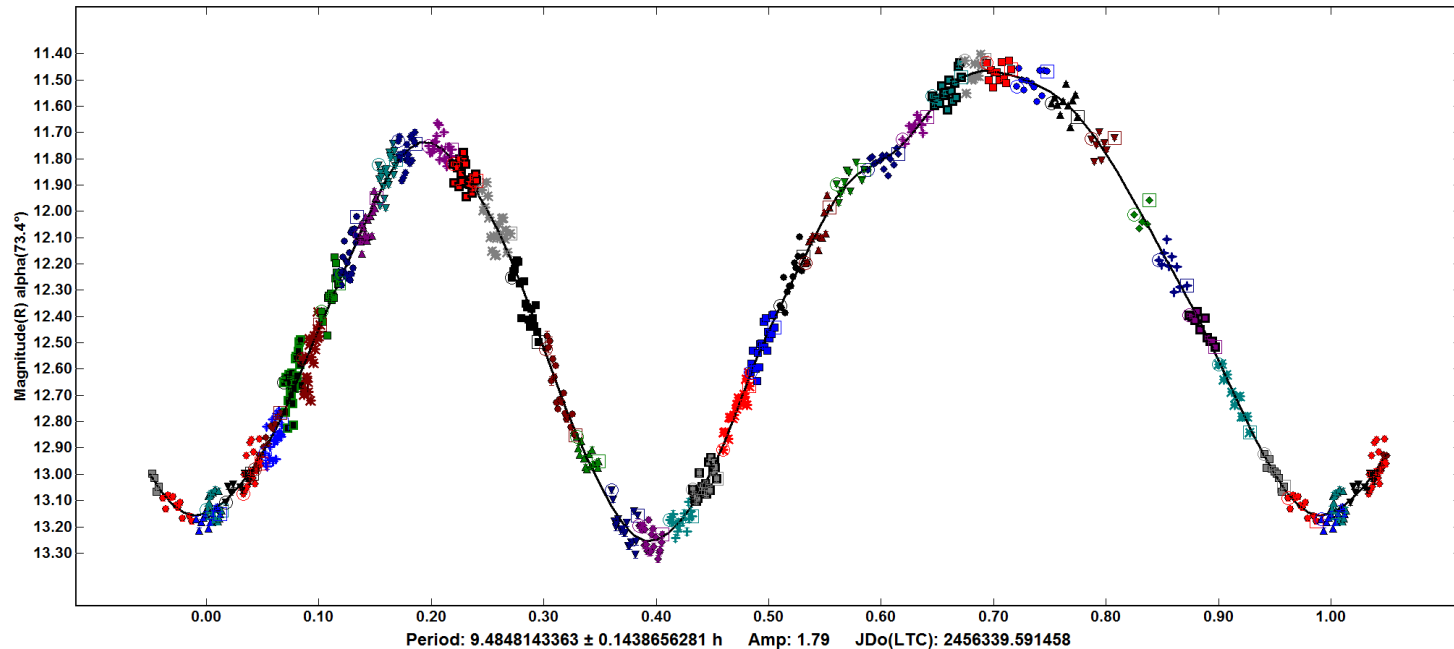


Scheirich et al. 2015. The binary near-Earth asteroid (175706) 1996 FG3 — An observational constraint on its orbital evolution. *Icarus Vol. 245*, 1 January 2015, Pages 56-63.

2012 DA14 campaign

February - March 2013

- H15 ISON-NM: Feb 15
- 119 Abastumani: Feb 20



P = 9.48 hrs +/- 0.14, A = 1.8 mag

Elenin L., I. Molotov. 2014. Lightcurve analysis of extremely close near-Earth asteroid – 2012 DA14. Minor Planet Bulletin, Vol. 40, No. 4, 2013.

Apophis campaign

February - March 2012

- 121 Chuguev: 2012 Feb 18 – not found
- 119 Abstumani: 2012 Feb 24 – not found

99942 Apophis comes back!: new campaign

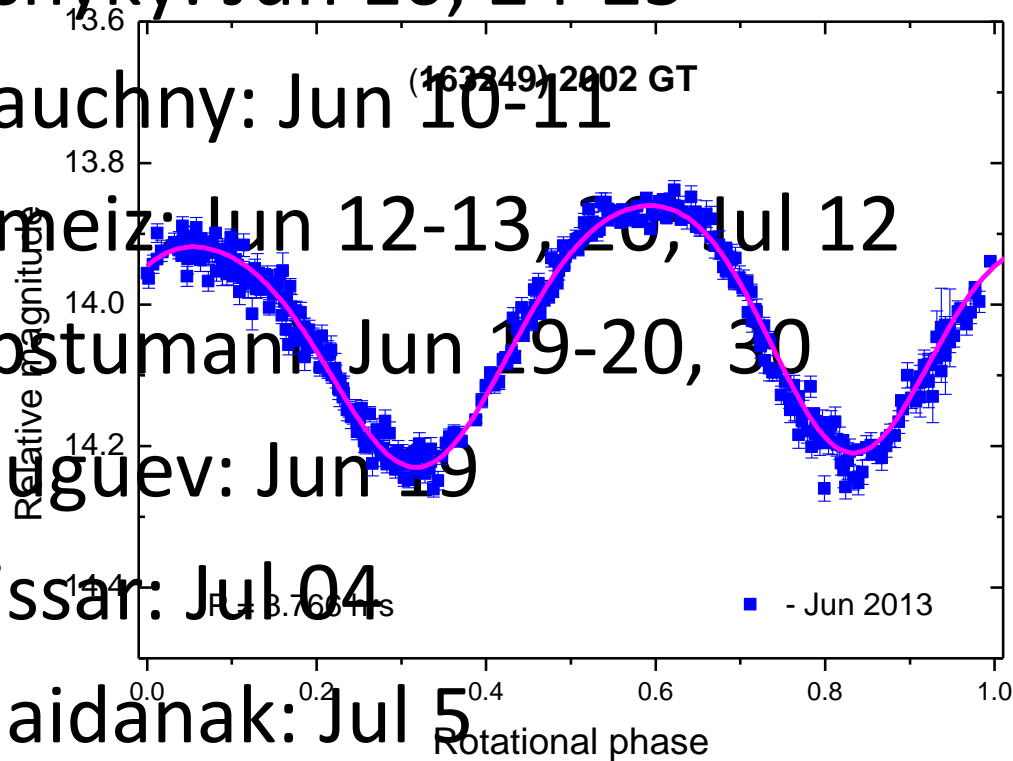
December 2012 - March 2013

- 188 Maidanak, Uzbekistan: 2012 Dec 3, 14
- 119 Abastumani: 2013 Jan 28, 30, Feb 2, 3, 11, 13, 14;
Apr 1
- 585 Lisnyky, Kiev: Feb 28; Mar 5-6

2002 GT campaign

June - August 2013

- 585 Lisnyky: Jun 10, 24-25
- 095 Nauchny: Jun 10-11
- 094 Simeiz: Jun 12-13, 20, Jul 12
- 119 Abstuman: Jun 19-20, 30
- 121 Chuguev: Jun 19
- 190 Gissar: Jul 04
- 188 Maidanak: Jul 5



2013 QW1 campaign

August - September 2013

- 121 Chuguev: 2013 Aug 24 – man-made object on the Earth-Moon orbit

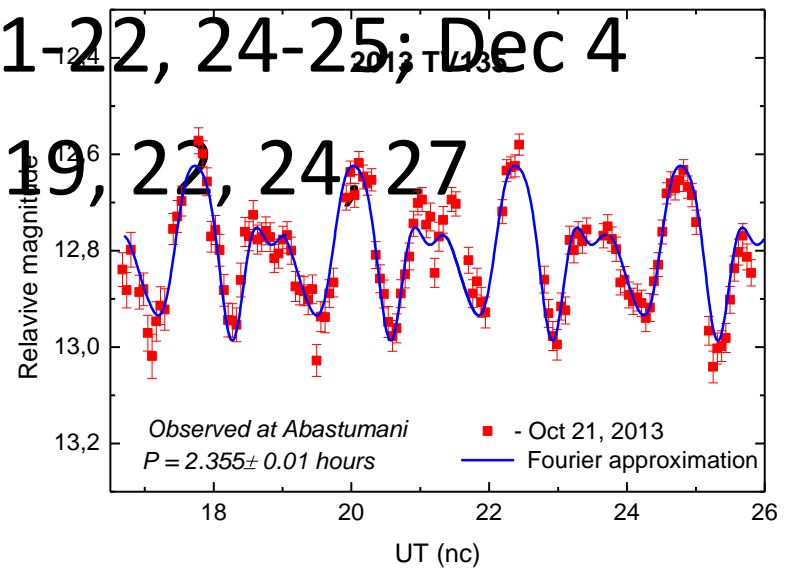
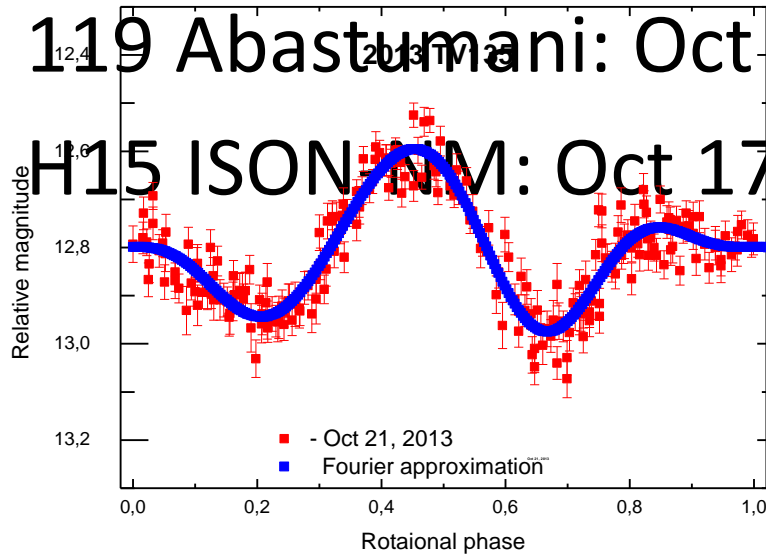
2013 TV135 campaign

October 2013- January 2014

- 121 Chuguev: Oct 23;

- 119 Abastumani: Oct 21-22, 24-25; Dec 4

- H15 ISON M: Oct 17, 19, 22, 24, 27



2014 HQ124 short campaign 8-11 June 2014

- Lisnyky, Abastumani, Chuguev: 2014 Jun 10

OUTLOOKS OF ISON

- Buracan, Armenia – 1 m and 2.6 m
- Kastelgrande, Italy – 1.5 m
- Abastumani, Georgia - 1.25 m
- Kislovodsk, North Caucasus, Russia – 0.65 m
- Blagoveschensk, Far East of Russia – 0.5 m
- Makon, Argentina – 50 cm
- Nauchny, Crimea – 2 x 40 cm

ISON - GAIA



ISON network is ready to support Gaia FUN SSO.

The ISON facilities:

- ❑ 18 telescopes of 0.4-0.7 m
- ❑ 4 telescopes of 1 m
- ❑ 1.5 m and 2.6 m telescopes

