

PHOTOMETRY OF NEAR-EARTH ASTEROIDS WITHIN NETWORK ISON

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ISON – International Scientific Optical Network

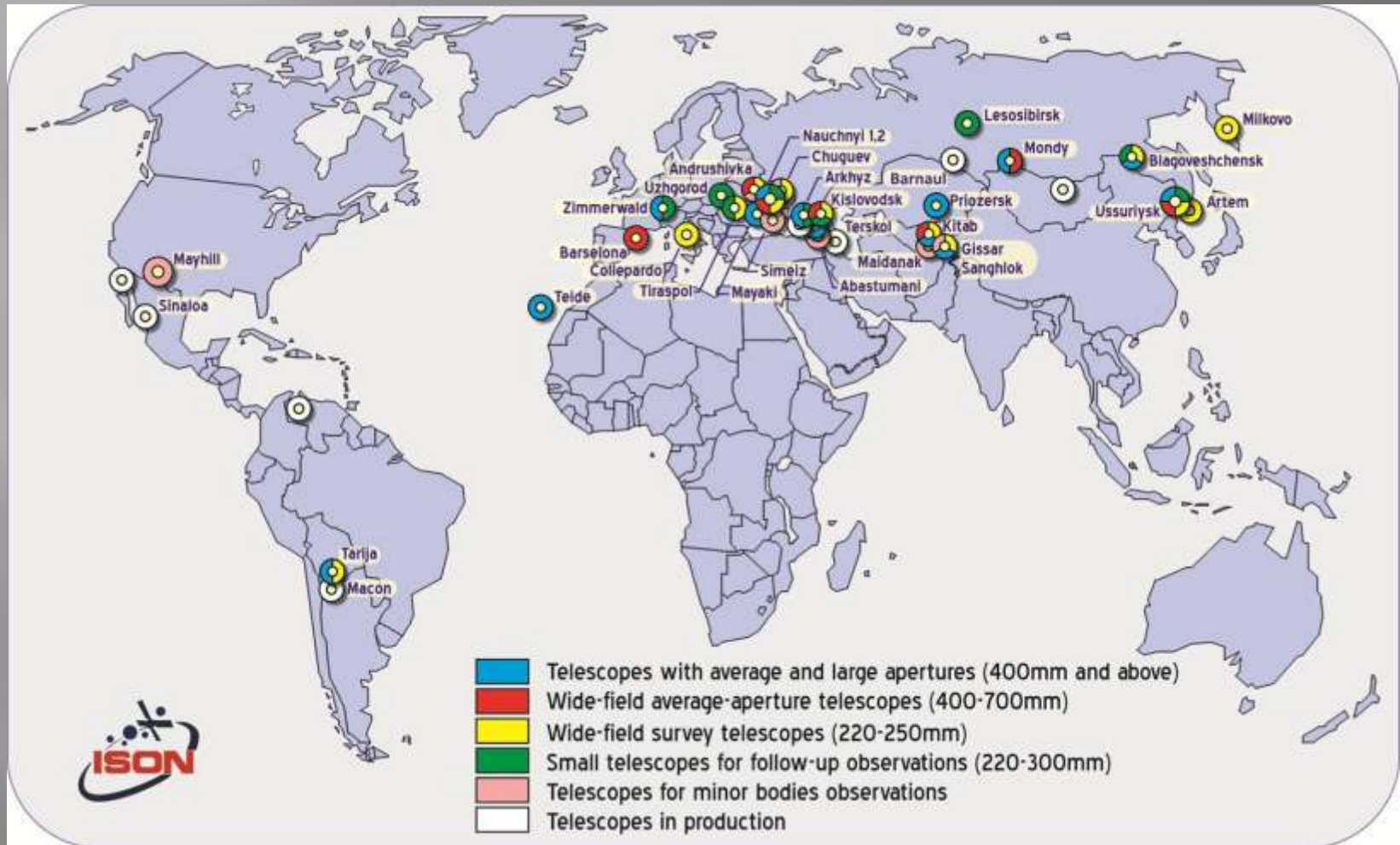


- ISON is non-government project established in 2004 to carry out regular monitoring of space debris.
- ISON involves more than 27 observatories and scientific institutes in 12 countries: *Russia, Ukraine, Moldova, Georgia, Uzbekistan, Tajikistan, Italy, Bolivia, Switzerland, Spain, Mongolia, Mexico.*
- The center of the cooperation locates in the *Keldysh Institute of Applied Mathematics (Moscow, Russia).*
- There are more than 42 telescopes in the network.
- Several wide-field telescopes were developed and made in frame of ISON, e.g. 22 and 25 cm, 40 and 50 cm telescopes, widefield camera lens with 195 mm diameter.
- Several old telescopes with diameters from 60 cm up to 2.6 m have been modernized and used in the network.

The Network Aims

- Monitoring of man-made space debris (primarily high-geostationary orbits, high-elliptical, circular type of GLONASS and GPS). This is the main task.
- Tracking of near-Earth asteroids (NEAs): to search for new objects, to improve orbital parameters and to study their physical properties.
- GRB optical afterglow observations.

The Network Observatories



The Network Telescopes: created in frame of ISON

D = 19.5 cm



D = 25 cm



D = 40 cm



The Asteroid Subsets

Two subsets are forming in frame of ISON for asteroid's observations during last 4 years:

- (I) Several telescopes (with apertures larger then 40 cm) are involved in carrying out photometry of asteroids.
- (II) Two wide-field telescopes (45.5 cm and 60 cm) used for searching asteroids. The main objects of our interest are NEAs.
- (III) Now the 3th subset is forming for operational refinement of the orbits of newly detected NEA (follow-up).
These telescopes will be able to participate in supporting the Gaia-alerts.

Photometric Telescopes in Network

The telescopes with diameters from 40 cm up to 2.6 m have been modernized and using in the network. Most of these telescopes have been equipped with modern CCD-cameras, mainly manufactured by Finger Lakes Instrumentation firm (FLI, USA)



Main Results

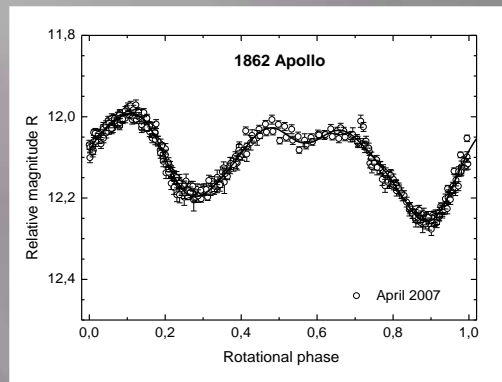
In past 3 years more than 60 NEAs were observed in the frame of ISON and the main results were attained:

- more than 200 lightcurves were obtained;
- 10 asteroids were observed to investigate of the YORP effect, and for 3 of them the YORP was detected;
- 14 new determinations of rotation periods were done;
- 6 from the obtained periods found to be longer 16 hrs;
- 2 super-fast rotators were found: 2001 FE90, 326290 1998 HE3;
- 2 binaries were found: 8373 Stephengould, 3352 McAuliffe; and another 3 NEAs were suspected as binaries;
- absolute magnitudes and BVRI colors were obtained for about 20% for the observed asteroids.

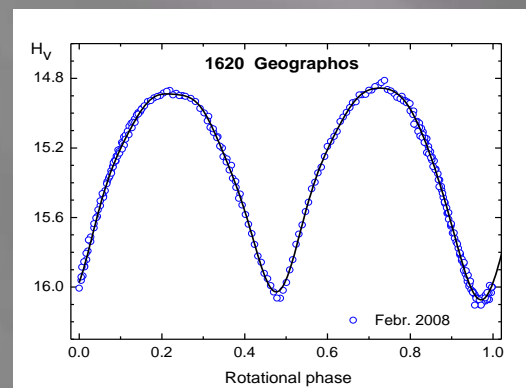
YORP Investigations

In results of the lightcurve observations an influence of the YORP effect on asteroid rotation was detected/confirmed for 3 NEAs (Apollo, Geographos, Eger). The work are performed in collaboration with David Vokrouhlicky and Josef Durech from Institute of Astronomy of Charles University (Prague, Czech). It is 3 of 4 asteroids with the YORP detected to the date.

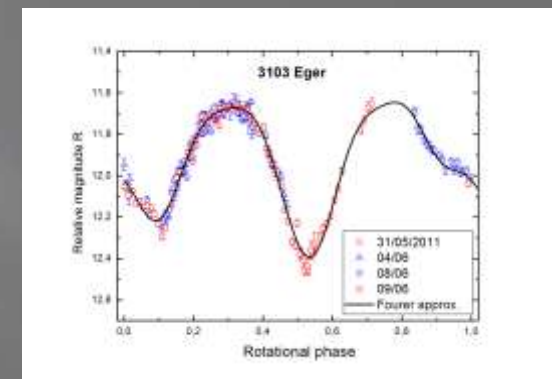
Apollo



Geographos



Eger



Kaasalainen et al. 2007;
Durech et al. 2008

Durech et al. 2008

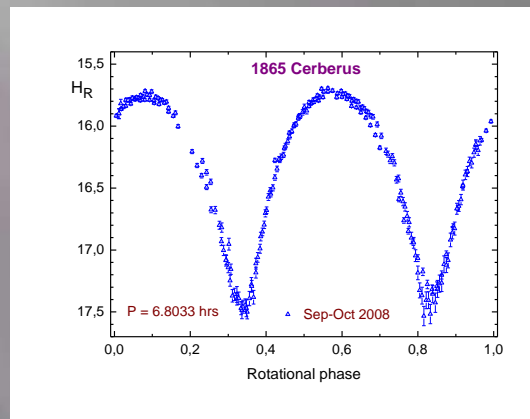
Durech et al. 2009

Detection of YORP effect: 1865 Cerberus



Cerberus was observed during two nights on Sept. 1 and 2, 2008 at Maidanak. The lightcurves are characterized with an unusually large amplitude, up to 1.75 mag. Additional observations were made at Kharkiv and Simeiz in 2008 & 2009.

Analysis of Cerberus' photometry showed that asteroid brightness variations are consistent with a constant-period model and no secular change of the spin rate was detected. We could only constrain maximum values of $|dw/dt| < 8 \times 10^{-9} \text{ rad } d^{-2}$ for Cerberus. (Durech et al. 2012, in prep.).



The convex shape model of Cerberus shown at equatorial aspect (left, center) , and pole-on (right).

Composite lightcurve of Cerberus.

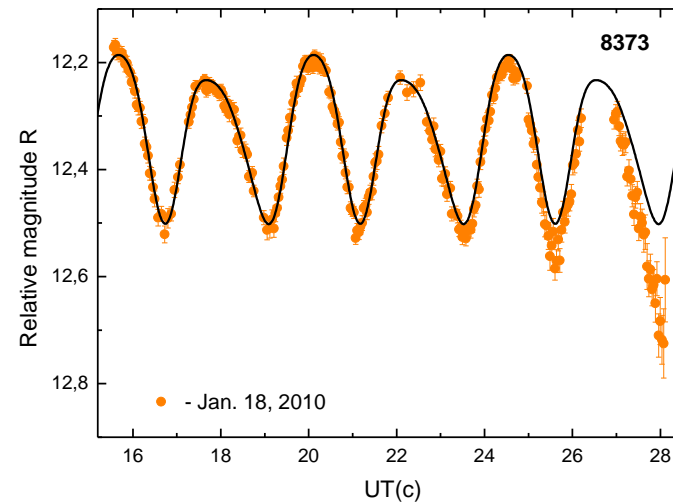
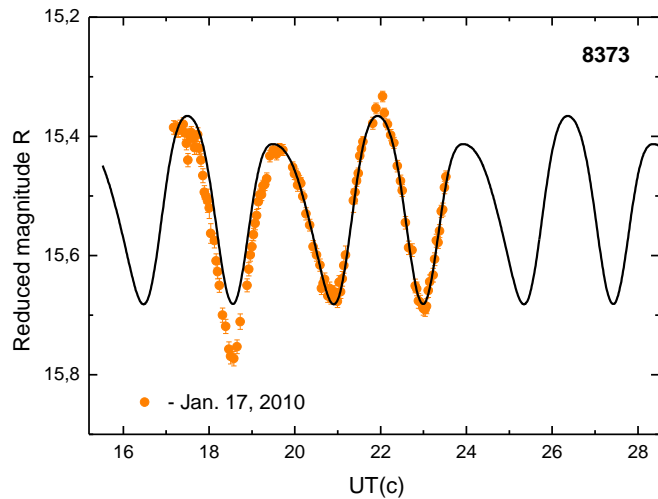
Binary Asteroids

Searching for binary asteroids and determining parameters of the binary systems is performed in cooperation with Czech astronomers from Ondrejov Astronomical Observatory, Czech Academy of Sciences

To obtain the good results for searching / investigation of binary system we need in regular observations, and as usually as it should be observations during several consecutive nights

Binary asteroids

8373 Stephengould – was discovered as binary in 2010



Outlooks of ISON

Telescopes which planned to start working in frame of ISON in 2012-2013:

- Kislovodsk Observatory (Russia): 50 cm reflector
- Maidanak Observatory (UZBEKISTAN): 60-cm and 1 m reflector
- Sanglok Observatory (TAJIKISTAN): 60-cm reflector
- Ussurijsk Observatory (Russia): 50 and 65 cm reflector



Collaboration

We are looking for cooperation partners in the installation and joint operation of new telescopes for searching asteroids, NEA's photometry, and observations of space debris.

We have plans to install our telescopes at the Western and the South hemispheres: in Argentina (Macon), Mexico (San Pedro Martir), Mongolia (Tavan Talgot), and South Africa (Sutherland) in 2012-2013.

We are searching for cooperation to install new telescopes in New Zealand.

The telescopes of the ISON network planned to be used for a ground-based support of the Gaia observations of Solar System objects.