Asteroid survey and follow up observations with small telescopes in framework of ISON network

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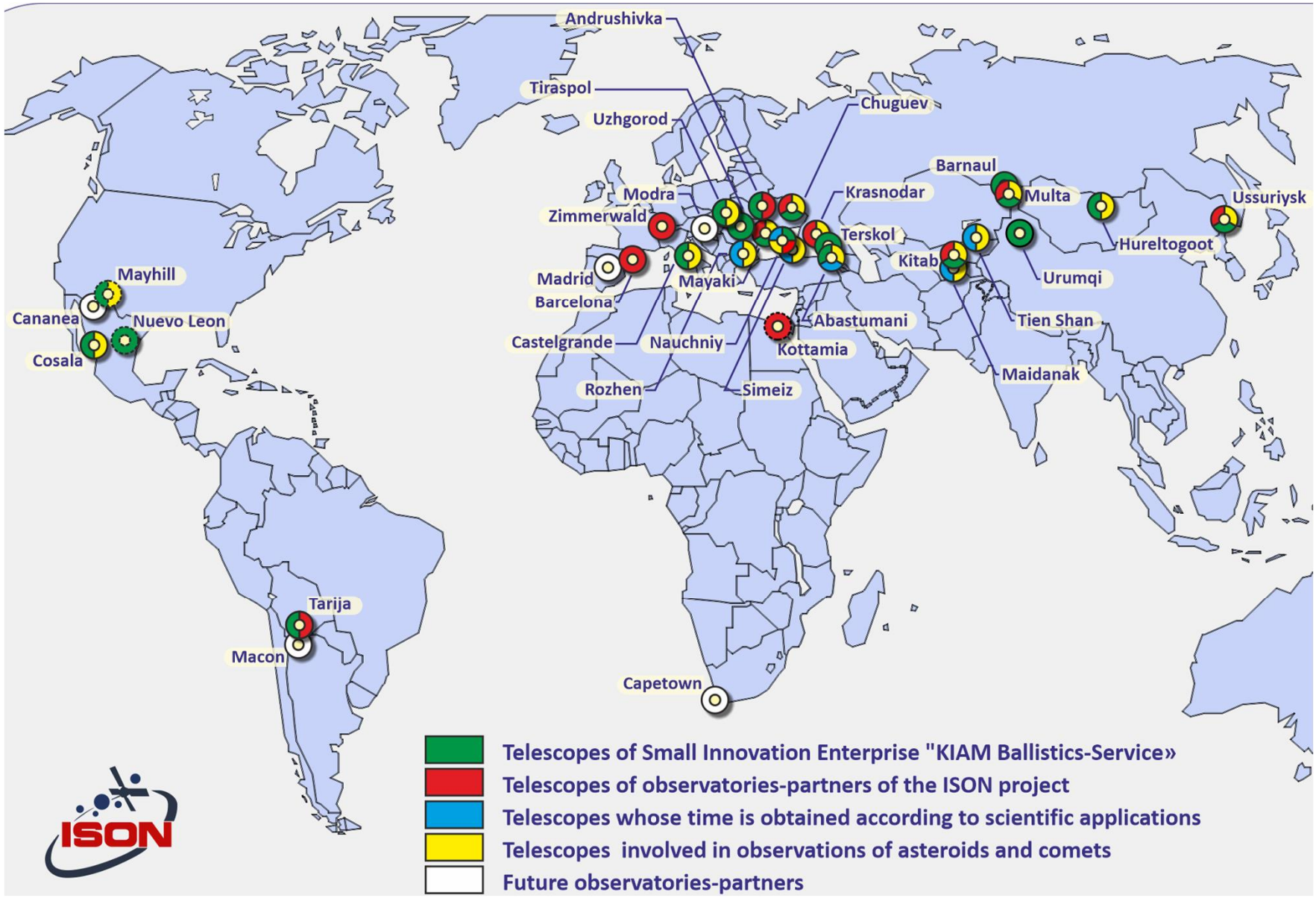
International Scientific Optical Network (ISON)

- ISON that have been started in 2004 is an open international project developed to be an independent source of data about natural and artificial space objects for scientific and applied purposes
- Main observation topics: space debris, asteroids, Gamma-Ray Bursts afterglows
- Core of ISON network is 30 own telescopes (mainly 20-cm – 40 cm apertures) installed in 18 observation points
- 12 telescopes (more 50 cm apertures) in 9 observatories-partners that have signed agreements on participation in ISON project
- 10 telescopes (60-cm to 2.6 m apertures) in 8 observatories allocate an observation time based on consideration of the annual scientific applications

Map of observatories collaborating with ISON



Asteroid activities of the ISON project

International cooperation:

- Cooperation of observatories (Abastumani, **Georgia**; Terskol, Simeiz and Multa, **Russia**; Chuguev and Mayaki, **Ukrain**e; Rozhen, **Bulgari**a; Tien-Shan, **Kazakhstan**, Maidanak and Kitab, **Uzbekistan**, Hureltogoot, **Mongolia**)
- ESA network of follow-up telescopes => UN IAWN project
- Chinese Near-Earth Object Survey Telescope, NAOC, **China**

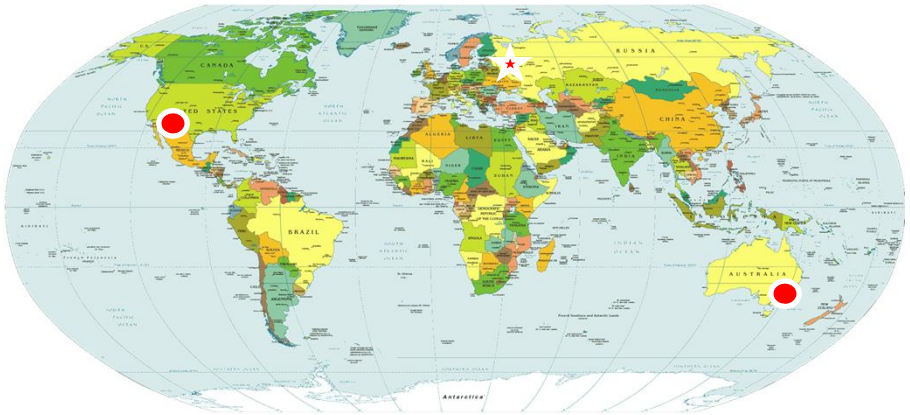
Observations:

- Dedicated asteroid surveys (temporarily suspended in 2019), survey method with small telescopes with big FOV;
- Discovery of NEA as by product of space debris observations;
- Follow up (astrometric measurements) of new NEAs;
- Photometry of asteroids to measure the lightcurves:

- **studying physical properties of PHA, comets and radar targets;**
- **searching and investigation of binary NEAs, asteroids with the YORP and BYORP effect**

ISON dedicated asteroid surveys

- Two surveys with 40 cm telescopes in New Mexico (H15), USA (**1.76x1.76 degree**) and Siding Spring (Q60), Australia (**2x2 degree**) (joint project with AIUB team) were scheduled, controlled and processed in KIAM, that made it possible adjust technique and software, which were stopped at end of 2018
- Both 40 cm telescopes covered 900 square degrees per night with a **limiting magnitude up to 20.5 m**
- Measured 1 230 500 astrometric positions
- Discovered **17 NEAs, 8 comets**, 20 Trojans of Jupiter, 4 objects from the family of Hilda, 4 Centaurs, **1605 main belt** asteroids.



Discovery of NEA as by product of space debris survey observations




- There are four two-tube 19.2 cm system with FOV 9x7 deg and four-tube system with FOV 9x14 deg of ROSCOSMOS which provide surveys of GEO and regularly (appr. 1 time per two weeks) detect new NEAs. Good example is NEA 2019 VS4.
- Problems – MPC-codes exist for two observatories only and the astrometry have not enough precision due the large FOV.
- Proposal – to arrange with ISON telescopes having MPC-code and good astrometry accuracy will be supplied by urgent follow up observations of the discovered NEAs.

New ISON subsystem for follow up NEAs





- 40 cm ChV-400 at Uzhgorod (K99) , 36-cm RC-360 at Kitab (186), *ORI-40 at Khuraltogote* (O75), 40-cm Santel-400 at Multa (N82), 50-cm ORI-50 at Andrushivka (A50) + telescope of photometry network
- Follow up by requests of ESA for IWAN (2018 -2020)
- Follow up by requests from Chinese Near-Earth Object Survey Telescope (2020-2021)
- Follow up from NEOCP up to V=20 - 21 mag
- 1062 NEAs, 4972 astrometric measurements, 984 MPEC

ISON photometry observation campaigns






- 10 telescopes (2.6 m ZTSh at Nauchniy, 1 m Zeiss-1000 at Simeiz and Tien-Shan, 2 m Zeiss-2000 at Rozhen and Terskol, 70 cm at Abastumani and Kharkiv, 1.5 m and 60 cm at Maidanak, etc.) participate in ISON photometric monitoring of asteroids
- Every year, 200 - 250 nights observations of 50 - 70 NEAs are carried out to determine or clarify periods of rotation, sizes and shapes, properties of the surface of these bodies, as well as to study binary asteroids, radar and space mission targets
- With ISON data, the YORP-effect was discovered for (1620) Geographos, (3103) Eger, and (1685) Toro, the BYORP-effect was first detected for the binary NEA (88710) 2001 SL9
- Smaller ISON telescopes participate in observation campaigns of bright NEAs passing close to the Earth. In 2020, the campaigns were organized for NEAs 2020 SW in September, and for 2000 TU28 and 2020 UA in October

Outlook

Significant outcomes in asteroid research were obtained with 40-cm class telescopes within ISON project

Development of ISON asteroid survey is connected with 40-cm telescope (first in Multa) with FOV 4x5.5 degree and 28-cm telescopes with FOV 6x6 degree (first will be installed in Mexico in this year).