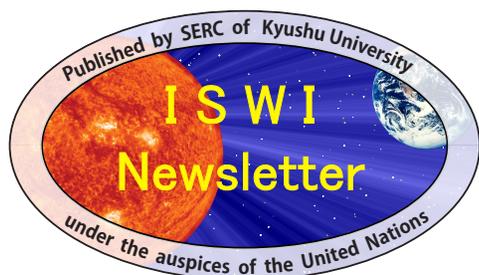




Russian Academy of Sciences  
Keldysh Institute of Applied Mathematics

## Results of GEO and HEO monitoring by ISON network in 2012



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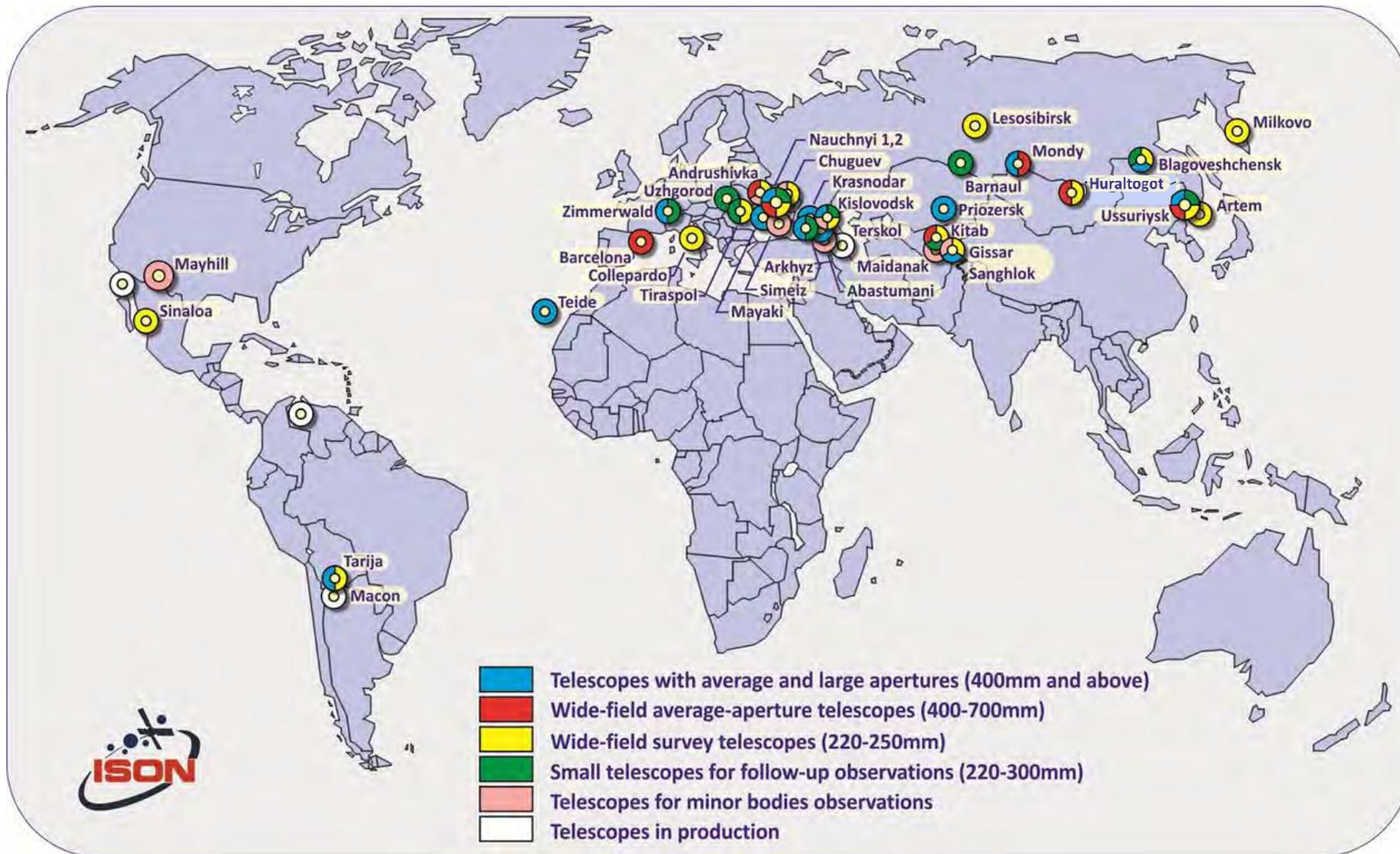
50th session of STSC COPUOS  
Vienna  
11-22 Feb 2013

# ISON – International Scientific Optical Network

As of Dec 2012 ISON joins:

- Observation scheduling, coordination and data processing center (KIAM RAS)
- 32 facilities (including 28 ones for space debris observations) in 13 countries with nearly 50 telescopes of different class (aperture from 19 cm to 2.6 m)
- Company for the network maintenance and instruments development (ASC Project-Technics)

# ISON observatories



# ISON Research Goals in Space Debris Area

- Estimation of real population of space debris at higher geocentric orbits
- Determination of physical properties of discovered space debris objects
- Determination of probable sources of newly discovering space debris fragments
- Verification of existing models of space debris distribution and evolution at higher orbits
- Higher orbit space debris risk assessment
- Improvement of technologies of studying of space debris population using optical instruments
- Improvement of motion models for space debris objects with complex physical properties

# ISON Milestones in 2012

The UN BSSI and ISON cooperation is established. UNBSSI-ISON Outreach Seminar as a side event of the 55<sup>th</sup> Session of the UN COPUOS

New partners joined ISON:

- The Autonomous University of Sinaloa (Universidad Autónoma de Sinaloa, UAS), Mexico
- The Research Centre of Astronomy and Geophysics of the Mongolian Academy of Sciences

3 facilities put into operation:

- Cosalá, Sinaloa, Mexico
- Khureltogoot, Mongolia
- Kislovodsk, Russia

Regular Molniya-type HEO surveys started.

270 new high orbit (GEO and HEO) debris are discovered



# UN BSSI - ISON



UN Basic Space Science Initiative (BSSI) - ISON Outreach Seminar took place as a side event of 55<sup>th</sup> Session of the UN COPUOS on June 11<sup>th</sup>, 2012.

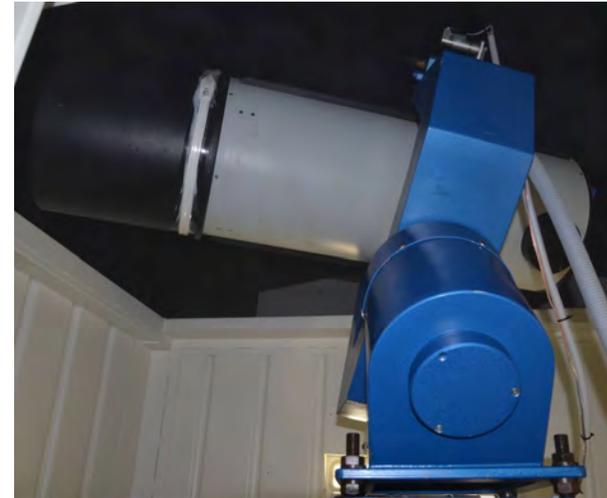
The established cooperation is a step towards broader involvement of all nations into fundamental and applied research of space debris problem, further development of international practice of information exchange and analysis in this area.

# First ISON observation facility in Mexico – joint project with Universidad Autónoma de Sinaloa



*left:* shelter with 25-cm telescope in Cosalá, Sinaloa (Mexico);  
*center:* the commemorative plaque  
*right:* outreach and educational seminar at the facility;  
*bottom:* numerous visitors around the telescope at the opening ceremony

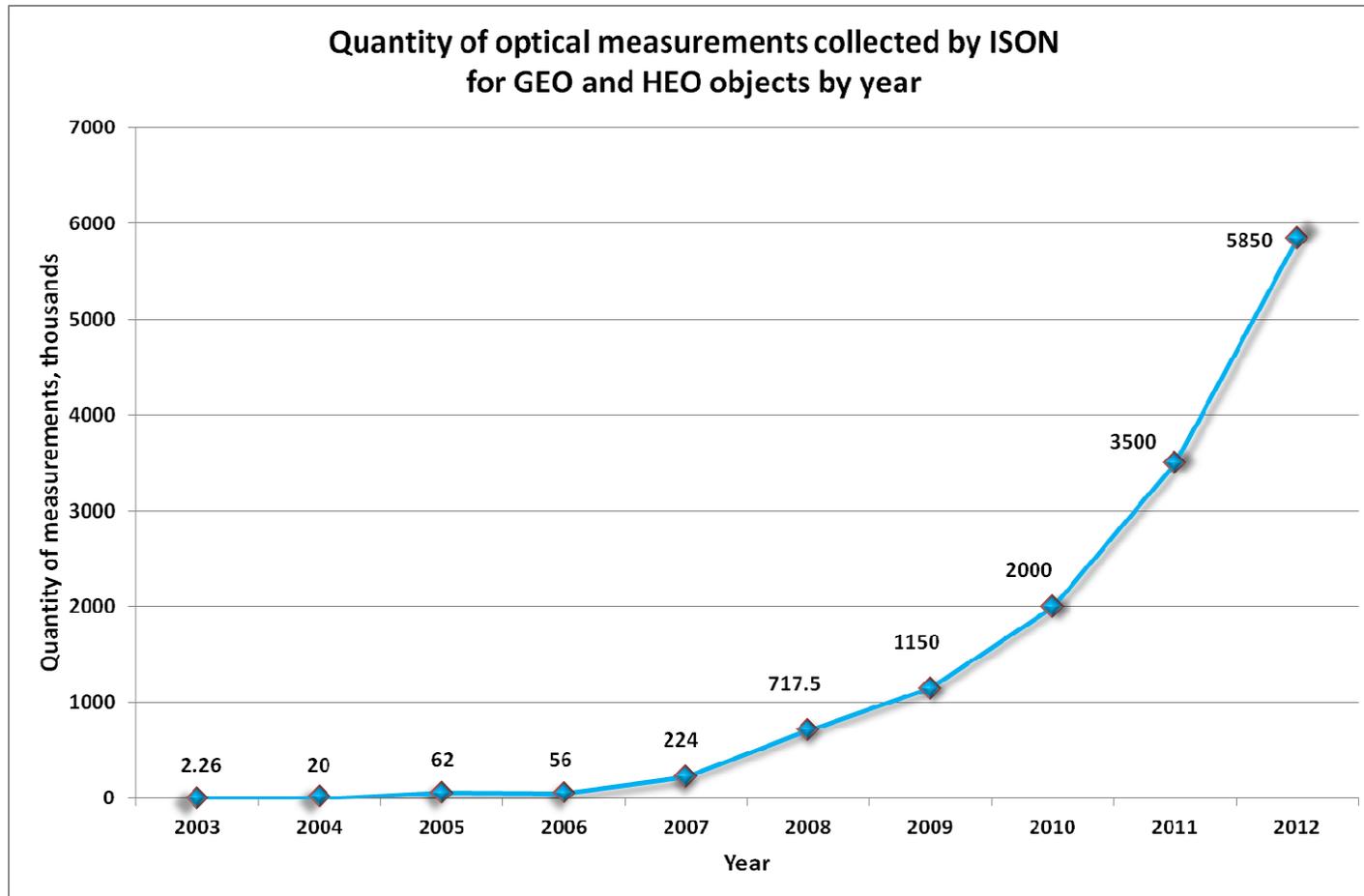
# Kislovodsk observatory (25-cm, 2x20 cm and 40-cm telescopes)



# Khureltogoot observatory in Mongolia started to work with ISON

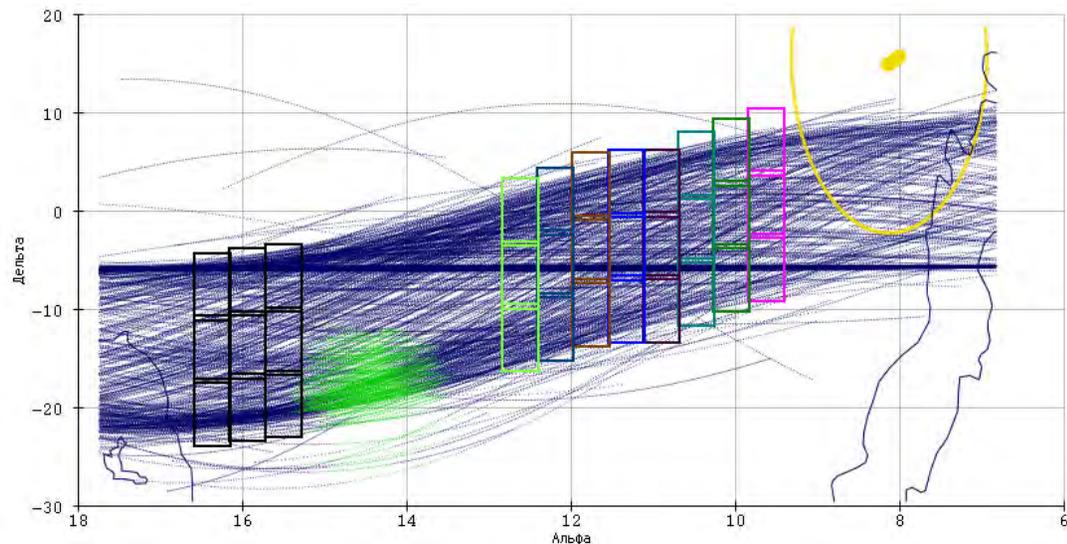


# Growing amount of measurements collected by ISON, 2003 – 2012



# Start of HEO surveys, extended GEO surveys

- 19.2 cm VT-78e and 18 cm VT-52c telescopes with 7x7 degree FOV are installed in Sanglok, Nauchnyi-1 and Khuraltogoot, twin 19.2 cm VT-78e telescope (FOV 7x5 deg for each channel) is installed in Kislovodsk
- **Kislovodsk, Sanglok and Khureltogoot** are carrying out extended GEO surveys (limited magnitude of detecting GEO objects – 14.5<sup>m</sup>)
- **Nauchniy-1** carries out targeted surveys of apogee area of Molniya-type HEO objects that already resulted in discovery of many previously unknown debris



# Extended GEO surveys (examples)

Sanglok VT-78e first extended GEO surveys, Jan 2012

Date	Duration, hh:mm	Tracks	Measurements	Objects
17.01.2012	11:47	2297	16006	577
18.01.2012	12:33	2413	16910	609
19.01.2012	11:08	2265	16063	597
20.01.2012	12:28	2428	17030	637
28.01.2012	12:14	2383	16822	606
31.01.2012	11:44	2184	15553	580

Khureltogoot VT-78e selected extended GEO surveys, Dec 2012 – Jan 2013

Date	Duration, hh:mm	Tracks	Measurements	Objects	Average arc length per GEO object, min	Max arc length per GEO object, min
05.12.2012	12:20	1513	10550	363	171.5	514.6
07.12.2012	10:46	1495	10424	299	271.6	529.8
09.12.2012	12:18	1044	7098	331	165.4	536.9
12.12.2012	12:15	1171	8150	342	163.0	559.5
16.12.2012	12:16	1539	10516	340	283.3	542.2
05.01.2013	13:04	1403	9444	366	286.5	591.6
18.01.2013	12:48	1570	10441	421	311.1	595

Increased measurement arc length is very important from the point of view of obtaining more precise orbits from just one night observations.

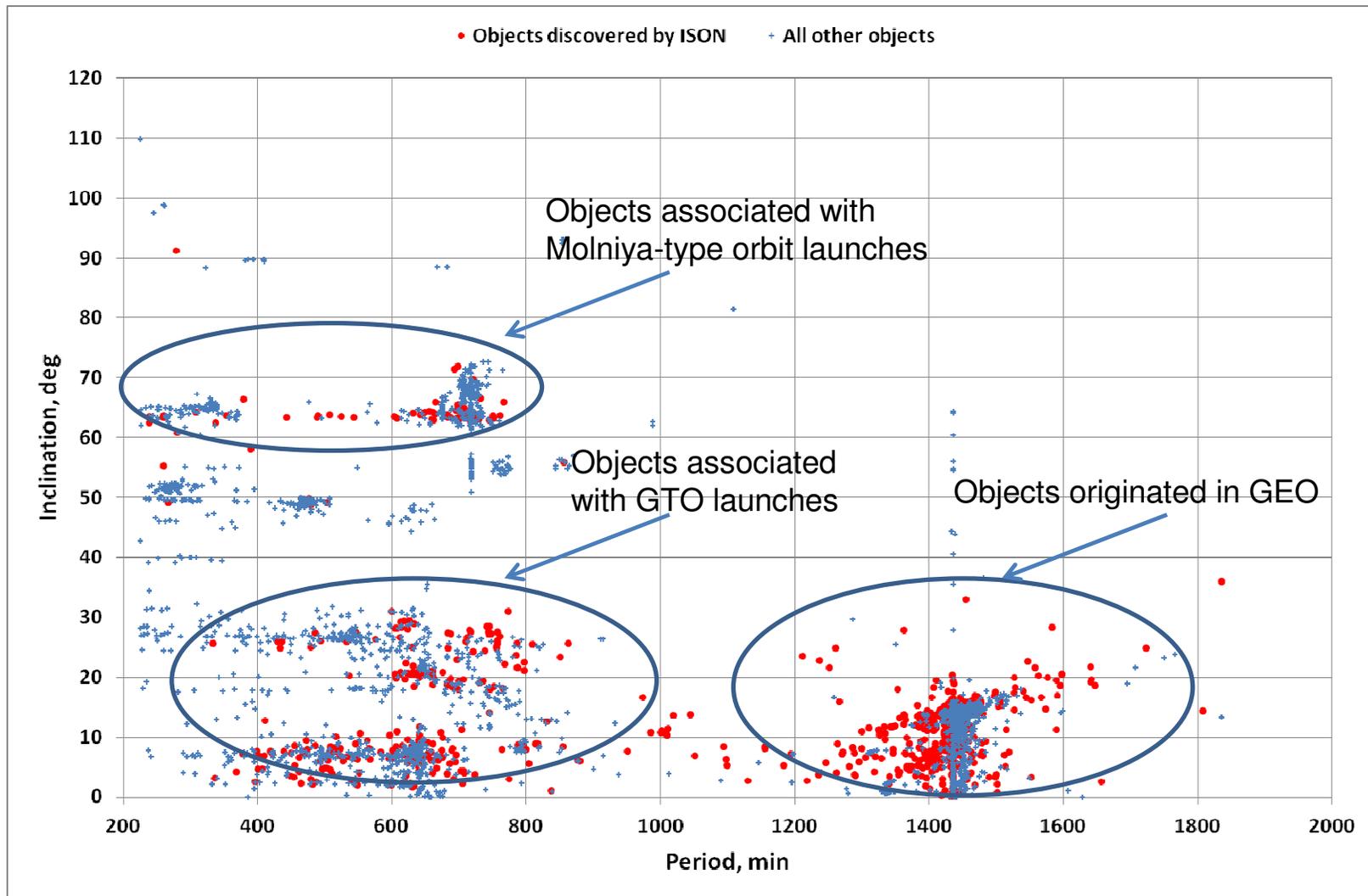
# ISON Database of HEO, MEO and GEO objects

As of Feb 1, 2013 the ISON database contains information for more than 3200 HEO, MEO and GEO objects with orbits updating using ISON optical measurements

897 of these objects are newly discovered during 10 years of ISON work

270 HEO and GEO space debris objects are discovered in 2012 (compare to 168 ones discovered in 2011 and 61 – in 2010).

# HEO, MEO and GEO Objects in ISON Database



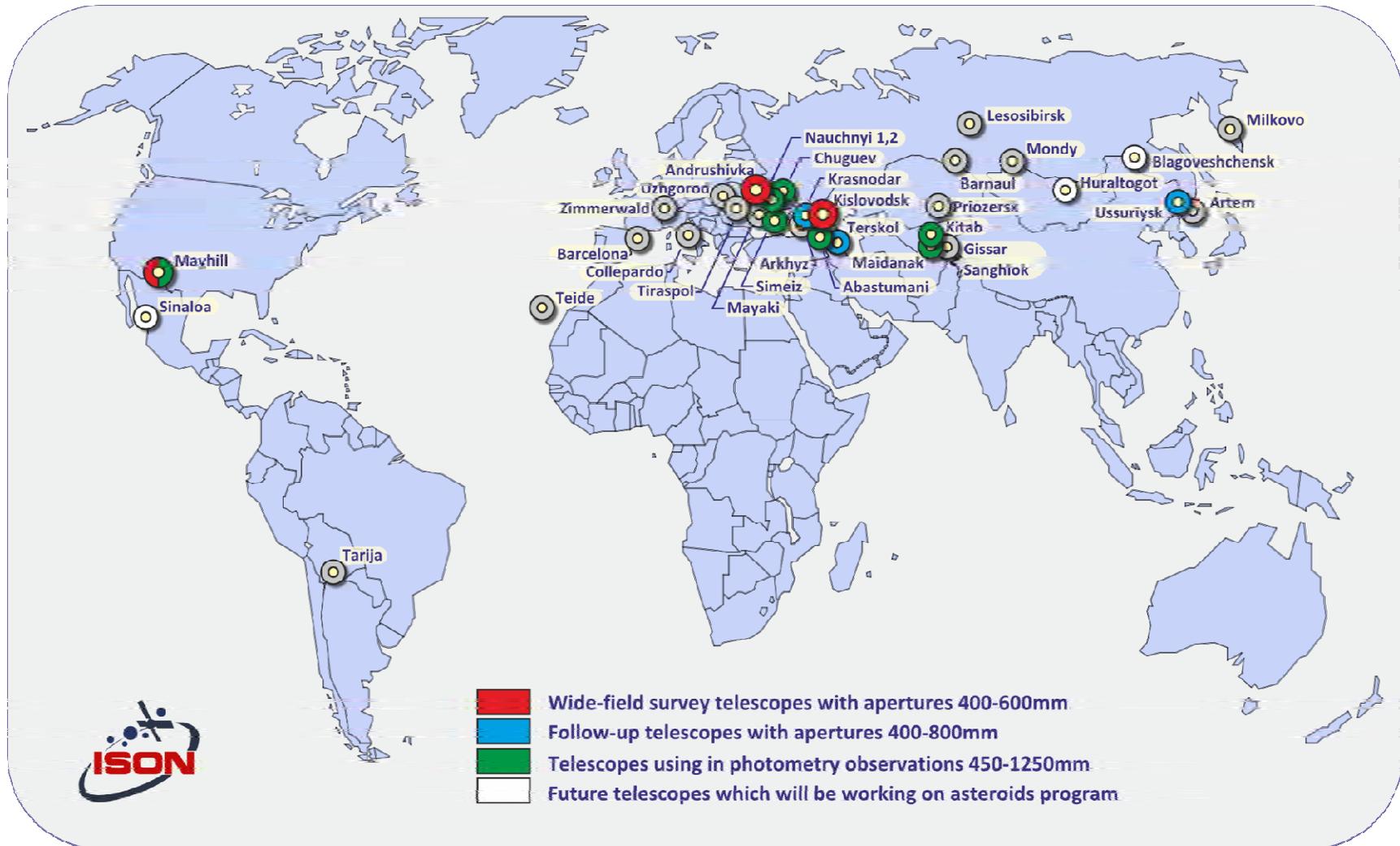
# Identification of GEO debris sources

New work on identification of ISON discovered GEO debris is started.

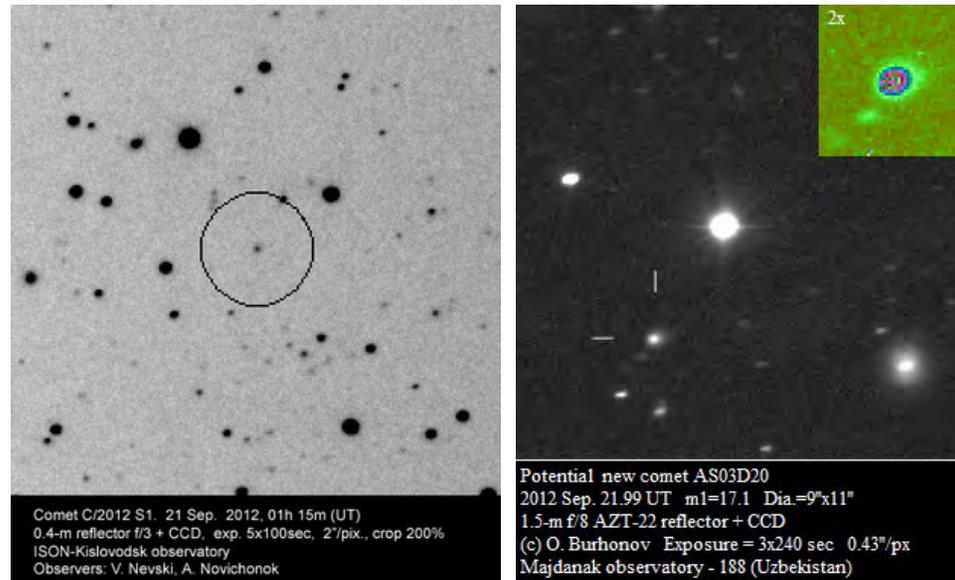
In 2012 we identified

- 4 GEO debris objects as associated with launches of FengYun-2 spacecraft in 1997, 2004, 2008 and 2012,
- 3 GEO debris objects as associated with launches of Meteosat first and second generation spacecraft in 1993, 1997 and 2012,
- 4 GEO debris objects as associated with launches of DSP spacecraft series in 1991, 1994, 1997 and 2007,
- 1 debris object as an AKM used to deliver GMS-2 spacecraft to GEO in 1981

# ISON observatories involved into asteroids research



# ISON comet (C/2012 S1)



Discovered on Sep 21, 2012 in ISON Kislovodsk observatory (Russia) and confirmed in Maydanak observatory (Uzbekistan), partner of ISON

Third comet discovered within the ISON project framework

A potentially Great Comet of the century – if it survives the Sun encounter (is due to fly 1.9 million km of the center of the Sun on Nov 28, 2013) then it is predicted to become brighter than the full moon and to be visible in the daytime sky

# Conclusions

- Partnership is established between UN BSSI and ISON
- ISON network collects on a routine basis astrometric and brightness measurements for more than 1800 objects in GEO region and more than 1400 objects at HEO orbits
- Obtained measurement data are processing to improve orbits and to find various events (appearance of a new object due to launches, fragments separation etc., possible close encounter, manoeuvres of different purpose)
- Accumulated information is using to support spaceflight safety tasks, including those ones solving within the framework of ASPOS OKP system by Roscosmos jointly with RAS
- ISON continues to develop an asteroid research program
- Development of ISON – the first international network for monitoring near-Earth space – continues and all nations are welcome to join us

**Thank you for your attention!**