International Scientific Optical Network (ISON) and UN BSSI – New Topical Goals for an Observing Program

Vladimir Agapov

Keldysh Institute of Applied Mathematics, Russian Academy of Sciences

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International Scientific Optical Network (ISON)

- **Open non-government scientific project having goals**

– to support existing and establishing new telescope facilities worldwide

– to enhance the international collaboration between observatories in developing countries and scientific organization in industrialized countries in the filed of optical observation of natural and man-made celestial objects

– to provide significant scientific output in ***3 key areas of research: space debris, asteroids and GRB afterglows***

- **Cooperation already joins *35 observation facilities* of various affiliation (Academy of Sciences, Universities, Scientific Institutions, Private Companies) in *15 countries*, *more than 70 telescopes* of different class (aperture from 19 cm to 2.6 m)**
- **Coordinated by the Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences (KIAM) and maintained with help of KIAM partners**

The UN General Assembly Resolution 46/45 (09.12.91) "International cooperation in the peaceful uses of outer space" and subsequent resolutions on the same subject

The General Assembly,

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Considering, that space debris is an issue of concern to all nations,

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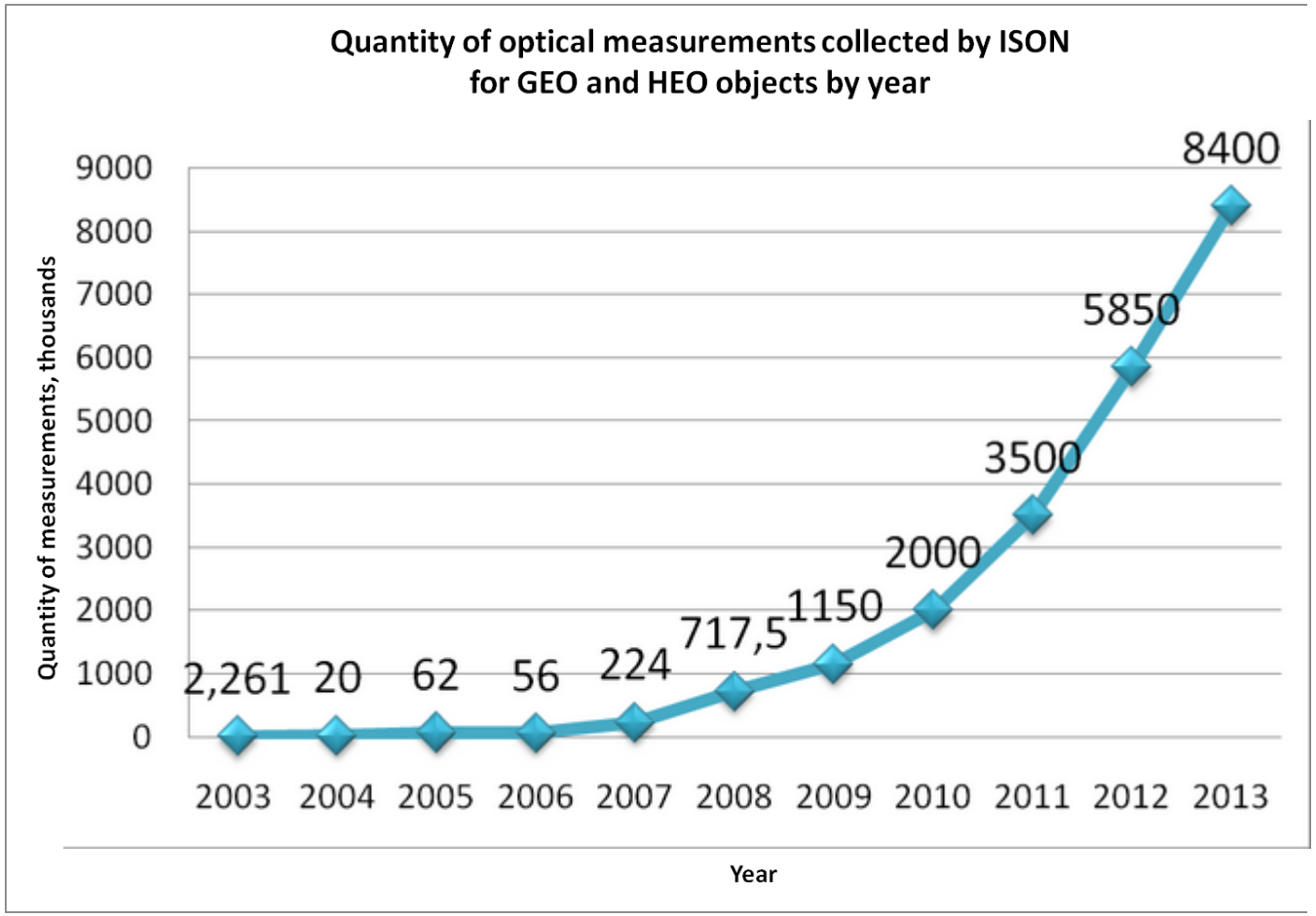
28. *Considers* that it is essential that Member States pay more attention to the problem of collisions of space objects, including those with nuclear power sources, with space debris, and other aspects of space debris, **calls** for the continuation of national research on this question, **for the development of improved technology for the monitoring of space debris and for the compilation and dissemination of data on space debris**, also considers that, to the extent possible, information thereon should be provided to the Scientific and Technical Subcommittee, and agrees that international cooperation is needed to expand appropriate and affordable strategies to minimize the impact of space debris on future space missions

ISON project presentations to the COPUOS STSC

- **Results of GEO region artificial objects population research and proposal for organization of cooperative international GEO space debris monitoring**.
  Presentation to the 44th Session of the COPUOS STSC , 12-23 February, 2007, Vienna
- **International scientific optical observation network (ISON) for the near-Earth space surveillance – results of the first years of work and plans for the future**.
  Presentation to the 45th session of the COPUOS STSC, 11-22 February 2008, Vienna
- **Estimation of current status of geostationary orbit based on results of research in the framework of ISON international project**.
  Presentation to the 46th session of the COPUOS STSC, 9 - 20 February 2009 , Vienna
- **GEO protected region: ISON capabilities to provide informational support for tasks of spacecraft flight safety and space debris removal**.
  Presentation to the 47th session of the COPUOS STSC, 8 - 19 February 2010 , Vienna
- **Review of events occurred in geostationary region in 2010 based on data obtained by ISON international network**.
  Presentation to the 48th session of the COPUOS STSC, 7-18 February 2011, Vienna.
- **Results of GEO and HEO space debris population research and asteroids study within the framework of ISON international project in 2011**.
  Presentation to the 49th session of the COPUOS STSC, 6-17 February 2012, Vienna
- **Results of GEO and HEO monitoring by ISON network in 2012**.
  Presentation to the 50th session of the COPUOS STSC, 11-22 February 2013, Vienna
- **ISON activities on highly elliptical orbit (HEO), geosynchronous orbit (GEO) and Near-Earth objects (NEO) observation and analysis in 2013.**
  Presentation to the 51st session of the COPUOS STSC, 10-21 February 2014, Vienna

See http://www.unoosa.org/oosa/en/COPUOS/stsc/index.html

Quantity of measurements accumulated by ISON participating instruments, 2003 – 2013



ISON results on space debris

Hundreds of new HAMR debris at GEO and HEO orbits

Numerous discoveries forced to re-evaluate existing space debris models, including space debris creation mechanisms and space debris short- and long-term evolution at high orbits

Significant non-gravitational effects in orbital motion assessed and their models improved

Small telescopes efficiency proved

Wide FOV surveys techniques developed, tested and implemented for regular observations. New optical designs proved the ability of small-class instruments to discover and track faint objects (with estimated size of 80 cm at GEO distance)

Top 30. Number of observations in 2010-2013

№	MPC code	Observations	Objects	Discoveries	Observatory name
1.	G96	7575459	1381391	67711	Mt. Lemmon Survey
2.	703	6186338	1013872	10390	Catalina Sky Survey
3.	F51	6037423	1404446	41714	Pan-STARRS 1, Haleakala
4.	704	5628876	807335	2593	Lincoln Laboratory ETS, New Mexico
5.	C51	4008160	207099	35037	WISE
6.	691	3221788	605533	34974	Steward Observatory, Kitt Peak-Spacewatch
7.	E12	867753	199141	1260	Siding Spring Survey
8.	D29	862778	209077	825	Purple Mountain Observatory, XuYi Station
9.	I41	469350	55688	4097	Palomar Mountain--PTF
10.	J75	407501	95277	2000	OAM Observatory, La Sagra
11.	H15	406570	97704	1357	ISON-NM Observatory, Mayhill
12.	926	343311	101432	1565	Tenagra II Observatory, Nogales
13.	J43	267461	52934	1653	Oukaimeden Observatory, Marrakech
14.	645	245718	58569	7	Apache Point-Sloan Digital Sky Survey
15.	106	204623	49178	309	Crni Vrh
16.	291	180787	47795	1562	LPL/Spacewatch II
17.	J04	140559	36365	1474	ESA Optical Ground Station, Tenerife
18.	W84	110213	8518	4160	Cerro Tololo-DECam
19.	644	95804	19044	1766	Palomar Mountain/NEAT
20.	A14	92556	25962	311	Les Engarouines Observatory
21.	461	76584	17745	1495	University of Szeged, Piszkesteto Stn. (Konkoly)
22.	D00	76152	18253	95	ISON-Kislovodsk Observatory
23.	H21	69945	12736	502	Astronomical Research Observatory, Westfield
24.	A50	63394	19207	113	Andrushivka Astronomical Observatory
25.	G92	51727	13673	107	Jarnac Observatory, Vail
26.	A24	42014	6775	0	New Millennium Observatory, Mozzate
27.	A77	39351	9729	488	Observatoire Chante-Perdrix, Dauban
28.	G32	38997	5086	680	Elena Remote Observatory, San Pedro de Atacama
29.	695	38209	8149	1779	Kitt Peak
30.	807	36346	8026	10	Cerro Tololo Observatory, La Serena

ISON results on asteroids and comets

Hundreds of light curves were constructed for tens of NEAs

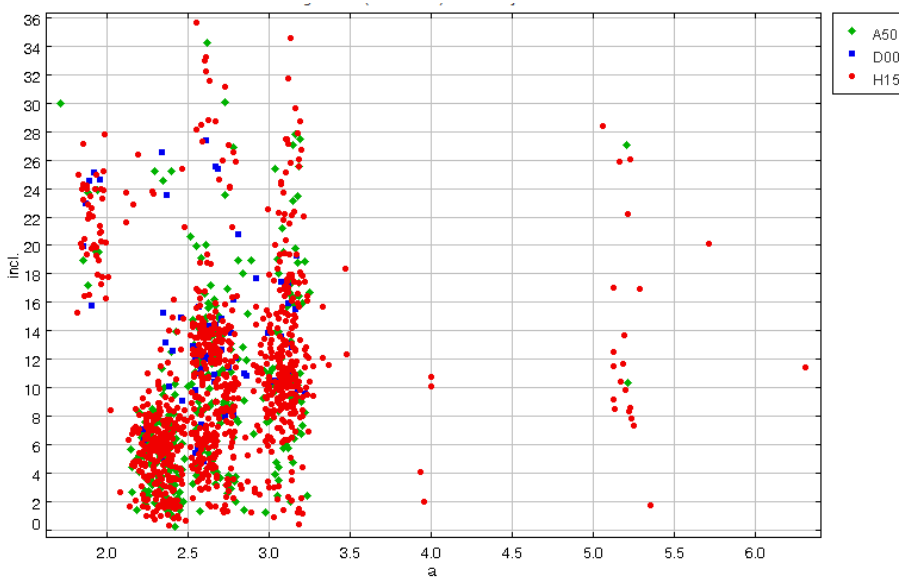
(3122) Florence, (20187) Janapittichova, (25916) 2001 CP44, (162004) 1991 VE, (7888) 1993 UC, 1998 VO, (47035) 1998 WS, 2000 WN22, 2001 WC47, 2002 GT, 2012 EG5, 2012 DX75, 2012 KP24, 2012 KT42, 2012 LZ1, 2012 QG42, 2012 TC4, 2012 DA14…

YORP-effects is estimated: (2100) Ra-Shalom и (88710) 2001 SL9

Binarity of asteroids:

(3352) McAuliffe, (8373) Stephengould, (7888) 1993 UC, (68216) 2001 CV26, (137170) 1999 HF1, (329437) 2002 OA22, (8306) SHOKO

Discoveries: 6 comets - C/2010 X1 (Elenin), P/2011 NO1 (Elenin), **C/2012 S1 (ISON)**, C/2013 V3 (Nevski), C/2013 N4 (Borisov), C/2013 V2 (Borisov),
8 NEAs, 1500+ asteroids



ISON and UN BSSI – need for cooperation

- Joining efforts to maximize scientific and practical output within the framework of strengthen international cooperation
- Involvement of new nations (mainly developing countries) into complex observation projects and interpretation and analysis of obtained results for education and capacity building
- Adding new topical goals to BSSI Observing Program to support current initiatives approved by the UN GA such as NEOs (in support of IAWN) and space debris (in support of LTSSA)
- Development of an international databases on natural and artificial space objects (including those under the UN OOSA to increase transparency and to support confidence building measures) as well as original CCD images for a virtual observatory
- Information and experience sharing via dedicated UN OOSA Web-site, outreach and educational workshops with direct involvement of UN OOSA

ISON and BSSI – similar aims and ways

- Both BSSI and ISON are long-term efforts in the development of astronomy and space science through regional and international cooperation in this field on a worldwide basis, particularly in developing nations.
- Material for teaching and observing programs for small optical telescopes were developed or recommended and astronomical telescope facilities have been inaugurated in a number of nations within the framework of both projects
- **UN BSSI** – 7 optical telescopes & CCD cameras and 20 planetariums are installed in **22 countries** under Official Development Assistance (ODA) program of BSSI
- **ISON** – 45 optical telescopes, >70 CCD-cameras, various other equipment are installed in **15 countries** under ISON project and there are preliminary negotiations to start collaboration with teams in another **7 countries** (***Argentina, Azerbaijan, Brazil, Chile, Namibia, South Africa, Vietnam***)
- ISON additionally provides special software tools for observations, helps to formulate the scientific goals, supports capacity building (including training, publications, outreach and educational workshops)

Joint ISON–BSSI Possible Project Requirements

For Educational Activity

- The available infrastructure and activity means (available facilities for the telescope installation: geographical coordinates, height above sea level, average number of clear and partially clear nights per each month, background illumination conditions (brightening) at the nighttime, average amount of precipitation, temperature and humidity for each month, astronomical seeing (if measured), transparency of atmosphere, Internet access channel bandwidth at the facility; available domes/shelters, equipment or tools that can be used for the activities.)
- Planned educational activities using the ISON-provided equipment and software:
  - How the equipment will be employed;
  - In which ways students will be involved in the project;
  - Expected average age of students taking part;
  - The project schedule and planning.

For Research Activity

- Research focus of a laboratory which is planned to be involved into the project
- The available infrastructure and project means (available facilities for the telescope installation: geographical coordinates, height above sea level, average number of clear and partially clear nights per each month, background illumination conditions (brightening) at the nighttime, average amount of precipitation, temperature and humidity for each month, astronomical seeing (if measured), transparency of atmosphere, Internet access channel bandwidth at the facility; available rooms/laboratories, domes/shelters, equipment and tools that can be used for the project, material, financial means)
- Planned research activities using the ISON-provided equipment and software:
  - Itemized planning and conducting of the observations (including joint observations within the framework of ISON project)
  - Ability to support regular observations (every clear or partially clear night)
  - Ability to perform additional analysis and processing of CCD-images
  - Ability to perform specific analysis of data extracted from CCD-images

UN BSSI – ISON first steps towards cooperation

- First working meeting in Vienna – Feb 2012 (OOSA: Mazlan Othman, Hans Haubold, Sergey Chernikov; ISON: Alexander Alferov, Vladimir Agapov). General support of the cooperation idea was expressed
- Jun 11, 2012 – joint UN – ISON outreach seminar on the margins of the 55th COPUOS meeting (35 attendees representing UN OOSA, 14 COPUOS member States and Secure World Foundations)
- The idea of cooperation between UN BSSI and ISON was highly supported by participants
- It was highlighted the ISON project uniqueness: *very important niche for small non-expensive optical telescopes is found for applications previously considered as requiring only large instruments*

UN BSSI – ISON first steps towards cooperation (2)

Joint UN BSSI – ISON outreach workshop

Conclusions

1. ISON activity is performing in full consistency with the UN recommendations regarding international cooperation in NEO and space debris scientific research, capacity building and development of practically important approaches
2. Cooperation between UN BSSI and ISON seems not just feasible but is promising significant advantages in international programs for NEOs and space debris research
3. Many nations, especially developing countries, could be involved without significant material and financial resources into the topical research areas defined by COPUOS
4. Sharing of information obtained within the framework of a joint project at the level of UN OOSA could help to support better transparency and confidence building measures
5. First steps are already done and we expect further steps soon