Russian Academy of Sciences
Keldysh Institute of Applied Mathematics

ISON: Existing Structure, Tasks, Characteristics and Further Development

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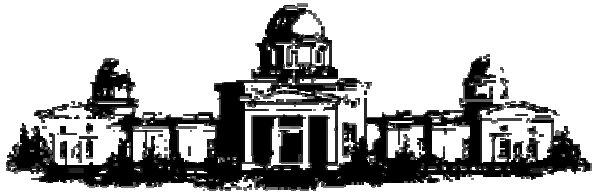
8th US/Russian Space Surveillance Workshop
18-23 April 2010, Wailea, Maui



ISON: International scientific optical network

- main goal is providing an open source of information about space objects accessible for scientific analysis

Current primary tasks:

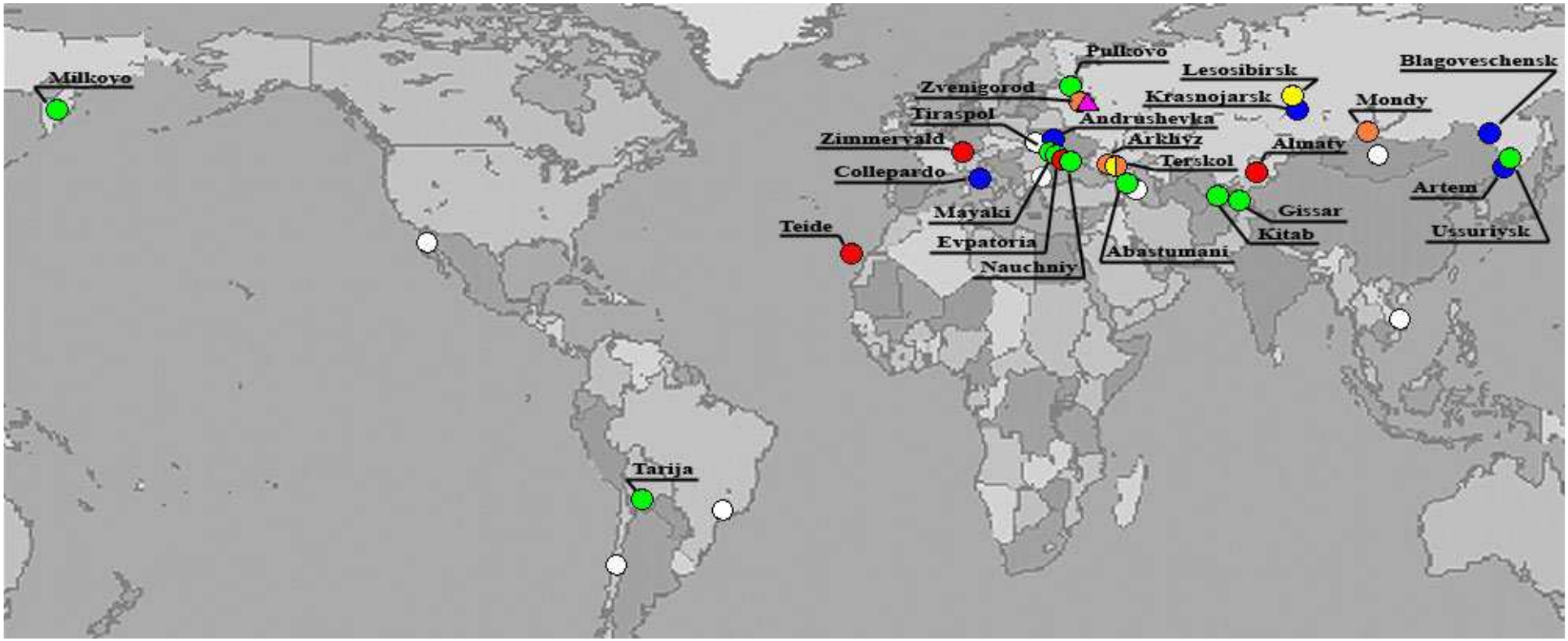
- regular GEO monitoring, new objects discovering and tracking, maintenance as complete GEO objects database as possible
- new objects on GTO and other HEO regimes discovering and individual tracking, special HEO surveys will start soon
- determining of possible origin of the discovered objects
- analysis of potentially dangerous situations in GEO

ISON milestones:

- May 2001, first observations with 10-cm telescope in Pulkovo
- Autumn 2004, trial observations of faint fragments with 64-cm telescope in Nauchny-1, first join campaigns with European observatories (AIUB, PIMS)
- 2005-2006 – ISON arrangement and telescope upgrade
- 2007-2008 – routine observations and new telescopes production. Full GEO coverage achieved
- 2009 – 2010 – forming ISON subsets for GEO surveys and fain fragment tracking

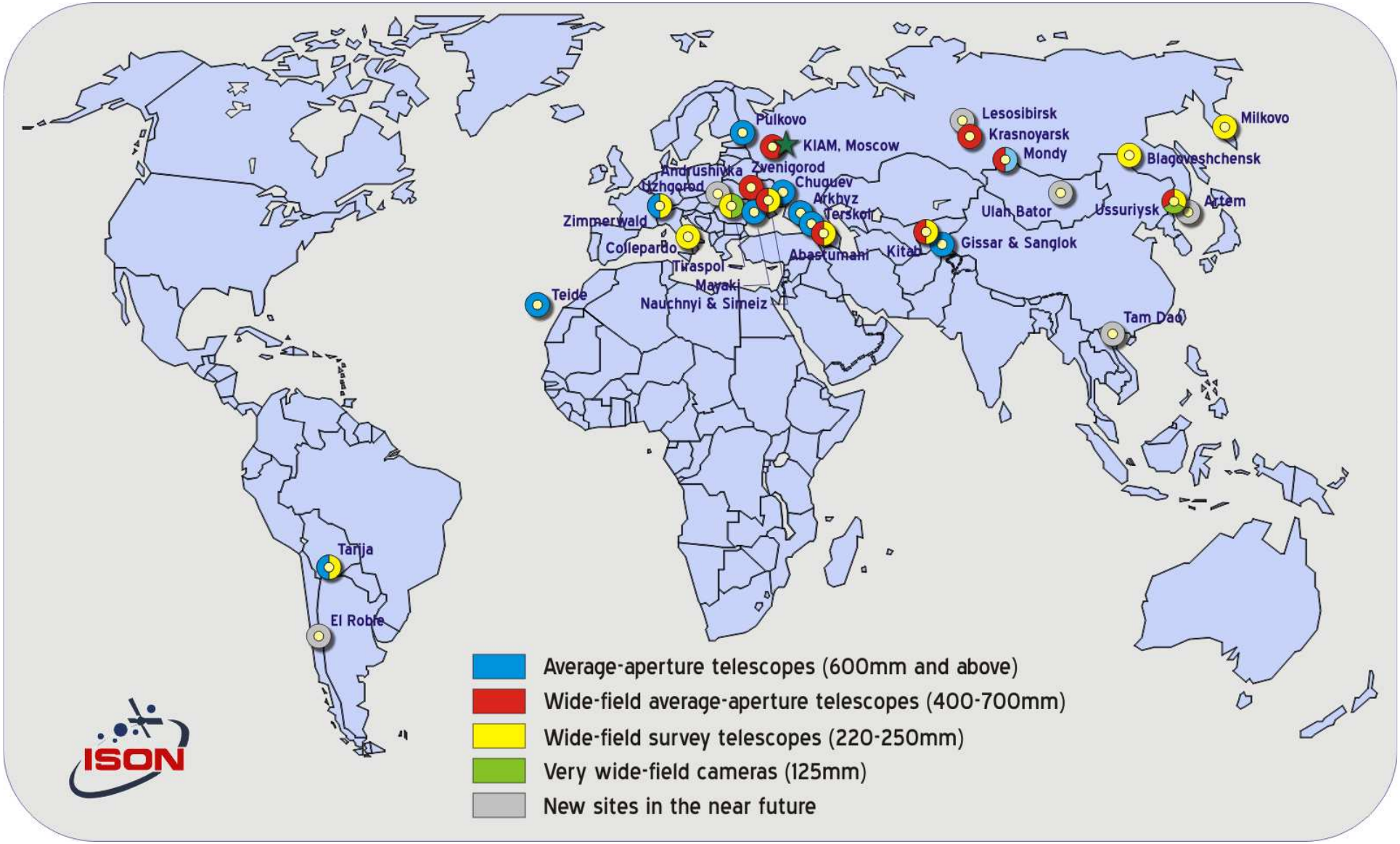
ISON is a civilian project coordinated by the Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences (KIAM RAS)

International scientific optical network



Green and Blue circles – ISON observatories
Orange circles – other Russian observatories providing follow up observations
Red circles – foreign observatories collaborating with the ISON
Yellow and White circles – ISON observatories in preparation

International scientific optical network



ISON structure

network of optical facilities:

- search and survey subsystem for surveys of the GEO region (partially operational)
- subsystem for high orbit faint (fainter than 15.5^{m}) space debris tracking (operational)
- subsystem for tracking of bright GEO and HEO objects (in development)

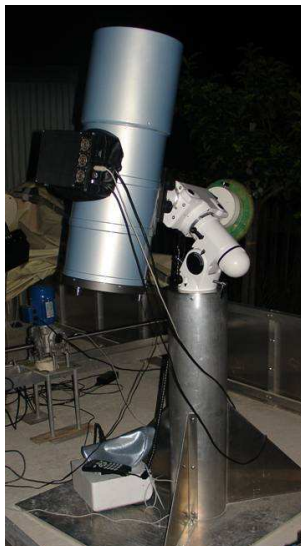
network operation supporting groups:

- electric and software engineering (Pulkovo observatory)
- optical and mount engineering (SPE “Project-Technics”)
- observation planning and data processing (KIAM, Vympel and KMZ)
- network development (KIAM)

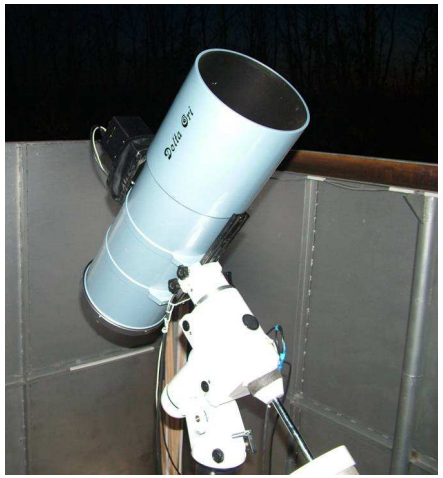
20 new telescopes and 35 GPS-based timing devices are produced, 30 CCD cameras are purchased, standard software for CCD frames reduction and telescope equipment control is elaborated

Search and survey subsystem for the GEO region: *nine 22-25 cm telescopes with FOV of 3.5- 5.5 degree*





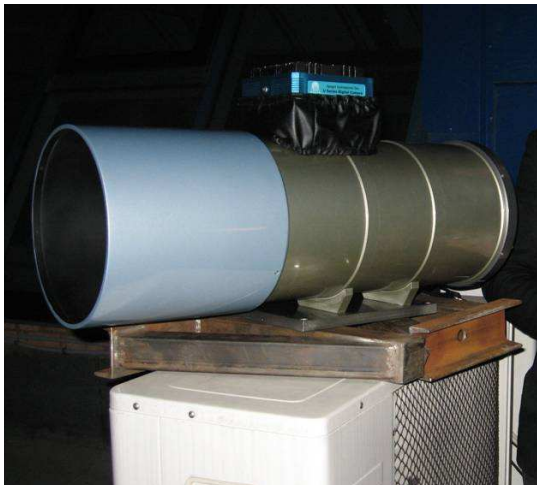


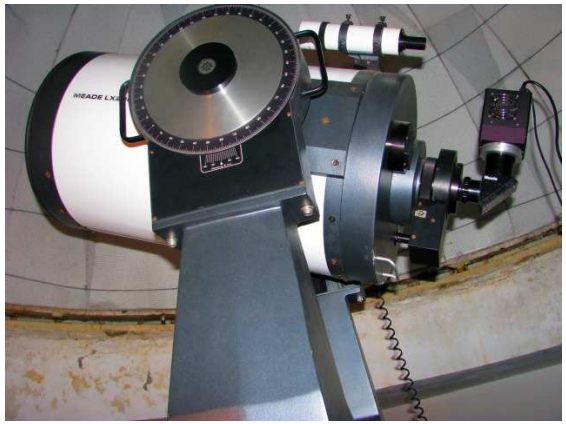


Subsystem for tracking of bright GEO and HEO objects: Ussuriysk, Uzhgorod, Abastumani, Artem, Lesosibirsk, Nauchny-2, TamDao





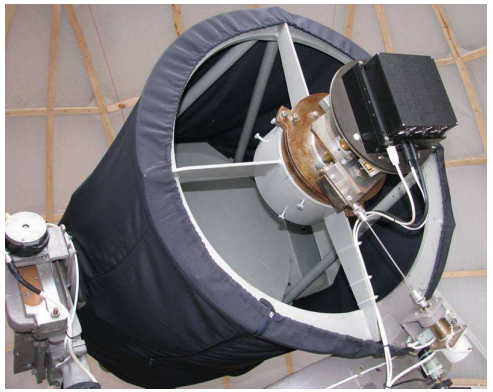




Subsystem for faint debris tracking:

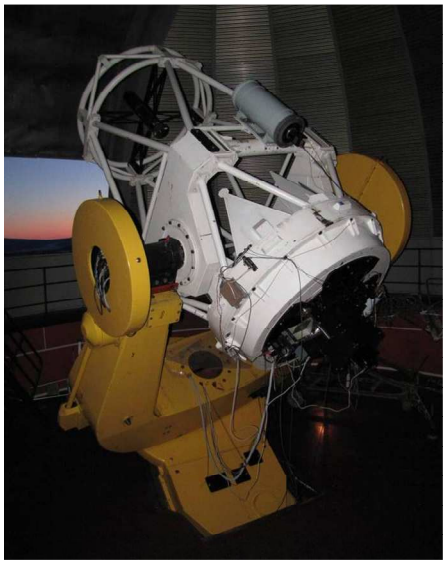
AT-64 Nauchny-1, RC-600 Mayaki, S-600 Andrushivka, ZIMLAT Zimmerwald, AZT-14 Mondy, AS-32 Abastumani, Zeiss-600 Arkhyz, AZT-8 Gissar

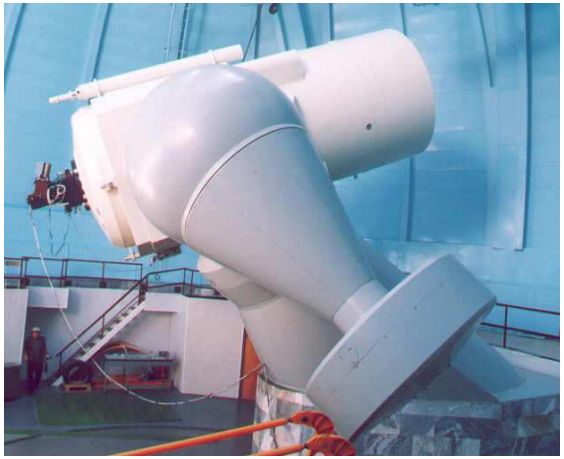


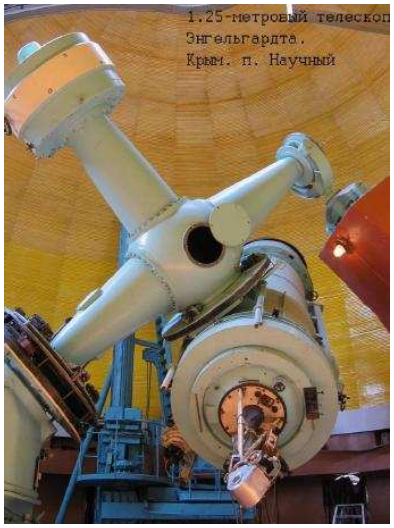




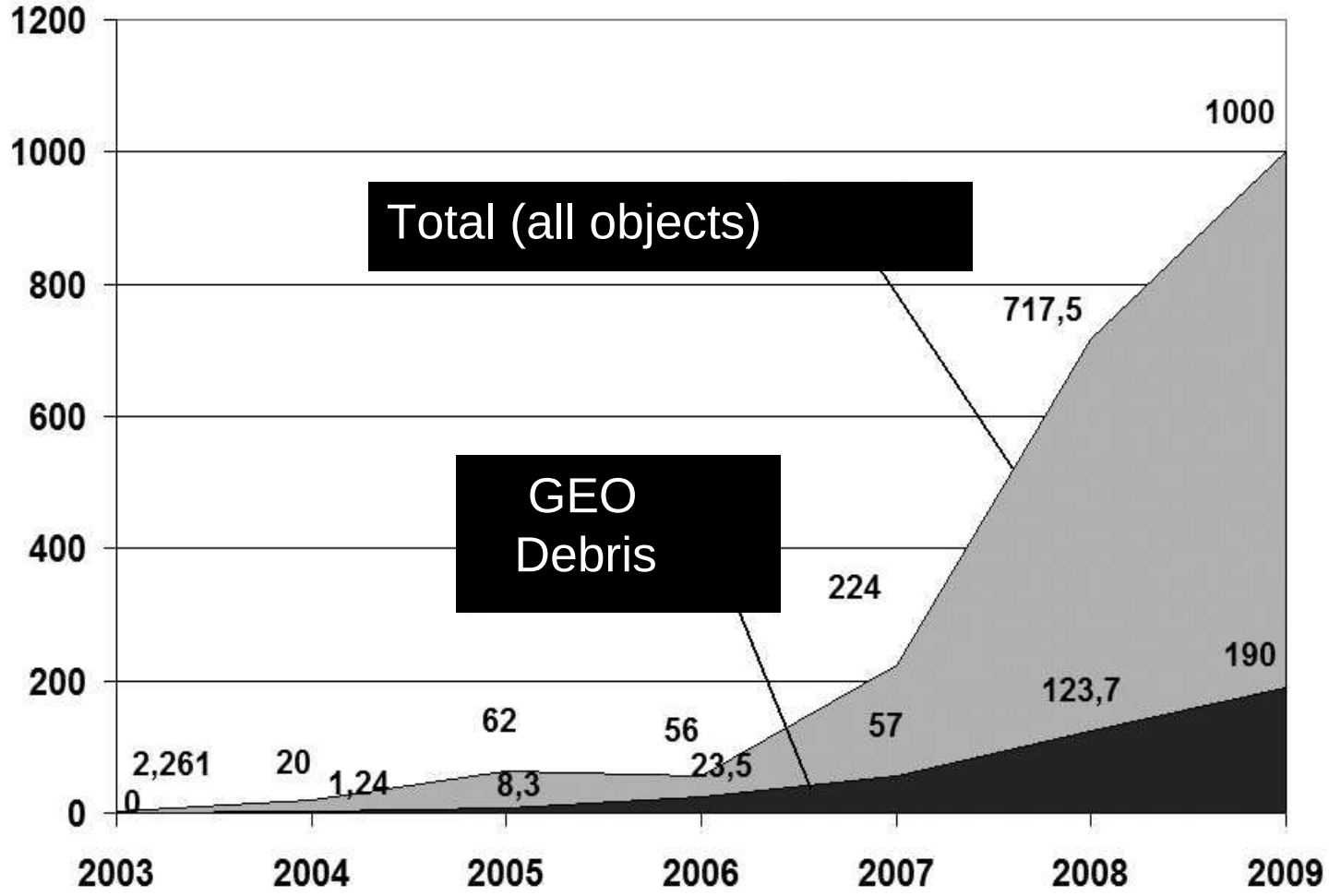

Subsystem for very faint debris tracking – down to 21m: 2.6 m ZTSh Nauchny-1, Zeiss-1000 Teide, Zeiss-2000 Terskol, 1.7 m AZT-33IK Mondy, 1.25 m ZTE Nauchny-2



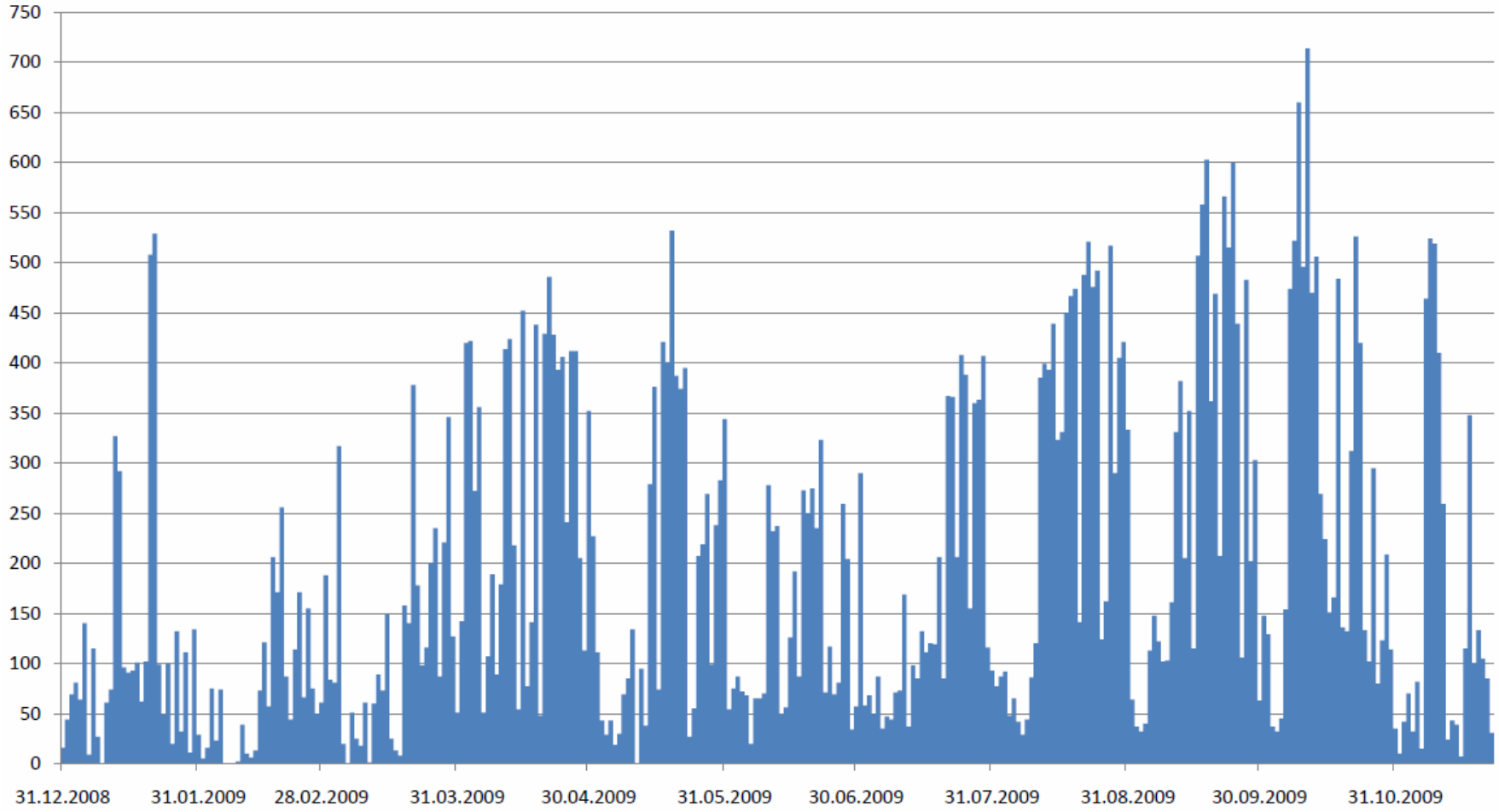




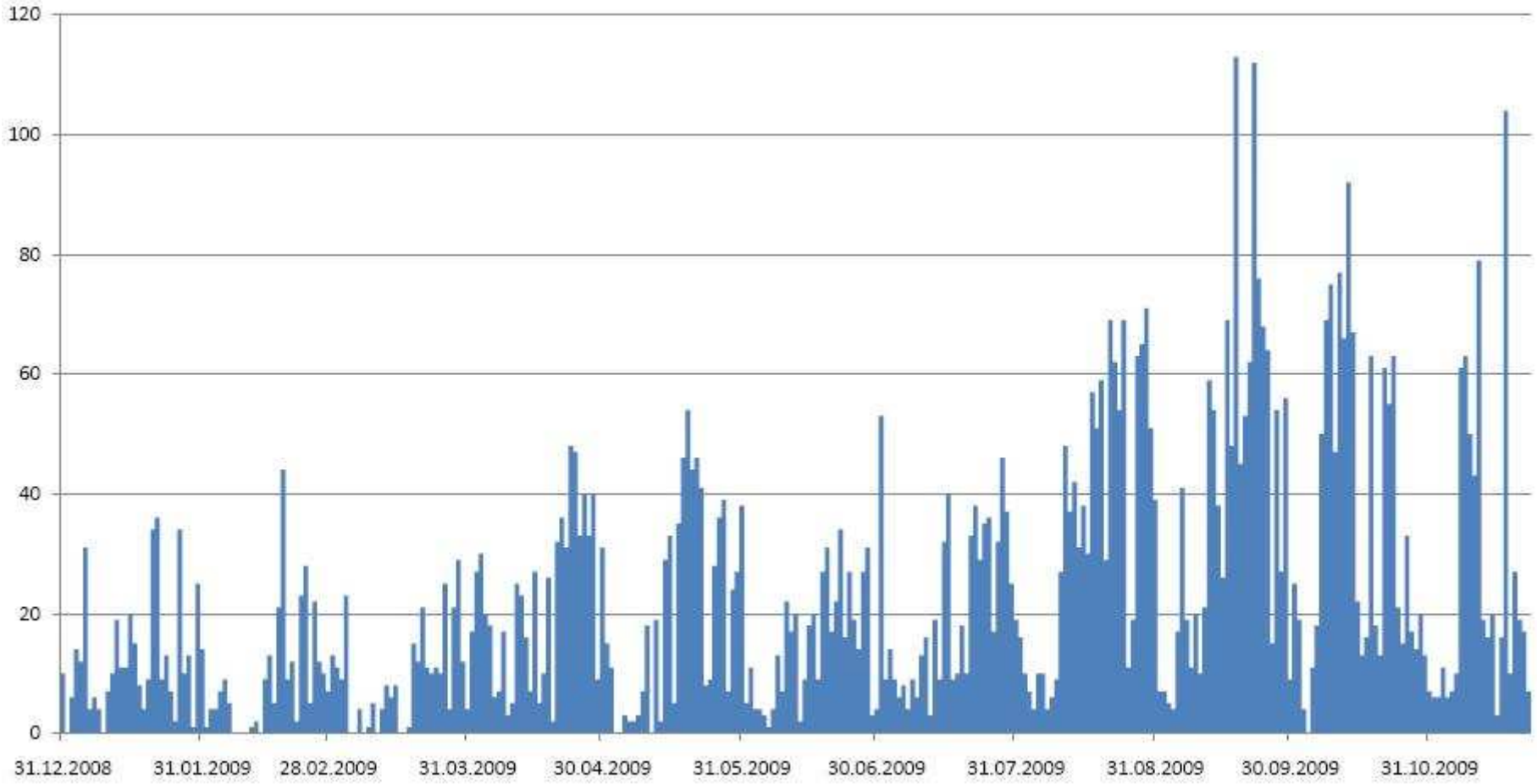
Number of measurements (in thousands) produced by years



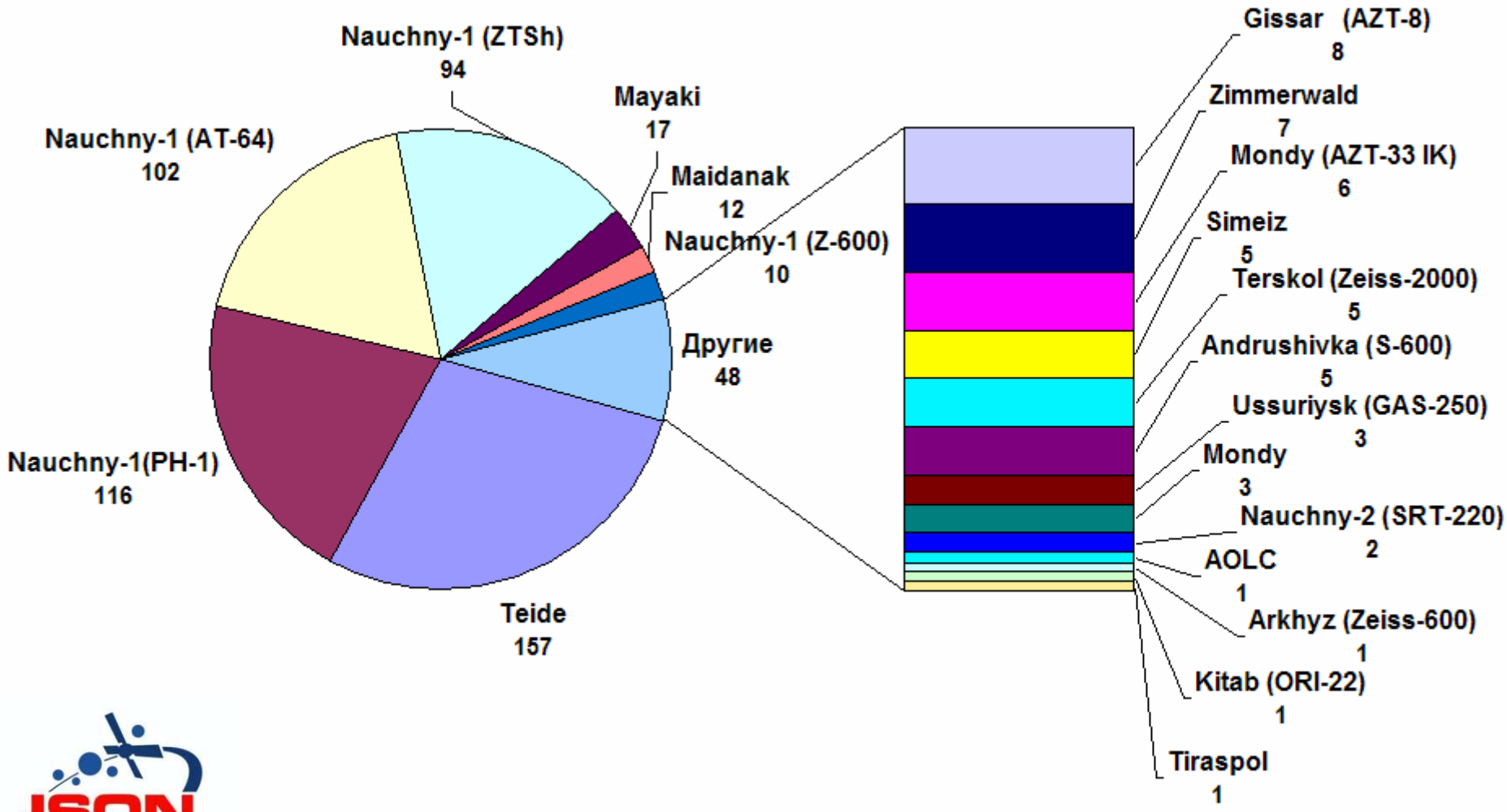
Observed GEO Objects Number (by day, Jan-Nov 2009 r.)



Observed HEO Objects Number (by day, Jan-Nov 2009 г.)



Distribution of discovered 556 fragments by telescopes (341 objects / 215 uncorrelated tracks)



Current ISON performances

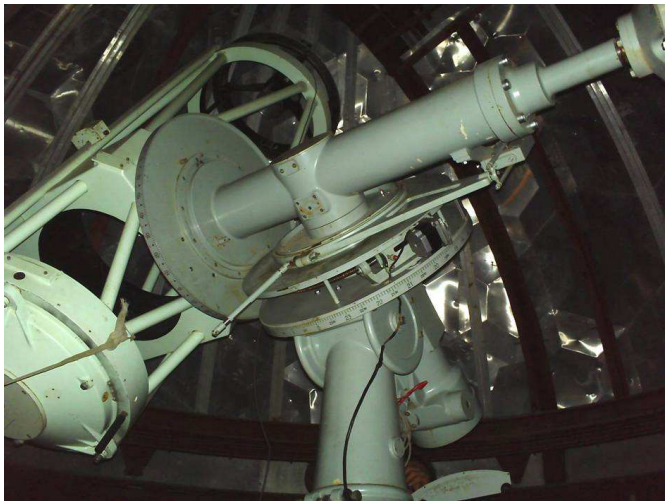
- more 30 telescopes in 20 observatories of 10 countries
- Control of full GEO arc
- uncatalogued GEO debris search (using different strategies, limiting magnitude 19^m) and tracking (limiting magnitude 21^m)
- measurements with precision of 0.5 – 2” to determine the high accuracy orbits for close encounters analysis
- GTO and other HEO objects observations including faint space debris
- observations of new lunches at GEO and HEO

Third switching on of DM-SLB Telstar-11N

Future ISON development

- improving of the faint fragment search and tracking ability across full GEO arc – putting into operation of series of 40-cm – 80-cm telescopes
- improving of western hemisphere coverage - involving of observatories in Chile, Mexico, Brasilia, New Zealand is under consideration
- upgrading 1-m Zeiss-1000 in Sanghlok, Tajikistan
- starting the special HEO surveys using lens objectives with FOV of 7.5 – 15 degrees

Future development – improving of the faint fragment search ability across full GEO arc



Future ISON development

Outlook

- **ISON is obtaining large volume of measurements on high orbit space objects on regular basis**
- **about 15 additional telescopes will be putted into operation during 2010-2011**
- **it will allow independent continuous tracking of all objects larger than 1 m in size and about 90% of objects larger than 0.5 m in size along all GEO arc and improved capability to detect and to track faint GEO and HEO objects with magnitude down to 21^m**
- **next stage of ISON development foresees monitoring of GTO, Molniya and other types of HEO**