

SPACE DEBRIS AND ASTEROIDS DETECTION FROM TOPPO DI CASTELGRANDE OBSERVATORY

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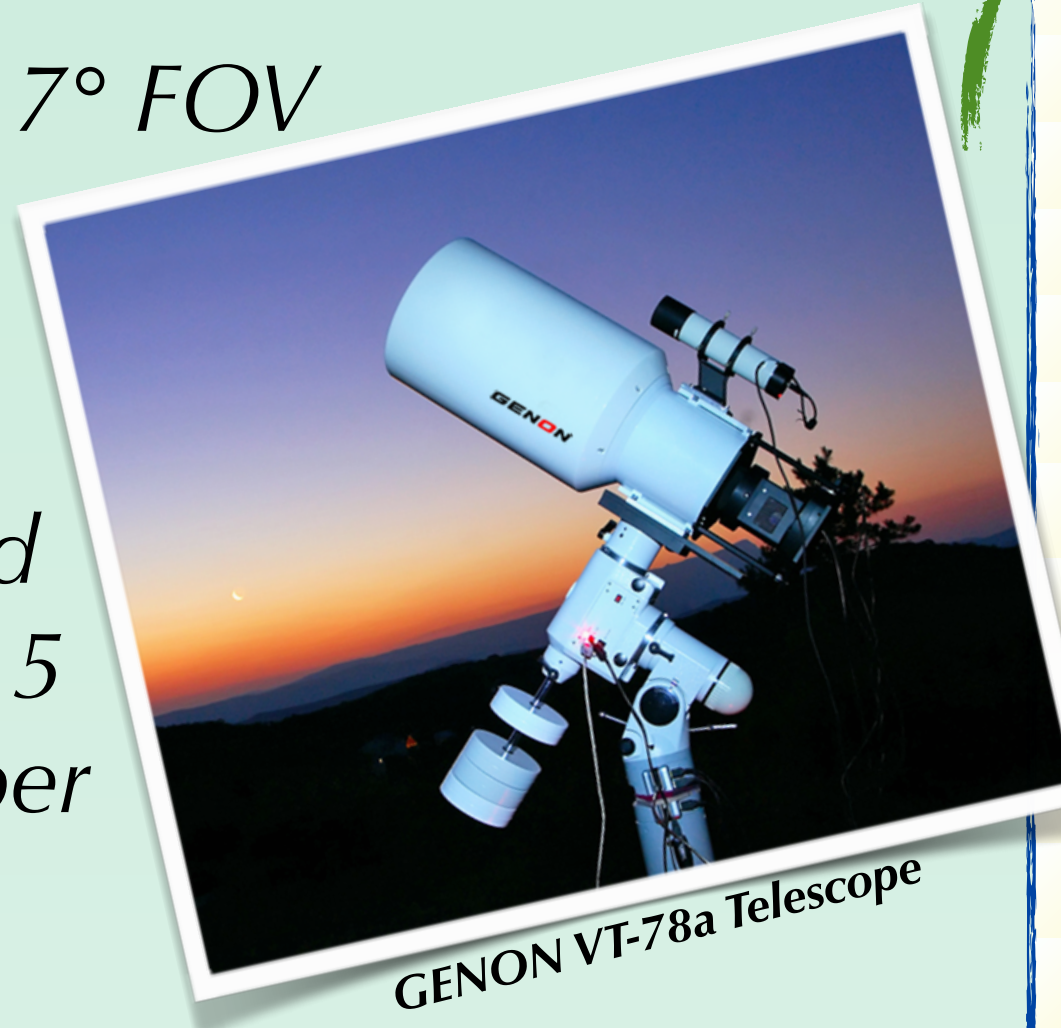
Toppo di Castelgrande is an area in the Basilicata region (Italy) of particular interest for space objects observation, with very good air quality parameters. In particular the seeing is the most favourable in Italy, with an average around 1.2arcsec with a minimum of about 0.7-0.8 arcsec. In such area is located a big observatory run by INAF-Capodimonte and hosting a 1.54 meter altazimuth telescope with a Ritchey-Chretien optical configuration (TT1). This telescope is equipped with an active secondary mirror, designed specifically for optimal image quality and a spectrograph is hosted inside the TT1 cupola.

A new building has been realized by the local authorities of Castelgrande to host an observatory dedicated to the space debris and asteroid detection. It is a 6x6 meters building in two levels entitled to "Giulio Ciani", and it will host three telescopes:

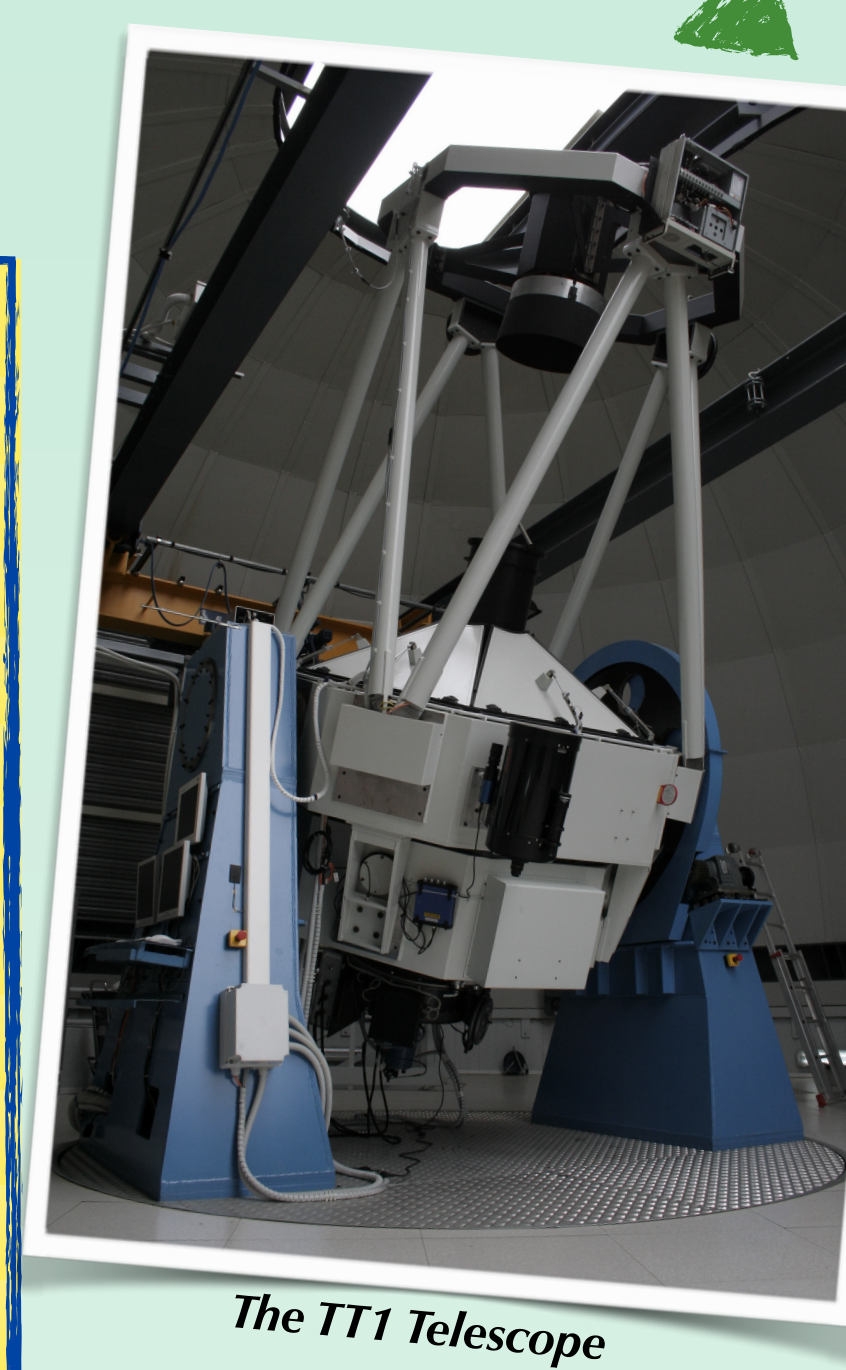
- GENON VT-78a telescope of 19.2 cm aperture with 7° FOV
- A telescope of 25 cm aperture with 1° FOV
- A telescope of 35 cm aperture with 40' FOV

The first telescope will be used for extended geostationary orbit (GEO) surveys providing up to 15 thousands measurements for 500 - 700 objects per night (with duration of object tracks up to a few hours). These surveys are performed to determine more precise GEO orbit parameters for conjunction analysis, to detect maneuvers of active satellites and to help maintain the orbits of GEO objects in clusters. Another output of this activity is the detection of many highly elliptical orbits (HEO) objects as background ones.

The other two telescopes will be used for further follow up tracking of dimmer objects at GEO and HEO orbits.



GENON VT-78a Telescope	
Entrance Pupil Diameter	1.537 m / 8.9
Effective Focal Length	0.545 m
FOV (angular)	87%
FOV (linear)	15.078 arcsec/mm
Wavelengths	0.361 arcsec/pix
Back Focal Length	F 8.9
RMS Diameter	F 11.5
Central Obscuration	F 5.6
Vignetting	+/-720°
Distortion	0-90°
Optical System Length	1 deg/sec



TT1 Optical and Telescope Description	
M1 - Diameter/focus	1.537 m / 8.9
M2 - Diameter	0.545 m
Free vignetting area	87%
Scale	15.078 arcsec/mm
Resolution (optics + detector)	0.361 arcsec/pix
Cassegrain focus	F 8.9
Nashmit foci	F 11.5
Trapped focus	F 5.6
Range AZ	+/-720°
Range ALT	0-90°
Pointing velocity AZ	1 deg/sec
Pointing velocity ALT	1 deg/sec
Max AZ tracking error	0.07 arcsec
AZ tracking error (rms)	0.02 arcsec
Max ALT tracking error	0.1 arcsec
ALT tracking error (rms)	0.02 arcsec
Spectroscopy and Imaging FOV	16' x 16'
Filters available	UBVRi, ugriz, uvbyH β , H α etc.

Collaboration with TT1

A telescope such as the TT1 will be a useful addition to the debris research, since its wide diameter will favorably limit the CCD exposure time in order to catch objects which have a high visual magnitude.

The TTSC detector (Toppo Telescope Scientific Camera) is a nitrogen-cooled SITe SI-424a grade 2 with a pixel size of 24 μ m. The CCD is back-illuminated and thinned to reach a better quantum efficiency in the UV spectrum.

Moreover, TT1 will be used in conjunction with several available instruments, for further spectrometry and photometry studies of the objects found by the other telescopes.

Some spectroscopic exposures are taken in order to associate new information to the target. The usage of TT1 in spectroscopic mode allows the users to determine the material of which the target is built. The combined use of the two telescopes in automatic or semiautomatic mode could therefore add auxiliary information useful to evaluate the risk parameter associated to the target itself and information on the material of the target.

A dedicated section of the TT1 main control system will be responsible of the automation of this task under a remote supervision if necessary.

The ISON Network

The observatory will be added to the International Scientific Optical Network (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.

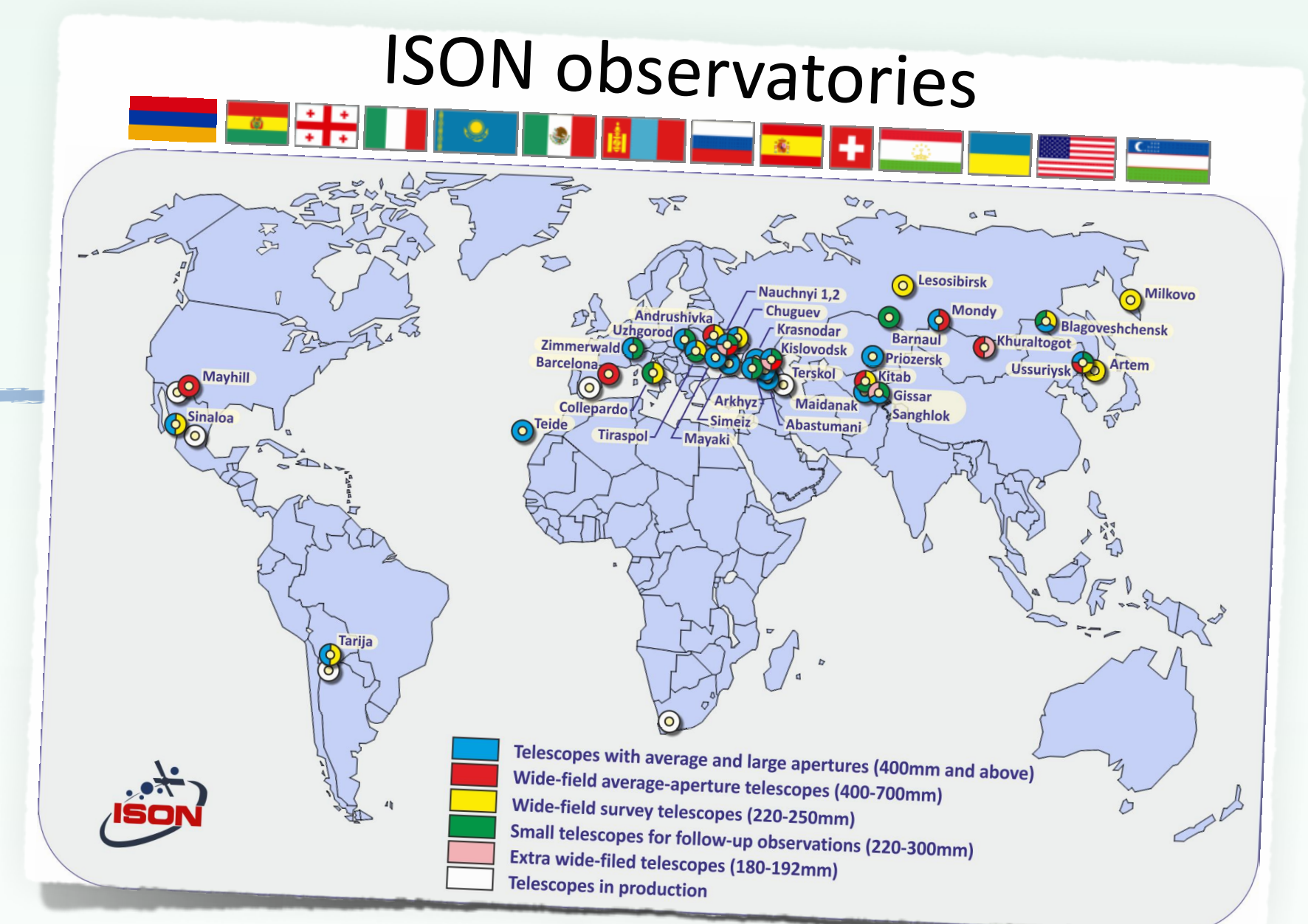
Obtained measurement data are processed in order to improve orbits and to find various events (appearance of a new object due to launches, fragments separation etc., possible close encounter, maneuvers of different purpose).

Accumulated information is used to support spaceflight safety tasks, including those ones solving within the framework of ASPOS OKP system by Roscosmos jointly with RAS.

In 2013 ISON has collected 8.4M astrometric measurements for HEO and GEO objects.

210 new debris objects were discovered, as well as 190 new asteroids, including a 1km diameter one.

ISON continues to develop an asteroid research program.



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Observatory Mission

The main purpose of these joint observations is to study characteristics of debris and asteroids such as rotation period, size and shape of the body, surface composition and other.

Many objects orbiting around Earth, especially those in High Elliptical Orbits (HEO) are not included in NORAD's JSpOC Database, since radar observations become increasingly difficult for those altitudes.

Cooperative optical observations made by Toppo di Castelgrande observatory, together with several ISON observatories simultaneously will serve as a useful instrument for quick objects detection and determination of their orbits.

Moreover, further studies conducted with the TT1 spectrograph will help debris assessment, based on material composition of the object surface.

The current activities of the new space debris observatory will be reported as well as the potentialities of its insertion into the Asteroid Search and Photometry Initiative pursued by the ISON network.