



MATERA SPACE CENTER
"GIUSEPPE COLOMBO"
ITALIAN SPACE AGENCY



SCIENCE, RESEARCH, HIGH-TECH AND RECORDS



MATERA SPACE CENTER

The Matera Space Center, dedicated to Professor Giuseppe “Bepi” Colombo, was established in 1983 in Matera, thanks to the joint effort of the National Space Plan of the National Research Council (replaced by ASI in 1998), in coordination with NASA, and the Basilicata Region. The Bepi Colombo Matera Space Center is the main ASI center for Space Operations and an important site for space research.

Space Geodesy was the first space domain of activities of the center and became a cen-

tral node for Remote Sensing, at the beginning of the 90’s, hosting the User Ground Segment for national missions. In the last two decades, Matera has extended its activities in the domains of “free space” quantum communications, the metrology of time and frequencies and finally, in the last years, in the area of Space Traffic Management with particular regard to the monitoring of space debris.

In the next five years, the Matera Space Center will be part of an important expansion

programme with a dedicated plan of investments. The aim to reach a primary position in the domains of Earth Observation, Space Traffic Management and Planetary protection, Optical and Quantum Technologies for Space Applications, and Downstream, with particular regards to integrated applications. The ambition to become in the next decade the reference Center for integrated application for southern Italy and the enlarged Mediterranean geopolitical Area.



SPACE GEODESY

Thanks to the combination of the three geodetic techniques- Satellite and Lunar Laser Ranging (SSR and LLR), Very Long Baseline Interferometry (VLBI) and the Global Navigation Satellite System (GNSS)- the Bepi Colombo Space Center is one of the very few multi-technique “core stations” of the Global Geodetic Observing System (GGOS).

The Matera Space Center contributes actively to the following international geodetic services: International Laser

Ranging Service (ILRS), International GNSS Service (IGS) and International VLBI Service (IVS). It thus provides of fundamental geodetic products, such as: coordinates and velocities of stations, Earth orientation parameters, atmospheric products such as tropospheric delays, total electron content, GNSS orbits and clocks, and SLR-detected Earth satellite orbits.

The Space Geodesy activity is being enhanced in the medium term thanks to a New VLBI antenna in line with VGOS

(VLBI Global Observing System) standard that will replace the existing antenna and the provision of a new Laser - the “Matera Satellite Laser Ranging” (MSLR) - fully devoted to the International Laser Ranging System (ILRS) Service.

Matera Laser Ranging Observatory (MLRO)

Laser system capable of tracking dedicated artificial satellites equipped with laser corner cubes at a millimetre-level accuracy. The Satellite Laser Ranging (SLR) technique is able to measure millimetric yearly movements of the earth's crust. The system SLR performs studies in the fields of Fundamental Physics and General Relativity and determines geocenter variations.

Facts: MLRO is able to perform the Lunar Laser Ranging Technique (tracking of corner cubes on the Moon), measuring the orbital escape rate of the Moon (average rate of 38 mm per year).



Very Large Baseline Interferometer (VLBI) S/X radio astronomy antenna

With a diameter of 20m it receives quasars' radio emissions for measuring shifts in the Earth's crust and the Earth Orientation Parameters (EOP) at millimetre level.

Facts: the Space Center measured the displacement of the earth's axis by almost 7 cm during the Sumatra earthquake in 2004.



National network of GNSS receivers

Through the collection of the GPS, GLONASS, BeiDou and GALILEO signals the network determines displacements of the earth's crust with precision comparable to those of SLR and VLBI. Main operative uses are monitoring of areas subject to hydrogeological hazards, coastal erosion, operational meteorology and precision farming.



GEODAF server

Data center for an easy access to the geodetical data and products of the Center for the scientific community.

REMOTE SENSING AND DOWNSTREAM

The Matera Center is a crucial node of the National Ground Segment for Remote Sensing Missions since the beginning of 90's it started with the "Italian Processing and Archiving Facility" (I-PAF) and Centre (I-PAC) for ESA ERS-1/2 and ENVISAT satellites and with an essential role in the Italian-German-American SIR-C/X-SAR (1994) and SRTM (2000) missions.

Since 2007 Matera has been the Civilian User Ground Segment for National missions such as the Dual Use X-Band Constellation "COSMO-SkyMed", "COSMO-SkyMed Second Generation" and the User Ground Segment for the Prisma Hyperspectral Mission. The Center hosts

the data from Missions in cooperation such as SAOCOM (L-Band) and ALOS (L-Band) as well as the data from Copernicus Sentinels. Work is in progress to host the User Ground Segments of National missions under development such as, but not limited to: PLATINO, PRISMA Second Generation, Maya, SBG and various nanosatellites.

The Center is developing a dedicated operational area for Downstream applications with the intent to become a reference center for the geopolitical area of the enlarged Mediterranean in the short-medium term.



Antennas

The Center has three antennas in X-Band for supporting the missions. Further antennas are planned or under procurement in order to support national missions.



Mapitaly

Repository of data systematically acquired on Italy with CSK Mission with a total refresh of the Italian peninsula every 16 days (ten years of archive).



The Matera Laboratories

Innovative project for the development of downstream applications by using the entire set of data accessible through the Agency's programmes or through Agency's international Cooperation. Particular lines of investments will be dedicated to the capacity building in southern Italy and for the enlarged Mediterranean, which will imply large cooperation in the relevant geopolitical area. The project is based on four dedicated lines:

The Matera Living Lab

Open working area (institutions, researchers, industries, etc.) devoted to create new application solutions using data fusion, in a concurrent mode, through the structured and combined access to EO constellations, SATCOM, GNSS and non-satellite data (e.i. drones, in situ measurements).

The In-Orbit Space Lab

Tools, applications, services and resources distributed on different orbiting platforms aimed at the quick testing of new applications in "edge computing" paradigm and in "as-a-service" mode. It is integrated in the Matera Space Center Lab.

New algorithms and management techniques

A dedicated line to the development of future processors for downstream applications.

The Multimission Platform

Infrastructure for accessing national multi-mission Earth Observation satellite

data, with features of efficiency, scalability, expandability, interoperability, automaticity, to be implemented in cloud paradigm. It will contain a data-lake of pre-processed (L1) data of ASI Missions.

Metrology, Spectroscopy and Quantum Technologies

This laboratory is dedicated to innovative experiments spanning from fundamental physics test to ground-breaking technologies for space applications. Pushing Metrological research enable new standards for improvement in navigation and geodesy measurements. High Resolution Spectroscopy experiments on going, are targeting innovative studies regarding planetary and exoplanetary atmospheres without neglecting sensors development for intercalibration of Earth observation tools. Regarding Quantum Technologies, ASI is involved in several national and European grants in the pillars of Quantum Communication, Quantum Simulation and Quantum sensing. The goal is a fast transfer of such ground-breaking tools towards space applications.

QUANTUM TECHNOLOGIES

QUANTUM COMMUNICATIONS

Since 2003, Matera has been a recognized international player in the field of “free-space” quantum communications, thanks to various research projects executed in the center, also in cooperation with other recognized institutions and the availability of the MLRO system, with a 1.5 meter-diameter telescope. Outstanding results have been reached in Space and free Space Quantum Key Distribution (QKD).

Facts: the cooperation with the University of Padua led to the first transmission of quantum states beyond the Earth’s atmosphere in 2015 and, recently, to a fundamental tests of quantum theory, such as wave-particle duality from space.

The Matera Space Center hosts the last node of the Italian fiber optic backbone managed by INRIM (National Institute of Metrological Research). ASI labs are equipped with frequency combs, laser sources, entangled sources, single photon detectors and telescopes.

SPACE TRAFFIC MANAGEMENT

SPACE DEBRIS

The Matera Space Center is involved in the monitoring of space debris, operating within the European EU-SST network, which provides collision avoidance, fragmentation and reentry monitoring services. The SPADE (SPAcE DEbris) optical sensor is a 40 cm surveillance telescope operating in MEO and GEO orbital regimes with the capability to track LEO objects. The system operates each night producing trackless provided in real time to the Italian Operation Center (C-SSA of MoD). Currently the telescope is 100% devoted to the EUSST activities with the target to monitor hundreds of objects per night. The MLRO Laser Ranging System operates for the 10% in the space debris context monitoring satellites equipped with retroreflector mirrors.

Matera CCS is entitled to host the ASI Center for Space Traffic Management (STM), named “IHS”. In addition, the IHS center will provide services

and orbital support to future In-Orbit Servicing (IOS) missions. It is a dual use (classified and civilian) cloud-based infrastructure.

A new laser-ranging technology sensor, the “Space Debris Laser-Ranging” (SDLR) facility devoted to Debris detection and tracking from LEO to GEO. SDLR will be based on adaptive-optics. It will also be partially used for Quantum Communications.

A network of FLYEYE telescopes for the identification and cataloguing of debris in the high LEO orbit, MEO and GEO. The FlyEye telescopes currently under development will be installed by 2026 in Matera and in other three areas of the globe in order to realize a global coverage of the Sky. The network will be fully operative starting from 2026.



**Matera Space Center
“Giuseppe Colombo”
Italian Space Agency**

Località Terlecchia
75100 Matera (MT), Italy
Tel.: +39 0835 377511/501
Fax.: +39 0835 339005



**Agenzia
Spaziale
Italiana**