

# ASI and the Space

As an engine of scientific and technological progress, an instrument of industrial policy, diplomacy, and sustainable development, space is a strategic sector. It brings benefits to countries and people in fields such as telecommunications, climate change monitoring, transport, security, agriculture, and cultural heritage.

Since 1988, ASI, the Italian Space Agency, has achieved the objectives set by the government in the space and aerospace field, promoting, developing, and disseminating basic and applied research, in collaboration with research institutions and industries. By coordinating this ecosystem, it aims at the progress, the competitiveness and the strengthening of the international component of the space sector in Italy, taking advantage of the opportunities offered by European and international development programmes.

Today, ASI is one of the leaders in the global scene of space, thanks to its strong technical and scientific skills, its support to the interaction between research and companies and the growing range of services and applications developed in the civil and military field. It plays a leading role both at European level, where Italy is the third highest contributor to the European Space Agency (ESA), and worldwide. ASI has also signed numerous bilateral and multilateral agreements with other space agencies and organisations.

# An Extensive Sector

About

250

companies, including start-ups, SMEs and large companies National Aerospace Technology Cluster (CTNA)

The activities planned and executed by ASI have made ltaly reach the current position of excellence in a sector of strategic importance, consolidating an extensive chain of knowledge, research, technologies, products and systems, in all aspects of space exploration. 3

National Industrial Association: AIAD, AIPAS and ASAS

**13** Regional Technology Clusters



research excellence, with about 60 nodes, including university deparments and research

# **ASI in Figures**

# LOCATIONS ROMA MATERA CAGLIARI MALINDI(KE)

3rd

Larger contributor to ESA

More than

180

international agreements signed

3

Investee companies (Altec, e-GEOS, Spacelab)

Foundation (E. Amaldi Foundation)

### **EMPLOYEES**

2019

 $\xrightarrow{2022*}{416}$ 

+47%

### BUDGET IN € MLN

# 2019 2022\* 1,056–**1,719 +63%**

\*Expected

# Earth Observation

A recognised production capacity and collaborations with the major players on the international scene make Italy a front-runner in the upstream, midstream, and downstream sectors with: national civil/dual-use/military high-performance infrastructures, platforms and subsystems, data processing capacity, an entrepreneurial network that includes a global service operator, numerous companies involved in the development of highly innovative products and services, universities, and research centres of excellence.

#### COSMO-SkyMed

COSMO-SkyMed is the first earth observation project designed for both civil and military purposes. Its satellites observe the Earth from space day and night and in all weather conditions. They help to predict landslides and floods, coordinate rescue efforts following earthquakes or fires, and monitoring environmental disasters from space. Developed by ASI in cooperation with the Italian Ministries of Defence and of University and Research, COSMO-SkyMed is based on a constellation of satellites equipped with synthetic-aperture radar (SAR) sensors working in the X-band. To the four first-generation satellites already in operation, four second-generation satellites are being progressively added, two of which are already in orbit.

#### PRISMA

PRISMA is a state-of-the-art Earth observation satellite with innovative electro-optical instrumentation that combines a hyperspectral sensor with a medium-resolution panchromatic camera. The satellite not only is able to distinguish the geometrical characteristics of the area under observation, but can also determine the chemical-physical composition of the Earth's surface by examining spectral bands. PRISMA, owned by ASI, was built by a group of companies, led by OHB Italia and Leonardo. The feasibility study for the second generation PRISMA mission is underway.



### The Solar System and Beyond

There are Italian scientific instruments on American and European probes including Mars Express, TGO and MRO (in orbit around Mars), BepiColombo, for the study of Mercury, and Solar Orbiter studying the Sun, or Dawn (which visited two major bodies in the asteroid belt. Vesta and Ceres) and JUNO (which studies the Jovian system, i.e. Jupiter and its moons). Italy was also a partner in the Cassini-Huygens missions (which studied the Saturn system) and Rosetta, dedicated to the study of the comet Churyumov-Gerasimenko. Italy will be also involved in the next European probes to study the exoplanets Cheops and Plato and on the Juiceprobe that will study the icy moons of Jupiter: Ganymede, Europa, and Callisto.

As part of NASA's DART mission,

which aims to measurably change the orbit of an asteroid, Italy has developed LICIACube, a CubeSat able to capture images of the target after the impact. It is the first mission in deep space based on a system developed entirely in Italy (by ASI, Argotec and a group of universities and research institutions).

#### Cosmology

Even in the field of space observation, ASI has developed a considerable expertise, as testified by the LARES 1 and 2 satellites and also having participated in some scientifically significant ESA missions.

LARES 2 is a satellite for the study and confirmation of Albert Einstein's General Theory of Relativity. It allows the precision measurement of the drag effect of inertial systems (frame-dragging), generated by mass-energy currents such as the rotation of a body with mass, as well as precision estimates in the geodetic field. LARES 2, put into orbit by the new VEGA C launch system in July 2022, will continue the research started by LARES 1, launched in 2012.

**GAIA** aims to obtain a three-dimensional map of our galaxy, revealing its composition, formation, and evolution. The huge amount of data produced by the mission will be analysed by the Data Processing and Analysis Consortium, a consortium of European research institutes of which Italy is a member, hosting one of the six Data Processing Centres on its territory.

*LISA* (Laser Interferometer Space Antenna) is a mission that will detect low-frequency gravitational waves from space. This requires the development, launch, and operation Space astrophysics, the study of the solar system, research of exoplanets, cosmology, and fundamental physics are all areas in which ASI, together with the Italian scientific community and industry, is an internationally recognised leader. Italy participates in all the missions of the ESA Science Programme, developing important scientific instruments, and in other relevant programmes in collaboration with NASA, JAXA, Roscosmos, and CNSA.

of a constellation of three satellites. The role of the Italian scientific and industrial community within the LISA Consortium is fundamental.

**EUCLID** is a program that aims to improve knowledge about dark matter and energy, through observation and research carried out by two independent cosmic probes.Italy is responsible for the overall coordination of the scientific Ground Segment.

#### High Energy

The astrophysics of high energy, in the X and gamma bands, was partly developed in Italy, which is among the leading countries in the field of space scientific research, under the coordination of ASI. Italy also played an important role in the success of the Beppo-SAX and AGILE missions. There have been many successful international collaborations and national initiatives.

**CALET** the Calorimetric Electron Telescope, is a mission sponsored by JAXA with the participation of ASI and NASA. The instrument, located on the International Space Station (ISS), studies the properties of high energy cosmic rays to obtain information useful in the search for dark matter.

*AMS*, the Alpha Magnetic Spectrometer, is an orbiting laboratory for the particle physics, operating as an external module of the ISS. It studies the composition and abundance of cosmic rays in space, searching for traces of primordial antimatter and dark matter at extreme energies.

*IXPE* the Imaging X-ray Polarimetry Explorer, is a mission part of NASA's SMEX space program. It has three telescopes on board, with detectors capable of measuring the polarization of X-rays emitted by astronomical sources. The detectors are being developed by a team of scientists from INFN and INAF, with funding from ASI.

ASI main activities

**AGILE** is a gamma-ray space observatory, which, thanks to its last generation detector, is able to locate gamma-ray sources with excellent resolution and can analyse data very quickly.

# Telecommunication & Navigation

Athena-Fidus (Access on Theatres and European Nations for Allied forces – French Italian Dual Use Satellite) is a satellite system aimed at providing broadband communication services for civil and military government uses, to ensure autonomy in a national emergency. It was developed by ASI and the Centre national d'études spatiales (CNES) with Thales Alenia Space and Telespazio, within the framework of agreements signed by the space agencies and the Italian and French Ministries of Defence.

*Galileo* is a satellite navigation system designed by the Europan Union and ESA, with an important contribution from ASI, which has enormous potential for use in a wide range of sectors: energy, transports, agriculture, and finance. When fully deployed, it will consist of 30 satellites (27 operational and three reserve) orbiting on 3 inclined planes above the equator. Designed for civilian use, it has an accuracy of less than 10 centimetres in positioning.



# Nanosatellites

In space activities, among the main challenges today and in the coming years is the miniaturisation of platforms and subsystems (nano, micro, and mini satellites) and the creation of multimission capabilities for faster and more efficient access to data. To this purpose, ASI launched the Alcor program, that aims to support the development of micro and nanosatellites through tenders to produce and finance prototype platforms that can provide major companies, SMEs, start-uos, and Italian universities with innovative services.

## Access to Space

Italy is one of the few countries owning the skills and technology for independent access to space.

#### VEGA programme

Created on the initiative of ASI and managed by ESA since 2000, it has led to the development of the small-launcher programme, one of the European family of launch systems, led by Italian industry. ASI is strongly committed in the development and implementation of a sustainable and competitive European launcher industry supply chain. The development of VEGA, VEGA C, VEGA E and VEGA G (using green technology) are ongoing. Italy is the main contributor to Vega-C, first launched in July 2022, that features increased performance, greater payload volume, improved competitiveness and flexibility.

#### Space Rider

It is an automated and reusable unmanned spacecraft. Strongly backed by ASI, Space Rider is the result of an agreement signed by ESA and Thales Alenia Space together with the European Launch Vehicle consortium consisting of Avio and ASI.It will be launched from the European spaceport in French Guyana on board the VEGA C carrier. It will be able to stay in orbit for up to two months, testing new technologies and conducting several experiments in microgravity, the results of which will be analyzed upon its return to Earth.

# Human and Robotic Exploration of Space

#### **Human Exploration**

For thirty years Italy has had a first-level role in human space missions. It has designed scientific and technological experiments to be carried out by astronauts in microgravity and Italian astronauts have gone into low-Earth orbit. Following the low-Earth orbit International Space Station, the Moon will become the new "branch" of our planet, home to a "new interplanetary generation". ASI's Artemis program aims to take humans back to resume the exploration of our satellite. Italy is an important partner in this adventure, a partner of excellence.



#### The International Space Station

The International Space Station is the most ambitious scientific and technological cooperation programme in the world to date, and the largest engineering project in human history. With the launch of the Leonardo Logistics Module in March 2001, Italy became the third nation, after Russia and the United States, to send a section of the ISS into orbit. Almost 50% of the station's habitable volume has been made in Italy: the three logistics modules Leonardo, Raffaello, and Donatello, Node-2 (Harmony) and Node-3 (Tranquillity), the Dome, and part of the European laboratory, Columbus.

#### Artemis Program

In the Artemis program, Italy is responsible for more than 50% of the I-HAB housing module and the window section of the Gateway (that will be the first station to orbit the Moon), the structure, the thermal control system and the micrometeor protection system of the ESM, the Orion capsule's service module, which will take the astronauts into deep space. In 2022 ASI has signed an agreement with NASA in order to produce the preliminary design study for the Lunar Surface Multi-Purpose Habitation Modules.

#### Italian Astronauts

Seven Italian astronauts have flown in low-Earth orbit since 1992. They carried out tasks and conducted experiments in microgravity on the Space Shuttle and later on the ISS. The substantial Italian contribution to the ESA for the ISS has made it possible to include Italian astronauts, who are members of the European Astronaut Corps, on an increasing number of missions. The next destination is the Moon.

From left to right: Franco Malerba, Umberto Guidoni, Maurizio Cheli, Samantha Cristoforetti, Paolo Nespoli, Luca Parmitano, Roberto Vittori.



#### **Robotic Exploration**

Robotic exploration is becoming increasingly important for scientific missions and the exploration of the solar system. For more than two decades, Italy has been contributing to the most important robotic exploration missions, which have made it possible to progress from remote observation to surface exploration. The targets for these missions are the same as those of human exploration programs: Mars and its moons, the Moon, and the minor bodies (e.g. near-Earth asteroids).

#### **Reference Projects for the Robotic Exploration of Mars**

The *ExoMars* mission, an ESA mission led by Italy, features the first ESA rover to attempt the difficult conquest of the Red Planet. The mission is now postponed due to the Russian-Ukrainian conflict. Rosalind Franklin, the ESA ExoMars rover, controlled through the ROCC (rover operations control center) located in Turin in the premises of Altec, is equipped with an Italian drilling & amp; sampling system to collect soil samples up 2 meters under Mars surface.

The *Mars Ice Mapper* is a joint initiative of ASI, CSA, JAXA and NASA to complete the first global map of ice reserves on Mars, using SAR radar techniques.

The *Mars Sample Return* is a mission developed by NASA in collaboration with ESA to bring the Martian samples that the NASA Perseverance rover is currently collecting back to Earth. ASI actively supports the project of the Sample Transfer Arm that the Italian industry will build for ESA.

#### **Reference Projects for the Robotic Exploration of the Moon**

**ArgoMoon** is the Italian CubeSat, part of the Artemis 1 mission. It will be aboard the Orion spacecraft and will be launched into space on the test flight of the new NASA Space Launch System, which will test the capsule that

will kick-start the new era of Moon missions. The Cube-Sat will capture images of the detachment of Orion from the launcher and then orbit the Earth-Moon system for a few months.

**Satelliti Luna** (Moon Satellites) aims to consolidate the Italian expertise in small satellites that are becoming increasingly important for international exploratory missions. Projects such as ArgoMoon and LICIACube have shown that such systems can be used to achieve scientific and exploration objectives as part of the Moon satellite programme.

*Luna Robotica* di superficie (Robotics for the lunar surface) is a project for the development of robotic instruments for future Moon missions. Luna Robotica ISRU aims to use in-situ resources for future medium and longterm planetary exploration missions.

#### **Reference Projects for the Robotic Exploration of Minor Bodies**

The *Robotic Asteroid Missions* is the project for the study and implementation of robotic missions targeting asteroids with the objectives of planetary defence and the exploitation of resource. Ongoing projects, such as LICIACube, of the NASA DART mission, are part of this project.

# ASI and Space Diplomacy

The long Italian tradition in the space sector is also the result of extensive international, bilateral, and multilateral relationships and cooperations. As part of its relationship with ESA and the European Union, ASI participates in numerous prestigious programmes and missions and contributes to drafting the new European Space Programme.

Alongside historical partners such as ESA and NASA and in line with European space policy, ASI also collaborates with numerous partners from emerging or developing countries. More than 180 agreements have been signed with other international agencies and bodies and the number is still growing.



Relations Agreements

## The Space Economy and Opportunities for Start-Ups

ASI contributes to the development of programmes and to the Italian space economy, supporting the space supply chain and facilitating the transfer of knowledge to and from the various business sectors. The initiatives implemented by the Agency, which will be extended in the coming years, promote and support the creation of new companies in the sector, the transfer of knowledge from research institutes and large companies to SMEs, the emergence of new business ideas, additional public and private investments (venture capital, risk finance,etc.), the cross-fertilisation with other sectors, the protection of intellectual property, and the promotion of knowledge through agreements with research and innovation stakeholders.

ASI supports the emergence of incubators and accelerators for innovative start-ups. This help strengthening the value chain in all its segments: upstream, midstream and downstream, this last consisting of high value-added services mainly developed and operated by SMEs.

## Education in Space and Research

ASI supports the scientific training of Italian graduates and young researchers in the field of space sciences, through agreements and relationships with universities, institutes, and research centres. Within the framework of collaborations with Italian and foreign institutions, ASI finances scholarships and internships, PhDs and postdoctoral courses, in the technical-scientific, political, strategic, administrative, and legal fields. For the youngest students, the Agency manages a great number of educational initiatives in order to inspire young people and encourage them to scientific studies (STEM). ASI makes its programmes known to students and teachers through events, conferences, open days, educational products and visits.



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