



THE EUROPEAN SPACE AGENCY

April 2013

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European Space Agency

PURPOSE OF ESA



“To provide for and promote, for exclusively peaceful purposes, cooperation among European states in **space research** and **technology** and their **space applications.**”

Article 2 of ESA Convention



- **Over 40 years of experience**
- **20 Member States**
- **Five establishments in Europe, about 2200 staff**
- **4 billion Euro budget (2013)**
- **Over 70 satellites designed, tested and operated in flight**
- **17 scientific satellites in operation**
- **Six types of launcher developed**
- **Celebrated the 200th launch of Ariane in February 2011**



20 MEMBER STATES AND GROWING



ESA has 20 Member States: 18 states of the EU (AT, BE, CZ, DE, DK, ES, FI, FR, IT, GR, IE, LU, NL, PT, PL, RO, SE, UK) plus Norway and Switzerland.

Eight other EU states have Cooperation Agreements with ESA: Estonia, Slovenia, Hungary, Cyprus, Latvia, Lithuania, Malta and the Slovak Republic. Bulgaria is negotiating a Cooperation Agreement.

Canada takes part in some programmes under a Cooperation Agreement.

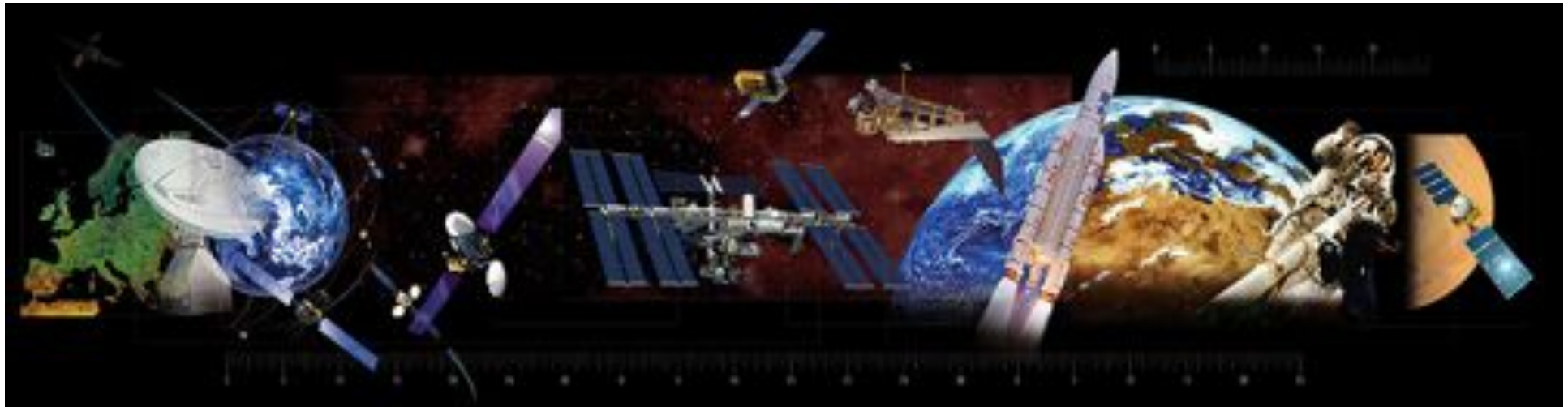


ACTIVITIES



ESA is one of the few space agencies in the world to combine responsibility in nearly all areas of space activity.

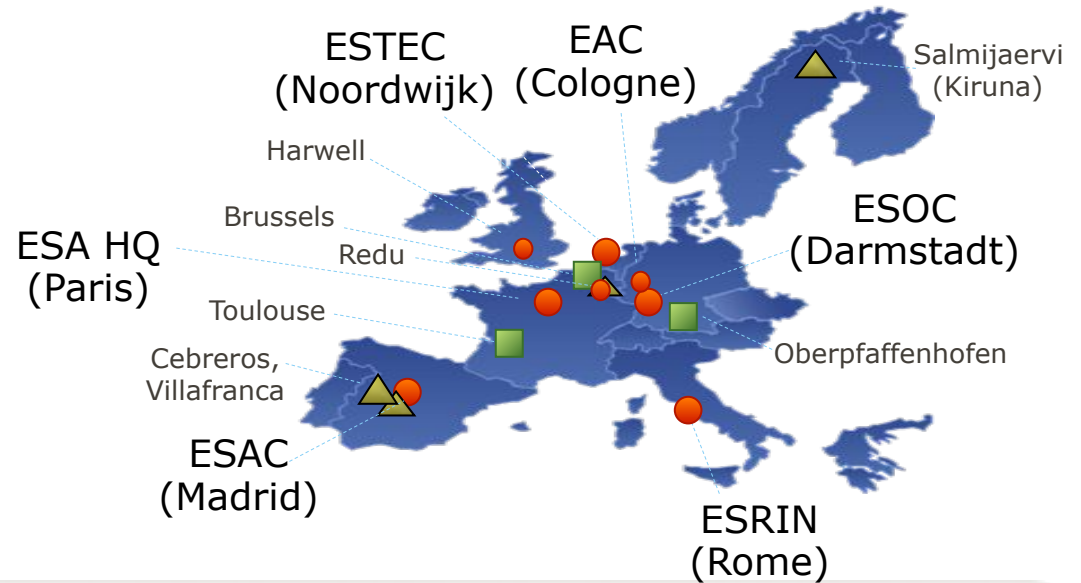
- **Space science**
- **Human spaceflight**
- **Exploration**
- **Earth observation**
- **Launchers**
- **Navigation**
- **Telecommunications**
- **Technology**
- **Operations**



ESA'S LOCATIONS



- ESA sites/facilities
- Offices
- ▲ ESA ground stations



All Member States participate (on a GNP basis) in activities related to space science and a common set of programmes (**Mandatory** programmes).

Mandatory

- General Budget: Future studies, technological research, education, common investments (facilities, laboratories, basic infrastructure)
- Science: Solar System science, astronomy and fundamental physics

In addition, Member States choose their level of participation in **Optional** programmes.

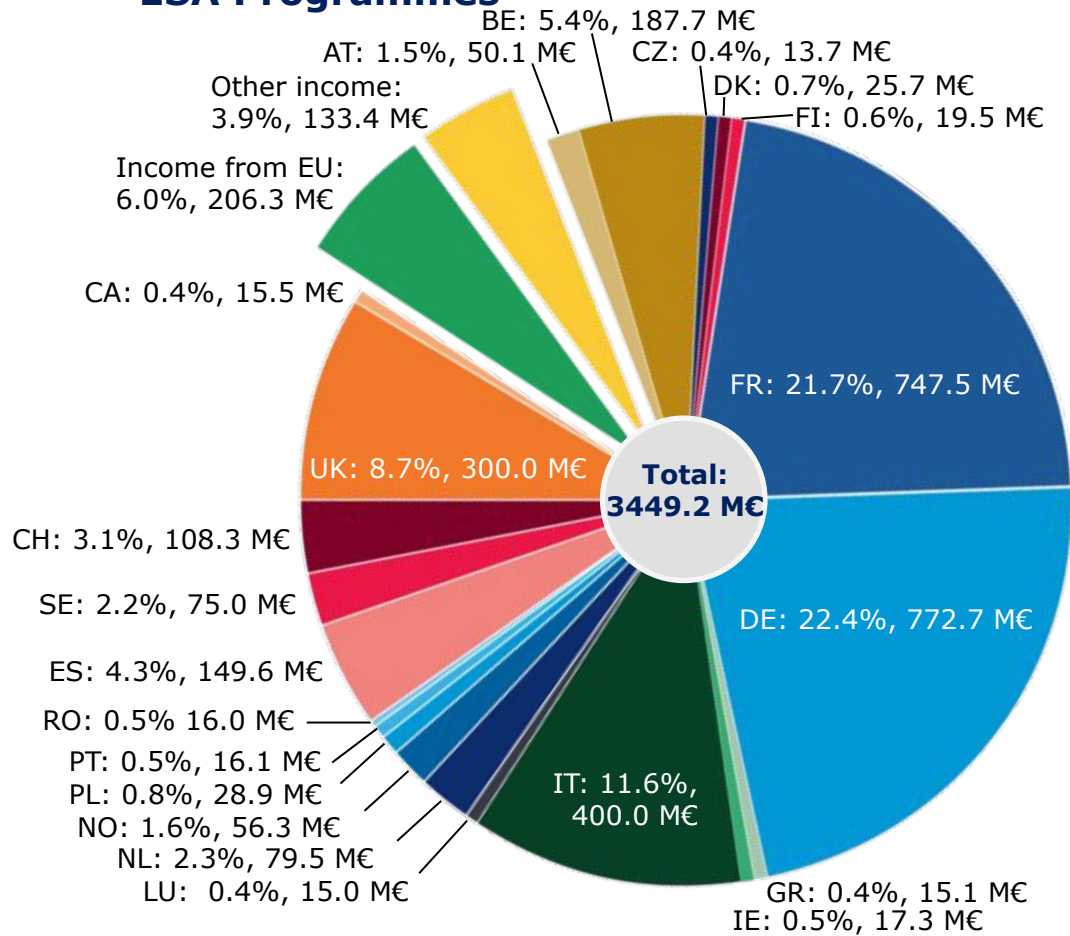
Optional

- Human Spaceflight
- Telecommunications & Integrated Applications
- Earth Observation
- Launchers
- Navigation
- Robotic Exploration
- Space Situational Awareness

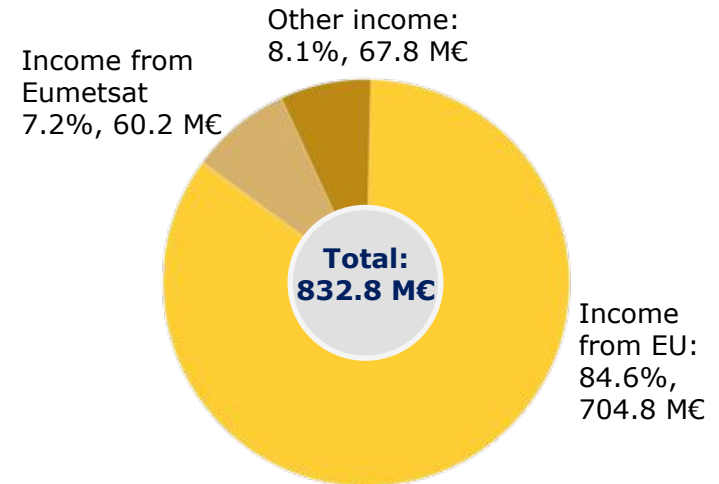
ESA BUDGET FOR 2013



ESA Programmes

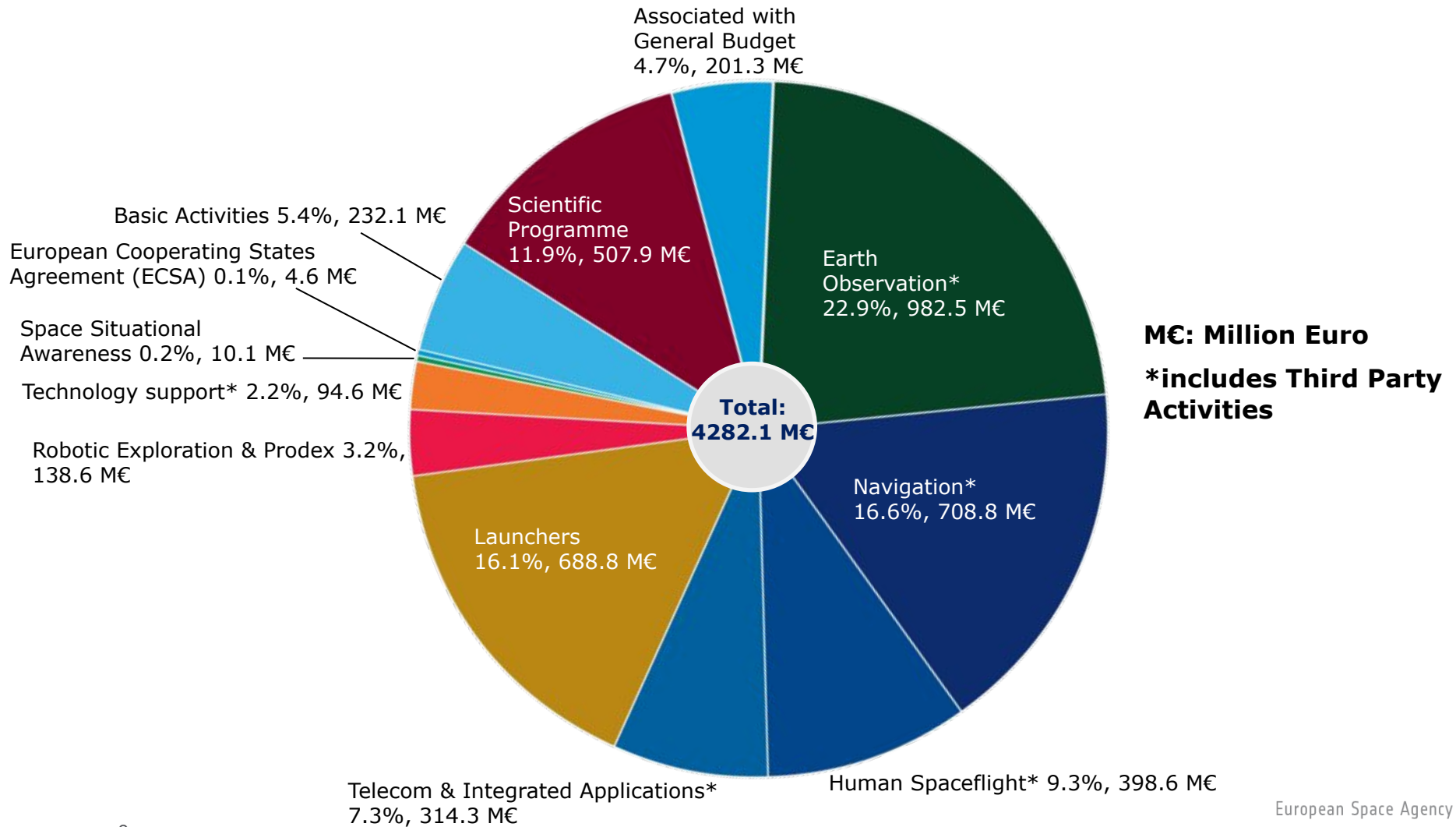


Programmes implemented for other Institutional Partners



TOTAL ESA BUDGET FOR 2013: 4282 M€

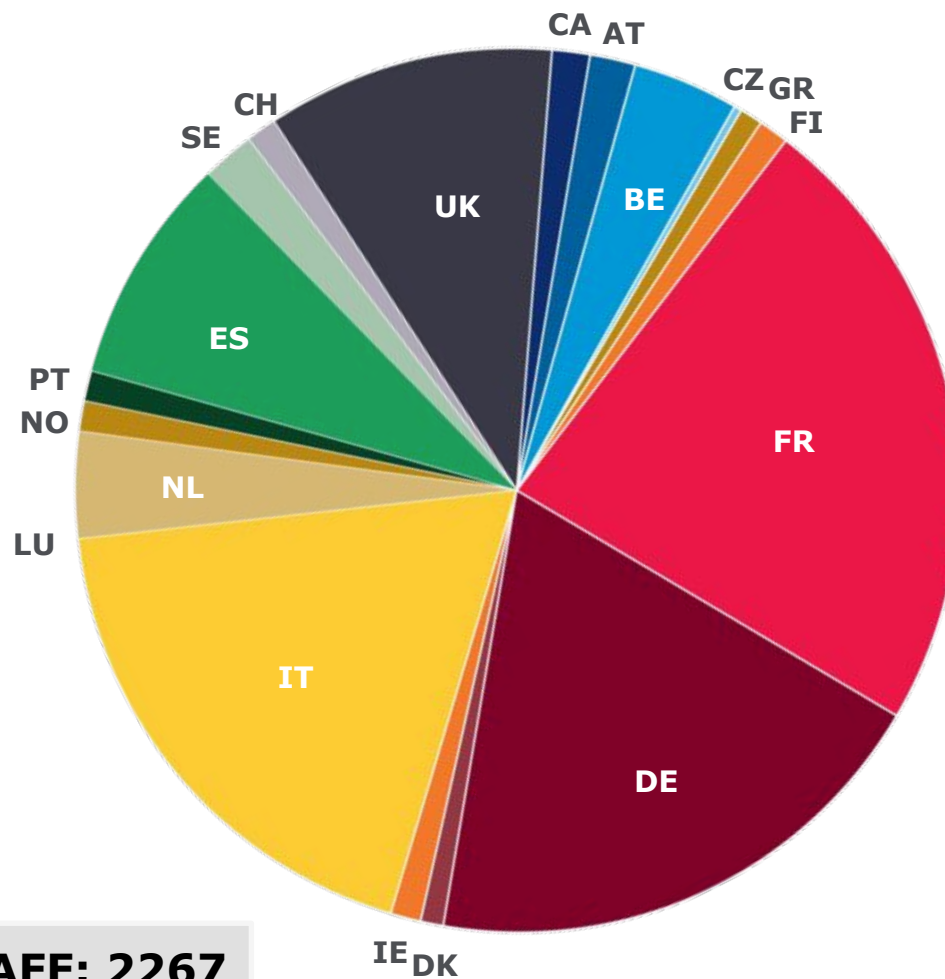
ESA 2013 BUDGET BY DOMAIN



STAFF BY NATIONALITY IN 2012

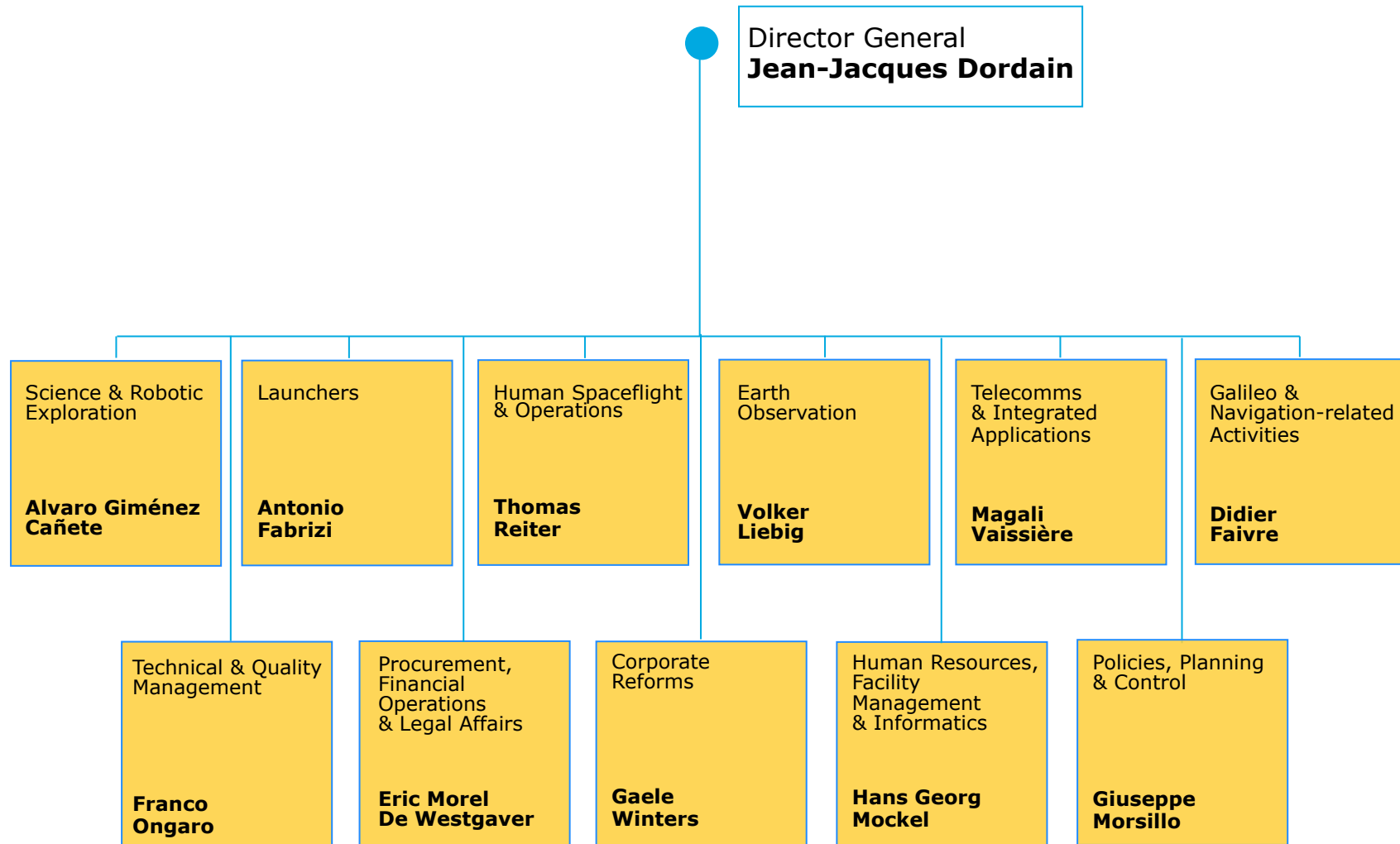


Austria	40
Belgium	91
Czech Republic	5
Denmark	21
Finland	21
France	525
Germany	431
Greece	18
Ireland	30
Italy	420
Luxembourg	2
Netherlands	88
Norway	23
Portugal	25
Spain	188
Sweden	44
Switzerland	28
UK	237
Canada	29



TOTAL INTERNATIONAL STAFF: 2267

ESA DIRECTORS



ESA COUNCIL



The Council is the governing body of ESA. It provides the basic policy guidelines for ESA's activities. Each Member State is represented on the Council and has one vote.

About every three years, Council meets at ministerial level ('Ministerial Council') to take key decisions on new and continuing programmes and financial commitment.

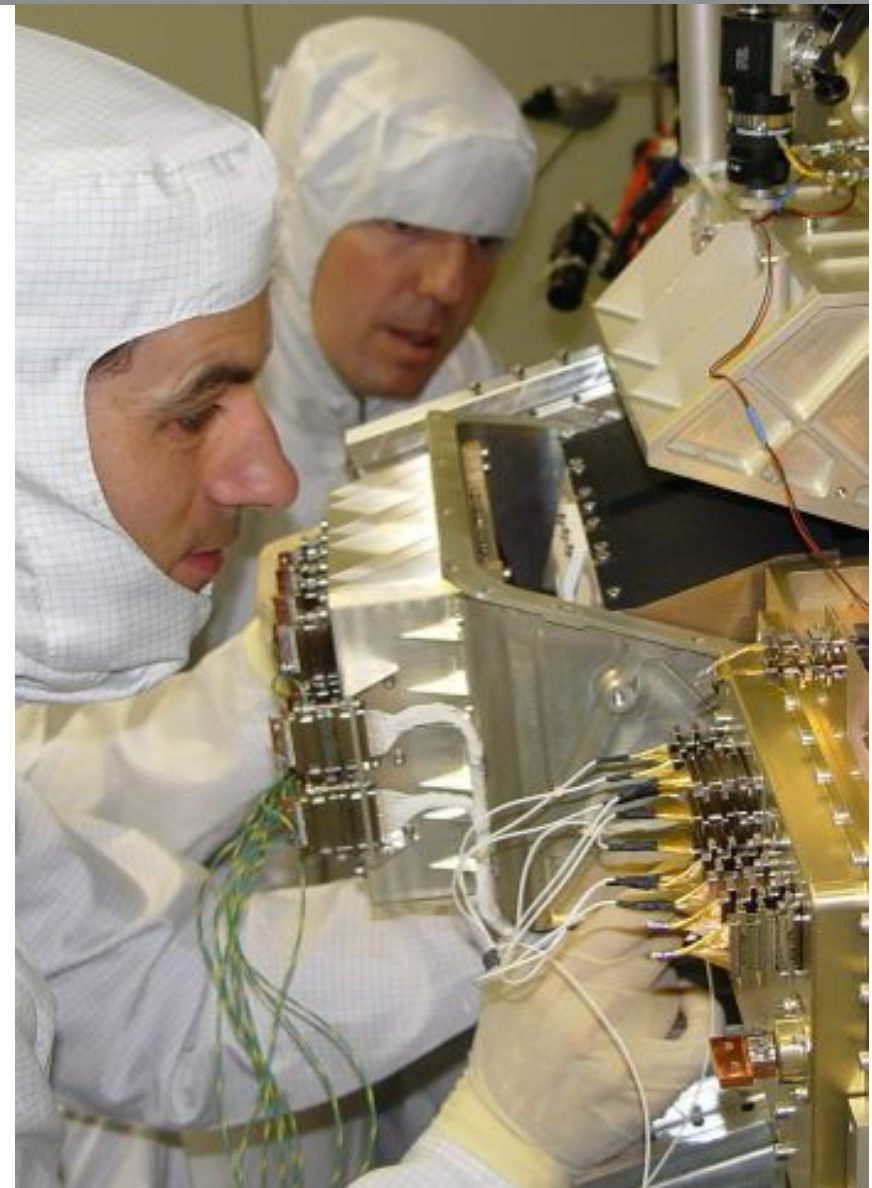
The ESA Council at ministerial level also meets together with the EU Council to form the European 'Space Council'.



About 90% of ESA's budget is spent on contracts with European industry.

ESA's industrial policy:

- ensures that Member States get a fair return on their investment;
- improves competitiveness of European industry;
- maintains and develops space technology;
- exploits the advantages of free competitive bidding, except where incompatible with objectives of the industrial policy.



BIRTH OF COMMERCIAL OPERATORS



ESA's 'catalyst' role

ESA is responsible for R&D of space projects. On completion of qualification, they are handed to outside entities for production and exploitation. Most of these entities emanated from ESA.



Meteorology: Eumetsat

Launch services: Arianespace

Telecomms: Eutelsat and Inmarsat



ESA AND THE EUROPEAN UNION

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The European Union and ESA share a common aim: to strengthen Europe and benefit its citizens.

Closer ties and an increased cooperation between ESA and the EU will bring substantial benefits to Europe by:

- guaranteeing Europe's full and unrestricted access to services provided by space systems for its policies, and
- encouraging the increasing use of space to improve the lives of its citizens.



COOPERATION WITH THE EU



- The Lisbon Treaty of 2009 reinforces the case for space in Europe and strengthens the role of ESA as an R&D space agency. Article 189 of the Treaty gives the EU a mandate to elaborate a European space policy and take related measures, and provides that the EU should establish appropriate relations with ESA.
- ESA/EU Framework Agreement currently in force
- Seven Space Council meetings and related resolutions and orientations provide directions and guidelines
- Two flagship programmes: Galileo, GMES



Strategic objectives of space for Europe:

- develop space applications to serve Europe's public policies, enterprises and citizens;
- meet Europe's security and defence needs;
- foster competitive and innovative industries;
- contribute to the knowledge-based society;
- secure access to technologies, systems and capabilities for independence and cooperation.

In May 2007, 29 European countries (17 Member States of ESA and 27 Member States of the EU) adopted a Resolution on the **European Space Policy**, adding a new dimension to European space activities.





ESA'S SPACE PROGRAMMES

European Space Agency



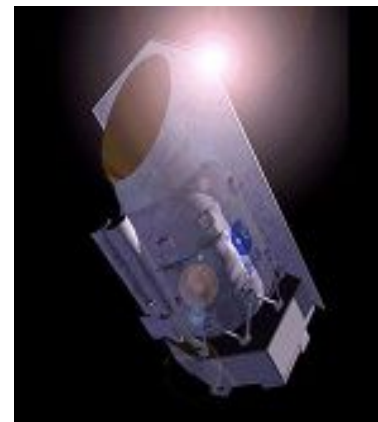
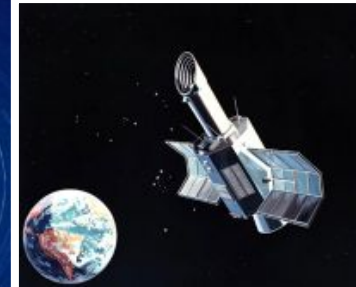
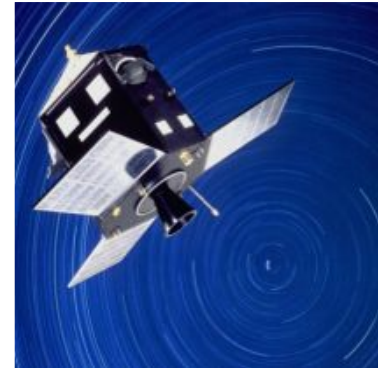
SCIENCE & ROBOTIC EXPLORATION

European Space Agency

ESA'S REMARKABLE PIONEERS OF SCIENCE

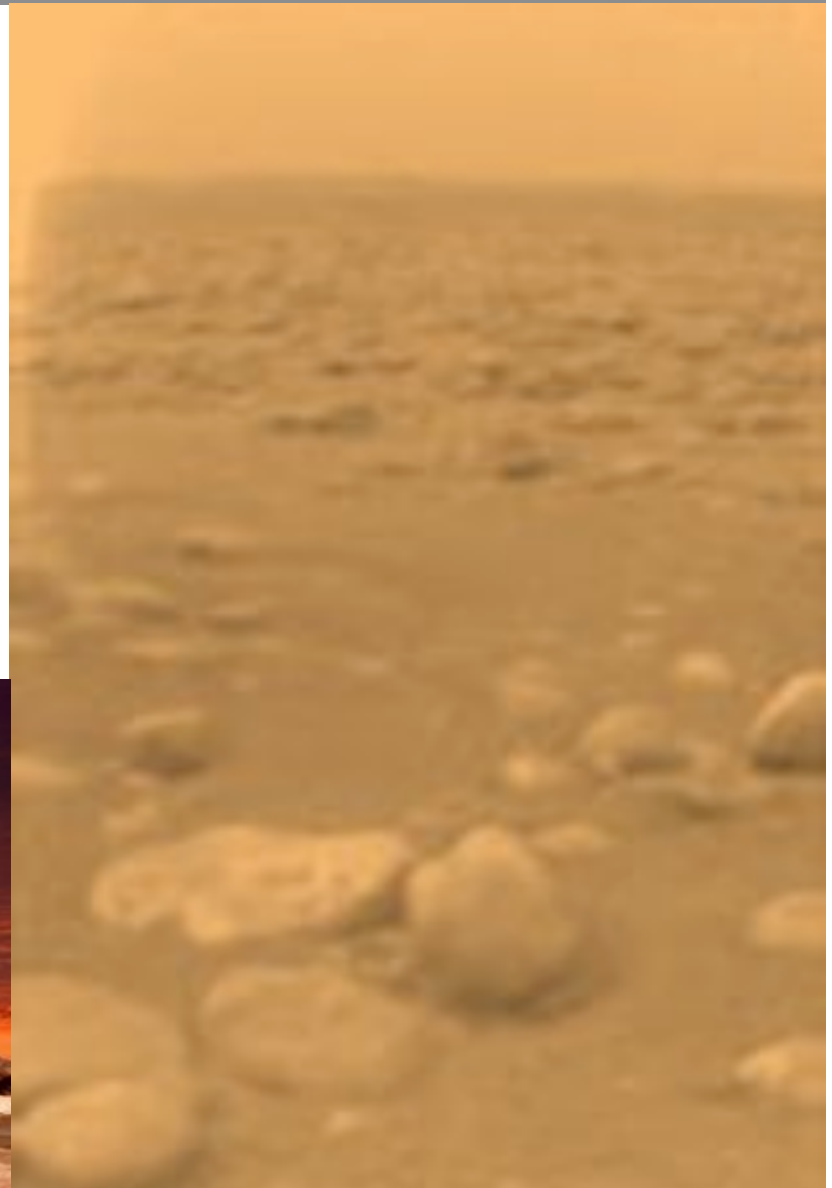


- **Hipparcos** (1989–93) most comprehensive star-mapper
- **IUE** (1978–96) longest-living orbiting observatory
- **Giotto** (1986) closest ever flyby of a comet nucleus
- **Ulysses** (1990–2008) first craft to fly over Sun's poles
- **ISO** (1995–8) first European infrared observatory
- **SMART-1** (2003–6) first European mission to the Moon



First landing on a world in the outer Solar System

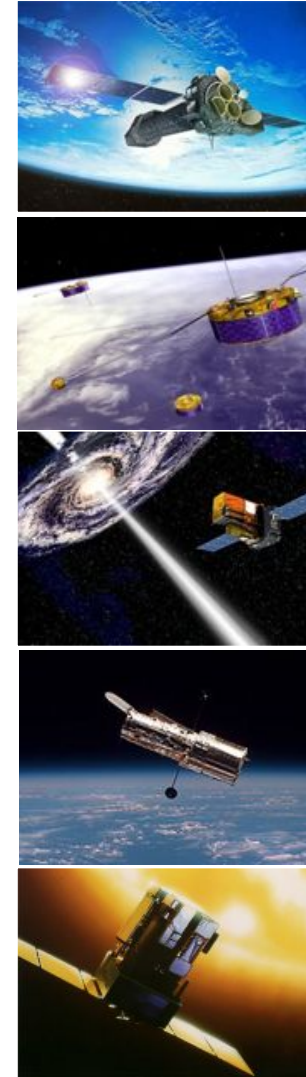
In 2005, ESA's **Huygens** probe made the most distant landing ever, on Titan, the largest moon of Saturn (about 1427 million km from the Sun).



TODAY'S SCIENCE MISSIONS (1)



- **XMM-Newton** (1999–) X-ray telescope
- **Cluster** (2000–) four spacecraft studying the solar wind
- **Integral** (2002–) observing objects in gamma and X-rays
- **Hubble** (1990–) orbiting observatory for ultraviolet, visible and infrared astronomy (with NASA)
- **SOHO** (1995–) studying our Sun and its environment (with NASA)



TODAY'S SCIENCE MISSIONS (2)



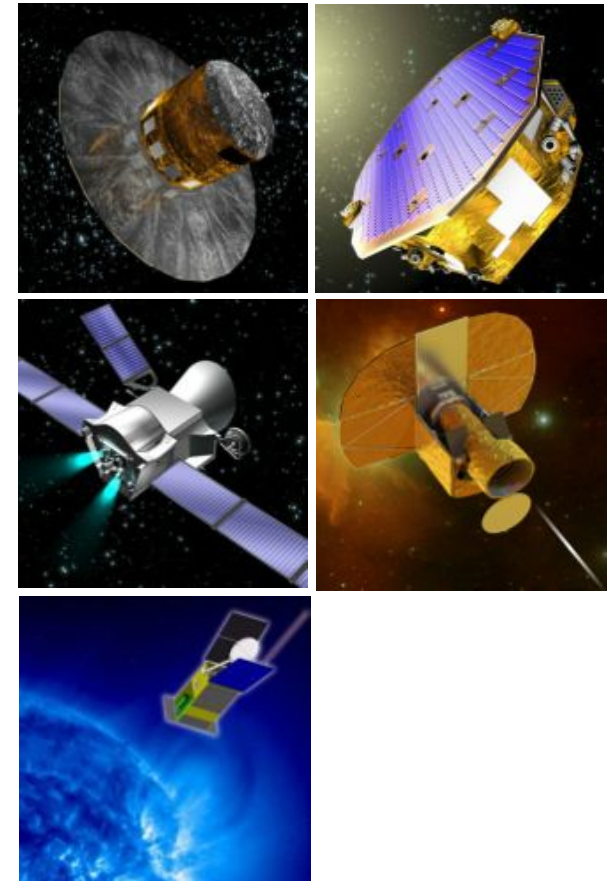
- **Mars Express** (2003–) studying Mars, its moons and atmosphere from orbit
- **Rosetta** (2004–) the first long-term mission to study and land on a comet
- **Venus Express** (2005–) studying Venus and its atmosphere from orbit
- **Herschel** (2009–) far-infrared and submillimetre wavelength observatory
- **Planck** (2009–) studying relic radiation from the Big Bang



UPCOMING MISSIONS (1)



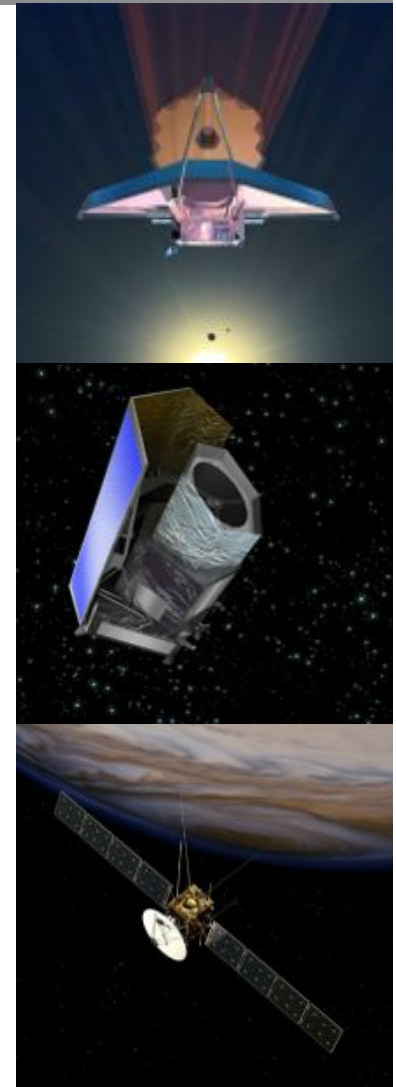
- **Gaia** (2013) mapping a thousand million stars in our galaxy
- **LISA Pathfinder** (2015) testing technologies for gravity wave detection
- **BepiColombo** (2014) a satellite duo exploring Mercury (with JAXA)
- **Cheops** (2017) studying exoplanets around nearby bright stars
- **Solar Orbiter** (2017) studying the Sun from close range



UPCOMING MISSIONS (2)



- **James Webb Space Telescope** (2018) studying the very distant Universe (with NASA/CSA)
- **Euclid** (2020) probing 'dark matter', 'dark energy' and the expanding Universe
- **JUICE** (2022) studying the ocean-bearing moons around Jupiter

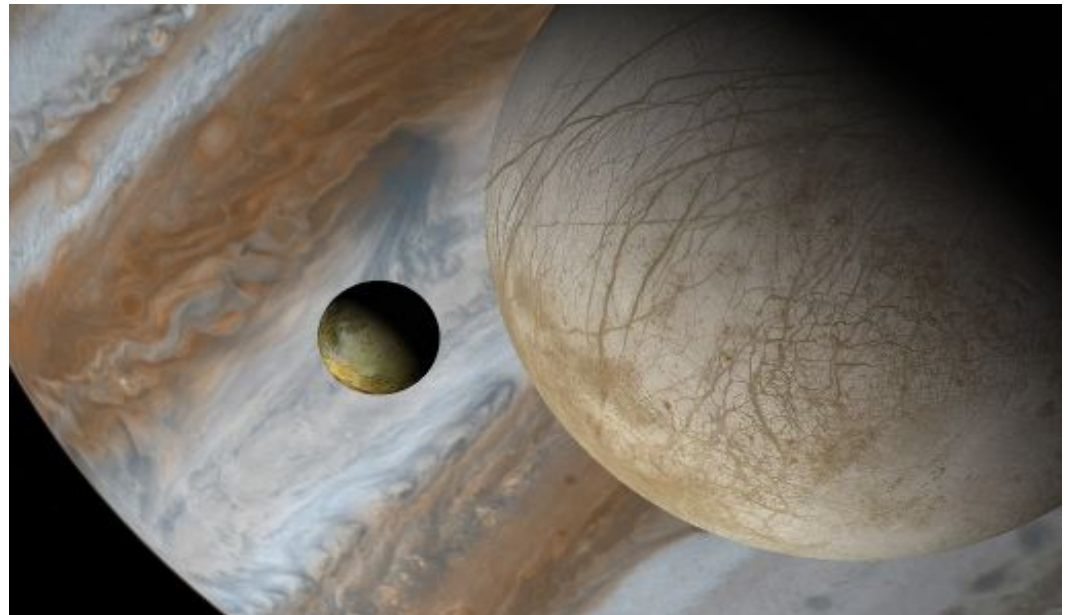


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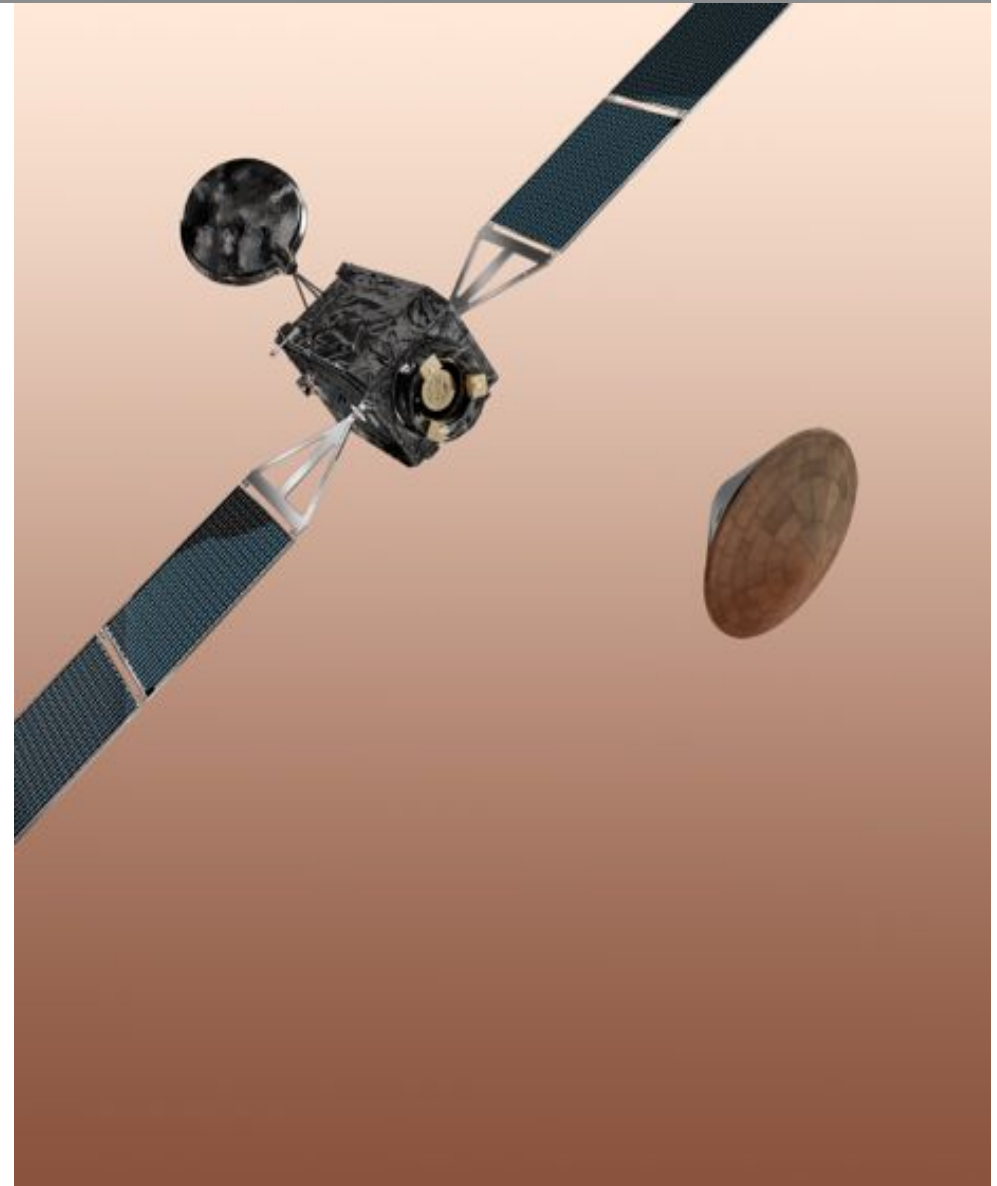
ESA's long-term scientific programme is based on a vision. The 'Cosmic Vision' looks for answers to mankind's fundamental questions:

- How did we get from the 'Big Bang' to where we are now?
- Where did life come from?
- Are we alone?

New challenging ESA missions will see probes at Jupiter and its moons, studying exoplanets and investigating dark matter and dark energy.



In cooperation with Roscosmos, two **ExoMars** missions (2016 and 2018) will investigate the martian environment, particularly astro-biological issues, and develop and demonstrate new technologies for planetary exploration with the long-term view of a future Mars sample return mission.





HUMAN SPACEFLIGHT

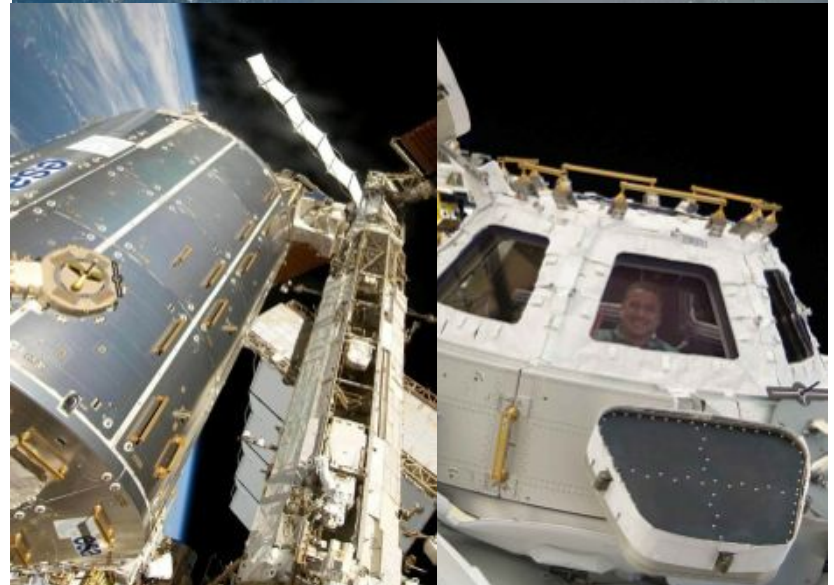
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INTERNATIONAL SPACE STATION (ISS)



The ISS unites USA, Russia, Japan, Canada and Europe in one of the largest partnerships in the history of science. Crews of up to six astronauts conduct research into life and physical sciences and applications, and prepare for future human exploration missions.

Europe's two key contributions are the **Columbus** laboratory and the **Automated Transfer Vehicle (ATV)**. Columbus provides a substantial part of the ISS's research capability, specialising in fluid physics, materials science and life sciences. Europe has also provided almost 50% of the pressurised part of the ISS, including **Cupola**, **Node-2** and **Node-3**.



AUTOMATED TRANSFER VEHICLE (ATV)



ATV is an autonomous spacecraft for resupplying and reboosting the ISS. Each ATV carries up to 7.7 tonnes of cargo and fuel to the ISS.

ATV ***Jules Verne*** (2008)

ATV ***Johannes Kepler*** (2011)

ATV ***Edoardo Amaldi*** (2012)

ATV ***Albert Einstein*** (2013)

ATV ***Georges Lemaître*** (2014)

To offset ESA obligations towards ISS partners, ESA is developing an ATV-derived Service Module for the NASA Multi-Purpose Crew Vehicle **Orion**.



EUROPEANS IN SPACE



The first ESA astronauts were selected in 1978: Ulf Merbold (DE), Wubbo Ockels (NL) and Claude Nicollier (CH). The European Astronaut Corps was formed in 1998, uniting astronauts of several Member States, including Michel Tognini (FR), Jean-Pierre Haigneré (FR), Umberto Guidoni (IT), Maurizio Cheli (IT), Claudie Haigneré (FR) and Gerhard Thiele (DE).



FLIGHT-EXPERIENCED ASTRONAUTS



Currently active or on other assignments: Christer Fuglesang (SE), Reinhold Ewald (DE), Jean-François Clervoy (FR), Pedro Duque (ES), Léopold Eyharts (FR), Hans Schlegel (DE), Thomas Reiter (DE), Frank De Winne (BE), Paolo Nespoli (IT), Roberto Vittori (IT) and André Kuipers (NL)



TRAINING FOR FLIGHTS



Based at the European Astronaut Centre (EAC), in Cologne, Germany: Luca Parmitano (IT), Alexander Gerst (DE) and Samantha Cristoforetti (IT) are assigned to ISS expeditions in 2013, mid-2014 and end-2014 respectively. Thomas Pesquet (FR), Andreas Mogensen (DK) and Timothy Peake (UK) are waiting for assignment to future missions.





MISSION OPERATIONS

European Space Agency

MISSION OPERATIONS



ESOC (Darmstadt, Germany) is ESA's centre for mission operations and ground systems engineering.

- Preparation and execution of combined ground- and space-segment operations
- Mission control systems, ground stations and operational communication and computer systems
- Operation of spacecraft and ground facilities, mission analysis, flight dynamics, navigation and space debris





SPACE SITUATIONAL AWARENESS

European Space Agency

The **Space Situational Awareness (SSA)** initiative aims to provide Europe with services to protect satellites and Earth. The initiative supports Europe's independent utilisation of space, through provision of timely and accurate information about the space environment.

SSA will strengthen reliability, availability and security of Europe's space-based services. It will be coordinated with international partners and the institutions of the European Union.

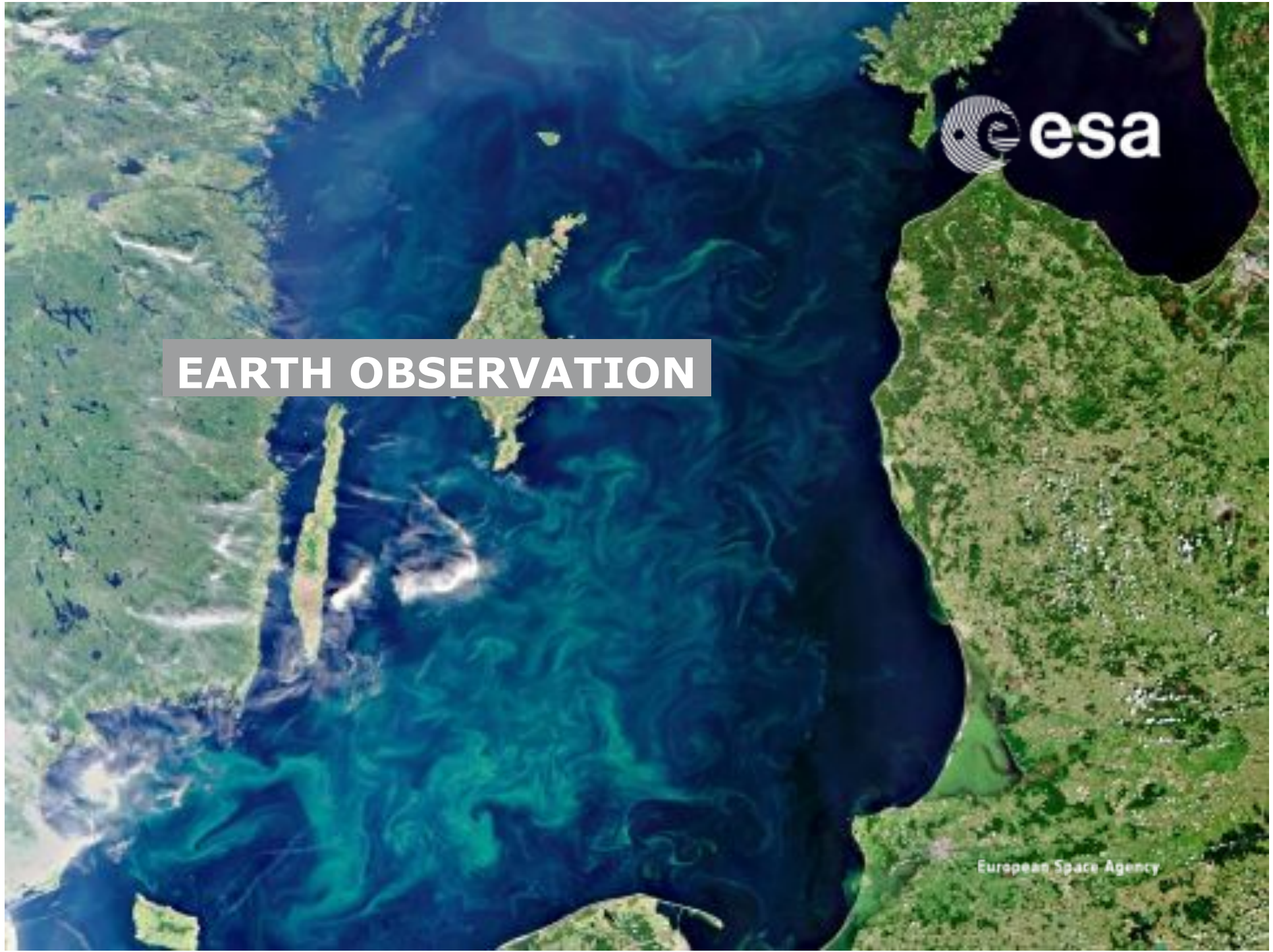
European industry will benefit from new contracts and world-class competitive capabilities gained through development of the SSA infrastructure and services.





EARTH OBSERVATION

European Space Agency



PIONEERS IN EARTH OBSERVATION



Meteosat (1977–) ESA has been dedicated to observing Earth from space ever since the launch of its first meteorological mission.

ERS-1 (1991–2000) and **ERS-2** (1995–2011) providing a wealth of invaluable data about Earth, its climate and changing environment.

Envisat (2002–12) the largest satellite ever built to monitor the environment, it provided continuous observation of Earth's surface, atmosphere, oceans and ice caps.



EARTH EXPLORERS



These missions address critical and specific issues raised by the science community, while demonstrating the latest observing techniques.

- **GOCE** (2009–) studying Earth's gravity field
- **SMOS** (2009–) studying Earth's water cycle
- **CryoSat-2** (2010–) studying Earth's ice cover
- **Swarm** (2013) three satellites studying Earth's magnetic field
- **ADM-Aeolus** (2014) studying global winds
- **EarthCARE** (2015) studying Earth's clouds, aerosols and radiation (ESA/JAXA)



Missions dedicated to weather and climate.

Meteosat Third Generation – taking over from Meteosat 11 in 2018, the last of four Meteosat Second Generation (MSG) satellites. MSG and MTG are joint projects between ESA and Eumetsat.

MetOp is a series of three satellites to monitor climate and improve weather forecasting, the space segment of Eumetsat's Polar System (EPS).

MetOp-A (2006–) Europe's first polar-orbiting satellite dedicated to operational meteorology. **MetOp-B** launched in 2012.



OBSERVING OUR PLANET FOR A SAFER WORLD



A joint ESA/European Commission initiative, **Global Monitoring for the Environment and Security (GMES)** is the response to Europe's need for geo-spatial information services. It will provide autonomous and independent access to information for policy-makers, particularly for environment and security issues.

ESA is implementing the space component: developing the **Sentinel** satellite series, its ground segment and coordinating data access.

ESA has started a **Climate Change Initiative**, for storage, production and assessment of essential climate data.





**TELECOMMUNICATIONS &
INTEGRATED APPLICATIONS**

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A PIONEER IN TELECOMS



1968 – Europe started to develop communications satellites. The **Orbital Test Satellite** (OTS) was launched 10 years later. OTS, and its follow-up ECS, was used for more than 13 years by ESA and Eutelsat.

Olympus (1989–93) an experimental satellite, at the time of launch it was the largest civilian telecommunications satellite in the world.

Artemis (2001–) this multi-purpose telecommunications and technology demonstration satellite introduced a new range of telecommunication services to the world.



ENSURING COMPETITIVE AND INNOVATIVE INDUSTRY



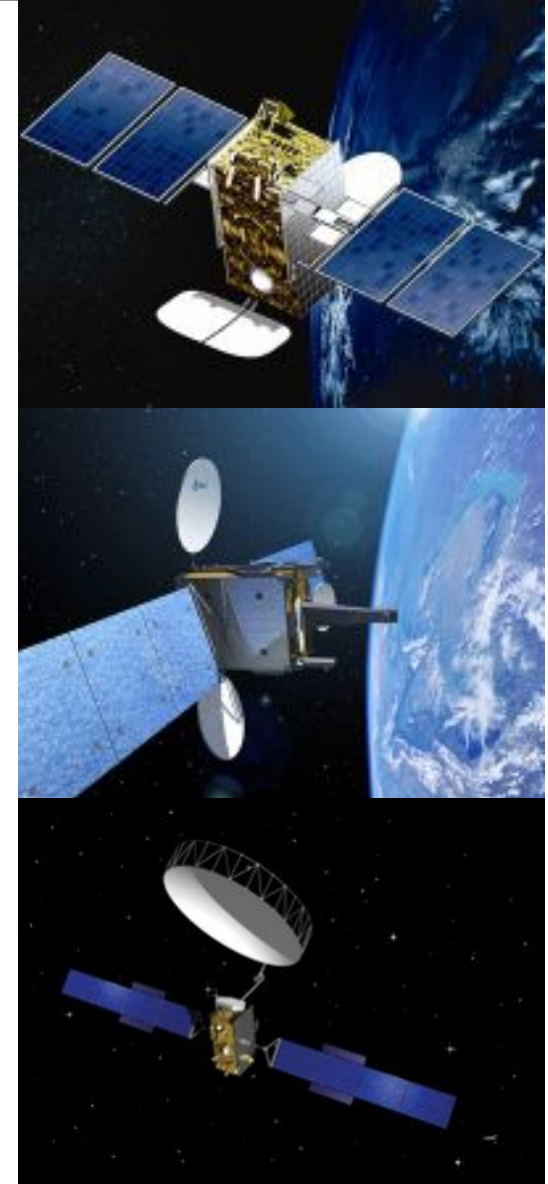
- Helping European industry to compete on the world stage;
- Supporting technological R&D and pioneering developments to bring new technologies near to market readiness;
- Building partnerships capable of creating wealth, jobs and new services for the citizens of Europe;
- Improving our daily lives, from health services to civil protection and rescue operations.

ESA's **Advanced Research in Telecommunications Systems** (ARTES) programme promotes the development of technology, products and systems in partnership with industry.

Hylas-1 (2010–) the ‘Highly Adaptable Satellite’ project with Avanti, to provide broadband internet services to remote areas across Europe.

SmallGEO – general-purpose small geostationary satellite platform, with subsequent mission in 2014 (with Hispasat). Will strengthen position of European industry in commercial medium-sized telecoms platform market.

Alphabus – multipurpose platform exploited by European industry to build future high-power communication satellites. First mission, **Alphasat**, due for launch in 2013 (in partnership with Inmarsat).



NEW TELECOM PROGRAMMES AND INTEGRATED APPLICATIONS



EDRS (2013/15) – the European Data Relay System, an independent European system to reduce time delays in transmission of large data quantities, making on-demand data available at the right place, at the right time.

Iris – developing a new air-to-ground communications system for air traffic management, the satellite-based solution for the Single European Sky ATM Research (SESAR) programme.

Integrated Applications Promotion – bringing together diverse space infrastructures to facilitate innovative solutions, leading to sustainable services.





NAVIGATION



European Space Agency

GALILEO: SATELLITE NAVIGATION



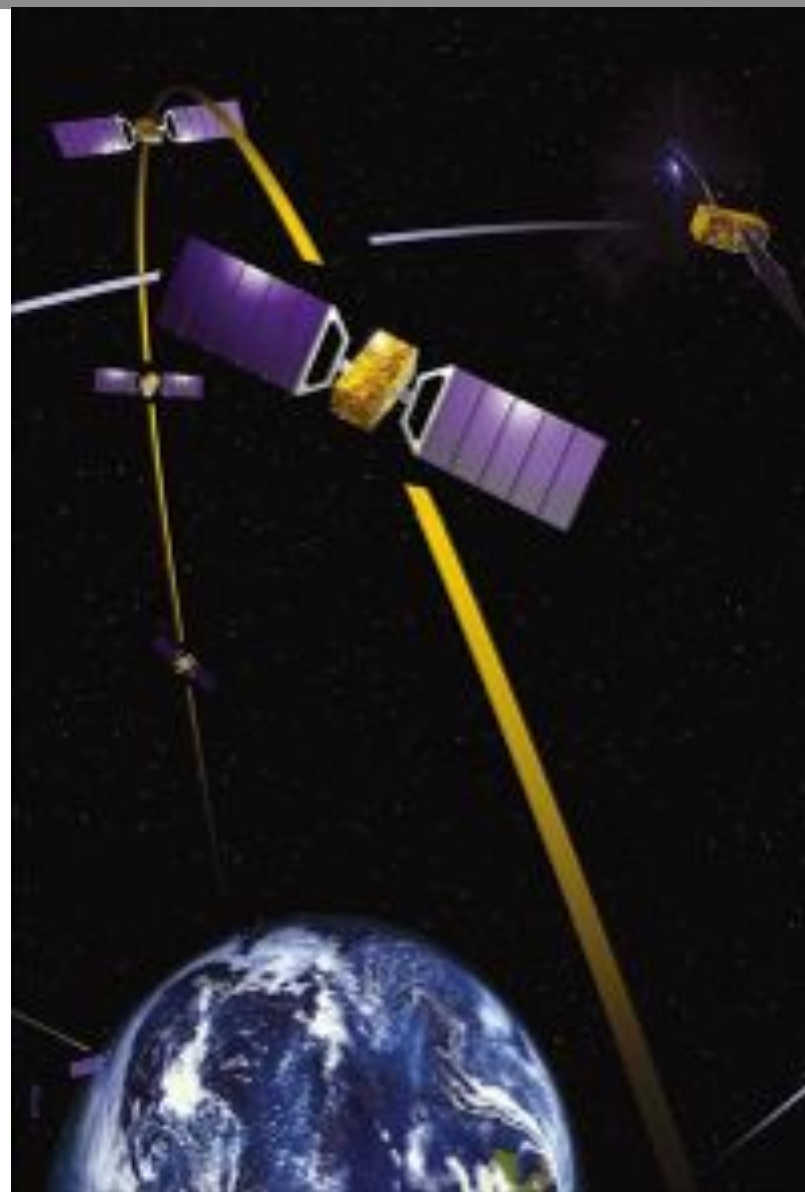
Putting Europe at the forefront of this strategically and economically important sector, **Galileo** will provide a highly accurate, guaranteed global positioning service under civilian control. The full Galileo system will consist of 30 satellites and the associated ground infrastructure. Galileo is a joint initiative between ESA and the European Union.

GIOVE-A (2005–12) Galileo test satellite

GIOVE-B (2008–12) validated technologies

Galileo IOV (2011/12) In-orbit Validation satellites (2+2 satellites)

FOC – Full Operational Capability (30 satellites). Early services available end 2015.

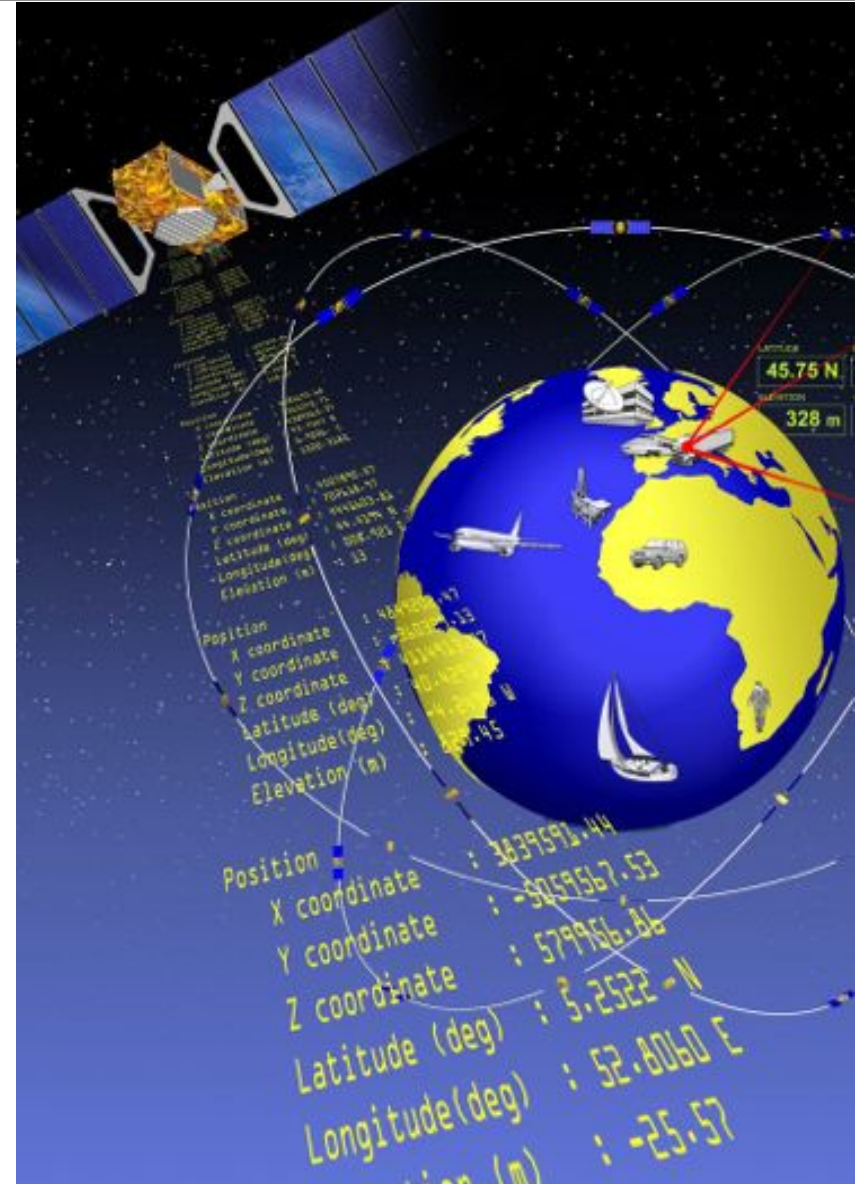


EGNOS AND GALILEO APPLICATIONS



Since 2010, **EGNOS** has been improving accuracy and augmenting GPS, offering safety-critical applications for aviation users.

Galileo is expected to spawn a wide range of applications, based on positioning and timing for transport by road, rail, air and sea, infrastructure and public works management, agricultural and livestock management and tracking, e-banking and e-commerce, network synchronisation, and for critical public services.





LAUNCHERS

European Space Agency

THE EUROPEAN LAUNCHER FAMILY



The launchers developed by ESA guarantee European access to space. Their development is an example of how space challenges European industry and provides precious expertise.

Ariane is one of the most successful launcher series in the world, now complemented by **Vega** and **Soyuz**, launched from Europe's Spaceport in French Guiana.



VEGA

SOYUZ

ARIANE 5 ECA

EUROPE'S SPACEPORT



European launchers lift off from the Centre Spatial Guyanais (CSG), Kourou, in French Guiana.

CSG is operated by the French space agency CNES and Arianespace, with the support of European industry.

ESA owns the launch infrastructure for the **Ariane 5**, **Vega** and **Soyuz** launchers.

CSG is ideally sited for launching satellites, in particular because it is close to the equator.





SPACE TECHNOLOGY

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The development of technology, along with access to space, is one of the enabling activities of ESA.

- Supporting the competitiveness of European industry
- Transferring technology from space to non-space applications (‘spin-off’), and bringing innovations from outside the space sector to use in the design of new space systems (‘spin-in’).
- Fostering innovation and enhances European technological independence and the availability of European resources for critical technologies.



PROBA



Proba satellites are part of ESA's In-orbit Technology Demonstration Programme.

New technology products need to be demonstrated in orbit, particularly when users require evidence of flight heritage or when there is a high risk associated with the use of the new technology.

Proba satellites are among the smallest spacecraft ever to be flown by ESA, but they are making a big impact in the field of space technology.

Proba-1 (2001-)

Proba-2 (2009-)

Proba-V (2013)





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