



WE ARE ESTEC

European Space Agency



**SPACE:
THE OTHER
99.999999999...%
OF OUR UNIVERSE**





Space is closer than you might think:

– A car driving vertically would reach the heights satellites fly in a couple of hours

– But going into orbit means moving horizontally, **400 times faster than a car** – nearly 7 km/s

2 HOURS





Life in space is stranger – and a lot more challenging – than on Earth

- It takes extreme acceleration, vibration and noise to get into orbit
- Spacecraft then endure hard vacuum, weightlessness, **extreme temperatures and high radiation**





ESA IS EUROPE'S SPACE AGENCY, ITS 20 MEMBER STATES COMBINING THEIR EFFORTS IN SPACE, FOR THE AVERAGE COST OF A CINEMA TICKET PER CITIZEN PER YEAR

European Space Agency



“

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

”



ESA HELPS TO MAKE SPACE PART OF DAILY LIFE FOR EUROPEAN CITIZENS

European Space Agency



- Wake up to watch **TV** distributed by telecom satellite (even cable and analogue TV)
- Check today's **weather** report, produced using ESA-developed Meteosats
- Drive a new car, with brakes derived from **aerospace composites**
- Let **satellite navigation** find your destination for holiday or work
- Withdraw cash from an ATM employing a **space-based communications** network
- Dine on food cultivated using satellite-guided **precision agriculture**





**EUROPE HAS
REACHED OUT TO
THE WIDER
UNIVERSE WITH
DOZENS OF
SPACE MISSIONS
THEY HAVE ALL
PASSED
THROUGH THE
GATES OF ESTEC:
THE EUROPEAN
SPACE RESEARCH
& TECHNOLOGY
CENTRE**



European Space Agency

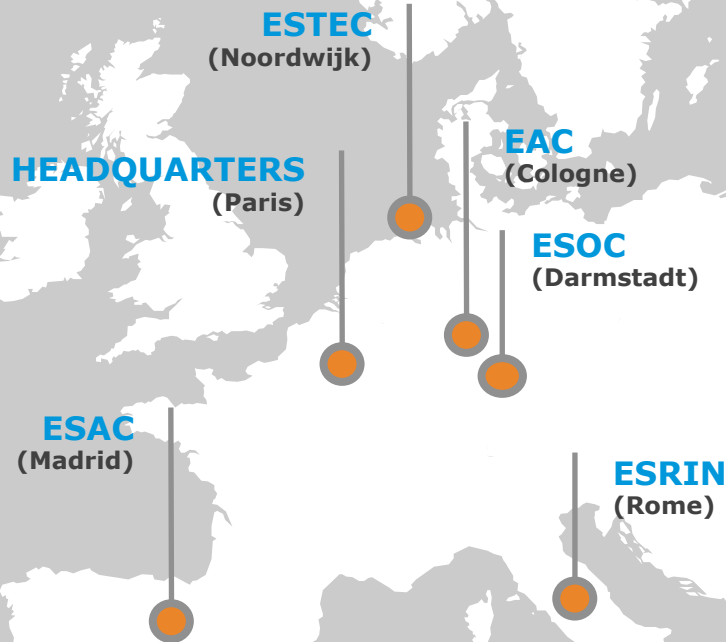


ESTEC



**Europe's largest
space centre,
technical heart of
the European
Space Agency**





Of all ESA establishments, ESTEC is the largest, around 2690 personnel

For almost all European space missions, **the path to space leads through ESTEC**



“

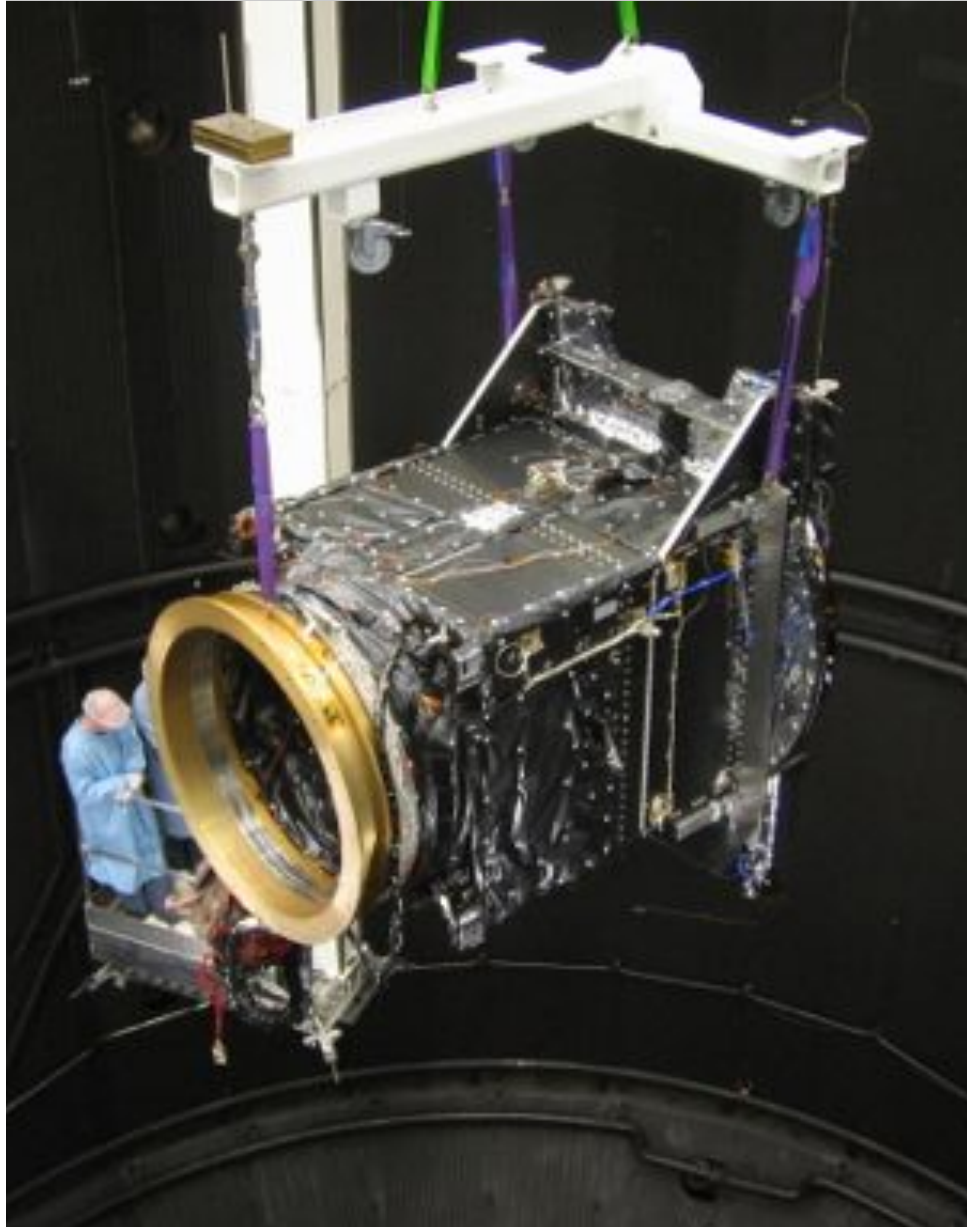
Give me a firm place to stand, and I will move the Earth.

Archimedes c. 287–212

”

ESTEC taking shape in 1966

25m foundations were sunk into sandy soil to ensure sufficient stability for the precision engineering tests carried out here



Today ESTEC is **the incubator of Europe's space efforts**

- Where missions are conceived then guided through development
- Where technology is developed to enable the missions to come
- Finally they are tested before launch in space-like conditions

 [OPEN VIDEO](#)



WHAT DO WE DO AT **ESTEC**?

European Space Agency



ESTEC



Designing for orbit takes teams specialised in every aspect of **engineering for the space environment**

Assembled together in Noordwijk, the Netherlands, **with almost half a century of experience** – these experts are a core part of the European Space Agency



Every space mission is born from a new idea for exploration or applications

Teams from different disciplines combine knowledge to design a blueprint

State-of-the-art networking technology supports this collaborative process

ESTEC's Concurrent Design Facility cuts the time required from months to weeks



OPEN VIDEO





ESA doesn't do routine:

The Agency is a research and development organisation

Each new mission originated at ESTEC marks a significant scientific or technical step forward



New ESA missions are based on technologies that do not exist – yet

Bringing future plans into the realms of the possible therefore demands a **steady stream of innovation**. This process is overseen by ESTEC experts, based on detailed R&D plans





The actual work is outsourced to European industry and academia

In general 90% of ESA's budget is spent on external contracts

ESTEC is Europe's space hub, performing coordination and oversight



When a particular item is selected for a mission, project teams must be sure it is suited for space



Candidate parts and materials are tested exhaustively, to the point of destruction if need be, in ESTEC's specialised laboratories



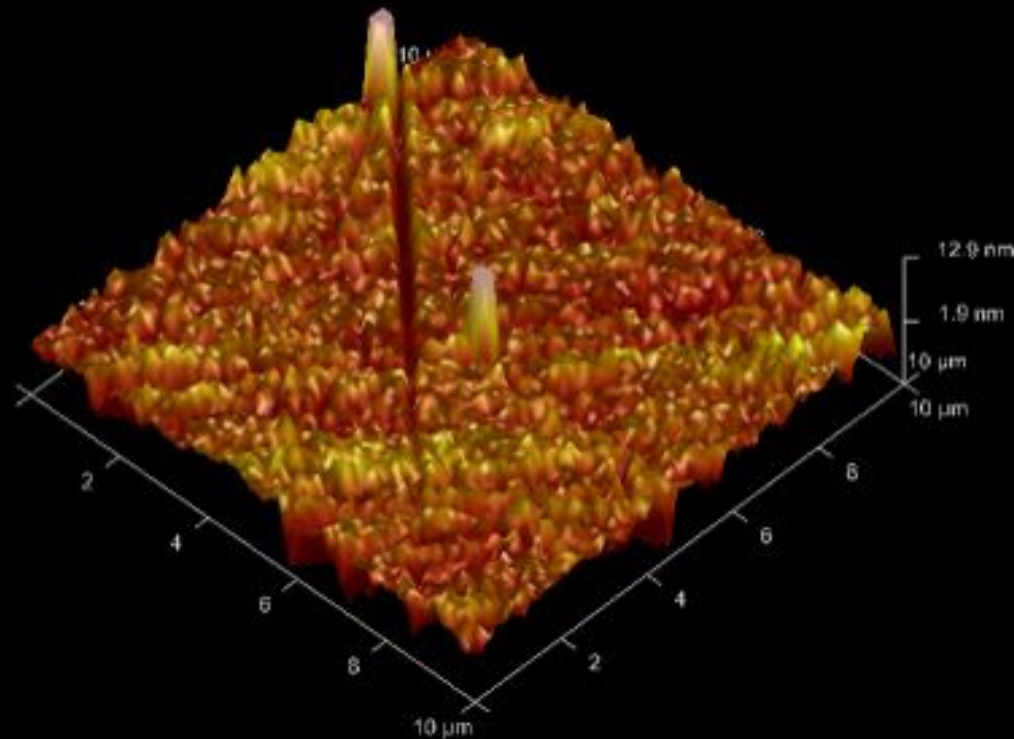
Items can be bombarded with radiation, crushed, shaken, heated or exposed to space-quality vacuum

- Tests are often long – such as **spinning items for up to six months**
- ESTEC maintains only facilities that are unique for Europe and relies on a network of external labs to perform standard testing



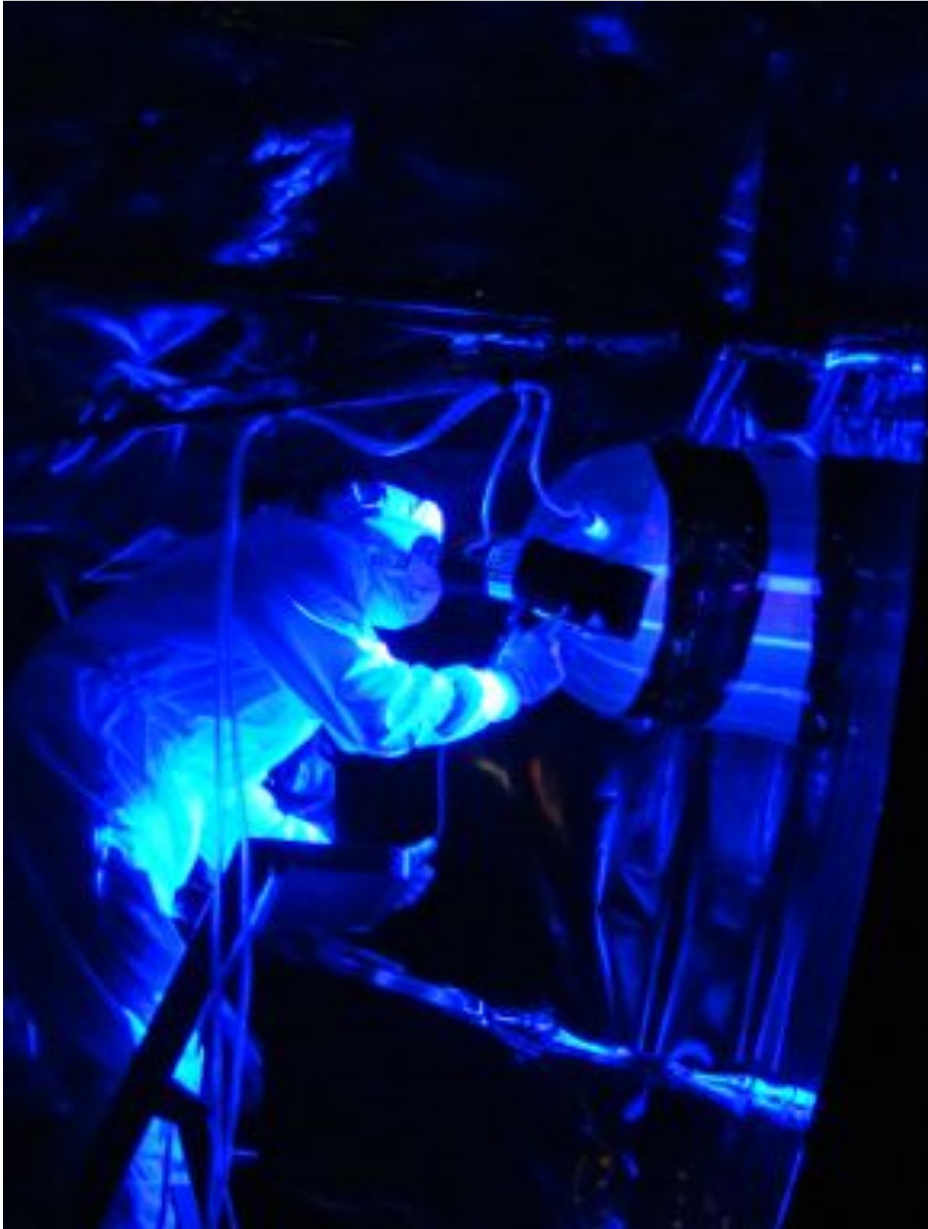
OPEN VIDEO





A unique array of tools is on hand:

- Tensile machines subject test items to 10 tonnes of load
- 'Nanoscratcher' checks the resistance of coatings a millionth of a metre thick
- 'Cooked' hardware releases vapours for spectroscopes and chromatographs to study
- Atomic force microscopes survey **results down to the scale of individual atoms**



ESTEC's labs have grown to meet the changing needs of European space industry

- **Cleanliness and contamination control** is vital as instruments grow more sensitive
- Potential contamination of alien biospheres by planetary probes must be prevented



Human beings do not have to go off the planet to do useful work there

– ‘Telerobotics’ involves advanced **human-machine interaction across the gulf of space**



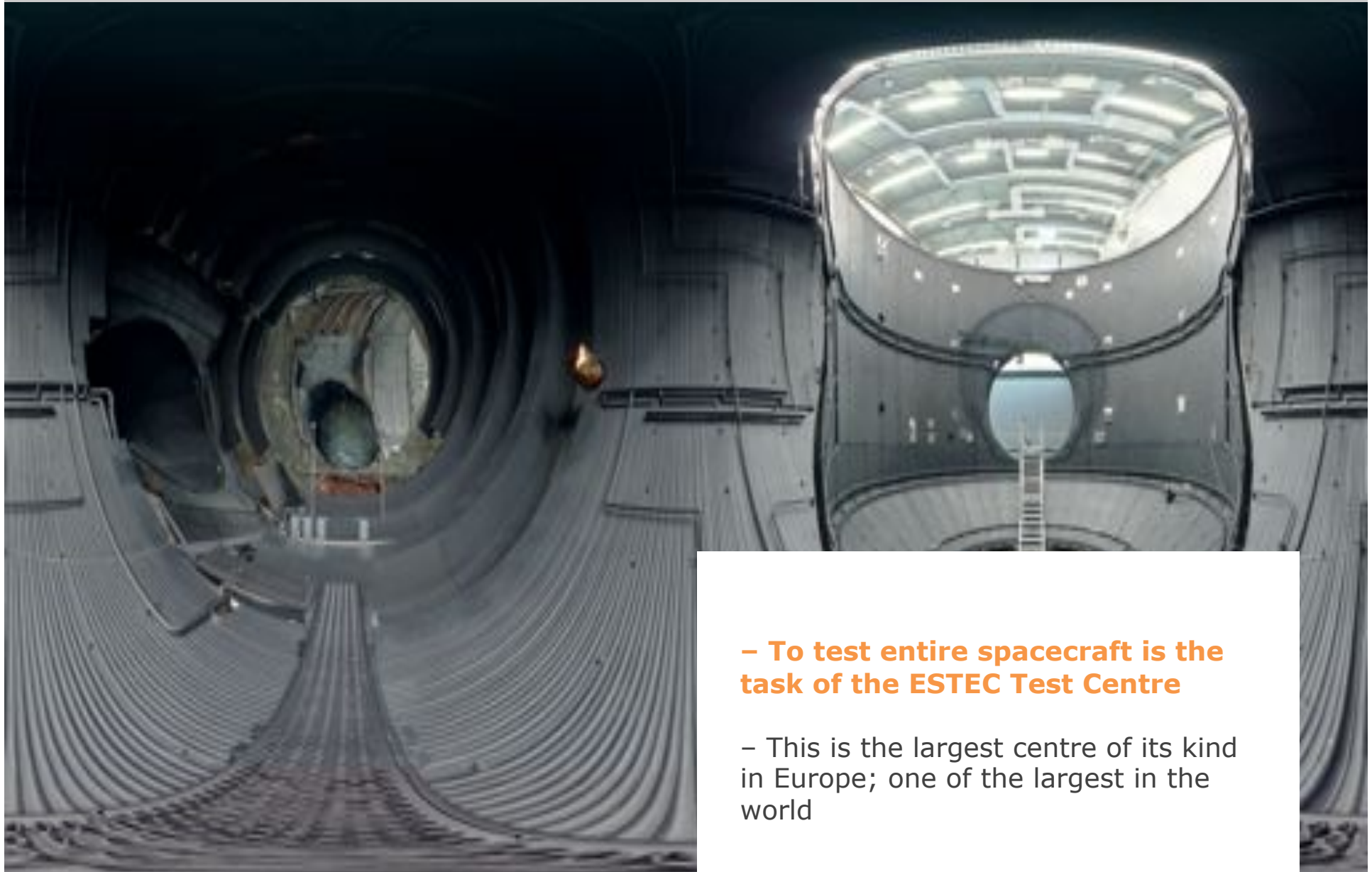
**The labs work with individual components and materials
The labs' work continues after missions reach space**

- **If spacecraft are hit by anomalies then labs act as 'CSI ESTEC'**
- They use their facilities to replicate the problem, understand it, and find solutions
- Entire missions have been salvaged in this way



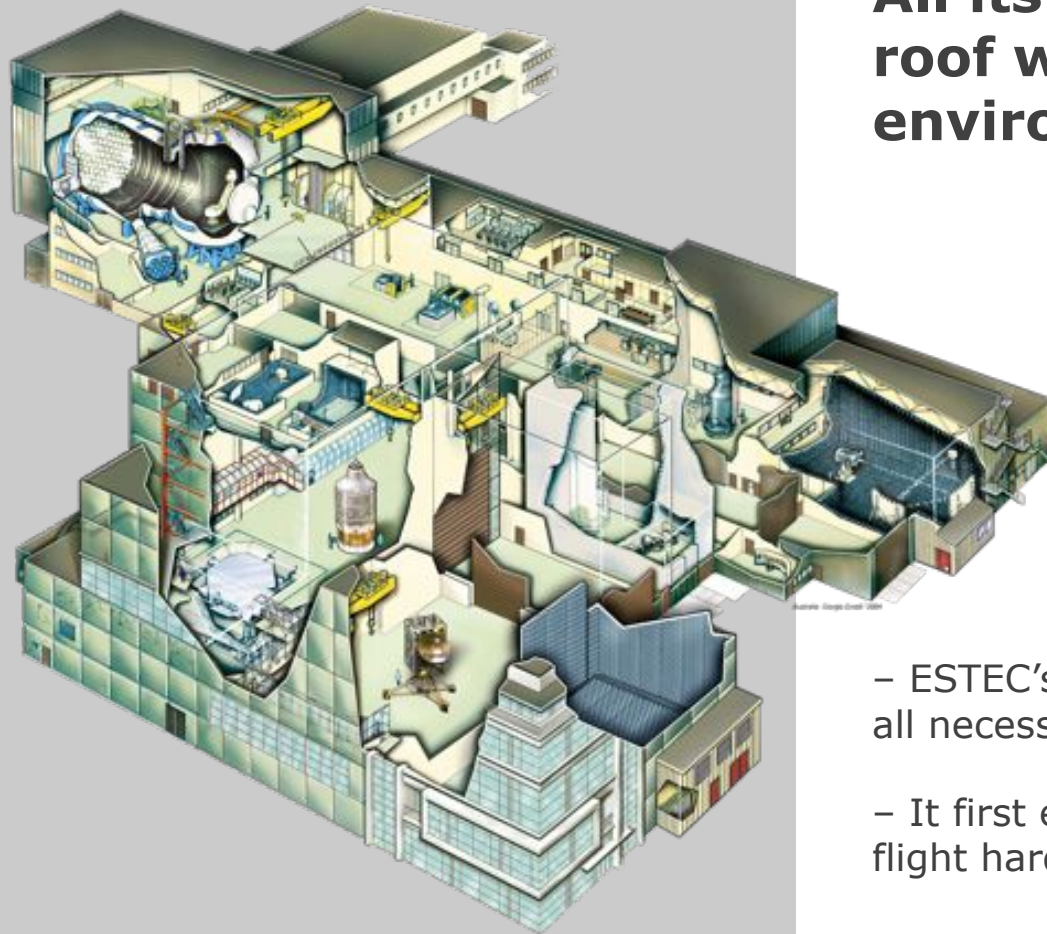
ESTEC'S TEST CENTRE

European Space Agency



– To test entire spacecraft is the task of the ESTEC Test Centre

– This is the largest centre of its kind in Europe; one of the largest in the world



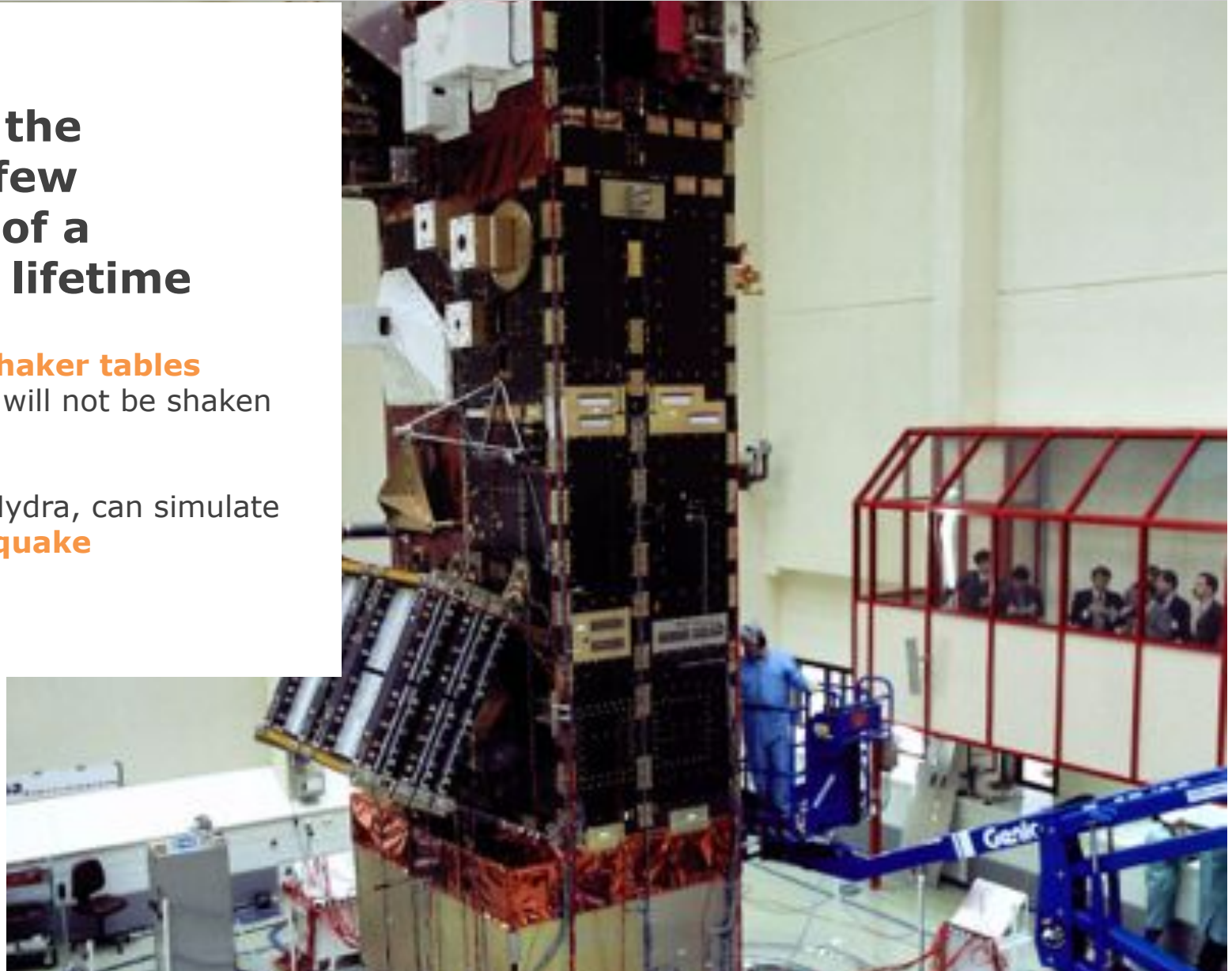
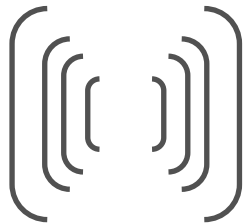
All its facilities under one roof within a clean-room environment

- ESTEC's Test Centre puts satellites through all necessary tests in a single location
- It first evaluates prototypes, then verifies flight hardware before launch



Launch is the toughest few moments of a satellite's lifetime

- **A range of shaker tables** check satellites will not be shaken to pieces
- The largest, Hydra, can simulate a **major earthquake**

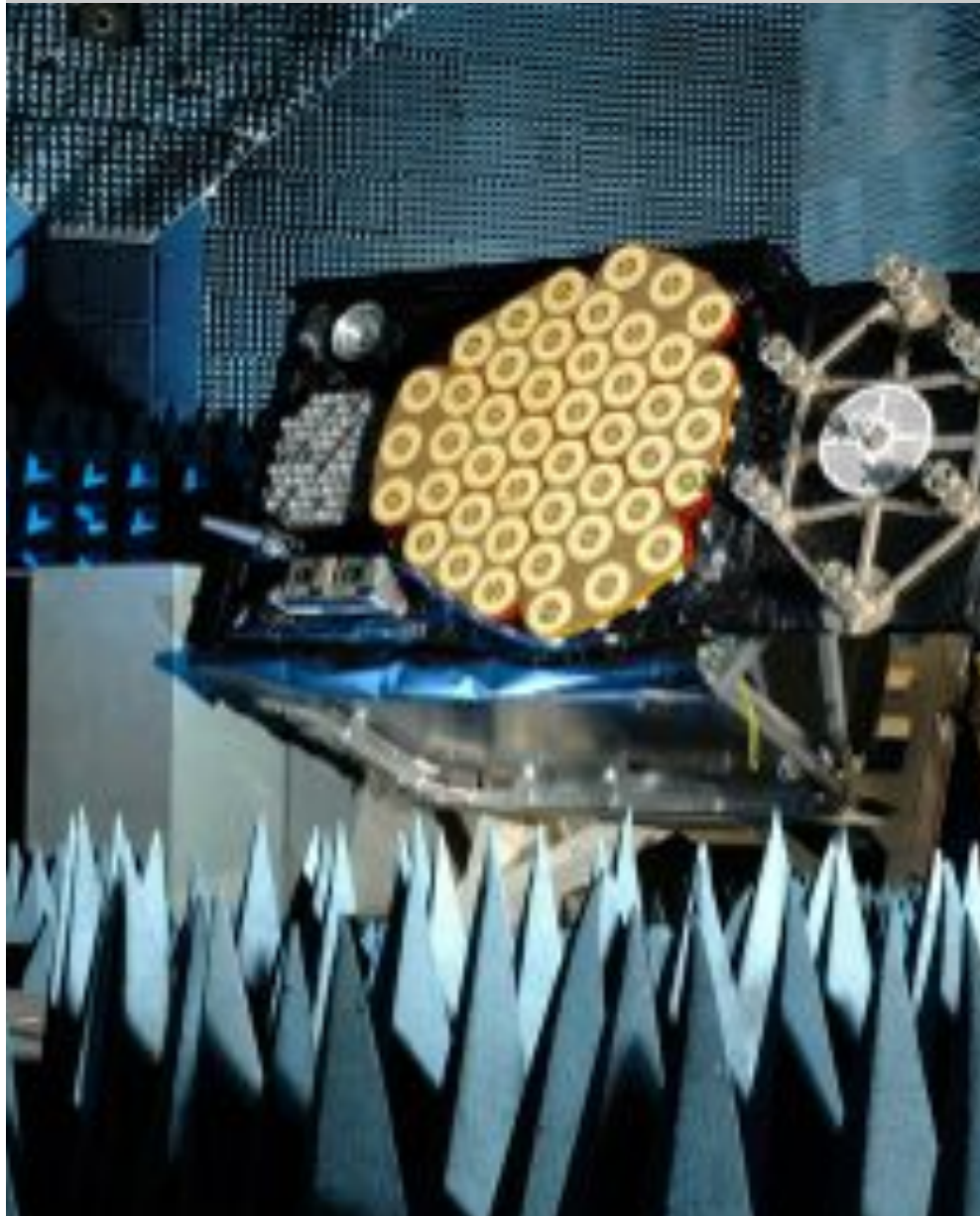




The Large European Acoustic Facility is like a giant music speaker

- Producing acoustic volumes equivalent to aircraft fleets taking off together
- **Ensures satellite can survive the sheer noise of lift-off**
- Chamber lined with 50 cm of steel-reinforced concrete with an epoxy coating
- Chamber hung on springs to isolate noise





Crammed with electronic equipment and communications systems, completed spacecraft must be tested against self-interference

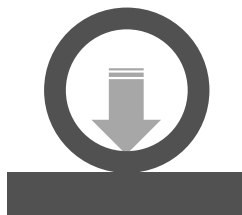
- Special facilities offer complete isolation from the external universe
- **Chambers lined with radio-absorbent material** reproduce space's infinite void





ESTEC facilities are at the disposal of wider European industry

- **Non-space research** is also performed here
- Including **Airbus simulating landing stresses** on aircraft airframes



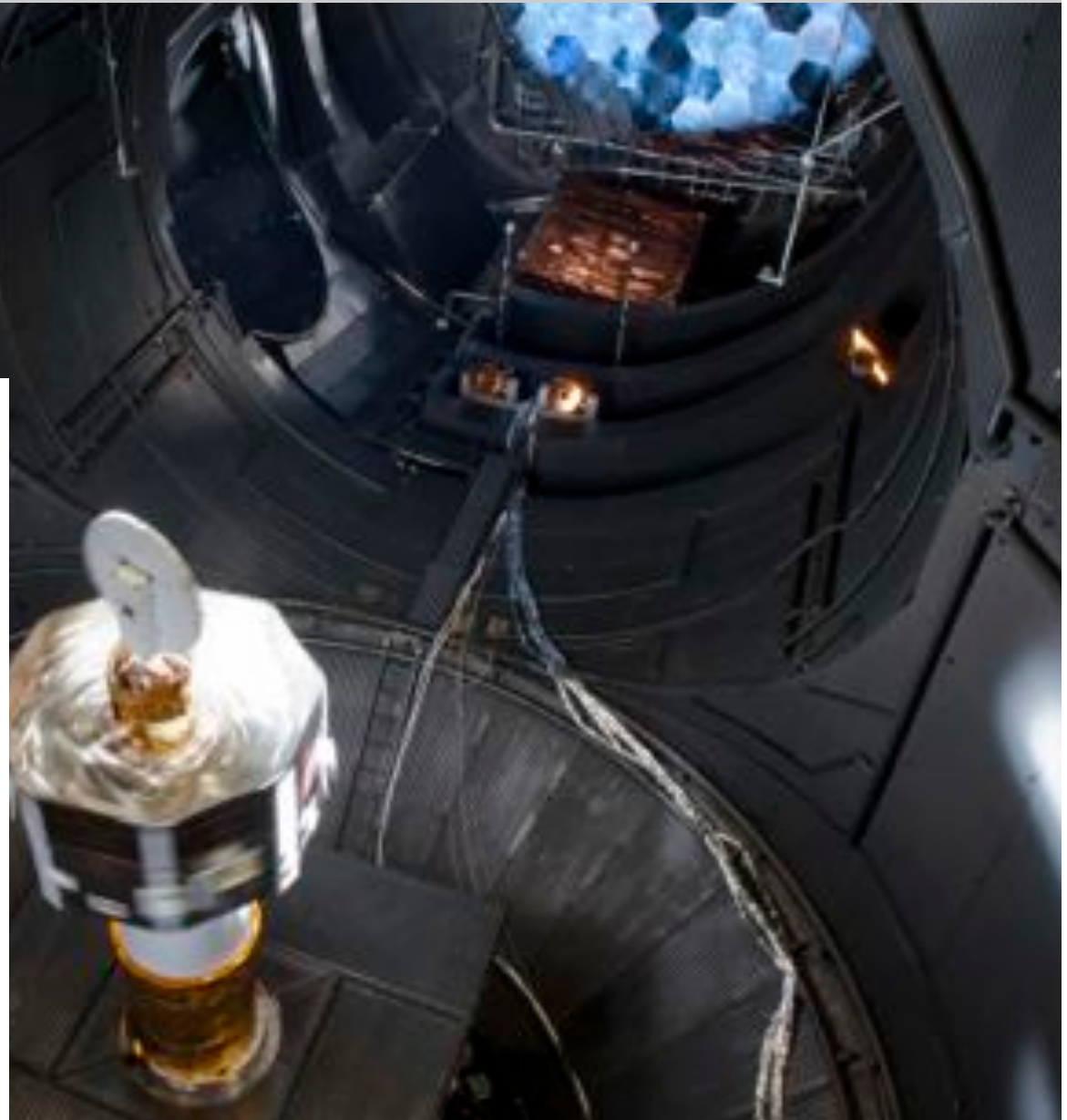


REACHING OUT



ESTEC is a centre for international cooperation

- ISS operations are only the most conspicuous example
- Tested the 16-nation 'CERN in space' Alpha Magnetic Spectrometer
- Tested Japan's contribution to the ESA/JAXA BepiColombo Mercury mission





All money devoted to space is spent down here on Earth

– In 2011, ESTEC created revenue in the Netherlands of 354 M€: 4.26 times the Dutch contribution in that year to ESA of 84 M€.

[white paper 2011]



Innovation is key to economic growth – and it takes new knowledge to innovate

ESTEC ranked as the **sixth largest 'knowledge institute'** in the Netherlands

- Its presence helps stimulate a Dutch space sector, with a €2000 million turnover
- For Dutch education, ESTEC is an **aspirational symbol of the knowledge-based society**

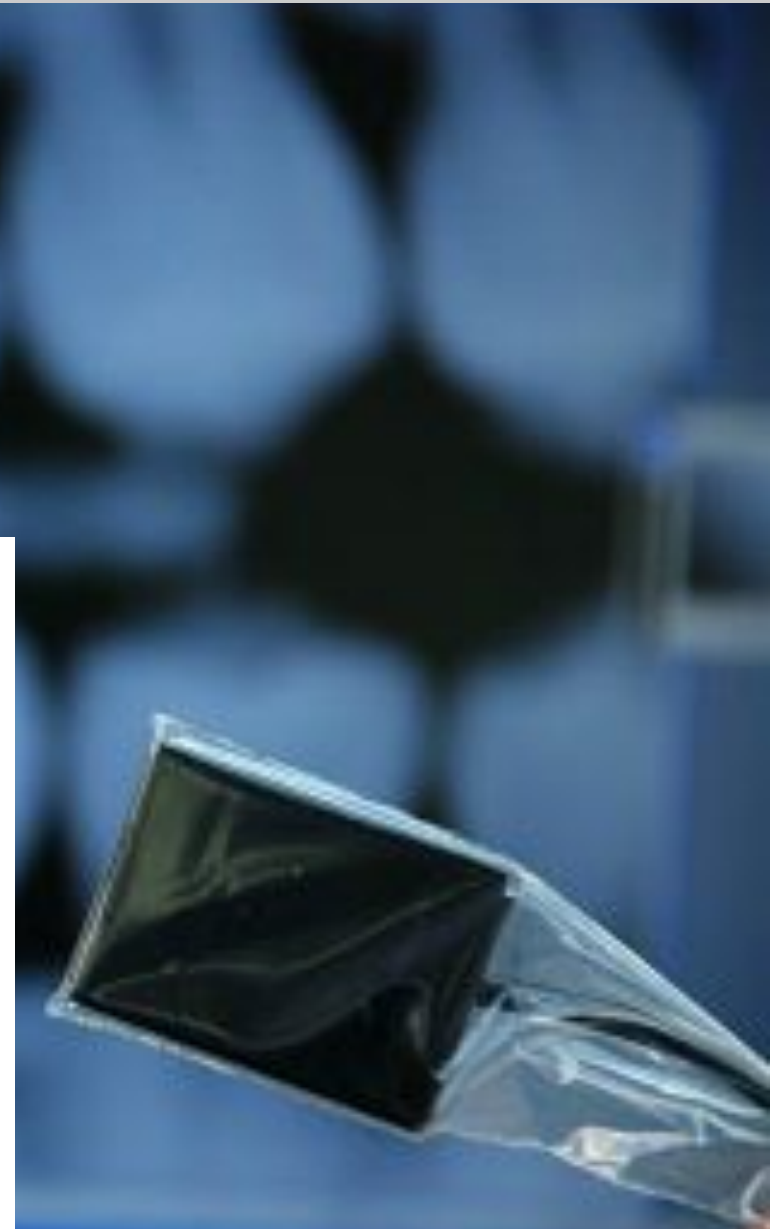
[from 2005 report, ESTEC's value to the Netherlands]





ESTEC's effect extends wider, stimulating innovation across the European economy

- ESTEC is home to ESA's Technology Transfer Programme Office
- **Upwards of 200 space technologies have been transferred to non-space sectors** - From cooling suits for Formula 1 racing to radar checking mine subsidence; iPhone-based medical sensors and **sharper X-rays for dentists**





ESTEC works with entrepreneurs directly

- Hosting one of ESA's seven regional Business Incubation Centres
- Growing business start-ups based on space technology
- Supplying them with **in-depth technical as well as financial advice**



ESTEC is a professional training and educational resource

Offering hands-on experience to Europe's next generation of engineers and scientists:

- Testing student-designed space missions, including CubeSats and 'CanSats'
- Young Graduate Trainee contracts and PhD and Post-Doc scholarships
- Experimental opportunities, such as 'Spin your thesis', using ESTEC's centrifuge



ESTEC is a gateway to space for Europe's media

- Interviewing European astronauts, such as **André Kuipers** and **Paolo Nespoli**
- Viewing space hardware during testing and speaking to project leaders
- Watching European space launches beside the experts that originated them



ESTEC is home to the Erasmus User Centre, guiding scientists and industry interested in space and microgravity experiments

Access to experimental platforms, from drop tower and parabolic flight access to sounding rockets and orbital capsules, up to payloads aboard ISS

Equipped with interactive models, 3D theatre and an extensive document archive





Erasmus performs work in space on an ongoing basis

- Teleoperates several International Space Station payloads
- The ISS 'User Support and Operations Centre' for the Netherlands and Belgium
- **Erasmus will help control the ISS 'handyman': the European Robotic Arm**





ESTEC is a source of inspiration for the Dutch and European public

- Space Expo is ESTEC's visitor centre
- An exhibition of space artefacts with ESTEC tours during weekends and school holidays
- **80.000 visitors annually** – a third of them schoolchildren





ESTEC is a piece of history

- Visitors to Space Expo experience a simulated Ariane launch, view replicas of key European spacecraft and glimpse an actual moonrock
- Astronauts visiting ESTEC make their mark on Space Expo's famous 'space explorer' table
- **Neil Armstrong signed the table** in 2010





10 KEY ESTEC ACHIEVEMENTS

European Space Agency



ESRO-2B

ESTEC's first mission in space, studying Earth's magnetosphere, launched in 1968

Orbital Test Satellite

Europe's first telecommunications satellite, launched in 1978, today Europe remains a global leader in this highly competitive industrial sector

Hubble Space Telescope

ESTEC oversaw the development of Hubble's solar wings, supplying power to its telescope instruments, launched in 1990



Meteosat-1

Europe's first weather satellite, the beginning of a series that continues to serve Europe to this day, launched in 1977

Giotto

Europe's first deep space mission, intercepting Halley's Comet, launched in 1985



Huygens Lander

launched with NASA's Cassini spacecraft in 1997, in 2005 it reached Saturn's moon Titan, the furthest human-made object on an alien surface

Columbus

Europe's own space laboratory, attached to ISS in 2008, resupplied by Europe's first Automated Transfer Vehicle 'space ferry' the same year

Galileo

Europe's own satellite navigation system conceived and coordinated from ESTEC, first satellites launched in 2011



Envisat

the world's largest civil satellite for environmental monitoring, launched in 2002

Herschel

a telescope with the largest reflecting mirror ever flown, launched in 2009 along with Planck – refrigerated to become the coldest object in the Solar System rendering it sensitive enough to map the Cosmic Microwave Background



ROSETTA - EUROPE'S COMET CHASER





**PLANCK – FIRST EUROPEAN MISSION
TO STUDY THE BIRTH OF THE UNIVERSE**



CRYOSAT – EUROPE'S FIRST SPACECRAFT DEDICATED TO THE STUDY OF ICE





ESTEC MISSIONS UNDER DEVELOPMENT



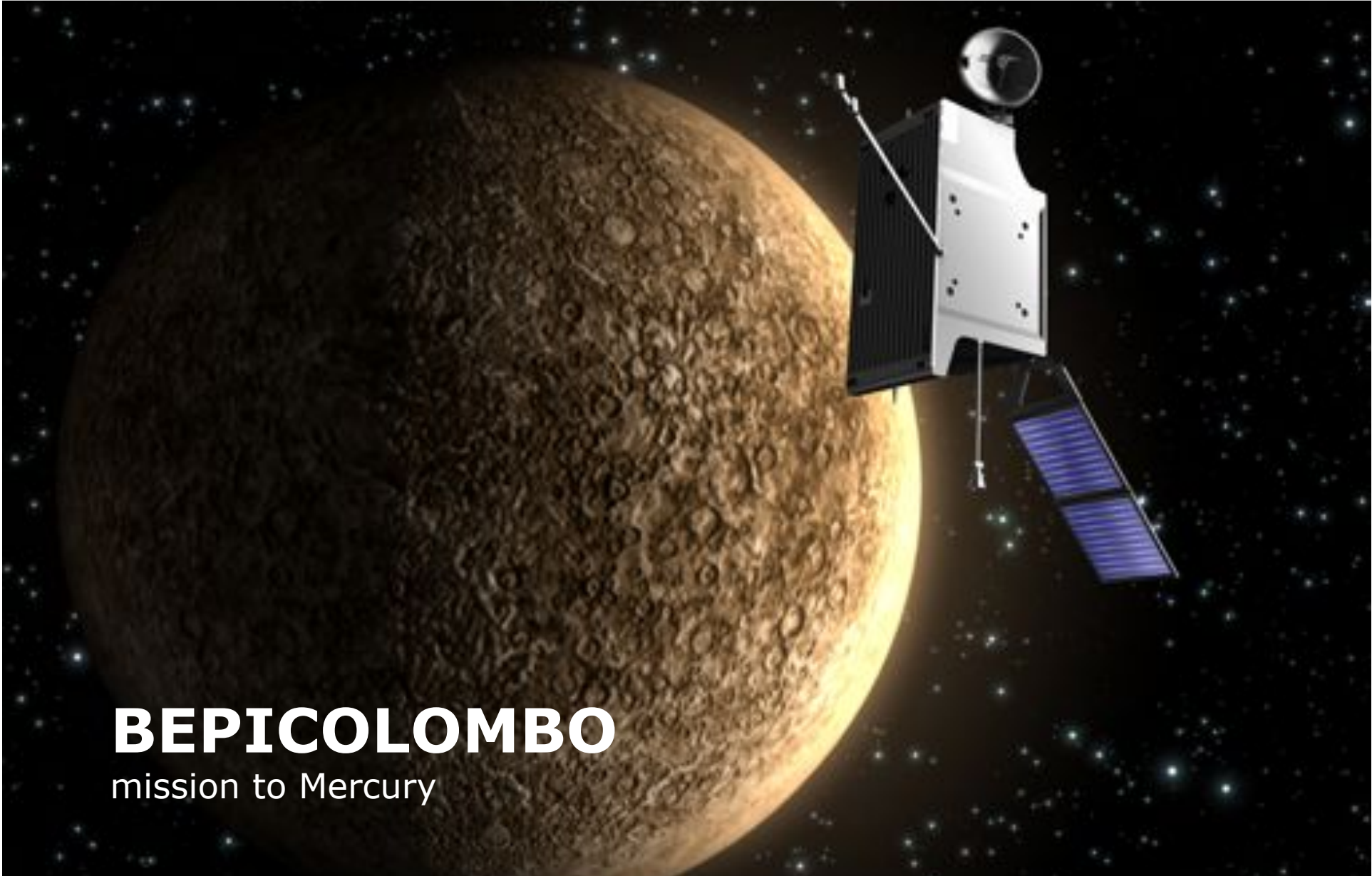
'Aiming at the stars' both literally and figuratively, is a problem to occupy generations, so that no matter how much progress one makes, there is always the thrill of just beginning.



Rocket pioneer Robert Goddard, 1932



UNDER DEVELOPMENT



BEPICOLOMBO

mission to Mercury



UNDER DEVELOPMENT



GAIA

performing a 3D survey of more than a billion local stars,
to make the most accurate map ever of
Earth's celestial neighbourhood





UNDER DEVELOPMENT



SOLAR ORBITER

venturing closer to the Sun than any mission before it



WE ARE ESTEC INDEX

- **SPACE**
- **WHAT IS ESA**
- **ESTEC**
- **WHAT WE DO AT ESTEC**
- **ESTEC'S TEST CENTRE**
- **REACHING OUT**
- **KEY ESTEC ACHIEVEMENTS**
- **UNDER DEVELOPMENT**