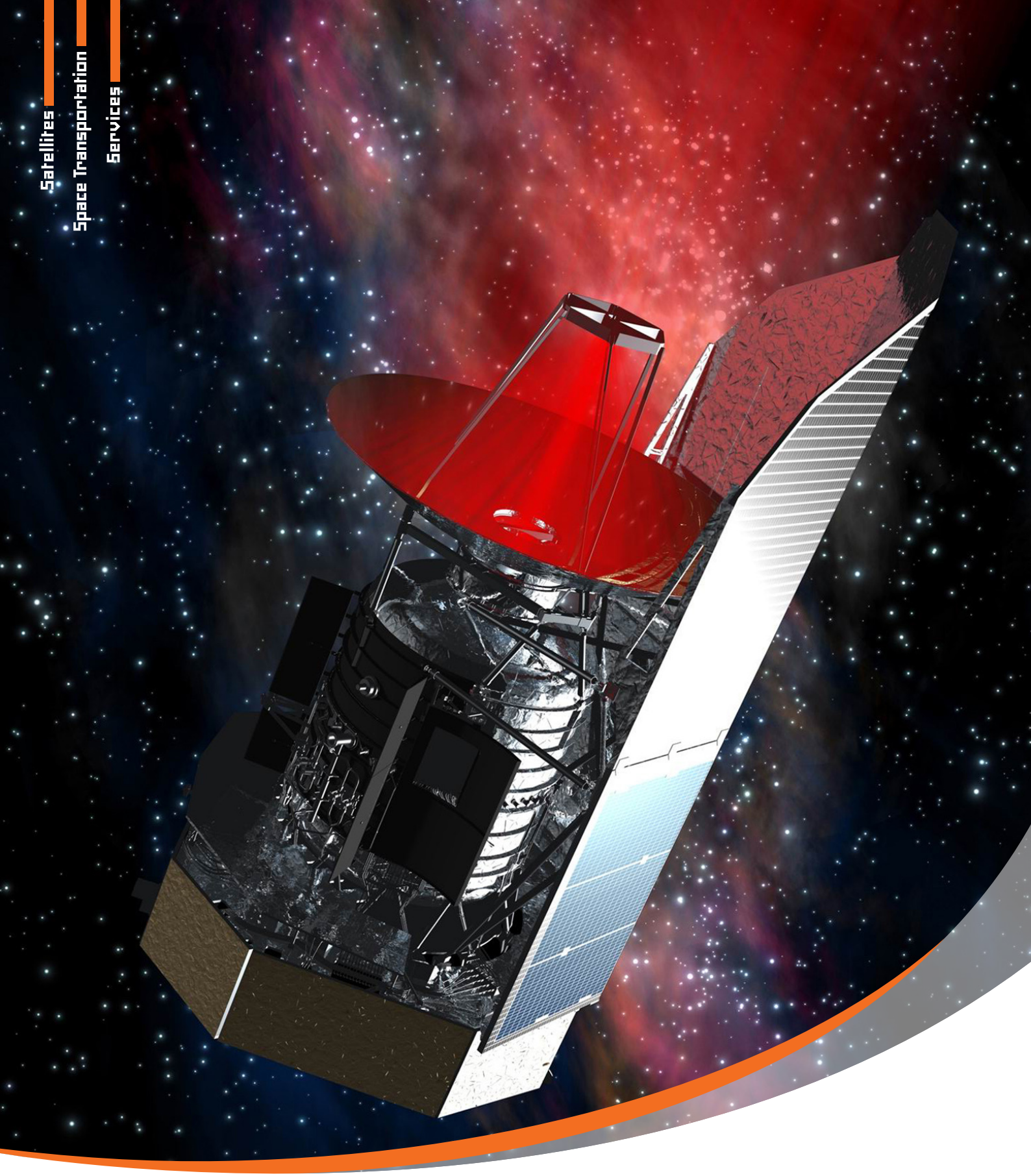
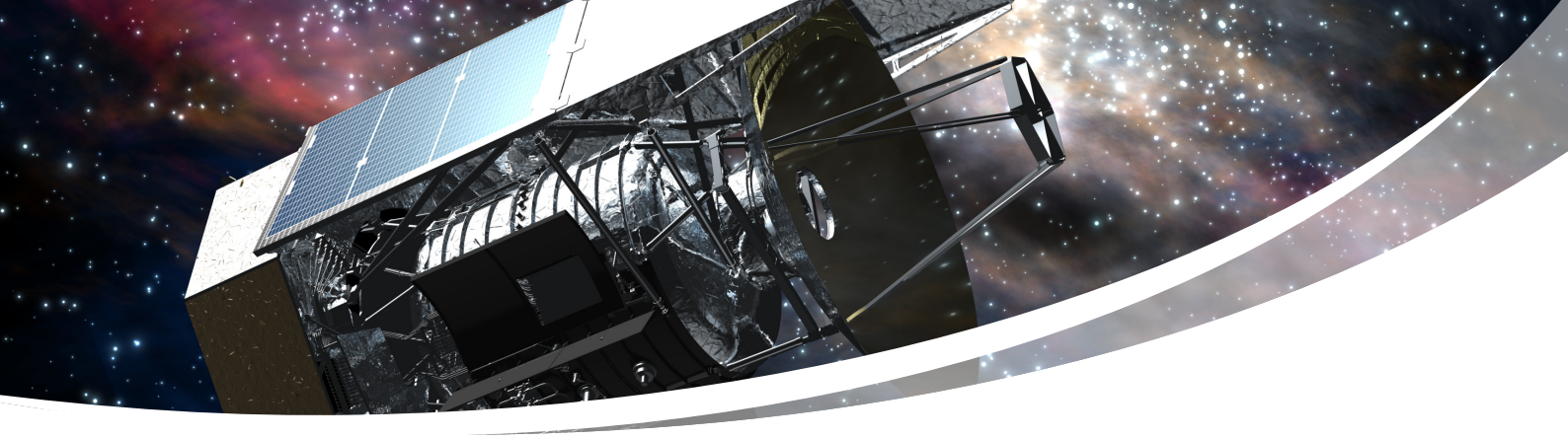
Satellites
Space Transportation
Services



HERSCHEL SPACE OBSERVATORY

All the space you need

EADS astrium



Herschel cryostat

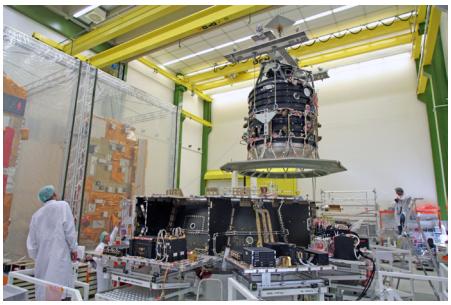
Herschel is an infrared space observatory system for investigation of the history of how stars and galaxies formed and for studying how they continue to form in our own and other galaxies. Herschel will observe at wavelengths never covered before, from far infrared (FIR) to sub-millimetre wavelengths.

Herschel is the fourth cornerstone mission in the European Space Agency's Horizon 2000 Science Programme.

Astrium's Involvement

Astrium developed the Extended Payload Module, the main constituents are the cryostat, the optical bench, the harness for the scientific instruments, the solar array and sun shade, and the interface structure for the telescope and the service module, and was responsible for the satellite assembly, integration and test program.

The cryostat keeps the instruments cool at a few degrees above absolute zero temperature, the necessary temperature for the faint infrared radiation from distant objects to be seen. The radiation sensors inside the focal plane units of the instruments will operate at less than 0.3 degrees Kelvin (-273°C). The cryostat concept is based on Astrium's heritage on ISO (Infrared Space Observatory) but, with advances in engineering and an unprecedented level of insulation, the service life of Herschel is doubled with about the same volume of liquid Helium.



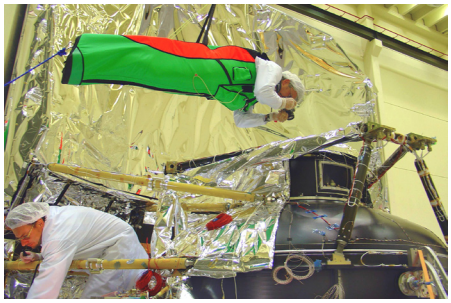
Mating Herschel's cryostat with its service module

The electrical harnesses for the cryostat were also produced by Astrium and involved thousands of wires made from steel and brass that are no thicker than a hair.

Astrium also built the Herschel Telescope, the largest imaging space telescope ever built, using novel silicon carbide mirror technology. The primary mirror, at 3.5 metres in diameter, is so large that it was built by brazing 12 pieces together into one single piece which was then ground, lapped and polished to the correct shape, and finally coated with its reflective aluminium layer. If the mirror had been built out of glass, in the conventional way, it would have weighed 1.5 tonnes. Using the silicon carbide, the mass was reduced to just 315kg.

The Herschel Observatory will be launched together with another mission, Planck, a mission to study cosmic microwave background radiation. The two spacecraft will separate about 2.5 hours after launch and will operate independently.

Fine optical alignment of the Herschel Telescope



Herschel in integration and testing

Herschel Science

In the infrared spectral range, the universe appears completely different to astronomers than in the visible light range. One central field of research that will be possible with the Herschel Observatory will be the study of the early and late phases of stellar evolution, in other words, the birth and death of stars.

Huge cold clouds of gas and dust are scattered all over the Milky Way. Under specific conditions and the pull of gravitational forces, individual areas inside these clouds continuously collapse to eventually form new stars. Our sun was created this way. Not until the stars begin to shine brightly do they clear the environment of the remaining dust and become visible.

In the visible light range of the electromagnetic spectrum, it is not possible to witness these early stages in the birth of a star because they take place deep inside these cold dust clouds. Infrared radiation, by contrast, makes this possible. The emission from within the clouds is in the infrared, yielding new insights into the formation of stars and their associated planetary systems

A second central field of research concerns the formation and evolution of galaxies. Astronomers have learned that in some young galaxies, that existed for a few billion years after the big bang, up to one hundred times more stars per year were formed than in our galaxy today. The hot nascent stars heated the dust around them to extreme temperatures, causing it to emit intensive heat radiation in the infrared range.

These young galaxies are many billions of light years away. Because of the expansion of the Universe, their light is displaced towards longer wavelengths. Astronomers call this phenomenon "cosmological red shift". As a result, the infrared radiation emitted by the dust at, say, 100 microns, could be reaching us at a wavelength more than double that. Herschel will be the first space telescope ever to be sensitive to this range, which is inaccessible from the Earth's surface because of the absorbing atmosphere.

Sir William Herschel and Caroline Herschel

The Observatory is named after astronomers Sir William Herschel and his sister Caroline Herschel.

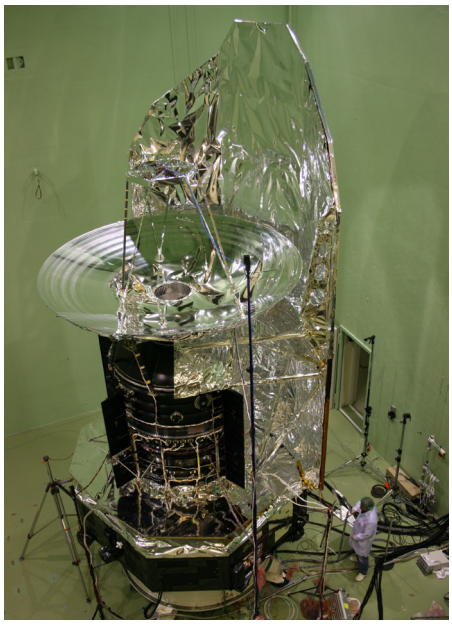
William Herschel was born in Germany in 1738 and moved to England in 1755 to become a music teacher. He developed an interest in astronomy and built his own telescopes. He invited his sister to join him in England as an assistant in his music business, but is it their joint interest in astronomy that brought them fame.

William discovered the planet Uranus, which prompted him to take up astronomy full time. He was appointed the King's astronomer by King George, with Caroline as his assistant. William went on to discover many new nebulae, clusters of stars and binary stars. He was also the first person to correctly describe the form of our Galaxy, The Milky Way.

Caroline discovered eight comets and three nebulae, and in 1797 she published the 'Index to Flamsteed's Observations of the Fixed Stars' and a list of his mistakes.

In 1800, Herschel performed a simple experiment to study the "heating powers of coloured rays" by splitting sunlight with a glass prism into its different constituent rainbow colours and measuring the temperature of each colour. He observed an increase in temperature as he moved a thermometer from the violet to the red part of the 'rainbow'. Out of curiosity Herschel also measured temperatures in the region just beyond the red colour, where no light was visible, and to his surprise, he recorded the highest temperature there. He deduced the presence of invisible "calorific rays", now called infrared radiation.

This discovery, and the contribution to astronomy by both Herschels, is why this space observatory is named after them.



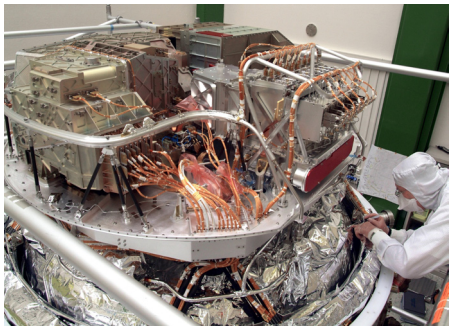
Herschel in acoustic testing

William Herschel (1738-1822)
Image credit: Royal Astronomical Society

Caroline Herschel (1750-1848)
Image credit: Royal Astronomical Society

Mission	Far infrared (FIR) to sub-millimetre wavelength telescope, 57 to 670 micrometers
Orbit	400,000 km orbit around Lagrange point L2 Launcher: Ariane-5 launcher system Transfer time to L2: 6 months
Spacecraft	The Herschel Observatory is configured modularly and is composed of four main elements: 1. The Herschel Payload Module 2. The Telescope 3. The Herschel Solar Array /Sun Shade 4. The Service Module
Payload	• HIFI - Heterodyne Instrument for the Far Infrared • PACS - Photo-detector Array Camera and Spectrometer • SPIRE - Spectral and Photometric Imaging Receiver
Features	• 3,5 m SiC Mirror. • Focal Plane Instruments between -265 C to -273 C (0.3K to 8K) • Cryostat (2367 l of liquid Helium)
Launch Mass	3300kg
Dimensions	Height = 7.5m, Diameter = 4m
Launch Date	April 2009
Mission Duration	More than 4 years

Astrium Responsibilities	• Herschel Telescope (Astrium France)
	• Extended Payload Module consisting of: (Astrium Germany)
	  • Cryostat
	  • Optical bench
	  • Scientific instrument harness
	  • Solar Array & Sun Shade (Astrium subsidiary Dutch Space)
	  • Telescope & SVM interface structure (Astrium Spain)
	• Satellite integration & testing (Astrium Germany)



Integrating the instruments

Herschel mirror

For more information please contact:
Wolfgang Fricke
Herschel Payload Module Project Manager
Earth Observation & Science Division
ASTRIUM SATELLITES
88039 Friedrichshafen
Germany
PHONE: +49 (0)7545 8 01
FAX: +49 (0)7545 8 4411
EMAIL: wolfgang.fricke@astrium.eads.net

EADS astrium