



Press Release
Max-Planck-Institut für extraterrestrische
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Looking into the Nursery of Stars

Herschel: With the largest Space Telescope ever built Max Planck Scientists explore the Depths of the Universe

After ten years of developing and building Herschel, the ESA mission will start into space on the 14th of May. In 1.5 million kilometres distance from earth the space probe will orbit the Sun for 3½ years. With its three instruments it will especially detect and analyse infrared radiation, which contains information on a wide range of phenomena like the evolution of distant galaxies and the existence of water in our solar system. Two of the three instruments on board have been developed or co-developed by the Max Planck Institutes for extraterrestrial Physics, Astronomy, Radio Astronomy and Solar System Research.



Herschel in Orbit (Artist's Impression)
D. Ducros, ESA, 2009

The Universe reveals many of its secrets in the infrared. Just like every object on Earth, the icy nebulae, galaxies and stars from the depths of the Universe emit infrared heat radiation – however, because of the low temperatures, at a significantly longer wavelength than a human being or a badly insulated house, for example. The Earth's atmosphere is impervious to these wavelengths. The instruments aboard the Herschel space probe investigate space in the wavelength range between 55 and 672 micrometers. No other infrared observatory so far has offered such a bandwidth in combination with the spatial resolution of a 3.5-metre telescope.

For the first time the scientists are able to resolve the cosmic infrared background into its individual sources and thus to determine the development of the Universe. The evolution of stars and galaxies, the formation of planetary systems, the history of our own solar system and the chemical composition of molecular clouds, stars and galaxies are the most important topics on which Herschel will provide information.

The Max Planck institutes played a crucial role in creating two of the three instruments: The PACS instrument was designed and built by the Max Planck Institute for extraterrestrial Physics (MPE) in Garching in cooperation with the Max Planck Institute for Astronomy (MPIA) in Heidelberg and other partners from six European countries. HIFI was developed by a global consortium, coordinated by the Dutch Institute for Space Research, and with significant input from the Max Planck Institutes for Radio Astronomy (MPIfR) in Bonn and for Solar System Research (MPS) in Katlenburg-Lindau and also from the Cologne University.

PACS (Photodetector Array Camera and Spectrometer) will carry out imaging photometry and spectroscopy with a never before achieved accuracy and sensitivity in the far infrared, between 57 and 210 micrometers. “For the first time we have been successful in developing relatively large, highly sensitive detectors for this still exotic wavelength range, which we can use to take quasi colour images in three larger wavelength ranges”, says Albrecht Poglitsch (MPE), PACS Principal Investigator. “At the same time this innovative optical instrument allows us to resolve an area of the sky into individual pixels and to split each pixel very finely into individual spectral colours or wavelengths.”

Stars form within huge clouds of dust and gas which visible light can not pervade. Infrared light is able to see through the dust and opens up a completely different Universe than observable in visible light. With its highly sensitive detectors PACS captures the weak heat radiation only a few degrees above absolute zero (minus 273.15 degrees Celsius), which was emitted at an early stage of the star formation by the so-called protostar, the precursor of the star, and thus offers the researchers deep insights into the infancy of stars. Only when the young star, influenced by gravitation, condenses so strongly that in its interior nuclear fusion processes are initialised it also emits visible light.

Galaxies from the young Universe, billions of light years away from us, have produced up to a thousand times more stars than are produced in today’s galaxies. This requires large quantities of gas and dust as “building material”, which block the direct view and initially swallow the energy released by infant stars, only to re-emit it at much longer wavelengths. Moreover the wavelength of the emitted light appears to us longer due to the expansion of the Universe, a phenomenon which astronomers call spectral redshift. The infrared light emitted by the objects which formed shortly after Big Bang reaches us with more than twice the wavelength. About half of the emitted light reaches us in the form of this cosmic infrared background. Exactly in this range the PACS sensors will “see” particularly well. So Herschel/PACS opens up new perspectives in a wavelength range barely studied so far. “With the start of this space telescope a dream comes true for which we have worked hard for more than ten years”, says Eckhard Sturm (MPE). His colleague Dieter Lutz adds: “With Herschel we will resolve the cosmic infrared background into individual galaxies and so be able to study the most active stage of star formation in the history of the Universe.”

Herschel also opens up new opportunities for our understanding of the trans-Neptunian region – remains of the disc from which our planets formed. Pluto is the best-known, but no longer the largest representative of the belt region on the far side of Neptune. There are now more

than 1.300 trans-Neptunian objects (TNOs) in the catalogues. The TNOs have remained virtually unchanged since the early years of the solar system and are very cold because they are so far from the Sun – which is why they are in Herschel’s field of vision. “The Herschel sample comes up to about ten percent of the currently known objects on the far side of Neptune”, explains Thomas Müller (MPE). “For the first time we can gain statistical information on the whole population, which then can serve as a reference for the interpretation of discs and remains of discs in other star planet systems.”

In order to minimize the interfering influence of Sun, Moon and Earth, Herschel will be stationed at the so-called second Lagrange point (L2). This point is 1.5 million kilometres away in a straight extrapolation of the line connecting the Earth with the Sun, and orbits the Sun once a year synchronously with the Earth. All three radiation disturbances, Sun, Moon and Earth, lie in roughly the same direction seen from there and thus can be hidden behind a "sunshade".

In order to avoid that the instruments are irritated by the thermal radiation resulting from the operation of the satellite, they have to be cooled down to a temperature of between 0.3 and 2 degrees above absolute zero before they are sent into space. For the cooling during operation 2000 litres of superfluid liquid helium are on board. At the same time the helium limits the mission duration of the giant telescope: in about three and a half years, the helium will be used up – and Herschel will become blind.

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Web Links:

<http://www.esa.int/SPECIALS/Herschel/index.html>

<http://pacs.mpe.mpg.de/>