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Research in orbit – Aims and prospects for using Columbus

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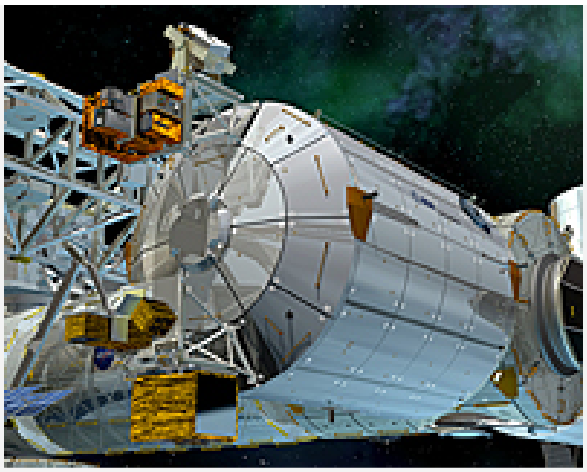


The Columbus Laboratory

The Columbus space laboratory is Europe's main contribution to the International Space Station (ISS). It is designed for long-term, multi-discipline research in space. Germany is one of the most important nations in terms of scientific research on the ISS. This applies particularly to bio and material sciences. About 40% of the projects selected in European competition originate from German research institutes.

It is 6.9 metres long with a diameter of 4.5 metres. Research will be carried out on Columbus, between Earth and space in the fields of material and life sciences. New technologies will be developed. Its designers also hope that it will one day be used for industrial and commercial purposes. This lab will be the main working area for European astronauts. There are platforms on the outer wall of the laboratory to attach experiments that will be exposed to outer space. The operation of the laboratory will be controlled by the European Columbus Control Centre within DLR's German Space Operations' Centre in Oberpfaffenhofen, near Munich.

German scientists have been carrying out research on the ISS for six years.

Doing research in orbit

German scientists started using the ISS as early as 2001 with projects on plasma crystal research and measuring radiation in outer space. Since then about 25 more experiments or series of experiments have been started and have already been partially completed. This was made possible by successful international cooperative ventures with the space station partners, USA, Russia and Canada. Up to now research has been carried out in the fields of plasma physics, space medicine and biotechnology.

Plasma crystal research

The very first scientific experiment that was carried out on the ISS commenced in March 2001. This was a series of experiments that is still continuing today to research plasma crystals by the Max Planck Institute for Extraterrestrial Physics in Garching (Co-ordinator: G. Morfill). This involves micro-particles arranged so that they are floating in a plasma at room temperature. The lattice-shaped arrangement can be used as an experimental model system for the atomic structure of a solid. Thus scientists can examine in detail the melting of a solid using individual particle movements in terms of time and space. Under certain conditions they are also able to analyse flowing liquids and gases at elemental micro particle level.

Space medicine

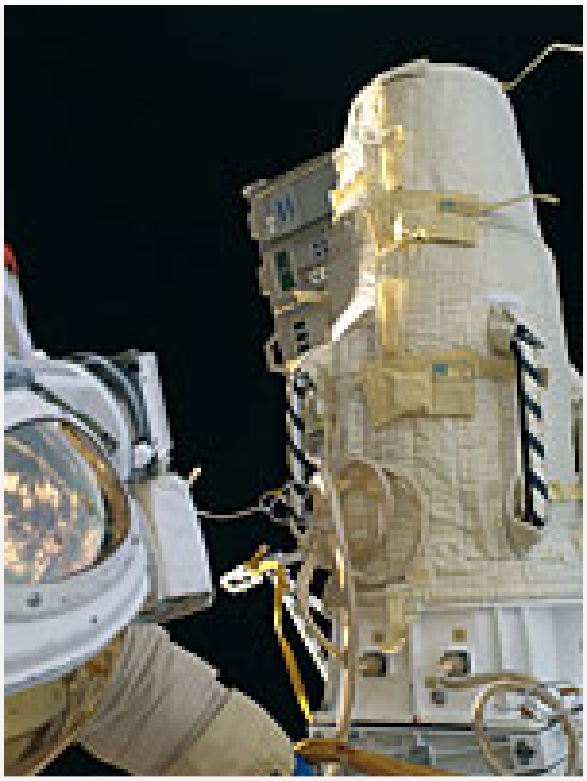
Thomas Reiter researches orientation during weightlessness

In the field of space medicine, German scientists from the Charité Hospital in Berlin (co-ordinator: A. Clarke) have already obtained important results on the way the balance system works, especially the interplay between the processes in the inner ear and the sight process to orientate yourself in space and in heart circulation regulation. Another experiment could prove that the accuracy of fine motor skills is affected when weightless which can be balanced by increased effort of thought. Doctors have also begun to work out the reasons for astronauts' immune systems to be affected in space. From this they are expecting to find out more general aspects of how the human immune system works.

Biotechnology

Biotechnology is focussing on the crystallisation of proteins in weightlessness. The basis for analysing crystal structures is the most perfect possible crystallisation of the substances to be investigated which is achieved perfectly under weightless conditions in space. Precise knowledge of the structure is a pre-requisite for understanding their properties and functions in order to optimise, for example, the pharmaceutical applications of a specific protein. Information on the structure of different molecules could actually be improved as a result of space experiments. This happened, for example, with the mistel lectin used in immune stimulation and the fight against cancer. In some cases the astronaut scientists actually achieved crystallisation for the first time with some surface bacteria proteins.

Radiation in outer space



Test Dummy in Space: the Matroshka experiment

In future researchers want to record the intensity and composition of radiation in outer space and its effect on organisms. This is another focal point of German ISS research. Using measurements taken inside and outside the space station, including those taken with *Matroshka*, developed by DLR in Cologne for ESA, they were able to gain significant information on the effect of exposure to radiation on astronauts. (Matroshka is a dummy, a mock-human of natural bone, simulated organs and synthetic skin).

2006 - Astrolab mission with astronaut Thomas Reiter

In the second half of 2006, the German, Thomas Reiter, was the first European astronaut to work on a long-term mission on board the ISS. During the six month Astrolab mission German researchers were the lead researchers in eight of the 30 scientific experiments and German institutes were involved with others. These experiments involved investigating the balance and immune systems in weightlessness, recording radiation in outer space and its biological effects and plasma physics. The mission was the start of European long-term research on the ISS.

A new era began for German scientists with Columbus. With its state-of-the-art facilities for research into biology, medicine and fluid physics and the equipment for astrobiology fitted onto the outside, Columbus will be available as the "laboratory in outer space" for the next few years of cutting-edge research under weightlessness.

Research goals for the next few years

In the next few years a large number of projects have already been identified for research in outer space. About 100 German projects have been accepted against international competition according to the best science principle and are now waiting to be implemented. As part of the primary aims of DLR's

"Research under space conditions" programme, these projects define the specific research goals for the next few years.

The Columbus space laboratory is a joint European project led by the European Space Agency (ESA). Germany was and is heavily involved in the construction, operation and use of Columbus. The Columbus Control Centre is located in the German Space Control Centre in Oberpfaffenhofen, near Munich.

You will find the research goals in the fields of biology and physics and an article on the industrial use of the ISS in the right hand column of this page in the form of .pdf documents.

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