SUCCESS STORY

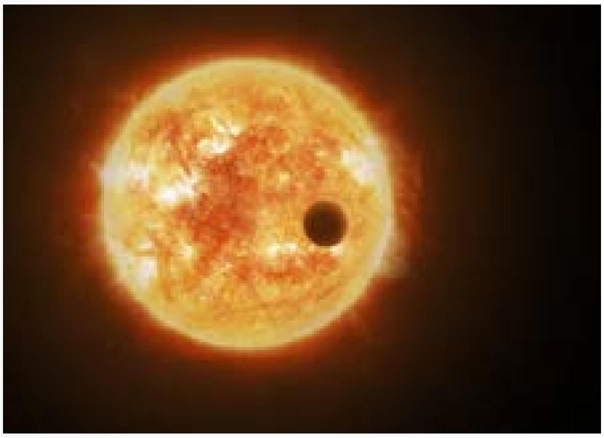
European Space Agency ESA tests CHEOPS satellite with Unistats

Aviation and space travel

Inspired by **temperature**

CHEOPS mission researches exoplanets in neighbouring star systems

Since the start of space flight in the first half of the 20th century, scientists have obtained numerous fascinating insights into our universe. The milestones of space research, such as Neil Armstrong's first step on the moon in 1969, are unforgettable. However, space still holds many secrets.



CHEOPS should provide new information about exoplanets

There are innumerable planets in neighbouring star systems, about which almost nothing is known. They are outside the gravitational pull of our sun and orbit other stars. For this reason, they are called extrasolar planets – or "Exoplanets" for short. Previously, only the properties of planets in or own solar system could be investigated with the available research methods, the characteristics of planets in other systems remained in the dark.

With CHEOPS (CHaracterising ExOPlanetSatellite), the European Space Agency (ESA) has now initiated a mission that should deliver information about these exoplanets. In close cooperation with a research institution in Switzerland, a 300-kilogram optical telescope has been created with a 30-centimetre long opening and a length of 1.2 metres.

From 2017 the telescope should collect information using the "transit method" about the currently known exoplanets: If a planet crosses in front of its central star, its brightness decreases because of the planet's shadow. In

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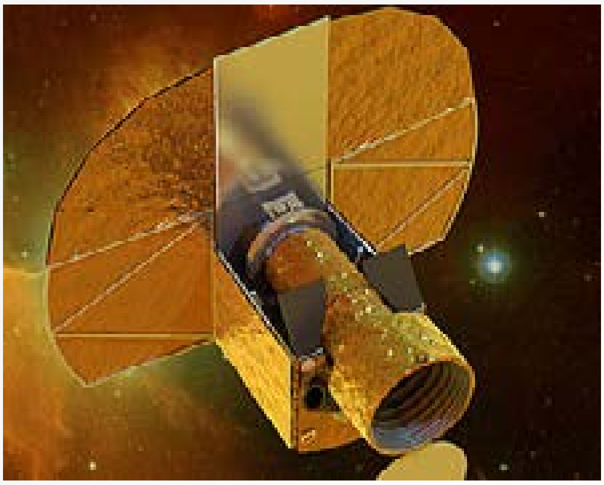

Schematic representation of the CHEOPS satellite

The chamber is insulated suitably for a clean room

this transit method, this is observed by the telescope. The diameter of the planet is calculated from the reduction in brightness. With Earth-based instruments and another method – known as the radial velocity method – the mass of the planet can also be determined. If the diameter and mass are known, the density can also be calculated. This in turn provides information as to whether the planet comprises gas, ice or rock. A large number of important figures about previously unknown planets in other solar systems can therefore be gathered with CHEOPS.

Vacuum chamber for space simulation

It is enormously important for the success of the CHEOPS mission that the telescope works highly precisely and reliably. To this end, precise preparation with a large number of tests is important. On Earth, these can only be performed in simulation chambers that create space conditions. For the CHEOPS telescope tests, a vacuum chamber is used that has been conceived specifically for this highly challenging use.

A Unistat 950w controls the temperature of the vacuum chamber, another Unistat 915w the table for the experiments

High technical requirements

The space simulation chamber for preparing the telescope for its space mission must fulfil high requirements:

› Creation of conditions similar to those in space
› High temperature range for instrument tests at extreme temperatures
› Fast change in temperature
› Low outgassing in the vacuum
› Surfaces without particulate release for tests under clean room conditions

For this, the vacuum experts at our customer developed a 5.5-tonne calibration and vacuum chamber for the CHEOPS telescope. All the specific requirements of the use were taken into account from the start. As a result, the necessary requirements can be created so that the telescope and its components can be tested and calibrated under real-time conditions.

The accurate preparation of the chamber had already started before the actual delivery: Because there must not be any reflections on the chamber walls during the optical tests of the telescope components, the interior is coated with a special black paint. This paint is also optimised for absorbing heat radiation from the test objects. During the tests in the vacuum, no chemical substance may

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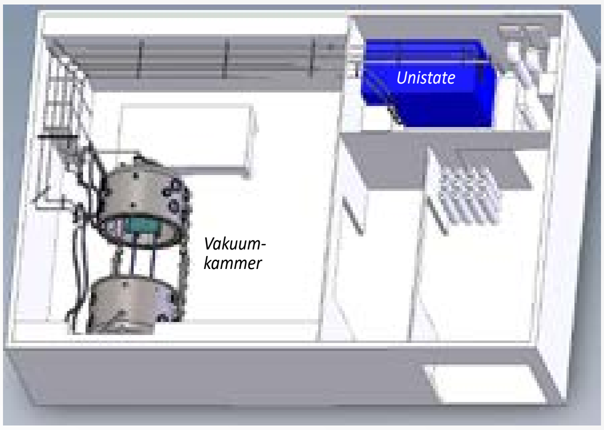
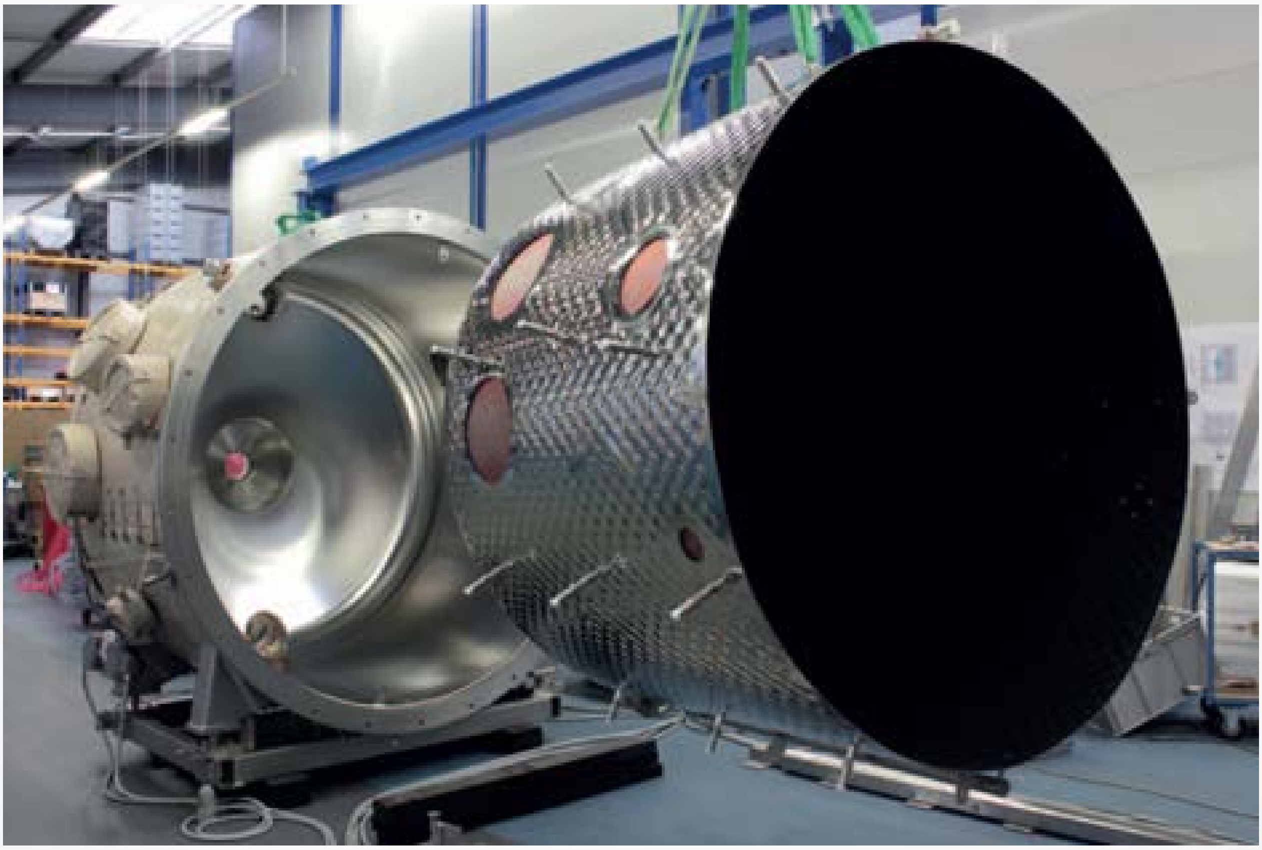
leech from the paint inside the chamber. For this reason, the vacuum specialists completely installed the chamber before delivery, commissioned it and heated it to 160 degrees Celsius for several weeks so that outgassing of the chamber surfaces could take place.

After the end of this process, the chamber was dismantled and, together with three Huber temperature control devices and the necessary vacuum accessories, was transported to the end user.



The image shows the vacuum chamber and the two Unistats, which are connected by a 15-metre long pipe. The flow temperature of the two devices is -80°C ... +160°C.



The thermal vacuum chamber is three metres long and has a diameter of 1.8 metres. The two halves of the chamber can be easily pulled apart and pushed together using a rail system.

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In the clean room laboratory at the research institute, the telescope's components were gradually exposed to temperatures in the vacuum of between -80 °C and +140 °C. Later, the structural model and then the final flight instrument were tested in the chamber.

Sophisticated vacuum system

The thermal vacuum chamber is three metres long and has a diameter of 1.8 metres. The two halves of the chamber can be easily pulled apart and pushed together using a rail system. Thanks to the vacuum and valve technology installed, the chamber can be evacuated to UHV pressure. The internal surfaces of the chamber are reflectively electropolished.

An optical table is positioned in the centre of the chamber to hold the telescope. A temperature-controlled „Shroud" surrounds the entire test volume and shields the telescope from the walls of the vacuum chamber. Towards the test object, the shroud is painted with a special black paint and is therefore optimised for the minimum absorption and outgassing. The paint „swallows" the thermal radiation from the test object in the same way that space does.

Using heating insulated suitably for a clean room, the chamber can be heated to +160 °C. The two Unistats pump a special thermofluid through channels inside and facilitate the cooling to -90 °C. Through the highly accurate control technology of the Unistats, the temperature of the thermofluid can be controlled to a few hundredths of a degree.

This vacuum chamber provides the basis for a further important step in space research. Universal testing equipment is available with it, which can be used for future satellite missions beyond the CHEOPS mission.

The components of the CHEOPS satellite telescope were tested under vacuum with a Unistat 915w.

Requirements

- Extreme temperatures -90...+160 °C
- Tests under clean room conditions
- High temperature constancy
- Reproducibility
- 15 m Pipe connection

References

- European Space Agency ESA
- Daimler
- Lufthansa
- Airbus
- Lockheed Martin

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