SIR looks for ice and minerals on the moon

Fig. 1:
The probe SMART-1 (Small Missions for Advanced Research in Technology) orbits the moon. The solar-electric drive mechanism does not require hydrogen.

Fig. 2:
Two spectrometers operate onboard SMART-1: the CIXS X-ray spectrometer and the SIR infrared spectrometer .

Fig. 3:
The SIR spectrometer onboard the SMART-1 space probe will chart the moon's surface in the infrared spectral range.

In September 2003 the probe SMART-1 of the European Space Agency ESA was launched towards the moon. The space probe has meanwhile achieved its objective with the aid of a new ion drive powered by solar energy and has been orbiting the Earth's satellite for several months. Located onboard is the SIR spectrometer of the Max Planck Institute for Solar System Research in Katlenburg-Lindau. SIR is based on an MMS NIR spectrometer of Carl Zeiss, which was modified in order to make it suitable for the requirements of space during its mission to the moon. SIR is intended to fulfill two principal tasks.

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Mapping in near infrared light

Determination of the chemical composition of the moon's surface still remains one of the most important tasks in lunar research. As on the Earth, it is also possible to estimate the proportion of silica on the surface of the moon using spectrometers and draw conclusions on the inner composition of the celestial body from this. Infrared observations of the moon from the Earth are not exactly new and have two drawbacks. Firstly, these measurements are restricted to the side of the moon facing the earth and, secondly, the measurements are distorted by the Earth's atmosphere.

The SIR spectrometer weighing just 2.1 kg is therefore the first NIR spectrometer to measure the light from the sun reflected on individual minerals of the moon's surface. This also continuously occurs at a wavelength of 0.9 to 2.4 µm on the side of the moon facing away from the earth and free of all interference. This, combined with the good spectral resolution of 18 nm, also enables SIR to demonstrate whether the much-discussed ice on the moon actually exists or not.

Exciting search for water-ice

It is universally accepted that water is an indispensable requirement for the origin of life as we know it. If there is actually water on the moon, it would have to be present in the form of ice owing to the extremely low temperatures. Scientists assume that it might exist in the polar regions or those such regions where direct sunlight never penetrates. Temperatures of around –200 degrees Celsius predominate there. The water would nevertheless not originate from the moon itself, but rather from comets which struck the moon a long time ago. Ice is especially easy to identify on account of its highly pronounced absorption spectra in infrared. Successful SMART-1 observations would therefore directly prove, without any further assumptions, that the areas flown over by the probe are really covered with ice. However, a vast amount of data, which SIR is currently recording and transmitting back to earth, must be evaluated before a definite statement can be made concerning this. The measuring period of ten minutes a day originally envisaged could be extended to between 7 and 8 hours. If all goes to plan, the probe will be in service until August 2006.

The initiative of NASA to establish a permanent base on the moon, gives the search for water a whole new dimension.

Urs Mall, Max Planck Institute for Solar System Research, Katlenburg-Lindau, mall@mps.mpg.de, http://sci.esa.int/smart-1

Chris Weikert, Carl Zeiss, Spectral Sensors, weikert@zeiss.de, http://zeiss.de/spektral

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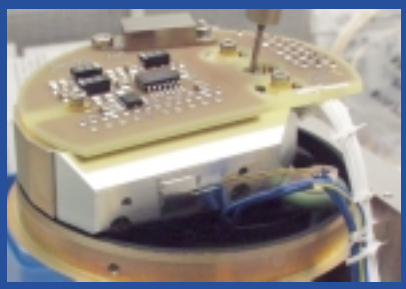

An NIR spectrometer module from the Carl Zeiss spectrometer family was modified jointly with the Max Planck Institute for Solar System Research in Katlenburg-Lindau. This serial MMS NIR is also used for quality control in the food and pharmaceutical industries amongst others. Many materials had to be exchanged for space-compatible ones. This affected the spectrometer body, for example, for which special fused quartz insensitive to cosmic radiation was used.
It also involved finding space-compatible adhesives and utilizing all opportunities for weight reduction.
SIR functions on 256 different infrared wave lengths. It is so powerful that even significantly smaller objects than previously can be examined on the surface of the moon. The SIR module – Smart-1 Near Infrared Spectrometer – is the sole German contribution to the first moon mission of the European Space Agency (ESA).


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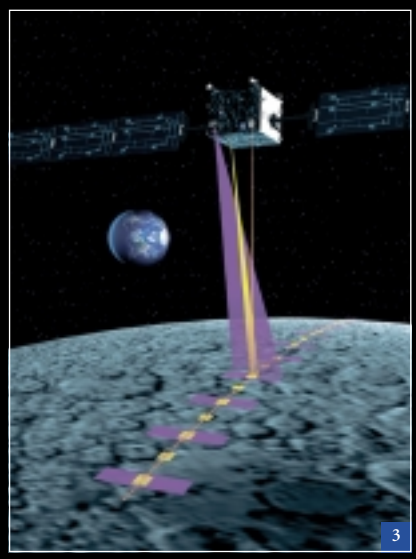
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