

Press Release

Fraunhofer IOF Supplies Optical Components for FLEX Space Mission

Precision Optics from Jena to Make Plant Health Visible from Space

Jena / Kourou (French Guiana)

When the ESA Earth observation mission FLEX launches into space on September 15, 2026, as scheduled, it will carry high-precision optical components from Jena, Germany. Researchers at the Fraunhofer Institute for Applied Optics and Precision Engineering IOF have developed and manufactured a silicon-based double-slit assembly as well as two high-precision mirrors for the spectrometer on board the satellite. The spectrometer is designed to detect the fluorescence of plants excited by sunlight from Earth's orbit. The data is expected to provide new insights into the photosynthetic activity, health, and stress levels of vegetation.

How much light do plants emit, and what can this light emission tell us about the health of the plants? The new ESA mission FLEX, scheduled to launch in mid-September, will address this question. At the heart of the satellite will be the "Fluorescence Imaging Spectrometer," or FLORIS for short. Unlike many other spectrometers, FLORIS does not operate with a single light channel but with two: One channel provides particularly high-resolution information on closely adjacent wavelengths, while the second covers a broader range of the light spectrum. This requires an extremely precise dual-slit assembly.

"The fluorescence signals emitted by plants are very weak. For FLORIS to analyze these signals reliably, the optical components must be manufactured and assembled with exceptional precision," says Dr. Falk Kemper, project manager for the FLEX project at Fraunhofer IOF. "The double slit enables a combination of high spectral resolution and broad spectral coverage. Its fabrication pushed the limits of what is technically feasible."

Precision in the Micro- and Nanometer Range

Each of the two slits in the assembly developed at Fraunhofer IOF is exactly 85 micrometers wide over a length of 44.15 millimeters—with a permissible deviation of only plus or minus one micrometer. Deviations beyond this would result in too much or too less light hitting the detector, thereby impairing the evaluation of the measurement data.

For the manufacturing process, Fraunhofer researchers developed a specialized lithographic process chain for silicon wafer structuring. The wafers were masked, patterned, and wet-etched in a time-controlled manner. The slits were then coated with a black layer to achieve the required optical properties and minimize unwanted reflections.

September 1, 2026 Page 2 | 3

The required accuracy of the slits in the mechanical holder means high demands on the assembly process: The sensitive silicon element had to be positioned in the holder with a precision of less than five micrometers, maintaining high parallelism to the apertures. The flatness of the slits had to be less than ten micrometers. A combination of form fit, clamping, and bonding ensures that the assembly can withstand the stresses of a rocket launch—including severe vibrations, accelerations, and temperature fluctuations.

In addition to the double slit, Fraunhofer IOF fabricated two mirrors that are integrated into the slit assembly. They direct the incident light onto the spectrometer's detectors. Their surfaces had to meet a roughness requirement of 0.3 nanometers rms (root mean square)—which corresponds roughly to the distance between one and two atoms.

Monitoring Plant Activity from Space

FLEX stands for "Fluorescence Explorer." The European Space Agency's (ESA) mission aims to provide global maps of plant fluorescence. The mission aims to provide global maps of plant fluorescence. This fluorescence arises during photosynthesis and can serve as an indicator of how actively plants are functioning and whether they are experiencing, for example, drought, heat, or other stress factors. Among other things, the data from FLEX are intended to improve the monitoring of ecosystems, agriculture, and forests, as well as to lay new foundations for climate and vegetation research.

The dual-slit assembly was developed and manufactured at Fraunhofer IOF under subcontract from OHB System AG. The integration of the spectrometer and other preparations for the mission were led by Leonardo S.p.A. and Thales Alenia Space. The mission is commissioned by ESA.

About Fraunhofer IOF

The Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena conducts application-oriented research in the field of photonics and develops innovative optical systems for controlling light - from its generation and manipulation to its application. The institute's range of services covers the entire photonic process chain from opto-mechanical and opto-electronic system design to the production of customer-specific solutions and prototypes. At Fraunhofer IOF, about 500 employees work on the annual research volume of 40 million euros.

For more information, please visit: www.iof.fraunhofer.de/en.html



Fig. 1: The Fraunhofer IOF double slit was fabricated from silicon. © Fraunhofer IOF



Fig. 2: The fragile slits must be installed with high parallelism relative to one another.
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Fig. 3: A Fraunhofer researcher mounts the double slit in a mechanical holder.
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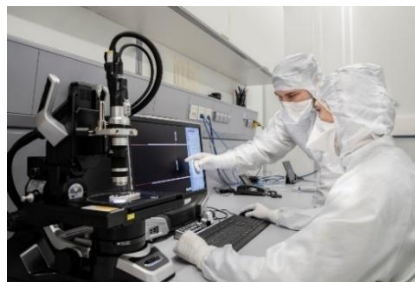


Fig. 4: Researchers at Fraunhofer IOF examine the double slit under a microscope.
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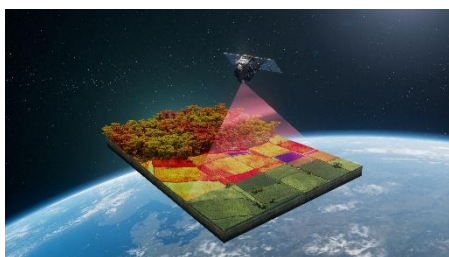


Fig. 5: The FLEX mission aims to provide global maps of plant fluorescence.
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Fig. 6: Logo of the FLEX mission
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