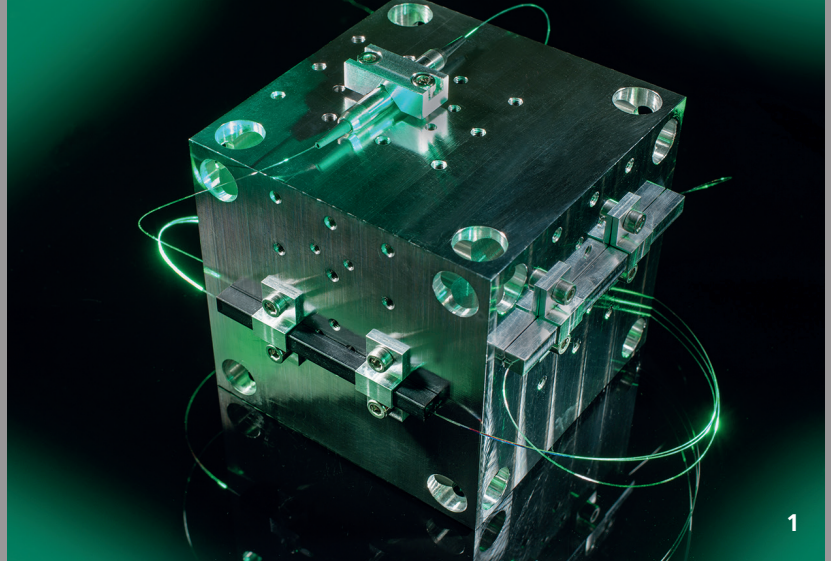

ENVIRONMENTAL TESTS ON FIBER COMPONENTS FOR SPACE APPLICATIONS

Task

For a study of the European Space Agency ESA, Fraunhofer ILT developed and built a narrowband and power-stabilized fundamental mode fiber amplifier with an output power of 500 mW to measure the earth's gravitational field.

The laser amplifier, including all components, underwent environmental testing for satellite-based operation. The aims were to clarify whether the manufacturing processes and components used in space can be qualified as well as to identify weak points.

Method

The temperature fluctuations, shocks and vibrations occurring in the storage and starting phase and during the space mission were also simulated in the tests as was the cosmic radiation during the mission. For this purpose, the fiber components were subjected to the specifications of the ESA vibration, shock, thermal vacuum and irradiation tests. Before and after the environmental tests, various parameters – such as transmission, polarization and spectral properties – were used to ensure that the components function properly.

The load on the components in the sinus and random vibration tests was up to 20 g per axis. Shock tests could be performed with an acceleration of up to 1,400 g in all three spatial axes of the component. In thermal vacuum tests, the functionality of the components was investigated in a vacuum of $< 1 \times 10^{-5}$ mbar and a temperature range of -40 °C to 50 °C. Due to the expected radiation exposure during the three-year mission of the amplifier in low-earth orbit, the components were exposed to gamma and proton irradiation.

Results

To date, Fraunhofer ILT has reviewed technological maturity levels of the fiber amplifier components and identified individual deficiencies. The test results will serve as the basis for the final qualification of the fiber amplifier.

Applications

The fiber amplifier can be used for inter-satellite communication as well as to measure the static gravitational field and gravitational waves. The methodology developed here can also be applied to other difficult fields of application.

Contact

Patricia Betz M.Sc.
Telephone +49 241 8906-623
patricia.betz@ilt.fraunhofer.de

Dipl.-Phys. Oliver Fitzau
Telephone +49 241 8906-442
oliver.fitzau@ilt.fraunhofer.de

1 Test components on mounting device for vibration tests.

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
DQS certified by DIN EN ISO 9001, Reg.-No.: DE-69572-01