



## HIGHLY STABLE FIBER AMPLIFIERS FOR GRAVITATION MEASUREMENTS

### Task

In studies conducted for the European Space Agency ESA, Fraunhofer ILT is developing linearly polarized, narrowband and power-stabilized single-mode fiber amplifiers for use in satellite-based gravitational-wave and gravitational-field measurements. Further development projects will be carried out in terms of power scaling and increasing the technological maturity level (TRL) based on a high-stability fiber amplifier from the preliminary study for the Next Generation Gravity Field Mission (NGGM), which has successfully met the specifications.

### Method

Currently, the institute is revising the design to adapt the fiber amplifier to the high requirements of gravitational wave measurement: an output power  $> 2$  W and sidebands at a distance of  $\pm 2.5$  GHz around the central wavelength of 1064 nm. The seed used is a commercial nonplanar ring oscillator (NPRO), whose signal is amplified from 10 to 100 mW by a semiconductor optical amplifier (SOA). The institute has achieved a high stability of the SOA by controlling the pumping current via an external photodiode.

1 Fiber amplifier and pump diode box of the laser for the measurement of the earth's gravitational field.

2 Active fiber in base plate.

The mechanical design was updated and the fiber optic components of various international manufacturers were tested environmentally, both of which enhanced the fiber amplifier's TRL. Then, based on the results, an advanced amplifier was built. The complete amplifier system was then tested for its space suitability in an environmental test campaign.

### Results

The necessary specifications could be demonstrated with the prototype for the gravitational wave measurement. In addition, the cw power could be scaled to within the range of 10 W. Thanks to the advanced module for gravitational field measurement, a comprehensive environmental test campaign consisting of vibration, shock and thermal vacuum tests was successfully completed.

### Applications

The innovative fiber amplifiers are used to measure gravitational waves and the static gravitational field as well as for inter-satellite communication.

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