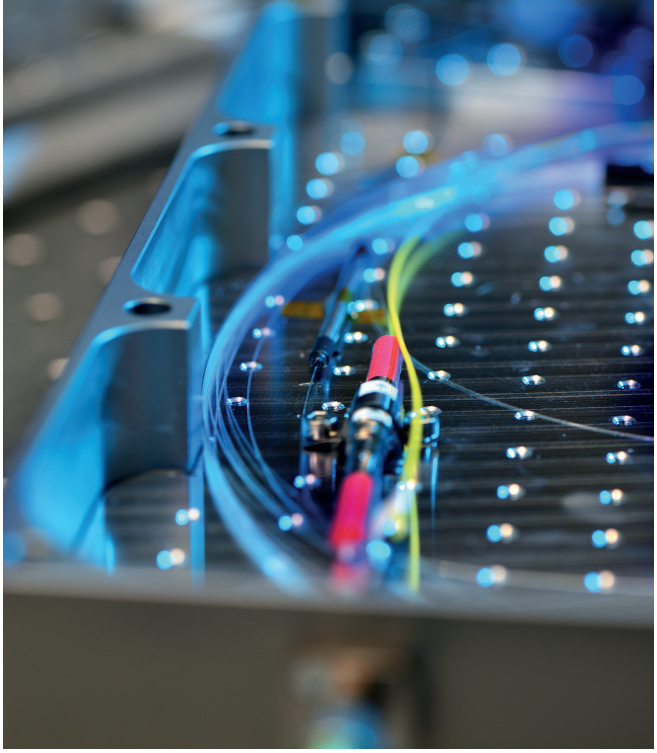

Holmium-doped fiber amplifier.

Highly stable fiber amplifiers for gravitational wave detection

Gravitational wave detectors provide an alternative access to interstellar processes, such as the collision of black holes and neutron stars, which can be detected by specific signatures in the form of gravitational waves. For next-generation gravitational wave detectors, Fraunhofer ILT is developing power-stabilized, spectrally narrow-linewidth fiber amplifiers in two projects: the LISA mission by the European Space Agency ESA and the Interreg project E-Test. While there are differences between these two applications – mainly due to the central wavelength of the radiation (1064 nm and 2090 nm) as well as the area of application in space and on earth, respectively – there is a great deal of agreement between them, especially with regard to the technology used for power stabilization.

Tailor-made fiber amplifier concepts

To meet the extreme stability requirements, Fraunhofer ILT has designed different fiber amplifier concepts while taking into account nonlinear effects, and compared the amplifiers experimentally. In all cases, a seed laser is amplified in a power-stabilized fiber amplifier to the output power required in each case.

Deployment in space and on earth

At a wavelength of 1064 nm (LISA mission), the system delivered an output power of 10 W with a spectral linewidth of < 10 kHz. In addition to meeting the power stability requirements of the LISA mission for the first time, the system successfully passed 1000-hour operational thermal vacuum tests in the current project phase. By doing this, Fraunhofer ILT can investigate how suitable the chosen components are for use in space. In parallel, a project partner is building an engineering model of the laser developed by Fraunhofer ILT. The institute successfully demonstrated amplification to more than 10 W at a spectral linewidth of about 2 MHz and a degree of polarization > 20 dB at a wavelength of 2090 nm (E-Test). The next step is the active stabilization of the output power to fulfill the stringent stability requirements.

Author: Patrick Baer M. Sc.

Contact

Patrick Baer M. Sc.
Group Manager Fiber Lasers
Phone +49 241 8906-8251
patrick.baer@ilt.fraunhofer.de