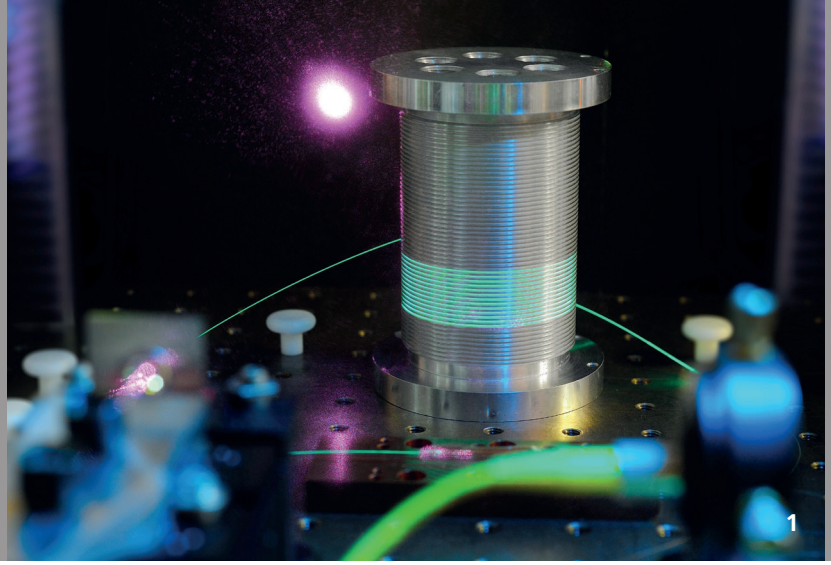



# NARROW-LINEWIDTH FIBER AMPLIFIER FOR THE INVESTIGATION OF STIMULATED BRILLOUIN SCATTERING

## Task

As part of a study for the European Space Agency (ESA), Fraunhofer ILT has developed a power-stabilized narrow-linewidth single-mode fiber amplifier with an output power of > 500 mW. The amplifier shall be used to measure the earth's gravitational field. As stimulated Brillouin scattering can destroy fiber components as well as disturb power stabilization in the existing laser system and especially in further power scaling, it shall be investigated theoretically and experimentally.

## Method

For the experimental investigation, Fraunhofer ILT built a narrow-linewidth fiber amplifier, which is used to measure both the threshold behavior as well as a temporal modulation of the signal by stimulated Brillouin scattering in active and passive test fibers. For the theoretical investigations, Fraunhofer ILT developed a numerical fiber-laser simulation tool that solves the time-, position- and wavelength-dependent rate equations. This simulation was extended to Brillouin source terms and also those of stimulated Brillouin scattering.

## Results

The fiber-integrated amplifier for seed signals with a bandwidth below 10 kHz provides an output power of 5 W, limited by the pump power, with no evidence of stimulated Brillouin scattering. The fiber amplifier was successfully used to examine the effect of stimulated Brillouin scattering on backscattered power, temporal fluctuations of the output signal as well as of its frequency shift.

Thanks to this development, designing future fiber laser systems has been simplified – with regard to further power scaling and suppression of temporal performance fluctuations – when the stimulated Brillouin scattering in the numerical simulation is taken into account.

## Applications

In addition to applications in optical measurement technology and communications, a narrow-linewidth fiber amplifier with an output power of approx. 5 W could also be used for satellite-based measurements of gravitational waves.

## Contact

Dipl.-Phys. Martin Giesberts
Telefphone +49 241 8906-341
martin.giesberts@ilt.fraunhofer.de

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

*1 Narrow-linewidth fiber amplifier with active fiber.*



Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
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