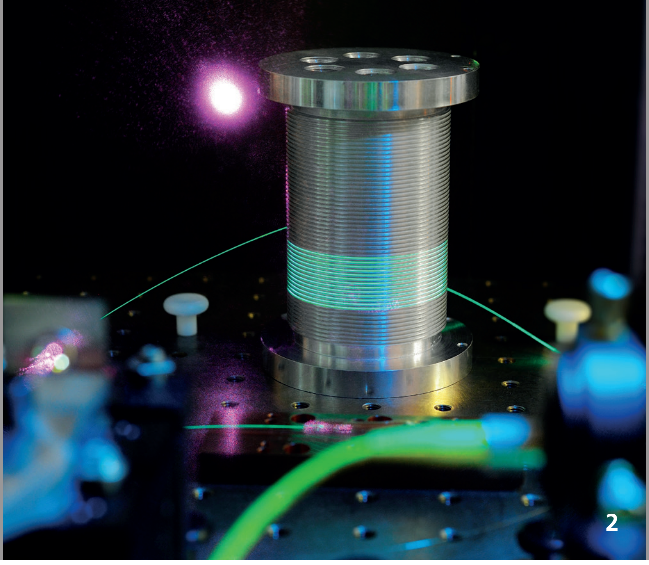

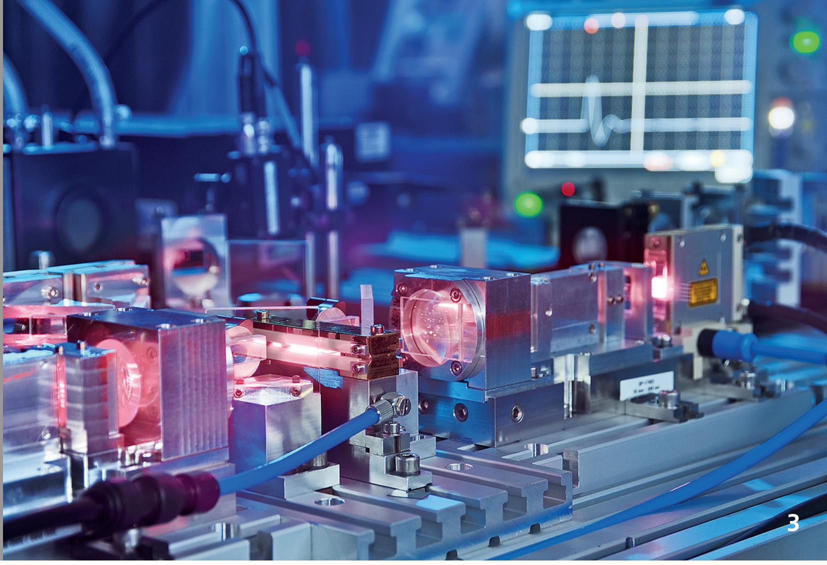

400 W INNOSLAB AMPLIFIER FOR ULTRA-STABLE SINGLE FREQUENCY LASERS

Task

Ultrastable laser sources are used in precision interferometry. They currently achieve their highest precision in length measurement in gravitational wave detectors. One way to further improve the sensitivity of these detectors is to scale the power fed into the enhancement cavity of the interferometer.

The low-noise and narrow-bandwidth high-power beam sources currently used consist of a non-planar ring oscillator (NPRO) as seed source and a downstream multistage amplifier chain based on Nd:YVO_4 rod lasers. A four-stage amplifier chain and four more amplifier modules constitute the state of the art: The latter are optionally arranged as a linear amplifier or ring oscillator and reach an output power of up to 220 W.

The aim of the work presented here is to investigate if a single-stage INNOSLAB amplifier developed at Fraunhofer ILT is principally suitable, and to achieve power values in the range of several hundred watts with an input signal in the watt range. This is intended to demonstrate a simple and highly efficient alternative to the multi-rod systems currently in use and also to fiber laser systems.

Method

The output power of a narrowband, low-noise NPRO laser oscillator has been amplified to a power of several watts by a stabilized fiber laser amplifier developed at Fraunhofer ILT, providing the ultra-stable input signal. The power is amplified with a highly efficient in-band pumped Nd:YVO_4-INNOSLAB amplifier. The radiation propagates in seven optimized single passes through the bilaterally pumped Nd:YVO_4 crystal.

Results

With input powers between 1 W and 3 W, the INNOSLAB amplifier achieved an output power of more than 400 W with a high optical-optical efficiency of more than 45 percent. In a subsequent step, the noise behavior of the amplifier system will be investigated using active control of the amplifier's pump diodes for noise suppression.

Applications

In addition to use in precision interferometry, the values achieved are attractive for applications such as the cooling of atoms in atom traps or as a beam source for subsequent nonlinear frequency conversion as well as the coherent superposition of multiple beam sources.

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2 Highly stable single-frequency fiber amplifier with active fiber.

3 Single stage 400 W NdYVO_4 laser amplifier.