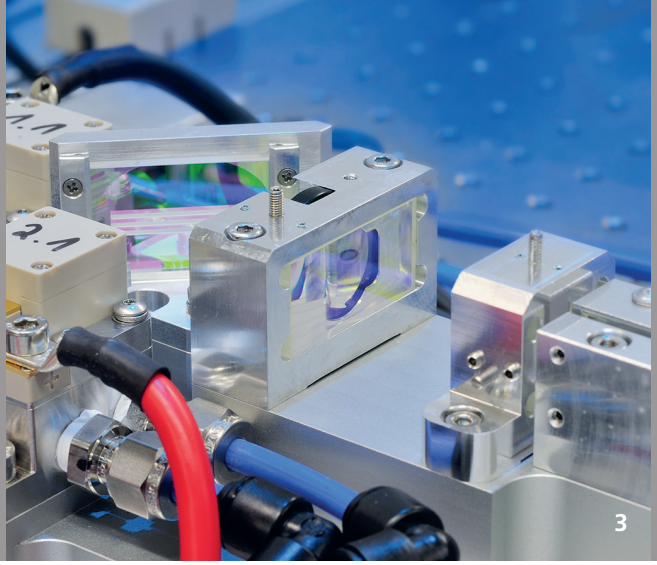

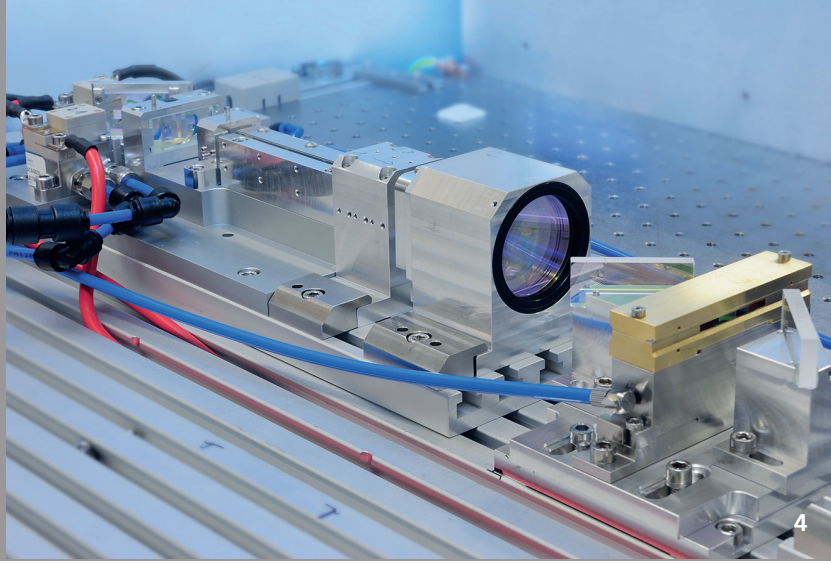

ER:YLUAG INNOSLAB AMPLIFIER AT 1645 NM

Task

To detect methane in the atmosphere, the Franco-German climate mission »MERLIN« requires single-frequency laser pulses at a wavelength of 1645 nm with a pulse energy of > 9 mJ with pulse durations between 10 ns and 100 ns. In addition to the approach pursued in »MERLIN« – to obtain this by frequency conversion of pulses at 1064 nm in optically parametric steps – erbium-doped garnet crystals as laser media can also be used to directly generate these pulses. The aim is to reduce the complexity of the beam source with comparable or higher efficiency. First, however, a feasibility study has to be conducted.

Method

Single-frequency laser pulses from a diode-pumped rod oscillator with a pulse energy of 4 mJ and a pulse duration of 80 ns are scaled in the pulse energy in an INNOSLAB amplifier. The amplifier crystal is an erbium-doped YAG/LuAG mixed crystal, in which the maximum of the emission cross-section is precisely matched to the measurement wavelength of 1645.2 nm (in air) through the mixing ratio (crystal field tuning). This crystal is pumped with four stacks, each consisting of four wavelength-stabilized diode laser bars, at a wavelength of 1532 nm. The two stacks are superposed geometrically through so-called interleaving by means of slotted coupling mirrors. The filling factor is thus doubled and the polarization retained. The pumping light transmitted in the first crystal passage can thus be reflected again into the crystal by polarization rotation.

Results

The laser pulses from the oscillator are amplified up to a pulse energy of 12 mJ in nine single passes through the amplifier crystal, which is currently limited by the absorbed pump power and the fluence attainable. In both beam axes, the measured diffraction index M^2 is < 1.1. The spectral properties attained experimentally also fulfill the requirements for the satellite-supported detection of methane.

Applications

The beam source constitutes a technology demonstrator for possible further future developments of LIDAR instruments for methane detection. Based on the work conducted to date, the erbium-based system has a scaling potential towards larger pulse energies up to about 30 mJ.

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3 Geometric superposition of the pump sources.
4 INNOSLAB amplifier with pump-beam shaping.