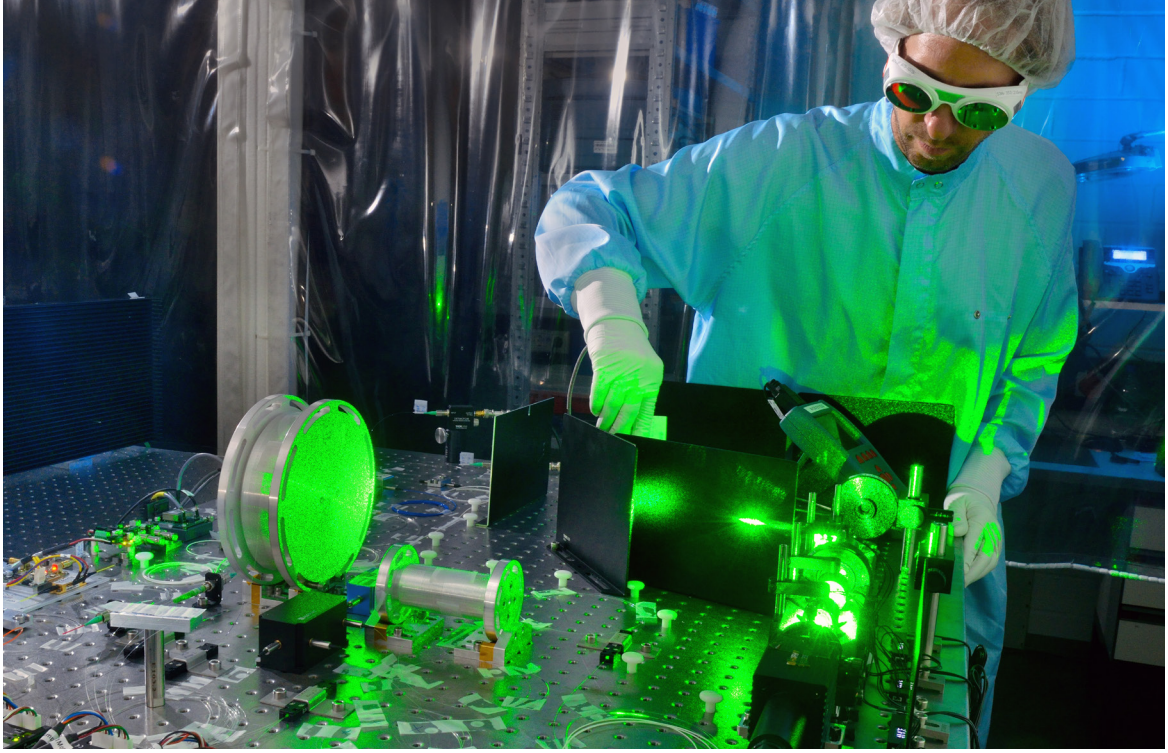

1 Laboratory demonstrator of the frequency-converted fiber laser.

Frequency-converted fiber amplifier for atmospheric research

Nitrogen oxides play an important role in atmospheric chemistry and their measurement provides important findings for air quality and for understanding climate change, among other things. The Institute of Energy and Climate Research at the Forschungszentrum Jülich is investigating tropospheric photochemistry using state-of-the-art physical measurement technology. For laser-induced fluorescence measurement of nitrogen oxides in the atmosphere, Fraunhofer ILT will develop and build an appropriate beam source by evaluating, adapting and improving an existing laser design. Subsequently, Fraunhofer ILT will set up a laboratory demonstrator by combining a fiber amplifier with a frequency conversion unit, which generates the required pulsed laser radiation with peak powers of > 1.5 W and with a wavelength of 215 nm in the deep ultraviolet.

Laser concept

The laboratory demonstrator consists of a polarized, three-stage fiber amplifier with a linewidth of < 10 MHz and a three-stage frequency conversion to convert the infrared wavelength to the deep ultraviolet. The fiber amplifier is seeded with a DFB diode at 1074 nm; the diode is pre-amplified with an electrically pulsed semiconductor amplifier to generate the 2 to 3 ns long pulses and then post-amplified in a core-pumped, regenerative fiber amplifier and two cladding-pumped linear fiber amplifiers. The individual amplifier stages are separated from each other by Faraday isolators. The required output wavelength is achieved with a subsequent frequency conversion unit, consisting of a frequency doubling from 1074 nm to 537 nm and two-stage sum frequency generation over 358 nm to 215 nm.

Results

By adapting and optimizing the fiber amplifier design, Fraunhofer ILT was able to demonstrate all target parameters. Furthermore, the peak power in the infrared was tripled and thus the peak power in the deep ultraviolet was increased disproportionately to > 6.5 W. The laboratory demonstrator was delivered to Forschungszentrum Jülich and can be used there for experimental studies in the future. This work was funded by the BMBF as part of the FONA strategy "Research for Sustainability" in the project "ACTRIS-D: National Facilities."

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