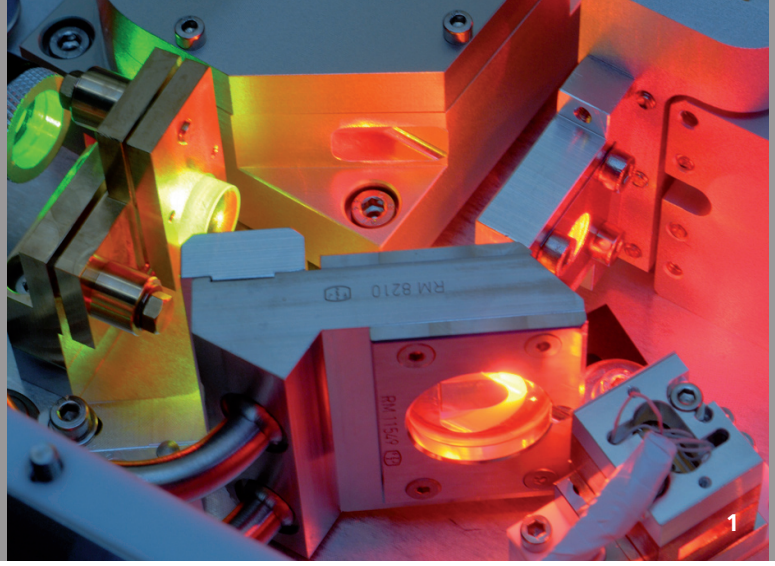

TUNABLE UV LASER FOR AIRBORNE MEASUREMENTS

Task

Measurements of climate-relevant gases make a valuable contribution to our understanding of atmospheric processes. The hydroxyl radical plays an important role in the decomposition of pollutants in the air and is relevant to predicting phenomena such as smog. The Institute for Energy and Climate Research – Troposphere (IEK-8) of Forschungszentrum Jülich GmbH (FZJ) is using a tunable dye laser with intracavity frequency doubling and an emission wavelength of 308 nm to measure hydroxyl radical concentrations using laser-induced fluorescence (LIF). Since the radicals are extremely short-lived, measurements must be taken at the relevant altitudes. Therefore, the laser is mounted on top of an airship. Temperatures of 10 - 40 °C and ambient pressures of 800 - 1000 hPa occur when measurements are taken up to an altitude of 1500 m. The laser system previously used was unable to take continuous measurements under these operational conditions.

Method

First, the previous laser was analyzed in terms of current shortcomings. This involves both a theoretical tolerance analysis of the optical design as well as experimental testing of the components and the entire laser system in a climatic test chamber at Fraunhofer ILT.

To increase stability against environmental influences and to create power reserves, experiments were conducted on the optical redesign and the stability of optimized components tested in temperature cycles.

Result

Based on the results of the analyses and experiments, an optically, thermally and mechanically stable design was implemented together with the Forschungszentrum Jülich. This setup provided continuous LIF measurements over several weeks as part of the European PEGASOS campaign.

Applications

The methods and results of the theoretical and experimental analysis of the laser can be applied to other laser systems. Thereby, for the layout of a new or the revision of an existing optical design, the susceptibility to changes in environmental conditions can be decreased.

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1 Resonator of a tunable dye laser with intracavity frequency doubling.

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