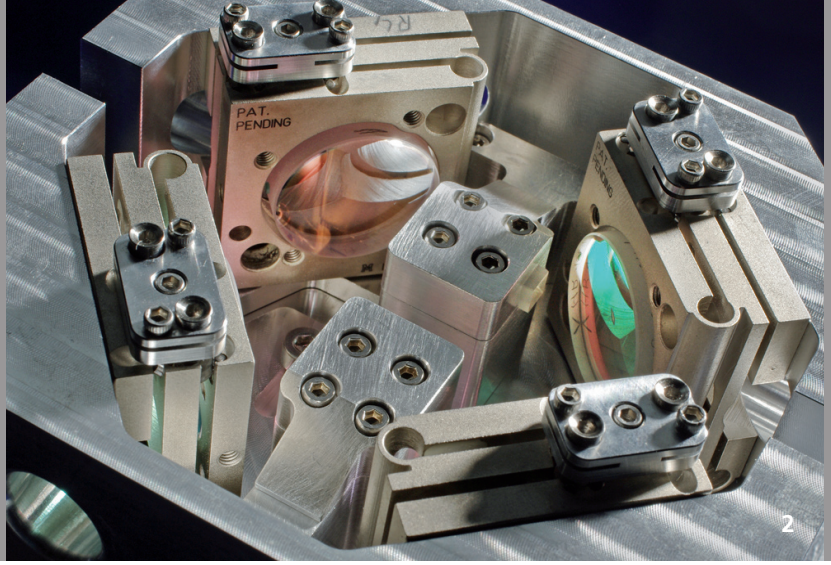

OPO FOR A SATELLITE-SUPPORTED METHANE LIDAR

Task

As a greenhouse gas, methane has a significant impact upon climate change. By comparison, however, the global distribution, the origin and the decomposition of this gas have been researched very little. Within the scope of the German-French climate mission MERLIN, a satellite-supported LIDAR system should be used to collect detailed data with global coverage. As a transmitter, a Q-switched Nd:YAG laser as a driver laser will be combined with an optical parametric oscillator (OPO) as a frequency converter. The OPO shifts the laser output wavelength from 1064 nm to that of methane absorption at 1645 nm. In parallel to this driver laser, an OPO is being developed at Fraunhofer ILT, which fulfils the requirements of the satellite mission on efficiency and frequency stability as well as mechanical stability.

Method

The optical design of the OPO is based on a concept of the German Aerospace Center (DLR-IPA) in Oberpfaffenhofen, Germany, and was optimized at Fraunhofer ILT by means of numerical simulations, in order to enable the required output parameters while loading the optic components minimally and with high adjustment stability. For the testing in the laboratory, an Nd:YAG-based MOPA system is used as a driver laser, which generates pulse energies of more than 30 mJ at pulse durations of 20 ns and a repetition rate of 25 Hz. Through an active control, the laser runs in longitudinal single-mode operation. These pulses run through a seeded, single-resonant OPO, which consists of four mirrors and two KTP crystals. The position of one mirror is moved with a Piezo element, in order to adjust the resonator length of the OPO to the signal wavelength. This way, the OPO again provides a longitudinal single-mode signal.

Result

The behavior of the OPO corresponds well with the calculations. From a pump energy of 30 mJ, a signal energy of 9 mJ is generated with a stable frequency. After the required laser parameters were demonstrated in the laboratory, the development of a highly stable set-up will follow, one which is based on monolithic mounts and soldered optics.

Applications

The optical design as well as the developed simulation tools and mechanical components can be used for OPOs in other wavelength ranges. This way, a large number of relevant gases can be detected.

Contact

Dr. Jochen Wüppen
Telephone +49 241 8906-8020
jochen.wueppen@ilt.fraunhofer.de

Dr. Bernd Jungbluth
Telephone +49 241 8906-414
bernd.jungbluth@ilt.fraunhofer.de

2 Laboratory set-up of the single frequency OPO.