**DETAIL SIMULATION OF A PARAMETRIC FREQUENCY CONVERTER FOR THE »MERLIN« MISSION**

**Task**

Within the Franco-German climate mission »MERLIN«, the methane distribution in the earth’s atmosphere shall be measured by satellite. For this purpose, the backscatter signal of laser pulses is measured with two different wavelengths on and close to a methane absorption line. For the laser transmitter, an optical parametric oscillator (OPO) is used, which alternately converts the laser pulses at 1064 nm input wavelength to 1645.5518 nm (online) or 1645.846 nm (offline). The OPO must provide the required pulse energy (9 mJ), efficiency (30 percent) and beam quality (M2 < 3) with precisely tuned beam characteristics at both wavelengths.

**Method**

Fraunhofer ILT will build a robust flight hardware with a mounting technology specially developed for space applications. The software tools used for the optical design of the OPO are also proprietary developments that enable a realistic and precise prediction of relevant beam properties.

**Results**

The detailed OPO simulation shows that the spatial beam characteristics of the OPO at the on- and offline wavelengths can differ significantly and to an extent that affects the measurement performance of the LIDAR method, if solely the pulse energy, efficiency and surface loading of the design are optimized. For example, the direction of both beam lines of sight can easily differ by more than 200 μrad while at most 40 μrad are tolerated. Only the targeted analysis and adaptation of all design degrees of freedom in the computer model make it possible to identify working points that actually fulfill all the requirements of the mission at the same time. An experimental search for this parameter set would be uneconomical and not useful when time concerns are taken into account.

**Applications**

The simulation tools developed by Fraunhofer ILT serve not only to optimize the MERLIN OPO but also to redesign or optimize the performance of other laser beam sources with output wavelengths from UV to MIR.

As part of the satellite project »MERLIN«, a cooperation between DLR Space Administration and CNES, Fraunhofer ILT is developing the beam source – the »Laser Optical Assembly« – of the laser transmitter on behalf of Airbus DS GmbH.

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**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

3 Technology demonstrator of the OPO.