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FIRST MEASUREMENT CAMPAIGN WITH A COMPACT LIDAR SYSTEM BASED ON AN ALEXANDRITE LASER

Task

At the Leibniz Institute for Atmospheric Physics (IAP), mobile resonance lidar systems are used to measure wind and temperature profiles of the atmosphere up to altitudes of 110 km. By using multiple systems with overlapping observation areas, Leibniz IAP can acquire a lidar network with unrivaled resolution and coverage. These data need to be collected at remote locations under harsh environmental conditions, e.g. in polar or tropical regions, over long periods of time. Therefore, rugged lidar systems must be compact, easily transportable, and operate autonomously with low maintenance. Using novel highly efficient alexandrite lasers and innovative lidar technology, Fraunhofer ILT and the Leibnitz IAP have developed a versatile, compact lidar system (~ $1 m^3$) that could be mass-produced cost-effectively.

Method

As part of a long-term collaboration with Leibniz-IAP, Fraunhofer ILT has developed the lidar emitter based on diode-pumped alexandrite lasers, built two prototypes and integrated them into a novel highly compact lidar system. An initial two-month measurement campaign was conducted with the lidar system during the winter. The institutes developed and tested methods for controlling the emitter and data acquisition with the lidar system. For this purpose, wind profiles with high resolution were recorded using aerosols up to an altitude of 30 km and compared with reference data. In addition, the reference wavelength of potassium was addressed and the potassium layer was investigated at an altitude of up to 110 km.

Results

The operation of the lidar system under realistic conditions was successfully demonstrated. Neither was performance degradation noticeable, nor was maintenance required during more than 1000 hours of measurements. The results of the wind measurements were compared with reference data and the higher accuracy and resolution were verified. In addition, the potassium layer could be measured for the first time at an altitude of up to 110 km during daytime. Thanks to the proven design and a new pump source, the pulse energy could be increased by a factor of three in laboratory tests. Two further highly compact prototypes of the next generation are currently being built with the increased energy, but unchanged dimensions.

Applications

The resonance lidar will initially be used for ground-based measurements of temperature and wind profiles. An array of lidar systems provides large area coverage. The potential for satellite-based use is currently under discussion.

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2 Alexandrite laser integrated in the lidar system.