Institute of
Technical Physics

Validation of a field-deployed detection system for angular light scattering measurements under natural weather conditions

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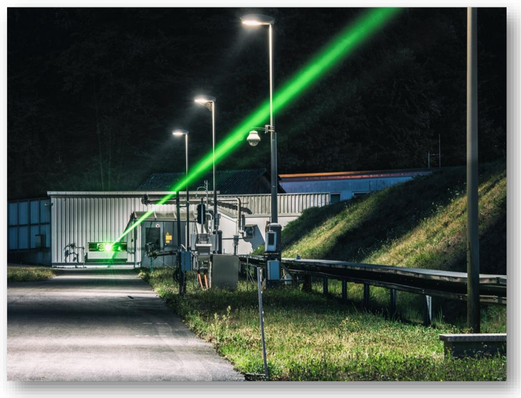
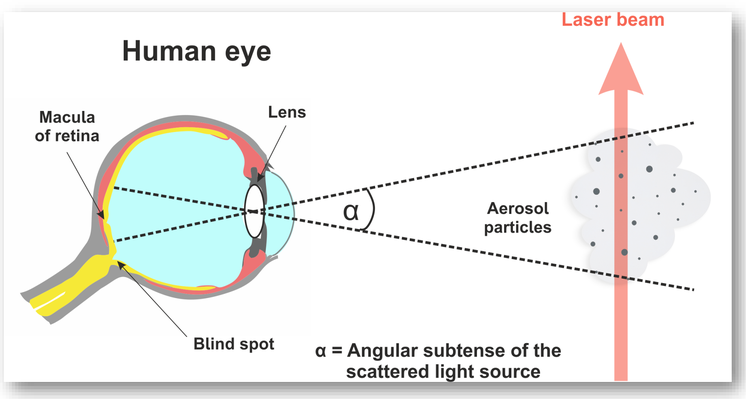
Motivation

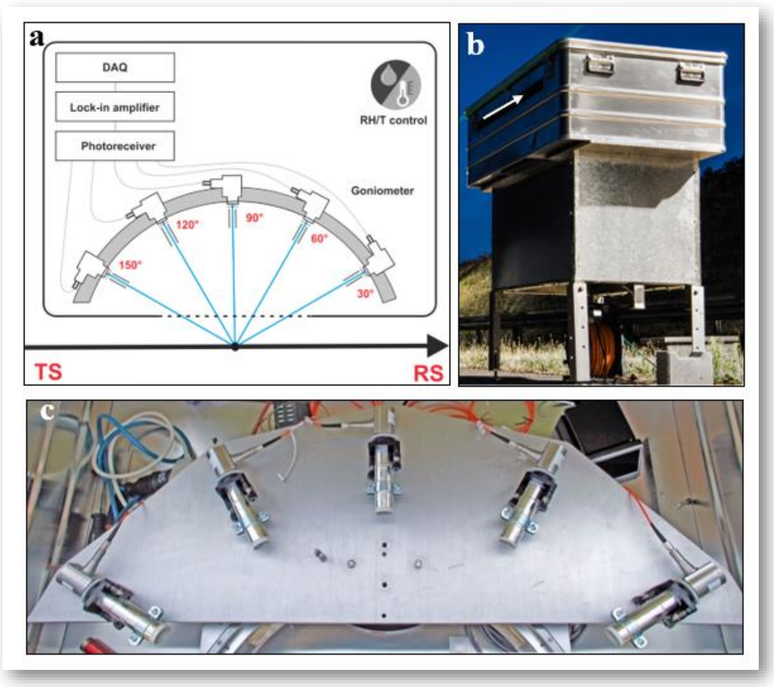
- Free-space propagation of high-power lasers raises the question of laser safety due to exposure of scattered laser radiation
- Off-axis scattered radiation due to atmospheric particles can be a potential threat to the human eye of operators and thirty parties in close vicinity to the laser source





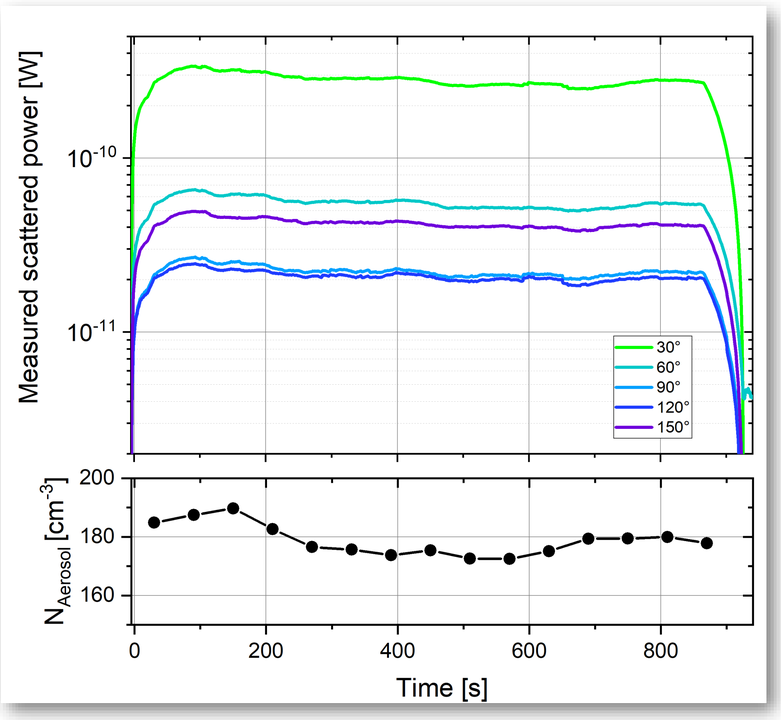
Experimental setup

- To determine the absolute scattered radiation relative to the laser beam direction, an optical detection system has been developed



- Scattered radiation is collected via off-axis parabolic (OAP) mirrors and detected with photoreceivers at scattering angles of 30°, 60°, 90°, 120°, and 150°
- Each of the detection units is radiometrically calibrated to obtain absolute powers
- The detection system is housed in a weatherproof box at the DLR test range

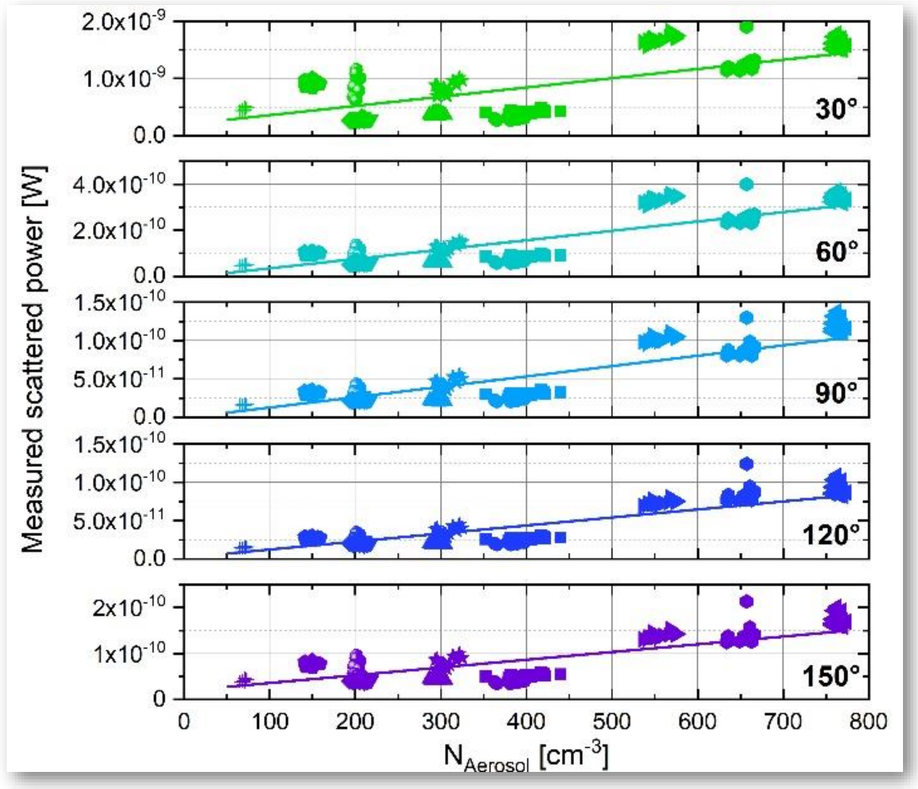
Times series of scattered radiation



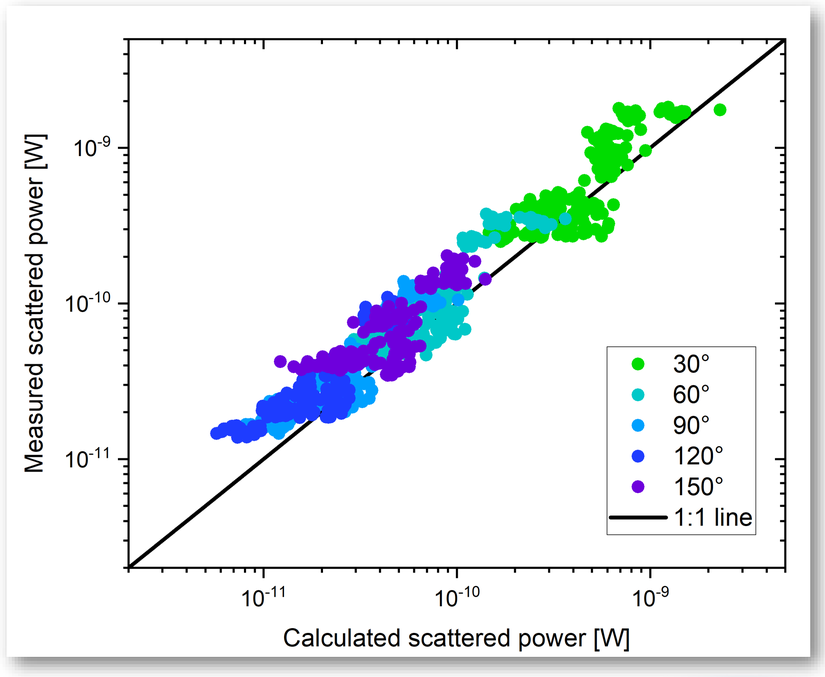
- Higher scattered powers are observed in the forward and backward direction and lower scattered powers in the sideward direction under clear weather conditions
- Less structured curves of scattered powers reflect a slightly changing number concentration of aerosol particles with time

Correlation of scattered radiation with aerosol particle concentration

- For clear weather conditions, the measured scattered powers are linearly related to the total number concentration of aerosol particles in the range from 0.18 µm to 18 µm



- Calculated scattered powers based on measured number size distributions and Mie theory are in reasonable agreement with experimental scattered powers for clear conditions
- Deviations come from an inaccurate knowledge of the chemical composition of the particles and different detection methods (single vs. ensemble)



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