ANGULAR-SCATTERING MUELLER-MATRIX MEASUREMENTS OF A PARTICULATE SAMPLE MEDIUM

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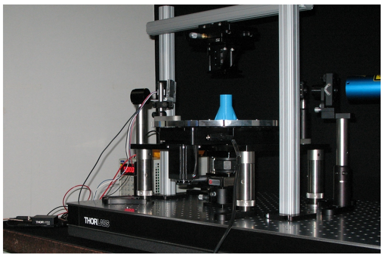
We develope an instrument for measuring the scattered light from an object with a size varying from micro- to millimeters. We obtain the full Mueller matrix response of the target for all observation geometries, excluding direct backscattering. We cover several discrete wavelengths across the visible range of the spectrum. The incident light is generated using lasers, and the polarization state of the incident light is controlled with a linear polarizer and a half-wave plate. The target is controlled with an ultrasonic actuator, implying that the sample levitates in the measurement volume.

As the laser beam is incident on the object, part of the incident power is absorbed and scattered. We employ efficient micro-PMTs featuring polarization-controlling filters around the target. We mount the micro-PMTs on a turntable, which permits us to cover nearly all scattering angles in a scattering plane around the target while using a small number of micro-PMTs (see Fig.). By controlling the polarization state of both the incident and the scattered light, we can derive all the elements in the 4×4 Mueller scattering matrix of the sample.

Ultrasound provides solutions to trap, levitate, and even rotate samples without physically touching them. We employ the latest design of symmetric and asymmetric traps enhanced with the acoustic screw-driver concept. The ultrasonic part is electrically synchronized to the illumination and receiver part of the scatterometer. The acoustic part allows for particles with sizes varying from micron and submicron scales to millimeter scales.

Having the full scattering matrix of the particulate sample provides extremely important input to any realistic light-scattering model, e.g., predicting radiative transfer in a macroscopic medium consisting of such particulate samples (e.g., [1]. Our main goal is to utilize the scatterometer in the experimental validation of a novel numerical method for multiple scattering by particulate samples.



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[1] K. Muinonen et al., Astrophys. J. **760**, 118 (2012).