Optical polarization studies of latex beads in aqueous solution: An analog for radar scattering in lunar icy regolith

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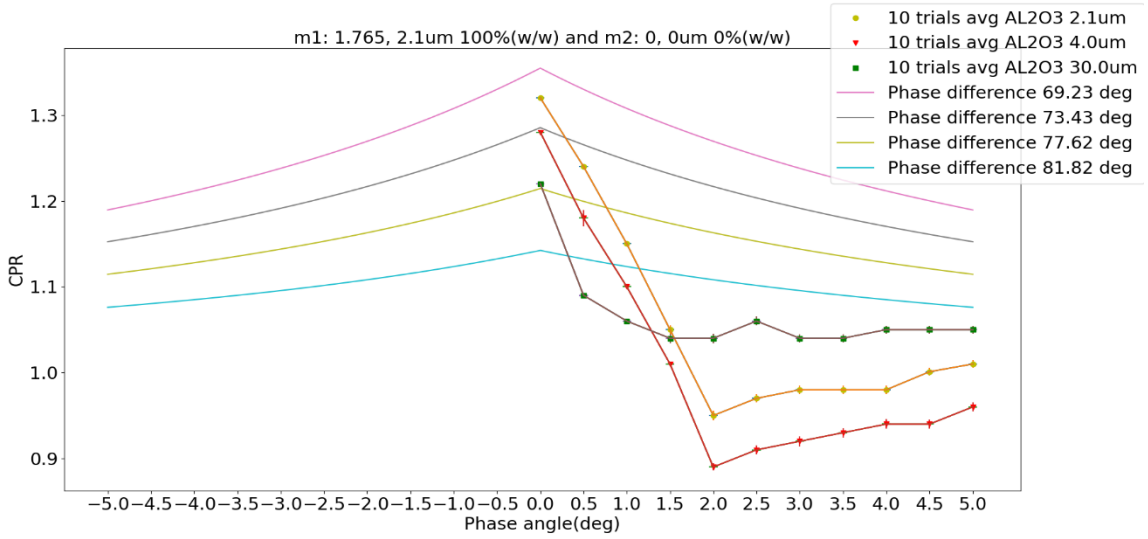
Background: On the Moon there are permanently shadowed craters at both poles, acting as cold traps due a combination of the Moon's small axial tilt and large variation in the topographic relief near the poles [1]. Permanently shadowed craters are very cold, only receiving heat from light scattered from high-standing topography, background stars, and from the Moon's geothermal flux. Therefore, areas containing water ice mixed within the lunar regolith may be stable for billions of years [2]. Radar observations of some polar craters of the Moon reveal unusually high CPR (circular polarization ratio). Models for high CPR are based on radar waves traveling in opposite directions in a weakly absorbing medium (such as water ice) that add coherently, resulting in high CPR [3]. The purpose of this research is to understand the physical process behind the polarimetric anomalies using a Multi-Axis Goniometer Instrument (MAGI), to collect polarimetric data from latex beads solutions at various concentrations using a 1064 nm right-circular polarized laser. To test the reliability of the instrument, low phase angle polarimetric data of standardized WCA Micro Abrasives Corp Al2O3 powders are collected and compared to the results from the literature. Aqueous solutions of micro-beads of various sizes and concentrations are used as optical analogs for icy regolith because polarization is very sensitive to the size, concentration, and shape of the scatterers. Polarimetric data are collected at emergence angles that prevent interference from specular reflections from the surface of the sample. To aid in understanding the experimental data, scattering theory is used as a framework for a model based on the propagation of Stokes vectors through a random walk in a polydisperse system. This paper will compare the experimental results to the model and literature.
Primary results:



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