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Imaging Polarimetric Measurements on porous materials : sands and basaltic soils

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The Moon and other atmosphereless celestial bodies present varied phase curves of linear polarization whose interpretation is still poorly constrained due to the limited availability of experimental datasets. A new facility able to produce imaging polarimetric measurements has been recently implemented in our institute. We carried out a campaign of observations on lunar and martian simulants (JSC1), with variable grain sizes, on basaltic soils, and on different types of sands. Polarization degree is derived from measurements at different angles. These observations are made at one selected visible wavelength (699nm) for a variable set of geometric conditions in terms of incidence and emergence angles, which may be in different planes of observation, leading to a range of phase angles comprised between 40 and 120° which permits to explore the behavior of the positive branch of the polarimetric phase curve.

For the basaltic soil, lunar and martian soil simulants, we find with varied grain size distributions, rather classical behaviors, with a positive branch toward large phase angles, reaching a maximum around 100°, and an overall trend consistent with the extrapolated occurrence of a negative polarization branch below 20° phase angle, which is out of our measurement range. There is a general agreement with measurements performed at 632nm on deposited JSC1 mars analogue sample by the PROGRA2 instrument. For these samples, an inverse correlation between albedo and polarization degree at large phase angles is found, in agreement with the general relationship referred to as Umov's law. In particular for a given material, the finer the grain size, the higher the albedo and the lower the polarization degree at large phase angle. Measurements on our sand samples, originating from the desert of Oman and from the Fontainebleau site (France), are underway. These preliminary results raise interesting questions on the current understanding of the polarimetric properties of regolith-like porous powdered materials and on the systematics of the polarimetric curve. We question whether the geometry of acquisition may not be critical, as in our case, a number of observations have been performed with a mirror geometry for incidence and emergence angles, since it has potential implications for interpreting telescopic observations of planetary objects, as is the case with the lunar surface.