DEVELOPMENT OF REGOLITH REFERENCE SURFACES FOR LABORATORY STUDIES. A. Collette[1], [1]R. Dee, M. Horanyi[1], D. James[1], S. Kempf[1], T. Munsat[1], Z. Sternovsky[1], C. Dreyer[1,2,] A. Abbud-Madrid[1,2] ([1]SSERVI Institute for Modeling Plasma, Atmospheres, and Cosmic Dust, University of Colorado, [2]Center for Space Resources, Colorado School of Mines)

Introduction: Experimental studies of the interaction of the lunar regolith with the environment have been almost exclusively based on simulants (JSC-1, MLS-1), which only reproduce some aspects of the genuine regolith. The chemical and mineralogical properties (including moisture and ice content), the surface roughness, the effective surface contact area, or the effective packing fraction, for example, all might have large effects on the results of dust impact, dusty plasma, or ISRU related experiments. The number of parameters that define all of the critical physical and geotechnical properties of the regolith can be very large, which creates a complicated and potentially intractable problem to isolate and assess the effects of any individual characteristic through experiment. We therefore describe a family of simplified but well characterized regolith reference surfaces.

Regolith reference surfaces: Surfaces under development at IMPACT consist only of glass spheres of defined size distributions and ice content, reducing the number of parameters to only three (two parameters characterizing the size distribution and one parameter describing the water content). Initial experiments will address the effects of these three parameters will be comprehensively explored, including their response to hypervelocity dust impacts, UV and plasma exposure, and geotechnical properties for ISRU potential. The size distribution of the IMPACT regolith reference surfaces is defined by two parameters: the size cutoff for the smallest particles within the distribution and the exponent in the power-law distribution. We have performed a feasibility study demonstrating that these power-law distributions and cutoff sizes are possible using only standard, commercially available materials. As an example, Fig. 1 shows the individual size distributions from various commercially available glass spheres in size ranges from 0.25μm to 100 μm, and the resulting power-law distribution created with an appropriate admixture spanning up to 10 μm diameter. Dry mixtures will be mixed with a paddle stirrer and gently stirred for 1 minute to attain homogeneity of all sizes. A sample from the resulting mixture will be evaluated using a Mastersizer 2000 particle size analyzer, which measures particle size distributions from 0.02 μm to 2 mm with 1% accuracy using combined Mie and Fraunhofer scattering. The third parameter of the IMPACT regolith reference surfaces is their ice content. We will produce samples ranging from pure water ice to ice with regolith contamination to dry regolith. Fig. 3. illustrates the 3-axis parameter space that will be created in this manner. Initial ice-regolith samples will be created by mixing the desired distribution of microspheres with pure water. We will adopt standard mixing techniques used in the pharmaceutical industry, where similar size distributions of organic materials are regularly handled over a wide range of conditions. The mixture will then be flash frozen in liquid nitrogen, which prevents the formation of crystals.

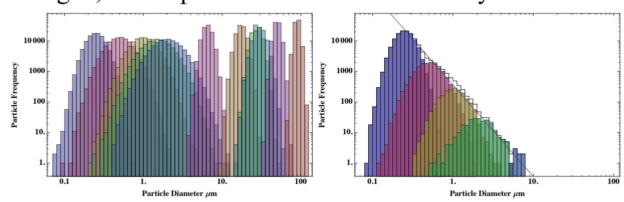

Figure 1. *Left:* Size distributions of commercially available glass sphere samples from 0.25 μm to 100 μm. *Right:* IMPACT will mix these samples to produce “standard surfaces” with a well-defined size distribution. As an example we show a mixture of particles with d > 0.1 μm with a power-law exponent of 3, created from the the samples shown in the left figure.

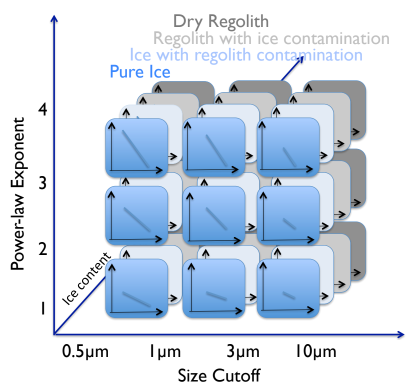

Figure 2. Standardized regolith samples will be used in to study the effects of dust impacts, UV and plasma charging, and geotechnical properties for ISRU. The regolith samples are based on pure silica glass spheres that are combined to match power-law size distributions and cutoff smallest sizes. Their water content will range from pure ice, to regolith contaminated ice, to ice contaminated regolith, and dry pure regolith.