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## Paper Session II-A - Results of a Wheel Electrometer for Measuring the Triboelectric Properties of Martian Regolith

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# Results of a Wheel Electrometer for Measuring the Triboelectric Properties of Martian Regolith

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## Abstract

The preliminary results of a prototype Wheel Electrometer System (WES) are presented that show that it is indeed possible to use the static electricity generated between polymers and soils after contact (triboelectricity) as a means of detecting property changes. Changes in the triboelectric signals offer information as to the mechanical properties of the soil such as grain size differences, texture, hardness and even moisture content. Initially, four polymers are chosen that span the triboelectric series such as Teflon, Lucite, Fiberglass and Lexan. It is shown that the average charge on Teflon is much higher when rolled over beach sand as compared to Martian simulant and limestone. Lucite was the most susceptible to particle size differences, while Lexan was able to detect underlying materials in the case of a soil lightly covered with a different soil type. All polymers responded differently when rolled over dry soil compared with moist soil. This information can be used as a type of “triboelectric spectroscopy” when a library of data is used to categorize the unique charging characteristics of individual polymers. This system is of great interest to planetary scientists and such measurements may be included in future Mars rover missions.

## **Progress Toward Electrostatic Radiation Shielding of Interplanetary Spacecraft**

Phil Metzger, NASA-Kennedy Space Center

Particle radiation remains a significant obstacle to human exploration of space. The sources of this radiation differ in variability, predictability, fluency, and isotropy. Because the most hazardous radiation is isotropic, it has been assumed that radiation shields must also be isotropic to protect the crew. Passive (materials-based) shielding technology has made significant progress but continues to be a costly in-flight option due to the required mass. Magnetic shielding has not come of age because it requires superconducting coils that are not only heavier than passive shields but contain single-point failure mechanisms and remain a technological challenge. However, electrostatic shielding has been largely overlooked because isotropic repulsion of the protons would attract a cloud of electrons, neutralizing the shield, whereas concentric shells of protection to repel both electrons and protons would require large voltages over short radial distances and exceed our current technology.

In this paper we review the history of electromagnetic shielding and advocate an overlooked alternative: anisotropic electrostatic fields, which leverage the asymmetries inherent in the physics so that nearly isotropic protection may be obtained without radial symmetry of the fields. This has the potential to dramatically reduce the mass of the shielding while increasing its effectiveness.