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Characterizing the Performance of the Wheel Electrostatic Spectrometer

Michael R. Johansen

P. J. Mackey, E. Holbert, C. I. Calle

Electrostatics and Surface Physics Laboratory

NASA Kennedy Space Center

J.S. Clements

Department of Physics and Astronomy

Appalachian State University

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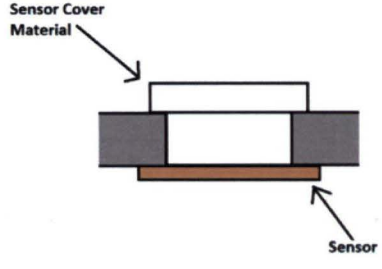
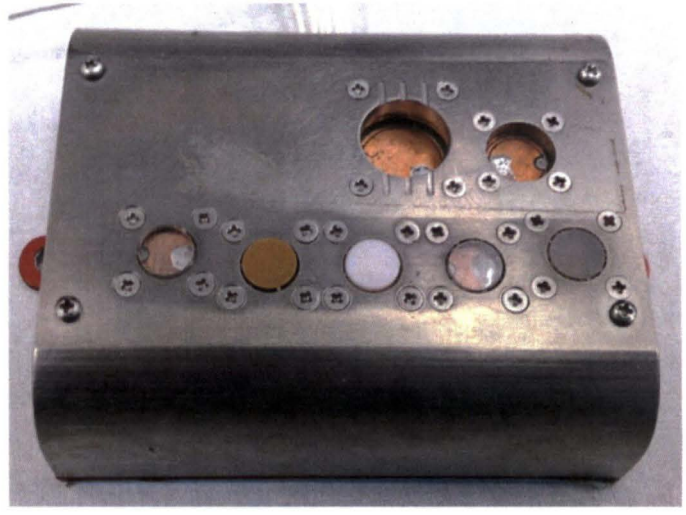
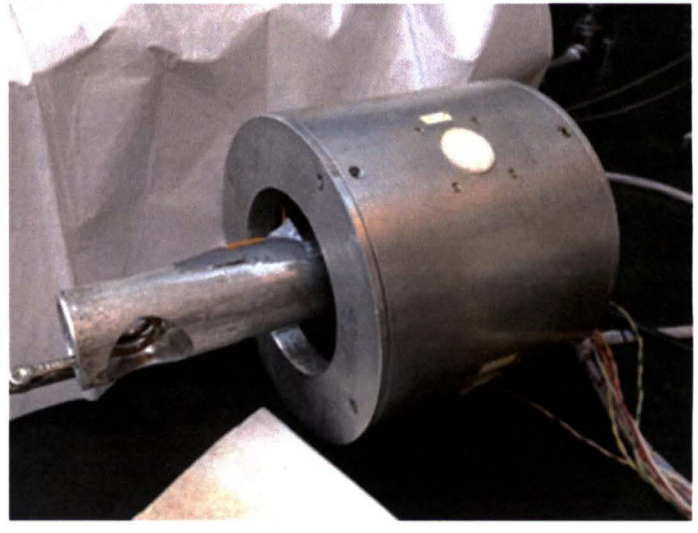
Background Information

- **Parent Technology – Mars Environmental Compatibility Assessment/Electrometer**
  - Electrostatic sensors with dissimilar cover insulators
  - Protruding insulators tribocharge against regolith simulant
  - Developed for use on the scoop for the 2001 Mars Odyssey lander
- **Wheel Electrostatic Spectrometer**
  - Embedded electrostatic sensors in prototype Martian rover wheel
  - If successful, this technology will enable constant electrostatic testing on Mars





MECA/Electrometer



Wheel Electrostatic Spectrometer

Wheel Electrostatic Spectrometer

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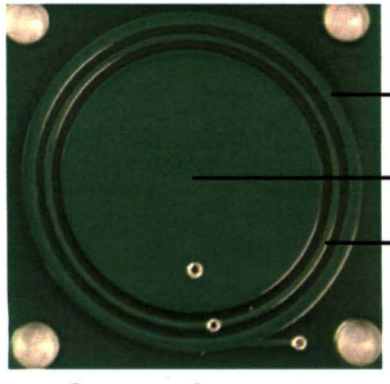
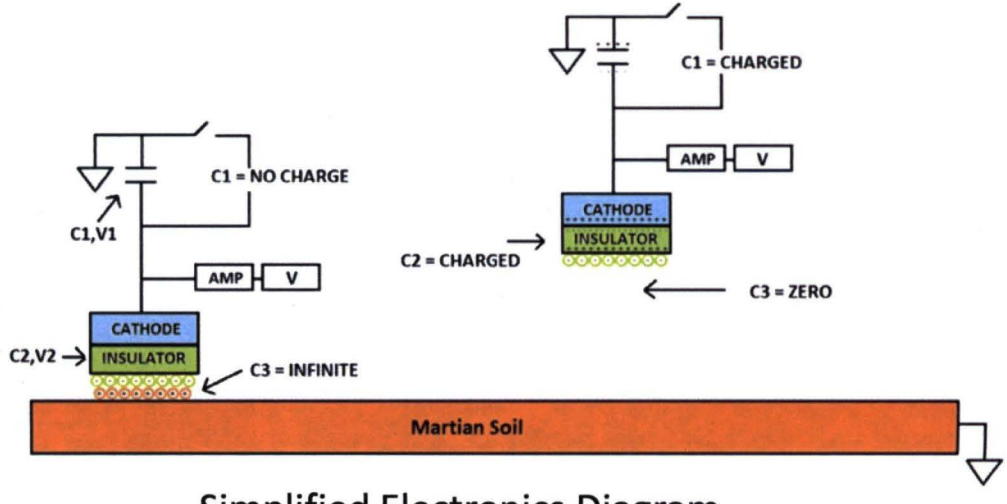
3-D Concept of WES



Sensor Layout

- Cover insulators
  - Teflon
  - Lucite
  - G10
  - Lexan
- Charge spectrum created may be useful in determining regolith properties
- Tribocharged insulator charges capacitor
- Voltage across the capacitor is measured as response signal



Simplified Electronics Diagram

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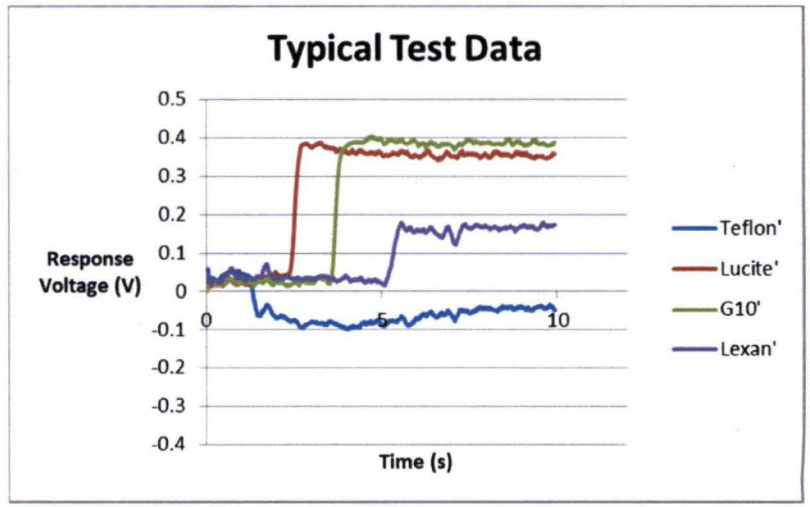
Testing

- Questions to answer
  - Do the insulators need to be cleaned?
  - Do the insulators need to be discharged?
  - Is the sensor response repeatable?
- Test conditions
  - Low humidity (~4%)
  - WES rolled by hand
  - Lunar and Martian regolith used during testing

Experimental Set-up



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Charge Neutralization

- Air ionizing fan used to neutralize the surface charge on cover insulators
- WES rolled on JSC1A lunar simulant
- Control experiment
  - Static elimination not conducted between trials
  - Capacitor discharged after each experiment
- Charge neutralization experiment
  - Static elimination conducted between trials
  - Capacitor discharged after each experiment

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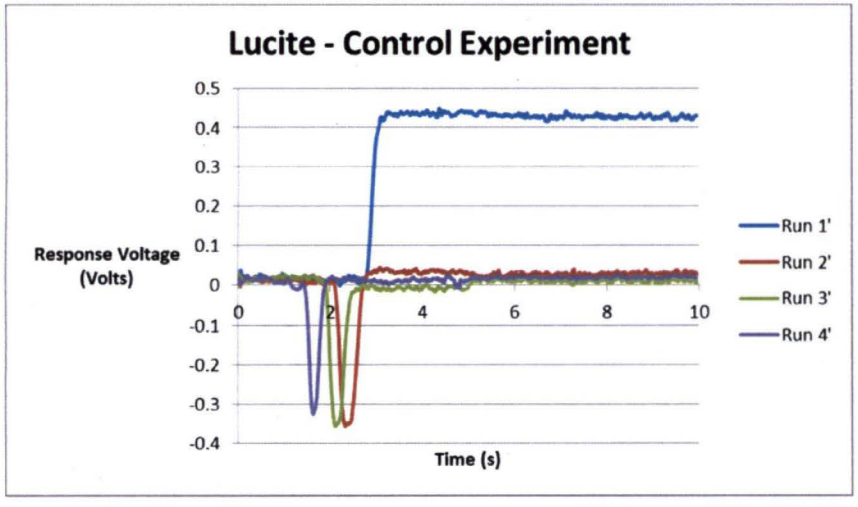
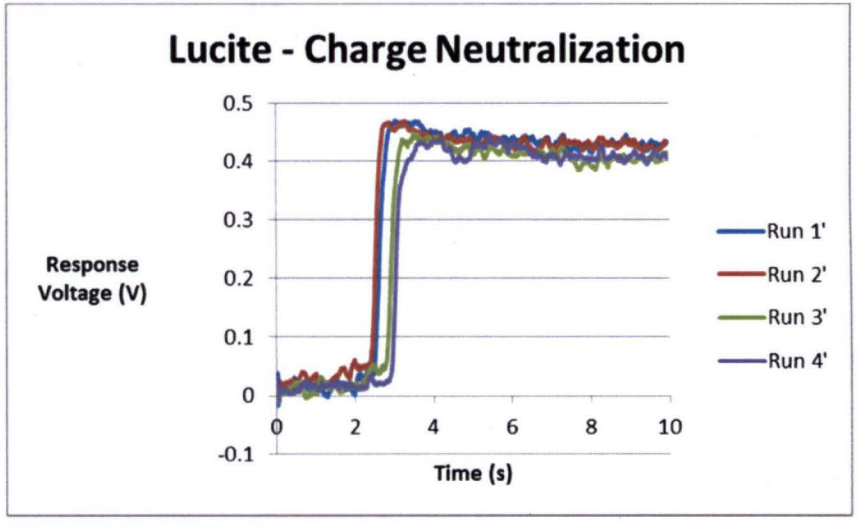
Charge Neutralization (Cont.)





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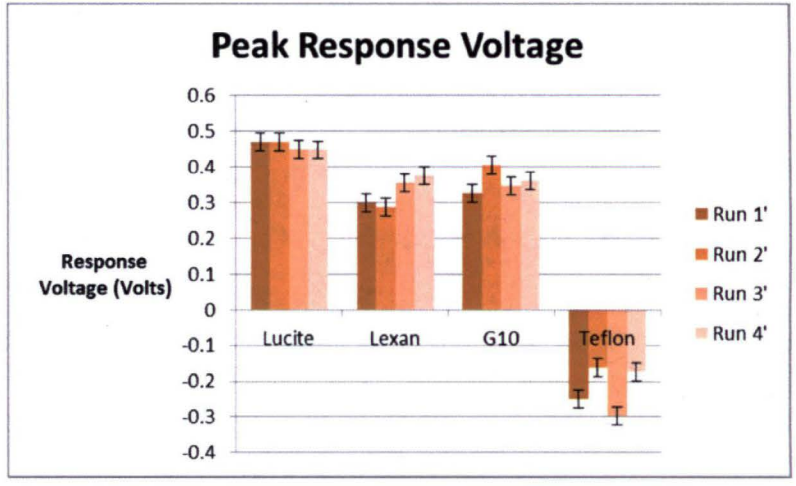
Sensor Repeatability

- Air ionizing fan used on insulators after each wheel revolution
- Capacitor discharged after each trial
- Care was taken to roll WES with same speed/pressure
- Error bars represent one standard deviation in the noise of each sensor



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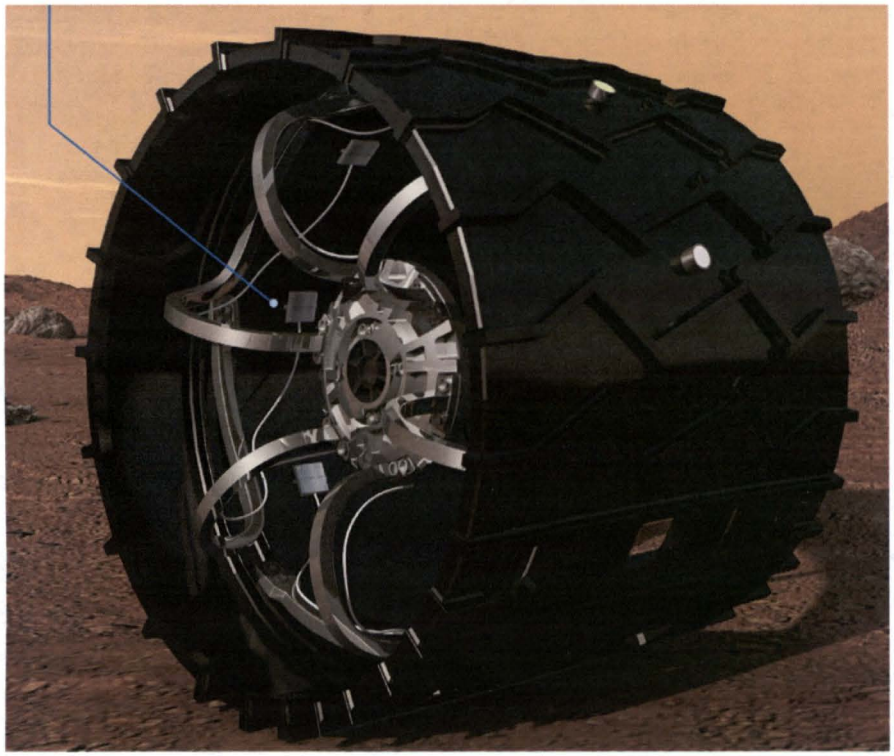
Conclusions



- Insulators need to be discharged after each wheel revolution
- Sensor responses repeatable within one standard deviation in the noise of the signal
- Insulators may not need to be cleaned after each revolution

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Future Work

- WES electronics have been redesigned to reduce noise and make each sensor independent
- Rolling mechanism is currently being manufactured
- Testing
- Martian pressure static elimination tool
- Technology will be proposed for the Mars 2020 mission