

BRIDGING A HIGH SCHOOL SCIENCE FAIR EXPERIENCE WITH FIRST YEAR UNDERGRADUATE RESEARCH: USING THE E-SPART ANALYZER TO DETERMINE ELECTROSTATIC CHARGE PROPERTIES OF COMPOSITIONALLY VARIED ROCK DUST PARTICLES AS TERRESTRIAL ANALOGUES TO MARS MATERIALS

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Introduction: NASA missions to Mars confirm presence of surficial particles, as well as dramatic periods of aeolian reworking. Dust deposition on, or infiltration into, exploration equipment such as spacecraft, robotic explorers, solar panel power supplies, and even spacesuits, can pose significant problems such as diminished power collection, short circuits / discharges, and added weight. We report results conducted initially as a science fair project and a study now part of a first year University undergraduate research experience.

Arkansas Science and Engineering Fair Institute: ASEFI was established to assist high school students in science and engineering research for their projects. The funding for this aspect of the project comes from NASA Educational Public Outreach, the University of Arkansas at Little Rock (UALR) TRIO Educational Talent Search Program, and a UALR Chancellor's University Partnership grant. ASEFI has conducted 5 large and 4 small workshops on research, serving over 200 students from 8 high schools. ASEFI assists high school students (to include those transitioning from 8th to 9th grade during the summer) and their teachers with research. Primary activities include group workshops and individual interaction by offering research faculty members and advanced graduate students opportunities to mentor 9th -12th grade students. Activities guide students to learn about scientific methodology, develop research plans coupled with selection of a mentor, perform research on and off campuses, and to gain an in-depth understanding of career opportunities in science, mathematics, medicine, and engineering.

Our partnership includes the strengths of TRIO, which allows for shared resources in recruiting students who would be first-generation college attendees or graduates in their families, and those that fall into low-income categories. A subset of the over 200 students applied for funded mentorship from which 30 were selected to work with faculty in university labs and receive funding to purchase supplies for their projects. Earth, space, and environmental categories were selected by several

students from projects ranging across a number of fields in 14 categories of the Intel ISEF-affiliated fairs [1]. Several students achieved at regional- and state-levels.

High School to First Year Experience: The first author of this study is a first generation college female that participated through ASEFI 2003-2004 during her senior year in high school. Prior to interacting with the faculty at the University of Arkansas at Little Rock, she considered attending a different out-of-town school and had not selected a science career. As a result of faculty mentorship and interaction with graduate student researchers during the science fair process, the student matriculated Fall 2004 to pursue an undergraduate degree in Geology. She is expanding upon her initial E-SPART studies now as undergraduate research.

E-SPART Analyzer and Project: The E-SPART analyzer [2] uses oscillating particles in an acoustic or electric field, or by simultaneous application of both fields. Real time measurement of particle motion is done using laser Doppler velocimetry and/or image analyses [3]. The Materials Group at UALR is developing a miniature, digitally controlled ESPART analyzer where the AC drive frequency is varied depending upon particle size and electrostatic charge distribution. This makes it possible to work with 0.5 – 30 micrometer particle sizes at zero to saturation charge levels, depending upon particle sizes present and environmental conditions.

The unit was used for this undergraduate research project first by evaluating Mars dust stimulant JCS Mars-1 [4]. We add our data to that determined using other techniques and conditions [5][6][7] . Since more is now known about the Mars surface compositions from images and data collected by Spirit and Opportunity, we also present particle size and electrostatic results for mechanically eroded particles derived from various terrestrial materials. We do this to provide preliminary analogue studies for what appears to also be present on Mars in addition to basalt (and probably contributing to dust compositions): sedimentary units such as sandstone and evaporite deposits.

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References:

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