Payload Integrated Education and Public Outreach: Student Nanoexperiments

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Student Investigators

Angle of Repose of Martian Dust

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Contradistinctive Copper

Kelly Trowbridge & Jessica Sherman
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Spacesuit Materials for Mars

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&

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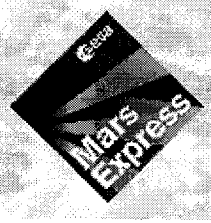
São Paulo, Brazil

The Motivation

- **Involvement of students worldwide in a planetary science mission.**
  - Stimulate students 18 years of age and younger to explore what is necessary to invent and propose an instrument for space flight.
  - Development of curricula to simulate the nanoexperiments using common materials and "kitchen chemistry."
  - Immediate distribution of returned scientific data to the public for use in classrooms, etc.
- **Prototype of small, self-contained experiments for future missions.**
  - Future competitions can be held for grade schools, undergraduate and graduate students.
  - Tiny "gas-can" type experiments may be proposed by the scientific community at large.



The Mars Environmental Compatibility Assessment (MECA) Nanoexperiment Challenge

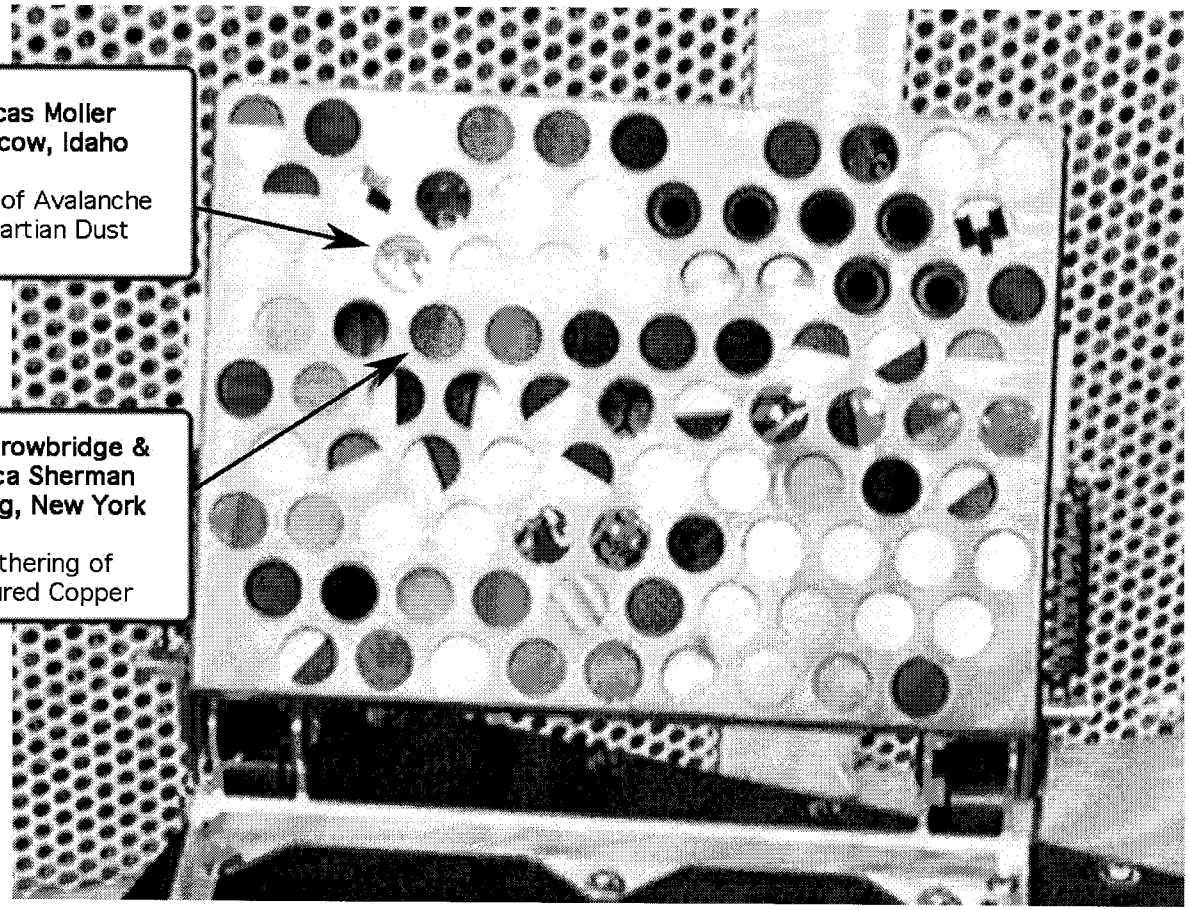
- **The MECA Student Nanoexperiments were the first student experiments proposed to go to Mars.**
- **Conducted in partnership with The Planetary Society, the world-wide competition was open to pre-college students, up to 18 years of age, in teams of 1-3.**
- **Flight hardware was fabricated by Visionary Products Incorporated, and integrated into the MECA Patch Plate at JPL.**

MECA Nanoexperiment Challenge: Requirements

Each proposed nanoexperiments was to:

- Be consistent with MECA's Mission: *"To help us better understand how humans will be able to live on Mars."*
- Plug directly into the MECA Patch Plate.
- Fit into a 1 cm diameter tube, 1 cm in height.
- Have mass less than 3 grams.
- Be fabricated from space-compatible materials.
- Be observed only by the Robot Arm Camera.
- Require no power or communications.
- Contain no moving parts.
- Submit prototype and short proposal.

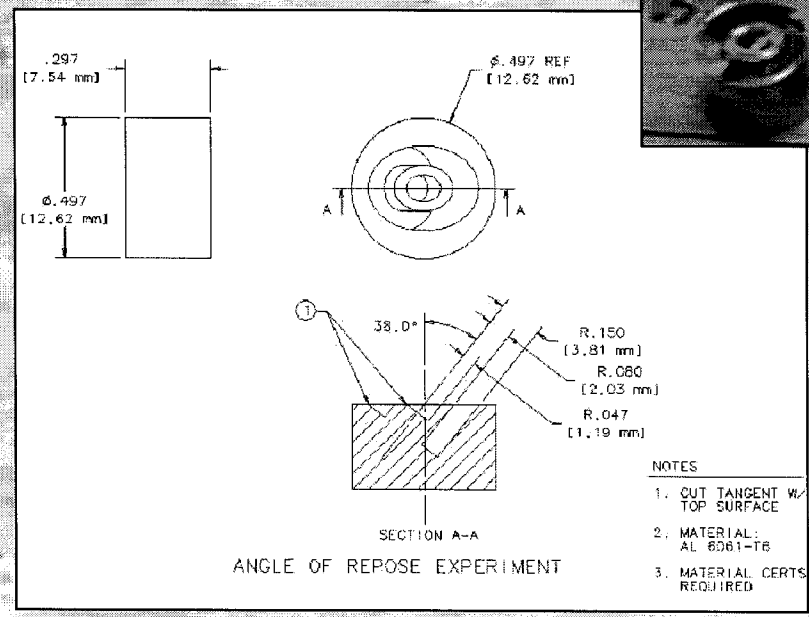
The MECA Patch Plate



Angle of Avalanche for Martian Dust

Lucas Möller
5th Grade, Moscow, Idaho.

- **Addressed angle of repose questions posed at Mars 2001 Workshop.**
- **Critical slope necessary for motion of the dust on a surface. (Angle of repose or static friction angle.)**
- **Will print out copies of images and measure the tangent angles with a protractor.**
- **Will compare these angles with results using sand,cement powder and other simulants.**



ANGLE OF REPOSE EXPERIMENT

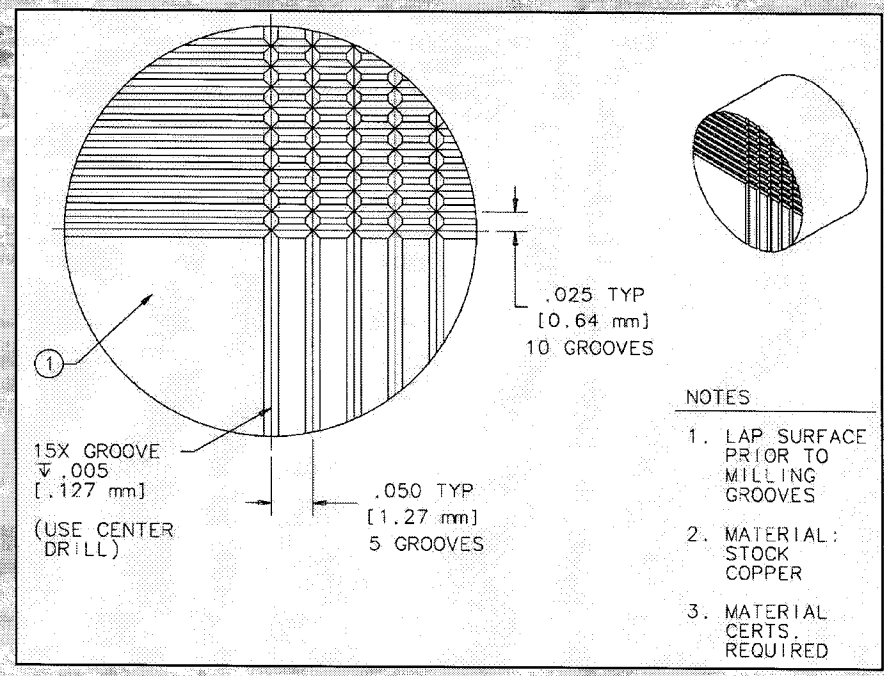
Contradistinctive Copper

Kelly Trowbridge & Jessica Sherman,
8th Grade, Ithaca, New York.

Investigating:

- **Corrosion properties.**
- **Oxidation properties.**
- **Temperature sensitivity.**
- **Dust deposition on different textures = different rates of corrosion and oxidation.**

Advisor: Anna Waldron, Cornell University Science Education Program.



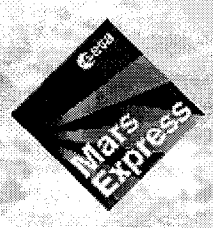
SNOOPY: Redesign of Experiments

Angle of Repose:

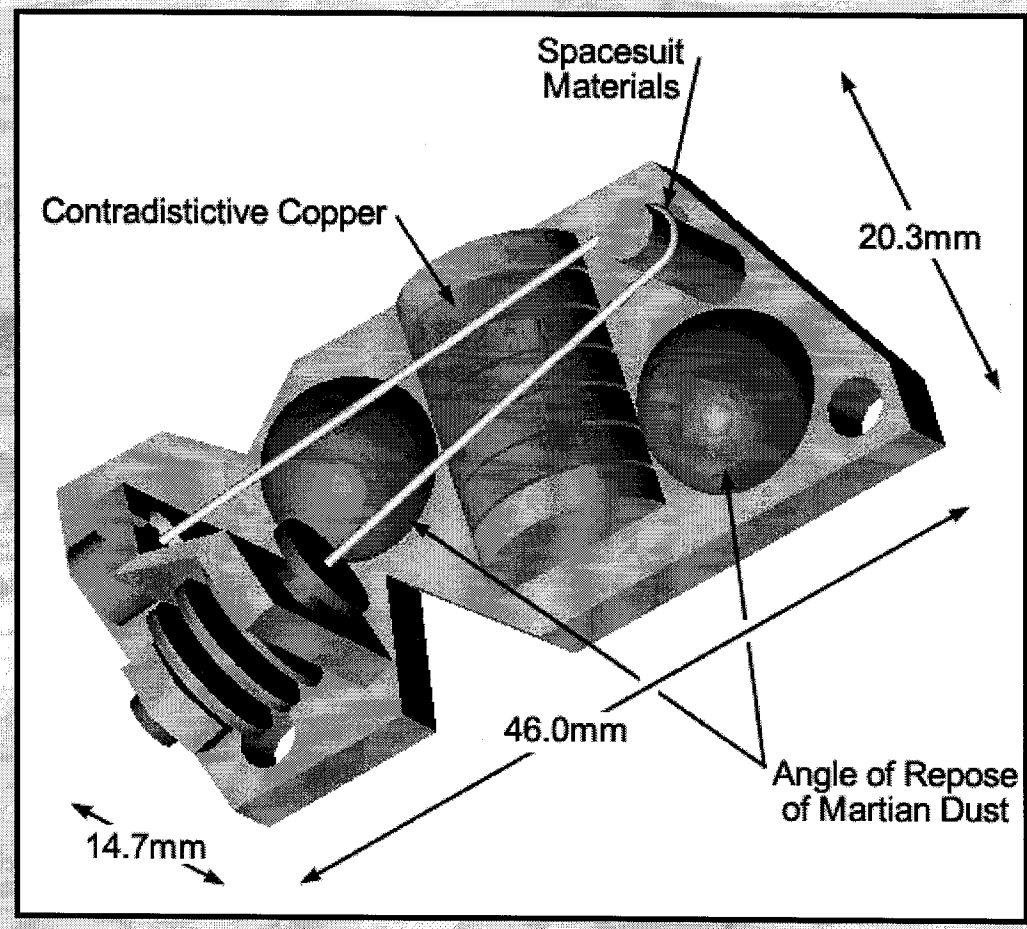
- Eliminates dependence on landing angle.
- Incorporates two materials, one insulating (Macor or alumnia) and one conducting (aluminum) to see if accumulated charge has an effect on the angle of repose.
- Allows for easier viewing using a camera.

Contradistinctive Copper:

- Eliminates dependence on landing angle.
- Provides range of textures through a spectrum of lighting conditions.
- Provides an *in situ* reference coated with Indium Tin Oxide



SNOOPY Payload



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SNOOPY Design: Spacesuit Materials

- Combination of two proposed nanoexperiments.
- Added since MECA. Although this was a finalist, there was not enough time to prepare this nanoexperiment to fly on MECA in 2001.
- Kevlar fiber will be held under tension and exposed to the Martian environment.
- Wear can be examined with a stereo camera and possibly with a microscope.
- Failure of the Kevlar fiber will be easily seen by a stereo camera. Creep of the Kevlar fiber will also be observed.

Planned Outreach Activities

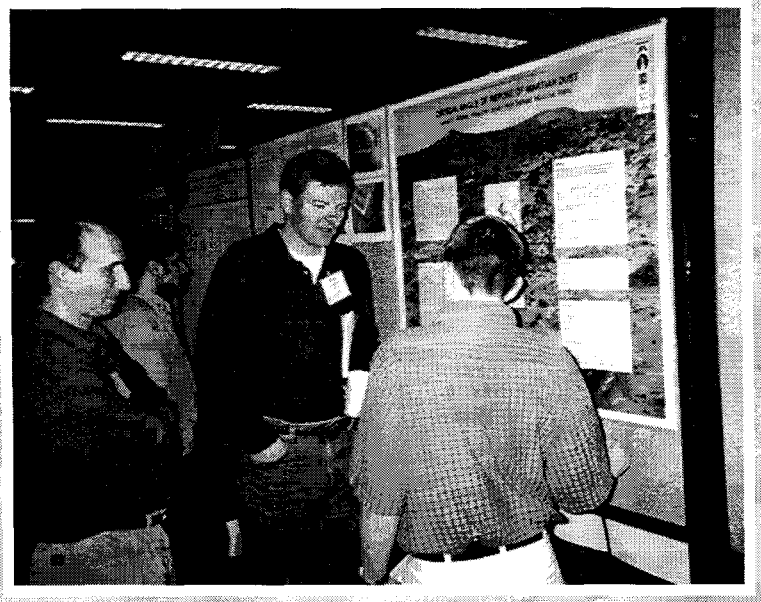
Student Nanoexperimenters

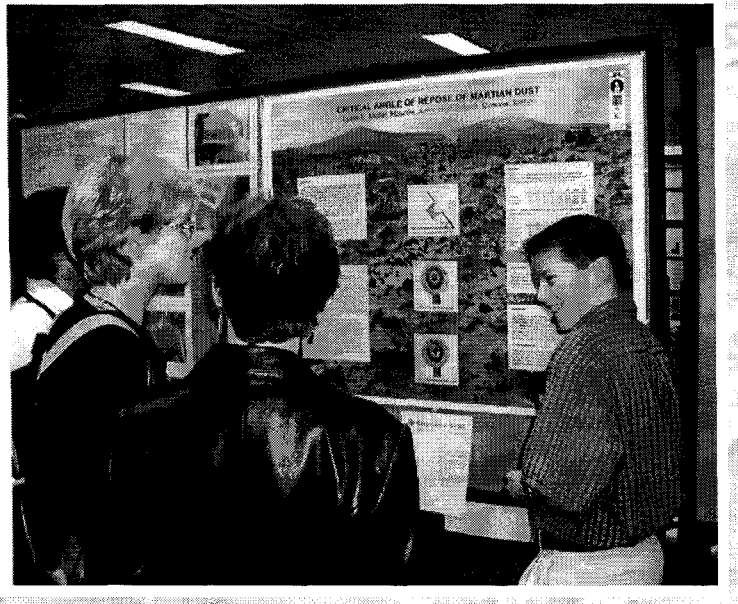
- Will provide science support of SNOOPY by calibrating their experiments.
- Will publish their results in the scientific literature and present them at the Lunar and Planetary Science Conference.

Students Worldwide

- Curricular Materials for students to duplicate SNOOPY Nanoexperiments using common materials and equipment.

Lucas Möller at 2001 LPSC





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