Z12.02-2955 - NeuRover: Rover Enabled Neutron Energy Detector for Lunar Resource Mapping

PI: Steven Bellinger , Radiation Detection Technologies, Inc. - Manhattan, KS

NON-PROPRIETARY DATA

IDENTIFICATION AND SIGNIFICANCE OF INNOVATION

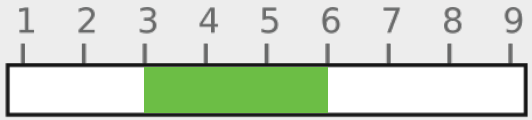
NASA requests a high spatial-resolution, wide-area scan of lunar soil composition, which may contain useful materials such as He-3 and H2O. Orbiting neutron spectrometer instruments are limited to spatial resolution in the 100's of km^2. The innovation proposed is a small-mass, low-power, Neutron Energy Spectrometer (NES) for Mapping of Sub-Surface Lunar water content that can be supported by a micro-sized rover. The Team has previously developed an instrument that can measure the hydrogen content (water) of soil by stacking alternating layers of neutron absorber, moderator, and detectors. The measurement of the neutron energy spectrum can yield the hydrogen content of the soil. A roving neutron spectrometer system, the NeuRover, is based on the microstructured semiconductor neutron detector (MSND) technology combined with Astrobotic Technology's CubeRover, and would be capable of scanning the lunar surface for He-3 and water, with unmatched spatial resolution (<1-m^2 scale).

TECHNICAL OBJECTIVES AND PROPOSED DELIVERABLES

Objective 1: Create mission and system engineering documents -Task 1.1: Create Software & Hardware Development Plan -Task 1.2: Produce engineering documents -Task 1.3: Create engineering and V&V Test Plans Objective 2: Mature modeling of SNES -Task 2.1: Characterize & document updated model of SNES -Task 2.2: Create model of NeuRover & lunar environment -Task 2.3: Create thermal model of SNES -Task 2.4: Create rover surrogate for SNES characterization Objective 3: Iterate design & build SNES -Task 3.1: Design hardware of SNES Engineering Test Unit #1 (ETU1) -Task 3.2: Fabricate SNES ETU1 -Task 3.3: Test SNES ETU1 -Task 3.4: Iterate design, fabricate SNES ETU2 Objective 4: Update SNES payload interface to CubeRover -Task 4.1: Mature design of NeuRover SBC payload SNES interface -Task 4.2: Iterate design, fabricate SBC ETU -Task 4.3: Unit test SBC ETU Objective 5: Complete Detailed Design of NeuRover -Task 5.1: Review Design of NeuRover -Task 5.2: Produce thermal analysis of NeuRover during operations -Task 5.3: Produce structural analysis of NeuRover during operations Objective 6: System Integration & Testing -Task 6.1: Fabricate NeuRover ETU -Task 6.2: Integrate SBCETU with SNES ETU2 -Task 6.3: Integrate SBCETU, SNES ETU2 in NeuRover ETU -Task 6.4: V&V testing of NeuRover ETU Deliverables: -A final report describing the design of the SNES and NeuRover -A prototype roving neutron detector "NeuRover"

TRL

Estimated



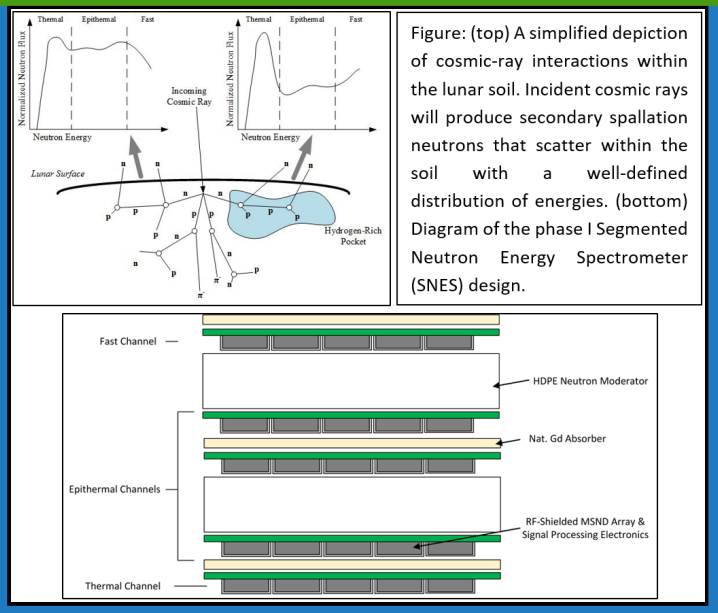


Figure: (top) A simplified depiction of cosmic-ray interactions within the lunar soil. Incident cosmic rays will produce secondary spallation neutrons that scatter within the soil with a well-defined distribution of energies. (bottom) Diagram of the phase I Segmented Neutron Energy Spectrometer (SNES) design.

NASA APPLICATIONS

Provide a viable semiconductor-based neutron energy spectrometer (NES) for remote lunar soil moisture determination CONOPS. A compact, low-power NES/NeuRover would yield benefits to the NASA mission beyond the search for hydrogen below the lunar surface as proposed. A major hurdle to overcome to ensure the success of the human exploration of space and extraterrestrial bodies is to limit the radiation dose to astronauts. A commercially-available NeuRover system could inexpensively map unknown areas before human astronauts arrive for missions.

NON-NASA APPLICATIONS

An application for a roving (autonomous), robust neutron energy spectrometer would be in the field of nuclear waste monitoring and mapping. It is possible that with the increase in nuclear fuel and waste storage, and along with the unfortunate radiological accidents at various sites, e.g., Hanford, Fukushima Daiichi, NeuRover's remote roving capability may be beneficial for inspecting these sites.

FIRM CONTACTS

Steven Bellinger
Radiation Detection Technologies, Inc.
EMAIL: bellinger@radectech.com
PHONE: (785) 532-7087