National Aeronautics and Space Administration

FY23 Innovative Spontaneous Concepts Research and Technology Development (ISC)

Deployable antenna for sounding of extensive ice deposits in airless Solar System bodies using cosmic rays

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Objective

Develop the deployable antenna system (from TRL 2 to TRL 3) that will enable passive sounding of extensive ice deposits in Solar System airless bodies using ultra high energy cosmic rays (UHECRs).

Background

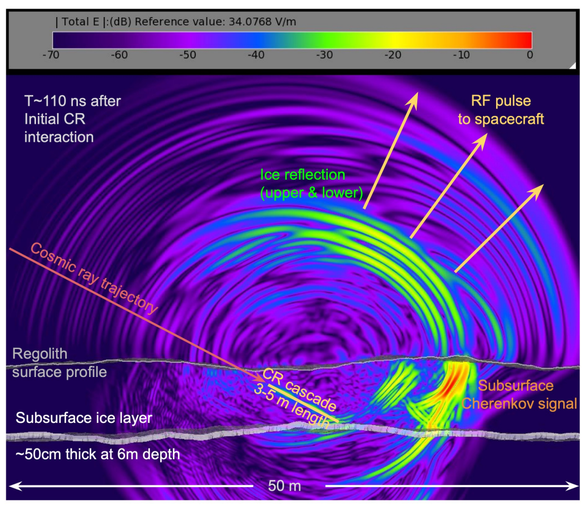
Cosmic Ray Lunar Sounder (CoRaLS) mission concept [1] is a sounder for extensive ice deposits in the permanently shadowed regions (PSR) of the Moon using radio signals produced by UHECRs incident on the lunar regolith.

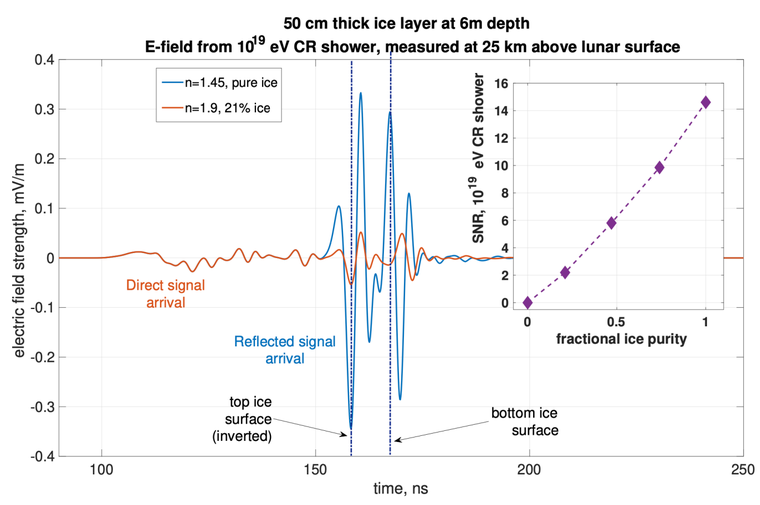
Approach & Results

- 150-800 MHz band with >9 dBi of gain is needed for this concept.
- ESPA-Grande spacecraft payload volume (1.06 m x 1.16 m x 0.71 m) used for payload stowage volume.
- Folding and rolling deployment approach raised to TRL 3.

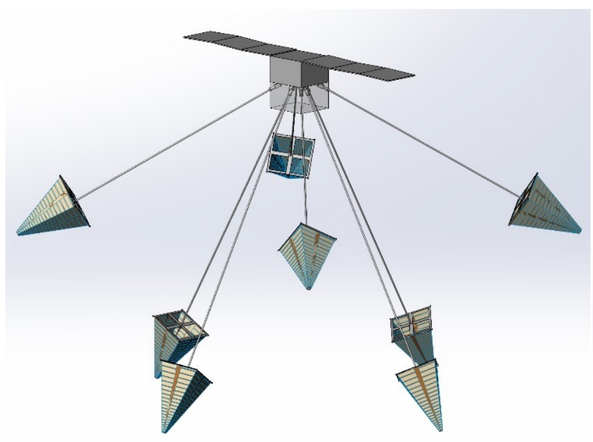
Significance / Benefits

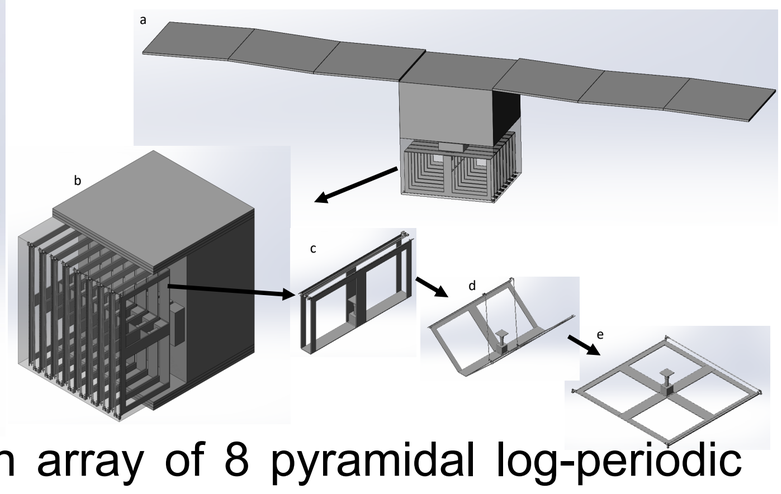
Finding these ice deposits, or ruling out their existence, would have a significant impact in the future direction of lunar exploration (manned or unmanned). This technique would also apply to the search for ice in the permanently shadowed regions of any airless body in the Solar System.



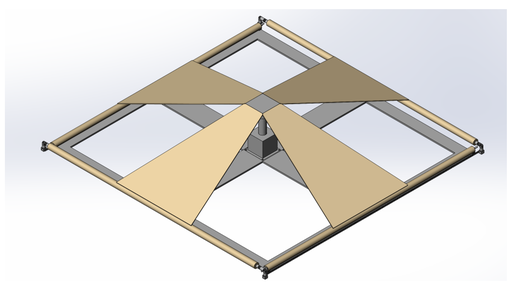


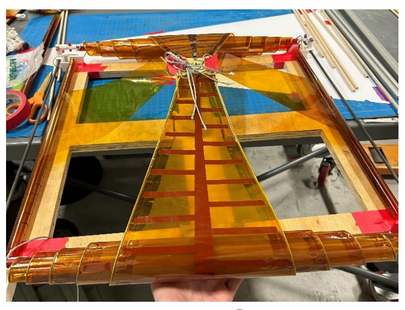
Left: finite difference model of cosmic ray impinging lunar regolith and producing a coherent radio impulse that reflects off ice. Right: predicted radio signatures. Figure from [1].



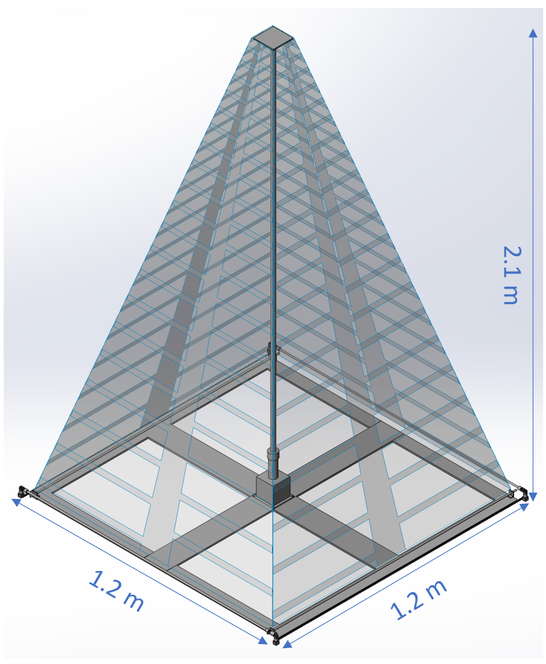


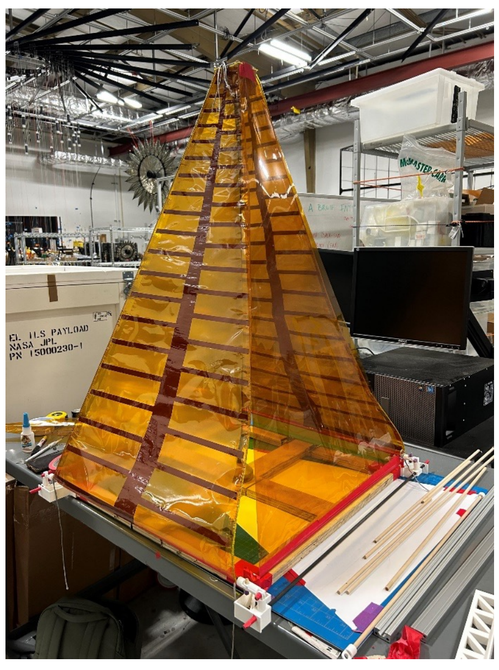
Left: spacecraft model with array of 8 pyramidal log-periodic dipole array (LPDA) antennas (1.2 m base x 2.1 m height each). Right: Spaceflight Laboratories Dauntless spacecraft payload volume with deployed antenna structures.





Left: CAD model of the rolled-up antenna on folding structure. Right: breadboard prototype





Left: CAD model of the deployed antenna mechanical structure. Right: half-scale breadboard prototype

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Poster Number: RPC#

References:
[1] Prechelt, R. et al., 2022, Passive bistatic radar probes of the subsurface on airless bodies using high energy cosmic rays via the Askaryan effect, arXiv:2212.07689

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