# A Search for Cerenkov Burst Emission from UHE Neutrino Interactions in the Lunar Regolith

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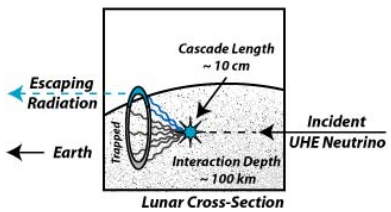
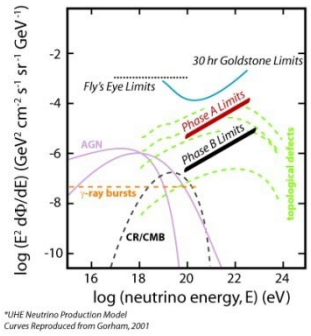
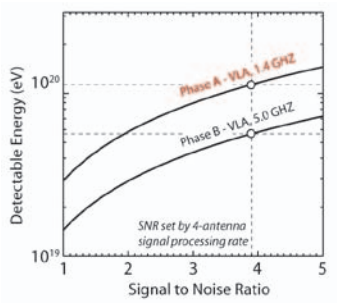
Astrophysical models predict the production of UHE neutrinos from a vast variety of sources including AGN, UHE cosmic ray - cosmic microwave background interactions (for E > 10^19.5 eV, GZK limit), gamma ray bursts and topological defects, yet no UHE neutrinos have been observed. A promising detection approach is the indirect observation of UHE neutrino interactions with the lunar regolith, where the resulting superluminal electron shower creates a sub-nanosecond burst of coherent Cerenkov radiation at cm wavelengths. Past experiments searching for these bursts have witnessed no interactions to date. The most sensitive flux lower limit was established by the GLUE Experiment (Gorham et al., 2001).




We describe two new experiments designed to improve previous detection limits by a factor of 10-100. Our method involves using multiple separated antennas to correlate observed pulses with the expected geometrical delay for signals of lunar origin. In each experiment, we monitor antenna voltages using an intelligent high speed digitizer; recording events only if every antenna observes a pulse within a time window spanning the greatest expected geometrical delay. The voltage threshold is also set to match the data readout latency time (~ 500 ms). When monitoring at least four antennas, this method provides sensitivity to signals as low as 3.9 standard deviations above system noise. We check each candidate event post-facto for coincident detections (with the proper signal delay) by the other telescopes. This is a highly constrained solution. When using four antennas, the probability of a false positive for ~ 1 km baselines and using 20 ns sampling is less than $10^{-5}$ per observing hour.




Our first experiment uses the EVLA and is separated into two phases. Phase A (Spring 2008) utilizes two sub-arrays, each consisting of 4 identical antennas observing at 1.4 GHz. We point each sub-array on opposite sides of the lunar disk, providing approximately 80% limb coverage while lowering the moon's contribution to the total system temperature. Phase B employs 6 sub-arrays of 4 antennas observing at 5 GHz and will be performed when all 27 EVLA antennas become available. The second experiment uses multiple antennas at the Green Bank radio observatory. We observe the entire lunar disk at 800 MHz with three antennas (43 m, 25 m, 20 m) and add an omni-directional "veto" antenna for RFI mitigation.