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The effects of surface roughness on lunar Askaryan pulses

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The effects of lunar surface roughness, on both small and large scales, on Askaryan radio pulses generated by particle cascades beneath the lunar surface has never been fully estimated. Surface roughness affects the chances of a pulse escaping the lunar surface, its coherency, and the characteristic detection geometry. It will affect the expected signal shape, the relative utility of different frequency bands, the telescope pointing positions on the lunar disk, and most fundamentally, the chances of detecting the known UHE cosmic ray and any prospective UHE neutrino flux. Near-future radio-telescopes such as FAST and the SKA promise to be able to detect the flux of cosmic rays, and it is critical that surface roughness be treated appropriately in simulations. of the lunar Askaryan technique.
In this contribution, a facet model for lunar surface roughness is combined with a method to propagate coherent radio pulses through boundaries to estimate the full effects of lunar surface roughness on neutrino-detection probabilities. The method is able to produce pulses from parameterised particle cascades beneath the lunar surface as would be viewed by an observer at Earth, including all polarisation and coherency effects. Results from this calculation are presented for both characteristic cosmic ray and neutrino cascades, and estimates of the effects mentioned above - particularly signal shape, frequency-dependence, and sensitivity - are presented.

Primary author: Dr JAMES, Clancy (University of Erlangen-Nuernberg)

Presenter: Dr JAMES, Clancy (University of Erlangen-Nuernberg)

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