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The lunar Askaryan technique with the Square Kilometre Array

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The lunar Askaryan technique is a method to study the highest-energy cosmic rays, and their predicted counterparts, the ultra-high-energy neutrinos. By observing the Moon with a radio telescope, and searching for the characteristic nanosecond-scale Askaryan pulses emitted when a high-energy particle interacts in the outer layers of the Moon, the visible lunar surface can be used as a detection area. Several previous experiments, at Parkes, Goldstone, Kalyazin, Westerbork, the ATCA, Lovell, LOFAR, and the VLA, have developed the necessary techniques to search for these pulses, but existing instruments have lacked the necessary sensitivity to detect the known flux of cosmic rays from such a distance. This will change with the advent of the SKA.

The Square Kilometre Array (SKA) will be the world's most powerful radio telescope. To be built in southern Africa, Australia and New Zealand during the next decade, it will have an unsurpassed sensitivity over the key 100 MHz to few-GHZ band. We introduce a planned experiment to use the SKA to observe the highest-energy cosmic rays and, potentially, neutrinos. The estimated event rate will be presented, along with the predicted energy and directional resolution. Prospects for directional studies with Phase 1 of the SKA will be discussed, as will the major technical challenges to be overcome to make full use of this powerful instrument. Finally, we show how Phase 2 of the SKA could provide a vast increase in the number of detected cosmic rays at the highest energies, and thus to provide new insight into their spectrum and origin.

Collaboration

– not specified –

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