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Extensive Air Shower Tracker using Cherenkov Detection

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Cosmic rays continuously bombard Earth's atmosphere triggering cascades of secondary particles. Many constituents progress to reach the surface and capturing these events can intrigue and awe young curious minds, opening them to the amazing world of physics. Cloud chambers are an established method of revealing the subatomic world; frequently used by universities to introduce cosmic rays to visitors and prospective students. Although their scientific use is limited, they provide a fascinating real-time display of the 'ghostly'particles showering upon those viewing.
Using the Cherenkov radiation detection technique, we have developed a novel, compact, Extensive Air Shower (EAS) particle tracking method that enhances the cloud chamber visualisation of cosmic ray interactions towards a digital audience. Once digital, live event interaction can be streamed to multiple display devices presenting an immediate illustration of the event that showered in that location.
Our instrument hardware is built around Cherenkov optimised silicon photomultiplier sensors. Each single detection unit is able to monitor particle event rate, track incident angle and measure Cherenkov intensity, thereby enabling energy discrimination between low versus high-energy interactions. By operating multiple detection units in one location, we can record time correlated air shower events to monitor and generate information on primary cosmic rays.
We introduce first results, illustrating instrument response and EAS rate variations, compiled from the initial six month running period of our development instruments. We also present instrument simulations to assess and optimise the number and position of our photosensors.
With further development towards low-cost readout electronics, we aim to build a networked array of trackers, located around the campus, to expand data gathering ability and scientific potential. By tracking EAS in real-time we can estimate the local distribution of secondary particles, allow us to determine particle radiation levels, and provide atmospheric radiation monitoring locally, regionally and potentially UK-wide.

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