

Coherent transition radiation at radio frequencies from the electron beam sudden appearance

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We report on the detection of coherent transition radiation from the electron beam sudden appearance. The Telescope Array Linear Accelerator (TA-LINAC) is constructed to calibrate the TA fluorescence detectors by directing a high-energy electron beam in to the air. This makes the TA-LINAC the perfect device to test future detection techniques, such as the radio detection method, to probe high-energy particle cascades. We report on the measurements of four independent radio set-ups searching for either the direct radio emission from the particle cascade or a radar echo. Due to the different signals sought for, these experiments operated over a wide range of frequencies from 50 MHz up to 12.5 GHz. Besides the signals sought for, all experiments detected a strong transient signal when the beam exits the accelerator. This signal can be described as an extreme form of coherent transition radiation. It is shown that the measurements agree well with the predicted signal over the entire frequency range. The in-nature application of this signal is found for high-energy particle cascades traversing different media such as air and ice or rock.

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