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A Multi-Purpose Active-Target Particle Telescope for Radiation Monitoring

Continuous monitoring of the radiation background is a key requirement in many applications. Traditional detectors can either measure the total radiation dose omnidirectionally (dosimeters), or determine the incoming particles'characteristics within a narrow field of view (spectrometers). Instantaneous measurements of anisotropic fluxes thus require several detectors, resulting in bulky setups. The multi-purpose active-target particle telescope (MAPT), based on a novel detection principle, can measure particle fluxes omnidirectionally. It consists of an active core of scintillating fibers whose light output is measured by silicon photomultipliers, and fits into a cube with an edge length of 10 cm. It identifies particles using extended Bragg curve spectroscopy, with an overall sensitivity range of 25 to approximately 1000 MeV per nucleon. MAPT's unique layout results in a geometrical acceptance of about 800 cm^2sr and an angular resolution of 6°, which can be improved by track-fitting procedures. During a first beam test of a simplified prototype, the detector's energy resolution was found to be less than 1 MeV for protons with energies between 30 and 70 MeV. Possible applications of MAPT include the monitoring of radiation environments in spacecraft, deep space habitats, and ground-based installations. Other use cases are the measurement of energy straggling in medical radiation therapy applications and the monitoring of beam profiles in accelerator facilities.

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