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Particle tracking and identification with Timepix-series detector setups in LHC experiments and space science

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In high energy physics experiments, hybrid pixel detectors are an integral part of the tracking systems closest to the interaction points, where their good spatial resolution and high radiation resilience allow for particle tracking by connection of “dots” registered in different layers of an onion-like detector. Another approach to particle detection and tracking relies on a complex analysis of the imprints seen in the pixel matrices (tracks), which provide a rich set of features. These allow for identification of impinging particles, particle trajectory or reaction kinematics reconstruction. The latter is particularly valuable for applications with limited resources, for example in space experiments, but it also enables fundamental-science-reach measurements with simple table-top experiments.

In this contribution, I will discuss how test beam data enhances data analysis methodologies, clarifies the limitations of various approaches, and ultimately leads to optimized detection setups. I will present the latest results from Timepix-type detectors used within LHC experiments or as a space radiation monitors in low Earth orbit and will discuss their application within a GeV-range particle spectrometer for measurement for galactic-cosmic-ray properties.

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