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Precise Timing Measurement for the CMS Upgrade and Beyond

In this contribution, I review growing interest in large area fast timing detectors based on Low-Gain Avalanche Detectors (LGAD) with a timing resolution of 30-50ps. Combining precise timing of minimum ionizing particles (MIPs) with tracking significantly benefits performance of the detector by improving resolution and background rejection. Large-scale high-precision timing detectors have to face formidable challenges in almost every aspect: performance of sensors, segmentation and radiation tolerance, very low-power and low-noise electronics, cooling, low material budget, and large data volumes. I will report on the current status and new development of such detectors for high energy physics. In particular, I will discuss the proposal of the CMS Collaboration to instrument the CMS detector with a timing layer to measure MIPs during the High-Luminosity LHC data taking period. The high pseudorapidity region ($1.6 < |\eta| < 3.0$) of the CMS detector will be instrumented with a hermetic layer of LGAD. This installation will represent the first large scale application of the LGAD in a high energy physics experiment.

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