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Silicon detectors: From the early days to the ATLAS and CMS upgrades in the HL-LHC era

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Silicon detectors are used in Nuclear and Particle Physics since the 60-ies. However, the real break-through came in the early 80-ies when micrometer-position resolution for charged particle was achieved and their superior performance for tracking down short-lived particles in the Particle Physics experiments demonstrated.

This presentation outlines the historical evolution from strip configurations to hybrid silicon strip and pixel detectors for the ATLAS and CMS upgrades at the High Luminosity upgrade of the Large Hadron Collider (HL-LHC) at CERN. New challenges for silicon sensors are highlighted with respect to radiation hardness. The production delivery of sensors has commenced for the tracker upgrades in the ATLAS and CMS detectors at the HL-LHC and the different design options are presented. The overall delivery period is anticipated to last 4 years to complete the approximately 22000 sensors required. Proposed new technologies as the depleted monolithic active pixel sensors (DMAPS) where the sensor and the readout blocks are integrated in the same silicon bulk are presented. The requirement of precision timing measurements in the HL-LHC, recently has boosted the development of low gain avalanche diodes (LGADs) designed and implemented in a pixel matrix in order to equip the end-cap timing detector layers in ATLAS and CMS. The aim is to improve the pile-up rejection.

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