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Next generation of silicon pixel detectors for the upgrade of the LHC experiments

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The particle sensors and the associated read-out electronics to be used for vertexing and tracking detection systems in high-energy particle physics experiments have very demanding requirements in terms of granularity, material thickness, read-out speed, power consumption and radiation hardness. The development of sensors based on silicon semiconductor technology and of read-out electronics based on CMOS technology (application specific integrated circuits, ASICs) in the 1980s revolutionised the implementation of such detection systems. This technology can be used to match the majority of the above requirements. Given this, silicon microstrip and pixel sensors are at the heart of the majority of particle tracking systems used in particle physics experiments today. The state-of-the-art silicon pixel detectors used in the innermost layers in the LHC experiments ATLAS, CMS, LHCb and ALICE all consist of Si pixel sensors bump-bonded to CMOS read-out electronics. The LHC experiments are preparing major upgrades of their experimental apparatus in order to deal with the planned upgrade of the LHC, which will increase the collision rate by an order of magnitude. This talk will give an overview of the main technological challenges that the upgrade of the silicon vertexing detectors have to face and the R&D activities that are being carried out. Special focus will be given to the upgrade of the ALICE Inner Tracking System that, for the first time at the LHC, will employ monolithic pixel detectors.

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