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Frontier sensor R&D for the ALICE 3 apparatus

The ALICE Collaboration plans to build a new experimental setup, ALICE3, which will be installed during Long Shutdown 4. This apparatus will maximize the potential of the HL-LHC as a heavy-ion collider by giving access to new and unexplored experimental observables, thereby enabling the investigation of open fundamental questions regarding the quark-gluon plasma and other aspects of the strong interaction. The hallmarks of the ALICE3 physics programme are discussed in a dedicated ESPP input document. They require unprecedented pointing resolution (e.g.about 10 μm at pT = 250 MeV/c), large acceptance (|η| < 4 and pT > 50 MeV/c) and extensive identification capabilities for electrons, hadrons and muons. Thesetup consists of a compact silicon pixel tracker within a new superconducting magnet (2 T), silicon time-of-flight layers, a ring-imaging Cherenkov detector, a muon identification system, an electromagnetic calorimeter, a forward photon conversion tracker, and two forward counting detectors. An intense R&D programme on frontier sensors is well underway. The primary focus of the R&D on Monolithic Active Pixel Sensors for the trackers is on high spatial precision, low material budget, low power consumption, and large-area sensors. A pioneering concept is being pursued for a retractable barrel vertex detector that closes to a minimum radius of 5 mm from the interaction point. For particle identification, R&D is in progress towards ultra-fast timing with silicon sensors for time-of-flight measurement, and towards improving the radiation hardness of silicon photo-multipliers. The target specifications of the ALICE3 silicon sensors are similar to those of detectors at future colliders. The advancements in sensor technologies targeted by the ALICE3 R&D programme constitute a significant milestone in the ECFA strategic roadmap for detector R&D.

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