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Silicon Detectors Beyond LHC –RD50 Status Report

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Within the RD50 Collaboration, a large R&D program has been underway for more than a decade across experimental boundaries to develop silicon sensors with sufficient radiation tolerance for LHC-Phase-II trackers. While these trackers are now entering their construction phase, RD50 is continuing to study silicon sensors for particle tracking, but shifting the focus to applications beyond the LHC. The next generation of collision experiments, such as the FCC, require unprecedented radiation hardness in the range of a few $10^{17} N_{eq}$ as well as time resolutions of the order of 10ps. Another challenge is to move the sensor technology away from traditional planar and passive float-zone sensors that from large parts of the LHC-Phase-II trackers to sensor technologies such as CMOS where front-end electronics can be integrated, and where a wide availability promises cost advantages.
Key areas of recent RD50 research also include technologies such as Low Gain Avalanche Detectors (LGADs), where a dedicated multiplication layer to create a high field region is built into the sensor, resulting in time resolutions of a few tens of ps. Another strong activity is the development of sensor types like 3D silicon detectors.We also seek for a deeper understanding of the connection between macroscopic sensor properties such as radiation-induced increase of leakage current, doping concentration and trapping, and the microscopic properties at the defect level. A new measurement tool available within RD50 are the Two-Photon-Absorption (TPA) TCT systems, which allow position-resolved measurements down to a few μm.

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