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Ultra-Fast Silicon Detectors. A roadmap for the development of particle tracking in space and time

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In this contribution I will review the most recent progresses towards the development of a silicon detector able to provide accurate measurements in both space and time, the so-called 4-dimension tracking. In particular, the Ultra-Fast Silicon Detectors (UFSD) project is described by discussing working principles of devices, technological state-of-the-art, measurements and TCAD (Technology Computer-Aided Design) simulations. To have a satisfactory timing resolution UFSD are based on the Low-Gain Avalanche Detectors (LGADs) principle, where carriers multiplication is obtained and kept under control through the implantation of a highly-doped p-type layer. This fact ensures larger output signals, very important for accurate time measurements, while providing the advantage of not having high-gain regimes as in standard APD structures, where also noise is typically enhanced. In the presentation I will also review the most recent beam test results, and the quest for a radiation resistant design.

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