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Ultra-Fast Silicon Detectors

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We report on the status and expectation of the development of Ultra-Fast Silicon Detectors (UFSD). UFSD are novel silicon sensors based on the Low-Gain Avalanche Diodes (LGAD) design and, due to internal gain, exhibit a signal which is a factor of ˜ 10 larger than standard silicon detectors. The internal gain allows obtaining fast and large signals, a pre-requisite for time applications, and thus they are poised to extend the use of silicon sensors characterized by excellent position resolution into the precision time domain.

UFSD with the desired gain are being manufactured routinely in a variety of sizes. Their time resolution has been measured both in beam tests with electrons and pions and with laser pulses. An important parameter for the time resolution is the "slew-rate" dV/dt which depends on the internal gain in addition to the charge collection time (i.e. the detector thickness) and the capacitance. The timing measurements compare well with the prediction of the simulation program Weightfield 2, and we extend the prediction of the performance to future applications in both particle physics and medical physics.

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