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Hyperfast Sensor Development for the HL-LHC Era

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There is a growing interest in applying timing measurement of physics objects (leptons, jets, photons) in the high pileup environment planned for the next decade at the LHC. Time of occurrence of events within the same bunch (“in-time pileup”) can be used analogously to the more commonly used “event vertex position” tagging to resolve events of interest in this busy environment. Extending to this 2-D tool (time and space discrimination) is likely key to enabling the challenging measurements of the next decade by suppressing pileup background.

Currently both ATLAS and CMS are exploring the potential of this tool for improving physics capability.

In parallel our group has been developing timing technologies specific to the high rate environments and high radiation doses appropriate for the LHC for the past 5 years- mostly as a generic detector R&D. Our current activities are within the framework of RD51 (where Ioannis Giomataris and I are co-PIs) and RD50 where our High Gain hyperfast Silicon APD work is partly done. Our current HG-APD with mesh readout is achieving <10 picosecond time jitter at 1 MIP equivalent and is therefore approximately an order of magnitude faster than any other available solid state option.

I will also discuss briefly our work on the necessary infrastructure for such measurements at the LHC (timing readout architecture, FEE, clock distribution, etc).

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