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## The CMS MIP Endcap Timing Layer: From concept towards production

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The HL-LHC opens up new windows for exciting discoveries but also brings about new challenges due to the high pileup environment of approximately 200 interactions per collision. Precise measurements of track and vertex timing can efficiently mitigate these pileup effects. The CMS detector will be upgraded with a MIP timing detector (MTD) capable of providing ultra-fast timing information of trajectories of charged particles. With a time resolution of below 50ps per hit, the MTD will be a key ingredient to discover new physics.

The endcap region of the MTD has to endure high fluences, motivating the use of thin, radiation tolerant silicon sensors with fast charge collection. Tests and developments of these low gain avalanche detectors (LGAD) by CMS, together with manufacturers, have resulted in a robust design of 16x16 pixel sensors. A custom readout chip for ETL sensors (ETROC) containing clock trees, preamplifier, discriminator, and TDC is being developed in parallel. 4x4 pixel array prototypes of the ETROC have been bump bonded to LGAD sensor prototypes and were tested at the Fermilab test beam facility, showing a time resolution of approximately 45ps per layer. FPGA based boards that emulate the final digital design of the ETROC are used for the development of full system tests including the front-end electronics. In this talk we will present the extensive developments and progress made for the entire ETL detector, from sensors to readout electronics and mechanical design.

### Primary experiment

CMS

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