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Development of a timing detector for the TOTEM experiment at the LHC

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The upgrade program of the TOTEM experiment foresees the installation of timing detectors inside vertical Roman Pots to allow the reconstruction of the longitudinal vertex position in presence of event pile-up in high β^* dedicated runs. The small available space inside the Roman Pot and the required time resolution led to the study of a solution using single crystal CVD diamonds.

The sensors are read out using fast low-noise front-end electronics developed by the TOTEM Collaboration, achieving a signal-to-noise ratio larger than 20 for MIPs.

A prototype was designed, manufactured and tested during a test beam campaign, proving a time resolution below 100 ps and an efficiency above 99%.

The geometry of the detector has been designed to guarantee a uniform occupancy in the expected run conditions keeping, at the same time, the number of channels below ten. In fact, each detector uses four diamond crystals of $4.5 \times 4.5 \text{ mm}^2$: one is segmented in four pixels, another in two, while the remaining pair is metallized with a single electrode.

The detectors are read out using the SAMPIC chip, a fast sampler designed specifically for picosecond timing measurements with high rate capabilities.

Four aligned detectors will be installed in each Roman Pot to achieve a final resolution below 50 ps.

The first set of prototypes was successfully installed and tested in the LHC in November 2015.

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