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Development of 3D Trenched-Electrode Pixel Sensors with improved Timing performance

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The high luminosities expected at collider experiments over the coming years will put stringent requirements on the vertex detectors used in these experiments. The increased pile up will require improved spatial and timing resolution to distinguish between particle tracks while also requiring the devices to have an increased radiation hardness. 3D sensors have already been proven as a viable technology with good radiation hardness due to the short distance between electrodes and are also capable of achieving the desired spatial resolution. 3D sensors have so far not been fully exploited to achieve good timing resolution due to the non-uniformity of the electric field in the sensors.

The TIMESPOT project aims to develop a complete integrated system for tracking with high precision in both space and time. Novel 3D sensors are being developed for this purpose, providing the normal advantages of this technology (such as radiation hardness and low depletion voltage), with the trench geometry also providing more uniform electric and weighting fields, optimized for timing.

This presentation will describe the recent progress that has been made towards the development of these sensors. TCAD simulations have been carried out to optimize the design of these sensors and to estimate their performance, finding a compromise between the capacitance and the intrinsic speed. Technological tests have also been carried out at FBK to determine the manufacturing constraints of these sensors. A first layout including pixel sensors compatible with the TIMEPIX read-out chip and several test structures has been submitted to FBK and is currently being fabricated.

Authors: FORCOLIN, Giulio Tiziano (Universita degli Studi di Trento è INFN (IT)); DALLA BETTA, Gian Franco (Universita degli Studi di Trento è INFN (IT)); VECCHI, Stefania (Sezione di Ferrara (INFN)-Universita di Ferrara); RONCHIN, Sabina (FBK); LAI, Adriano (Universita e INFN, Cagliari (IT)); LOI, Angelo (Universita e INFN, Cagliari (IT)); BOSCARDIN, Maurizio (FBK Trento); MENDICINO, Roberto (UNITN)

Presenter: FORCOLIN, Giulio Tiziano (Universita degli Studi di Trento è INFN (IT))

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