Contribution ID: **224** Type: **Oral**

Invited - Measuring charged-particles with 10ps time resolution using innovative 3D trench-type silicon pixel sensors

Tuesday, 20 September 2022 15:30 (45 minutes)

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Future collider experiments operating at very high instantaneous luminosity will greatly benefit in using detectors with excellent time resolution to facilitate event reconstruction. As an example, when the LHCb experiment will operate at 1.5x1034/cm/s after its Upgrade2, 2000 tracks from 40 proton-proton interactions will cross the vertex detector (VELO) at each bunch crossing, and to properly reconstruct primary vertices and b-hadron decay vertices VELO hit time stamping with at least 50ps accuracy will be needed. To fulfill these requirements, several technologies are under study and one of the most promising today is the 3D trench silicon pixel, developed by the INFN TimeSPOT Collaboration. These 55µmx55µm pixels are built on a 150µm-thick silicon and consist of a 40µm-long planar junction located between two continuous bias junctions, providing charge-carriers drift paths of about 20µm and signals'total durations close to 300ps. The design of these sensors, their detailed simulation, their characterization both in laboratory and on the beam test, and the performance of irradiated sensors will be presented in this talk, showing that 3D trench-type silicon pixels appear to be a promising technology matching the requirements of future vertex detectors operating at very high instantaneous luminosity.

Alessandro Cardini, after his Master's degree in Physics at the University of Pisa (Italy) in 1989, with a thesis on innovative vertex detectors based on scintillating microfibers bundles, got his PhD in Physics at the same University in 1993, working on the silicon strip vertex detector and correlated charm production studies at the CERN fixed-target experiment WA92. After a 3-years post-doctoral period at UCLA working on the CERN neutrino oscillation search experiment NOMAD, he became a permanent Researcher at Istituto Nazionale di Fisica Nucleare (INFN) Italy. In the first years he participated to the construction of the ATLAS barrel MDTs and then to the development and construction of the first triple-GEM detectors to be used at LHC, the LHCb triple-GEM muon system detectors. From 2012 to 2015 he was appointed LHCb Muon System Project Leader and then elected as Italian LHCb Coordinator in the period 2015-2018. Always involved in innovative detector R&Ds, Alessandro Cardini joined in 2008 the DREAM Collaboration to develop dual-readout calorimeters for future HEP applications. He has also been involved in other R&D initiatives to study cryogenic solid-state photodetectors for very low threshold energy detectors for rare-events applications. In more recent years he has been one of the proponents of the INFN R&D initiative TimeSPOT to develop new silicon pixel detectors with time resolutions in the 10ps range. In October 2022 Alessandro Cardini will start its mandate as Director of the INFN Institute in Cagliari, an Institute with a long-standing tradition in detectors and ASICs development for CERN experiments.

Summary (500 words)

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Session Classification: Invited