Contribution ID: **17** Type: **WG1 - Monolithic Sensors**

Applying DMAPS technology to the Upgrade of the Belle II Vertex Detector

Monday 17 June 2024 09:30 (15 minutes)

The Belle II experiment currently records data at the SuperKEKB e+e- collider, which holds the world luminosity record of $4.7x10^{34}cm^{-2}s^{-1}$ and plans to reach $6x10^{35}cm^{-2}s^{-1}$ at the end of the decade. In such luminosity range for e+e- collisions, the inner detection layers should both cope with a hit rate dominated by beam-induced parasitic particles and provide minute tracking precision. An R&D program has been established to develop a new pixelated vertex detector (VTX), based on the most recent pixel detection technologies. The proposed VTX will be more robust against the expected higher level of machine background and more performant in terms of standalone track finding efficiency.

The VTX design is comprised of five layers in a barrel-shaped configuration, targeting minimal material budget from 0.2 to 0.5% X_0 with increasing radius.

All the ladders feature the OBELIX depleted-MAPS CMOS sensor, with an active area of approximately 1.5 cm × 3 cm, designed in the Tower 180 nm technology. The pixel-matrix is derived from the TJ-Monopix2 sensor developed to match the requirements for a fast (< 100 ns) and radiation tolerant (10^{15} 1MeV n_eq/cm2 or below) pixels, needed for the outer layers of the ATLAS-ITk of the ATLAS experiment and close to the Belle II specifications. However the digital logic handling the information issued by the pixel matrix is entirely new, in order to match the Belle II needs. Featuring a 33 µm pitch, OBELIX integrates hits over 50 or 100 ns while dissipating less than 200 mW/cm^2 at an average hit rate of 60 MHz/cm^2. The digital trigger logic matches the required 30 kHz average Belle II trigger rate with 10 µs trigger latency and a maximum hit rate of 120 MHz/cm^2. Hit rate pikes of up to 800 MHz/cm^2 can also be sustained for sub-microsecond periods without loss of data. Additional features are intended for the outer layers with expected hit rates below 10 MHz/cm^2. They allow additional time stamping of the hits with 3 ns precision and providing fast hit information for track-triggering with a substantially reduced spatial resolution.

The presentation will outline some VTX relevant tests of the TJ-Monopix2 to validate pixel-matrix performance, then focus on the OBELIX features development and performance estimates calibrated with those measurements of TJ-Monopix2. Finally the submission in 2024 and tests of the first version OBELIX-1 will be discussed.

Type of presentation (in-person/online)

in-person presentation

Type of presentation (scientific results or project proposal)

Presentation on scientific results

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