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Characterization of a baseline vertex detector prototype for the CEPC

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The proposed Circular Electron Positron Collider (CEPC) presents new challenges for the vertex detector in terms of material budget, spatial resolution, readout speed, and power consumption. To address these challenges, a Monolithic Active Pixel Sensor (MAPS) prototype called TaichuPix has been implemented, which is based on a column drain readout architecture. The TaichuPix sensor chip has been characterized at the DESY test beam facility, and the results indicate a spatial resolution better than 5 μm and a detection efficiency better than 98% under the set threshold.

The baseline vertex detector is proposed with a three-ladder architecture, which will be double-sided with TaichuPix sensors. The double-sided structure is adopted to reduce the multiple scattering of particles and improve the impact parameter. This means that the silicon pixel sensors and cables are installed on both sides of the support structure. A ladder is made of common support together with two layers of silicon detectors. For this prototype, one side of a ladder is proposed to assemble two TaichuPix sensors on a flexible printed circuit board. Two flexible boards are installed on the front and back sides of the lightweight carbon fiber support structure.

To verify the performance of the baseline vertex detector, six ladders were installed on the barrel, and the beam test was conducted at the DESY II TB21 facility. The beamline runs straight through the prototype, producing precise reconstruction points by multi-layer TaichuPix sensors. This presentation proposes to show the architecture and beam test results of the baseline vertex detector prototype.

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