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Development of monolithic pixel sensor prototypes for the first CEPC vertex detector prototype

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The TaichuPix chip is a dedicated monolithic CMOS pixel sensor developed for the first 6-layer silicon vertex detector prototype for the Circular Electron Positron Collider (CEPC) vertex detector R&D. Two small-scale demonstrator chips (25 mm^2) had been designed to optimize the in-pixel circuit and readout architecture, and to verify the radiation hardness. The promising test results of the small-scale prototypes led to a submission of the first full-scale ($\sim 4 \text{ cm}^2$) TaichuPix prototype in 2022. Figure 1 shows the architecture of a full-scale TaichuPix chip, including a matrix of 512×1024 pixels with a size of $25 \times 25 \mu\text{m}^2$. The full-scale sensor chip was characterized at the DESY test beam facility. The preliminary results indicate that the best spatial resolution of the individual TaichuPix-3 sensor is better than $5 \mu\text{m}$ combined with a detection efficiency better than 99% (see Fig. 2). The TaichuPix-3 chip also fulfills the TID tolerance requirement. This talk will report the design and test of TaichuPix prototypes and the readout electronics of the ladder for vertex detector. The design of the first vertex detector prototype and its beam test results will also be presented.

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