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sPHENIX MVTX Pixel Detector Internal Alignment with AI-ML Approach

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The sPHENIX experiment has achieved a major milestone with the construction and installation of the cutting-edge three-layer Monolithic-Active-Pixel-Sensor (MAPS) based VerTeX detector (MVTX) in April 2023, in preparation for first beam in Spring 2023. The MVTX is the innermost tracking detector, boasting a spatial resolution of 5 μm and covering 2.5-4.0 cm radially, and a pseudorapidity range of $|\eta|$ <2. With 432 ALPIDE sensors, each containing approximately 0.5M 27 μm x 29 μm pixels in an area of 1.5cm x 3.0cm, determining the position of each pixel in the sPHENIX global coordinate system presents a significant challenge. Our first step is to establish the relative position of each sensor in the local MVTX coordinates with an accuracy of better than 5 μm. To this end, we have developed an AI-ML-based approach to determine the deviations of each sensor's position and orientation from the ideal geometry (dx, dy, dz) in translation and (dα, dβ, dγ) in rotation. In this presentation, we will showcase the status of the MVTX detector's internal alignment based on first-year commissioning data, and discuss its impact on heavy flavor measurements

Category

Experiment

Collaboration (if applicable)

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