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Performance study of a MAPS detector prototype for the BESIII inner tracker upgrade

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As one of the prototype schemes of the BESIII inner drift chamber upgrade, a MAPS (monolithic active pixel sensor) detector prototype is under developed. The mass production and quality verification of the pixel detector ladders with low material budget and high chip position precision have been performed based on the optimization of the single ladder. The ladder, consisting of ten MIMOSA28 chips thinned to 50 μm, a flex cable and a carbon fiber support, is the basic structure and functional block of the prototype. In order to verify the design and quantify the performance of the ladders in terms of the detection efficiency, the spatial resolution, the gap between two chips and the material budget, a detector prototype system, including five layer ladders, readout electronics and the DAQ was set up and tested at T24 beam line in the DESY, Germany. The test and the data analysis will be presented, including the alignment method based on Karimäkic's algorithm, track reconstruction and analysis software. The results show that the tracking efficiency of 96% is achieved, and the spatial resolution is about 5μm. The average gap between neighboring chips is measured to be about 340μm. The actual gap and the chip location accuracy is better than 10μm if the insensitive part of the sensor is taken into account. The material budget of one ladder is 0.35% X0, which is well consistent with the predicted value of 0.37% X0. These test results validate a good performance of the prototype.

Submission declaration

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