

Development of Monolithic Active Pixel Sensors for Belle Vertex Detector Upgrade

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Technological development of Monolithic Active Pixel Sensors (MAPS) has reached a stage where their application in an upgrade of existing vertex detectors can be seriously considered. MAPS show excellent single point resolution and low occupancy even with high track densities. As their active volume extends only few tens of microns deep in the silicon, it allows them to be thinner than classical strip or pixel detectors, which is an important feature in multiple scattering limited B-factory environment. In the context of the upgrade of the Belle detector for operation at a Super B-Factory, major concerns have been MAPS radiation resistance and readout speed.

Two small 132x48 pixel prototypes, implemented in 0.35um TSMC process, named Continuous Acquisition Pixel (CAP1 and CAP2) have been developed and tested in 2003 and 2004 to address these issues. Another larger 928x128 pixel CAP3 prototype, implemented in 0.25um TSMC process, was developed and tested in 2005, and it included a 5 deep correlated double sampling pipeline for each of its 22.5um by 22.5um pixels. CAP3 test results and the results of the performance of the CAP architecture after its extrapolation to a larger size will be presented, showing certain inherent limitation of this structure. Based on the experience gained from CAP3, a new generation CAP4 prototype has been designed and implemented in the 0.35um AMS opto process, containing several pixel architectures in the same sensor. We will present the architecture design considerations.