Contribution ID: **7** Type: **not specified**

HFT PXL Vertex Detector Mechanics

Tuesday, 1 July 2014 11:00 (30 minutes)

The HFT PXL detector is a new two layer, inner, vertex detector which has just been installed in the STAR experiment at RHIC. This is the first time that a vertex detector based on MAPS[1] technology has been used in a collider experiment. The MAPS silicon chips have 20.7 micron square pixels and are thinned to 50 microns to reduce multiple coulomb scattering. The detector is configured in two layers with one layer at 2.8 cm radius and the other layer at 8.0 cm radius from the beam. The small pixel size, thinned silicon and small radius provides the opportunity to achieve the excellent pointing resolution required to topologically identify D mesons in the high track density environment of Au Au collisions at RHIC. The mechanics have been designed to take advantage of this potential providing a stable low radiation length structure. Air cooling, thin very rigid carbon composite support structures and aluminum flex cables are used to achieve a radiation length of 0.4% at the inner layer for non-angled tracks. The mechanics are also designed for detector withdrawal and replacement within a day should this be required mid run in the event of a beam excursion accident. We will report on design details and testing addressing the successful control of thermal deformations, air induced vibrations and other stability issues. We will also cover the CMM methods that were developed to fully map the silicon surfaces and pixel locations. As planned from the beginning this mapping is used because fabrication of the very thin structures cannot be done to the mechanical tolerance required for our pointing resolution. The system designed for insertion and closure of the detector around the central beam pipe to a locked in position will be presented. Initial cosmic ray testing of the PXL detector installed in STAR demonstrates a 3D hit determination of better than 8 microns RMS.

[1] The cmos MAPS pixel chips were developed at IPHC by Marc Winters group.

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