Contribution ID: **132**

Type: **Oral**

ULTIMATE: a High Resolution CMOS Pixel Sensor for the STAR Vertex Detector Upgrade

Tuesday, September 21, 2010 5:35 PM (25 minutes)

A pixel detector, composed of two layers of high resolution Monolithic Active Pixel Sensors (MAPS), is being designed for the STAR Heavy Flavor Tracker (HFT) upgrade. It allows topological identification of D mesons in heavy ion collisions at RHIC. The sensor chip: named ULTIMATE, is optimized for the ultimate phase of the upgrade in terms of resolution, power consumption and radiation tolerance. It features a matrix of 928x960 pixels, covering an active area of ~382 mm2. Its architecture is based on that of MIMOSA26 allowing a fast readout frequency of ~5 k frames/s. This paper presents the sensor design.

Summary

A major goal of the STAR detector upgrade is the construction of a new, high resolution vertex detector (PIXEL) to extend the physics range of STAR by providing capability for precision measurements of yields and spectra of particles containing heavy quarks. The detector system will allow for direct topological reconstruction of D (and B) mesons through the identification of decay vertices displaced from the primary interaction vertex by 100-150 µm. In order to achieve a vertex pointing resolution of about, or better than, 30 µm, two nearly cylindrical MAPS layers with averaged radii of about 2.5 and 8 cm, will be inserted in the existing detector. No space will be available for a sophisticated cooling system. Only simple air flow can be used, meaning that MAPS sensors have to be operated at room temperature. The power consumption of MAPS should therefore be, in the order of 100 mW/cm2. Moreover, multiple coulomb scattering concerns impose to keep the material budget per layer as low as ~ 0.3% of radiation length. All sensors should therefore be thinned down to 50 µm. The final pixel sensors, expected to be operated with Au + Au collisions at a RHIC II luminosity of ~ 8 x 1027 cm-2s-1, will face a hit density in the order of 106 hits/s/cm2 in the inner layer. The total ionising dose was estimated to 150 - 300 kRad per year and the non-ionising radiation dose should mainly come from an annual flux of 3–12 x 1012 charged pions per cm2 traversing the inner layer.

ULTIMATE, the sensor adapted to these physics requirements and running conditions is being designed at IPHC and will be submitted for fabrication in October 2010. Its architecture reproduces that of MIMOSA-26, the sensor equipping the beam telescope of the EUDET project (FP6). It is based on a column parallel readout with in-pixel pre-amplification and pedestal subtraction. Each column is ended with a discriminator. The latter are followed by a zero suppression circuitry integrated at the chip periphery.

Starting from the interpretation of the test results of MIMOSA-26, the contribution to the workshop will provide an overview of the ULTIMATE sensor design. The latter integrates several improvements w.r.t. MIMOSA-26. ULTIMATE will be manufactured in a process featuring a commercial available high resistivity epitaxial layer, a key point to improve the signal to noise ratio and hence radiation hardness. The modification of the MIMOSA-26 design being explored and optimised with a prototype is currently fabricated with such a high resistivity epitaxial layer. Its performances, which will be evaluated in Summer, will also be presented in support to the main choices of the ULTIMATE design optimisation.

Primary author: Dr HU-GUO, Christine (DRS-IPHC (IReS), University of Strasbourg, CNRS-IN2P3)

Presenter: Dr HU-GUO, Christine (DRS-IPHC (IReS), University of Strasbourg, CNRS-IN2P3)

Session Classification: ASICs

Track Classification: ASICs