International Workshop on Semiconductor Pixel Detectors for Particles and Imaging (PIXEL2014)

Contribution ID: **158** Type: **ORAL**

The DEPFET Pixel Detector for the Belle II Experiment at SuperKEKB

Monday, 1 September 2014 15:30 (25 minutes)

A pixel detector built with the DEPFET technology will be used for the two innermost layers of the Belle˜II experiment at the e^+e^- SuperKEKB collider at KEK. The physics goals of the experiment impose challenging requirements to the design of the pixel detector in terms of performance, material budget and power consumption. The DEPFET technology has proven to be a suitable solution for the Belle II requirements and has been chosen as the baseline for the detector. This paper reviews the DEPFET pixel detector for Belle II and the various system aspects that have driven its final design.

Summary

The SuperKEKB collider, an upgrade of the former KEKB, is under construction at KEK. It is an asymmetric (4 GeV, 7 GeV) e^+e^- collider working at the center of mass energy of the $\Upsilon(4S)$ resonance. The design peak luminosity is $8{\times}10^{35}$ cm^{2}s^{-1}, about 40 times larger than KEKB, aiming at an integrated luminosity of 50 ab^{-1}.

To fully exploit the higher luminosity the former Belle detector is being upgraded. This new detector must cope with the higher backgrounds and event rates and the corresponding larger radiation damage, occupancy and fake hit production. As a consequence, improved vertexing and tracking capabilities are needed in the Belle II detector. This converts the vertex detector in one of the key elements that drive the physics performance. It consists of four layers of double-sided silicon strip detectors in the outer radii, SVD, and two layers of highly granular pixel sensors in the innermost part, known as PXD.

The PXD, built with DEPFET pixel detectors, is intended to improve vertex resolution. As a consequence of the low momentum of the particles in the final state (< 1 GeV/c), the hit position determination is intrinsically limited due to the multiple Coulomb scattering. This sets a lower limit of 10μm for the spatial resolution in the PXD that can be achieved with a moderate pixel size of 50×50 μm^2. This pixel size is also enough to cope with the expected occupancy of 0.4 hits μm^{-2}s^{-1}. For the same reason the material budget must be kept low, up to a maximum of $\sim$0.2 % $X_\circ$ per layer, implying a thickness of 75 μm of the sensitive part of the sensor. The acceptance of the detector must cover the range 17°-155° in azimuth angle. The detector will be read continuously with a frame time of 20 μs keeping the occupancy below 3%. This continuous readout means that ASICs are ON all the time, which together with the restrictions on the material budget sets the requirements for cooling. Finally, according to the simulations, the radiation dose expected in the inner region of the detector is around 2 Mrad/yr.

Primary author: KODYS, Peter (Charles University (CZ))

Presenter: KODYS, Peter (Charles University (CZ))

Session Classification: Monolithic Devices