

A Novel Pixel Vertex Detector for the Belle II Experiment at SuperKEKB

vendredi 22 juillet 2011 15:15 (15 minutes)

With the completion of the first-generation experiments at asymmetric e^+e^- colliders (BaBar and Belle) studying CP violation in the B-meson system, a new era of high luminosity machines is at the horizon. We report here on the plans for future experiments on CP violation and searches for physics beyond the Standard Model at the upgraded KEKB machine in Japan (SuperKEKB), providing an almost two orders of magnitude higher instantaneous luminosity. Due to the much higher backgrounds expected at SuperKEKB, a massive upgrade of the Belle detector (Belle II) is necessary. In particular, the tracking detectors, the Central Drift Chamber and the Silicon strip vertex detector need to be replaced. Due to the expected large occupancy close to the beam pipe a pixel detector is mandatory at SuperKEKB for the precise vertex determination. We report here on the design and construction of a novel silicon pixel detector for Belle II, based on the DEPFET-technology. The DEPFET ("depleted p-channel field effect transistor") pixel provides a high signal to noise ratio and therefore allows for thin sensors, down to 50 microns. The principles of the DEPFET technology will be explained as well as the construction of large pixel matrices where the readout ASICs are mounted at the ends of the sensors, outside of the acceptance region for particle detection. The sensors are monolithic and self-supporting and are arranged in two layers to make up the detector structure. Some details concerning the readout, mechanics and cooling schemes are also presented. Finally, we show some simulations on the expected performance of this unique vertex detector, which should be ready for installation in Belle II by the end of 2014.

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Classification de Session: Detector R & D and Data Handling

Classification de thématique: Detector R & D and data handling