Contribution ID: **93** Type: **ORAL**

# Charge collection and ionizing radiation tolerance of CMOS Pixel Sensors using the 0.18 µm CMOS process

*Saturday, 26 September 2015 16:50 (20 minutes)*

The Circular Electron Positron Collider (CEPC) as a Higgs Factory was proposed by the Chinese high energy physics community in 2012. To fulfill the stringent requirements, the vertex detector must be constructed based on sensor technologies that push for fine pitch, low power consumption and fast readout. Among the candidate technologies, CMOS Pixel Sensors (CPS) has demonstrated excellent performance as vertex detectors. However, it remains challenging to lower the power consumption down to 50 mW/cm$^2$ or below for its application to the CEPC vertex detector.

This work presents the preliminary studies on the sensor optimization to reduce the analog power consumption, which is mostly determined by the collected charge over input capacitance ratio (Q/C). Detailed studies are performed on the charge collection as well as the ionizing radiation tolerance of CMOS pixels sensors using a 0.18 µm CMOS imaging process. This process allows high-resistivity (˜kΩ·cm) epitaxial layers, leading to significant improvements on charge collection. In addition, the sensitive volume is partially depleted, which accelerates the charge collection and hence improves substantially its tolerance on non-ionizing radiation damage. To exploit these features, we have performed detailed 3-D simulations with the Sentaurus-TCAD package. The boundaries treated with the reflective boundary condition, as a standard method used in Sentaurus-TCAD, usually lead to overestimated signals. Defining artificially high recombination velocity at the interface can partially alleviate the problem but has been found unreliable due to the arbitrary recombination rate. We propose a new approach by extending the auxiliary silicon surrounding the simulated pixel cluster to hundreds of micro-meters, which approximates the real device condition. Together with the simulation studies, we have designed the first exploratory prototype for sensor optimization. It hosts matrices with 32 different pixels types, which vary in terms of pixel pitch, as well as size and geometry of the collection electrode. We expect to compare the simulation results with the measurements of the prototype.

**Primary author:** Dr ZHANG, Ying (IHEP)

**Co-authors:** Dr ZHU, Hongbo (IHEP); Dr ZHANG, Liang (SHANDONG UNIVERSITY); Dr FU, Min (Ocean University of China)

**Presenter:** Dr ZHANG, Ying (IHEP)

**Session Classification:** Pixels (including CCD's)-1

**Track Classification:** Pixels (including CCD's) - Charged particle tracking