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## Study of Charge Collection Diode in a Monolithic Active Pixel Sensor for beam monitoring in heavy ion beam therapy facility

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Heavy ion beam therapy is becoming an ideal treatment for cancer. China is building a heavy ion beam therapy facility in Lanzhou. Beam monitoring system in the therapy facility ensures the beam energy deposition can accurately cover the dedicated tumor region. On the purpose of building a high-precision beam monitoring system, we are developing a Monolithic Active Pixel Sensor (MAPS) in a 180 nm CMOS Imaging Sensor process with deep p-well. This process has been chosen mainly because it allows the integration of the full CMOS circuitry within the pixel array without reducing the full charge collection efficiency. The charge collection diode is the critical part in this MAPS. The charge collection diode is formed by an n-well -  $p^-$  epitaxial layer junction. The  $p^-$  epitaxial layer is a high resistivity ( $>1k\Omega\cdot\text{cm}$ ) layer with thicknesses ( $18\mu\text{m}$ ), significantly widening the depletion region. To reduce diode capacitance, the n-well structure is designed with an octagon shape instead of a square shape. And the p-well can be biased to a negative voltage, significantly increasing the depletion region. Meanwhile, considering about improving charge collection efficiency and reducing charge collection time, the diameter and spacing of diode, the location and depth of the heavy ion hit and the deep p-well area has been studied to optimize the structure.

**Primary authors:** Dr YANG, Haibo (Institute of Modern Physics, Chinese Academy of Science); Mrs YANG, Xiaoyu (Microelectronics Department, Harbin Institute of Technology); Dr FU, Fangfa (Microelectronics Department, Harbin Institute of Technology); Prof. WANG, Yongsheng (Microelectronics Department, Harbin Institute of Technology); Dr LAI, Fengchang (Microelectronics Department, Harbin Institute of Technology); Prof. QIAN, Yi (Institute of Modern Physics, Chinese Academy of Science); Prof. ZHAO, Chengxin (Institute of Modern Physics, Chinese Academy of Science)

**Presenter:** Dr YANG, Haibo (Institute of Modern Physics, Chinese Academy of Science)

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