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Monolithic HV-CMOS sensors for a beam monitoring system of therapeutic ion beams

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Today, cancer treatment with ion beam is well established and studied. This method allows to deposit the maximum dose to the tumor and minimize the damage of healthy tissue, due to the Bragg peak of the ion energy deposition near the end of the particle range. During the treatment it is possible to provide volumetric dose delivery by changing the particle energy (penetration depth) and adjusting the beam position via magnetic system. For the beam monitoring system, the precise measurement of the beam position, shape and fluence in real time becomes crucial to provide effective and safe dose delivery to the tumor. Additionally, the system should work for beam intensities up to 10^{10} s^{-1} for protons, be tolerant to 1 MeV neutron equivalent fluences up to 10^{15} cm^{-2} per year and magnetic fields (for MRI-guided proton therapy).

The studies presented in this talk are focused on the application of the HitPix sensor family with counting electronics and frame-based readout for such a beam monitoring system. The HitPix sensors are monolithic pixelated silicon sensors based on HV-CMOS technology and have been developed at the ASIC and Detector Lab (ADL, KIT). Recent measurements with ion beams and a multi-sensor readout as well as future developments are discussed.

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