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Testbeam measurements with ALICE MAPS prototype

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In light of upgrades such as the High Luminosity LHC (HL-LHC) and proposals for future collider experiments, continued development of particle tracking technology is crucial. Monolithic Active Pixel Sensors (MAPS) are established vertex detectors, which combine the readout electronics and sensitive volume in one sensor, providing excellent spatial resolution, while maintaining a low power consumption and material budget. The Digital Pixel Test Structure (DPTS) is a MAPS prototype for the inner tracker of the ALICE experiment (ITS3) manufactured in the Tower Partners Semiconductor Co. 65 nm process for their upgrade for the HL-LHC. It is important to characterize the DPTS performance, in particular their radiation tolerance, given their estimated yearly radiation exposure of up to 10 kGy and 10^{13} 1 MeV neq cm^{-2} .

Here, we will present the results of a 2022 testbeam at CERN PS. DPTS sensors were irradiated to various levels up to 100 kGy and 10^{15} 1 MeV neq cm^{-2} and characterized in a 10 GeV/c positive hadron beam. The detection efficiency and spatial resolution were measured for each chip. It is shown that all the chips can be operated at 99% efficiency and with a spatial resolution of around 4.3 μm . The demonstrated performance and radiation hardness of the DPTS sensor makes the 65 nm technology a viable candidate not only for the ALICE inner tracker, but also a technology with potential applications, such as future e+e- colliders.

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