Summary

The MALTA2 sensor is the second prototype in the MALTA family of Depleted Monolithic Active Pixel Sensors (DMAPS), produced with a modified Tower 180 nm CMOS imaging process and optimized for next-generation collider experiments. We studied the performance of a VH-dop (very high doping of n^- layer) MALTA2 sample irradiated to an exceptionally high fluence of 5×10^{15} 1 MeV n_{eq}/cm^2, beyond the fluence explored in prior MALTA2 test beam campaigns. The experiment was performed at the CERN SPS facility using a 180 GeV hadron beam, using the grazing angle technique to access the charge collection and cluster formation under significant radiation-induced damage. The sensor was mounted on a rotatable stage to vary the beam incidence angle between 0° and 60°, allowing detailed study of how the charge collection depends on the effective path length through the sensor. The measurements were performed using the MALTA telescope, a dedicated pixel tracking system located at the SPS North Area. It features six tracking planes, precise time reference with scintillator-based triggering, and a cold box setup to maintain the irradiated samples at −20 °C. Hit efficiency and cluster size were analyzed as functions of beam angle and substrate bias voltage. The sensor maintained hit efficiencies above 95% up to 3×10^{15} 1 MeV n_{eq}/cm^2, with a performance reduction observed at the highest fluence, in line with expectations for radiation-induced damage (shown in figure 1). At the highest rotation angle of 60° and substrate bias of −60 V, the sensor irradiated to 5×10^{15} 1 MeV n_{eq}/cm^2 demonstrated a maximum hit efficiency of ~80% (shown in figure 2). Cluster size increased with incidence angle (shown in figure 3), providing insight into lateral charge diffusion and electric field behavior under irradiation. The depletion depth is extracted by analyzing the angular dependence of the cluster size. The detailed experimental set up and analysis technique with the results will be reported.

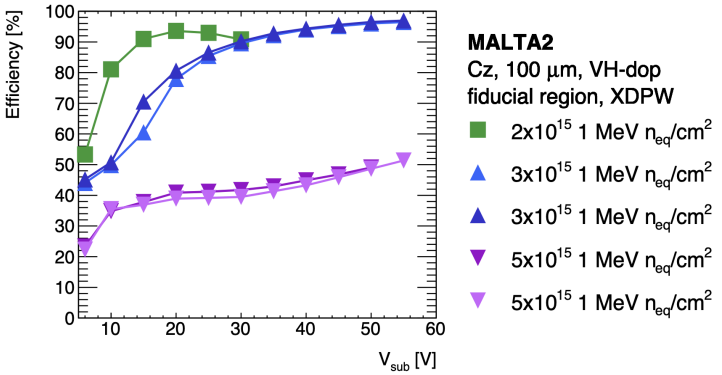

Figure1: Average efficiency vs SUB voltage (at 0 degree)

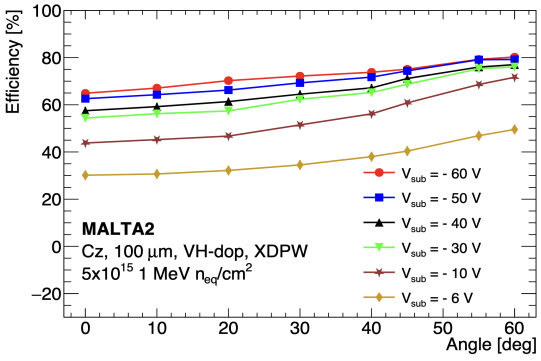

Figure2: Average efficiency vs angle of beam incidence

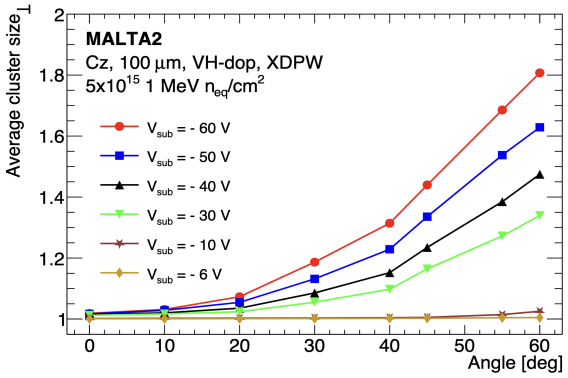

Figure3: Average cluster size, in the direction perpendicular to the rotation axis of beam incidence vs angle of beam incidence.