

# FLUKA Simulation results for HGTD

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These two plots from FLUKA simulations show the ionising dose in the layer of the proposed HGTD detector, closest to the endcap and the 1 MeV neutron equivalent fluence in the ITk volume just next to the HGTD z-position. Three different HGTD layout alternatives are considered and compared to the baseline layout without a HGTD detector. In the simulation the HGTD has been described by azimuthally symmetric disks, but with a detailed layer structure along z, representing the different materials and sensitive layers.

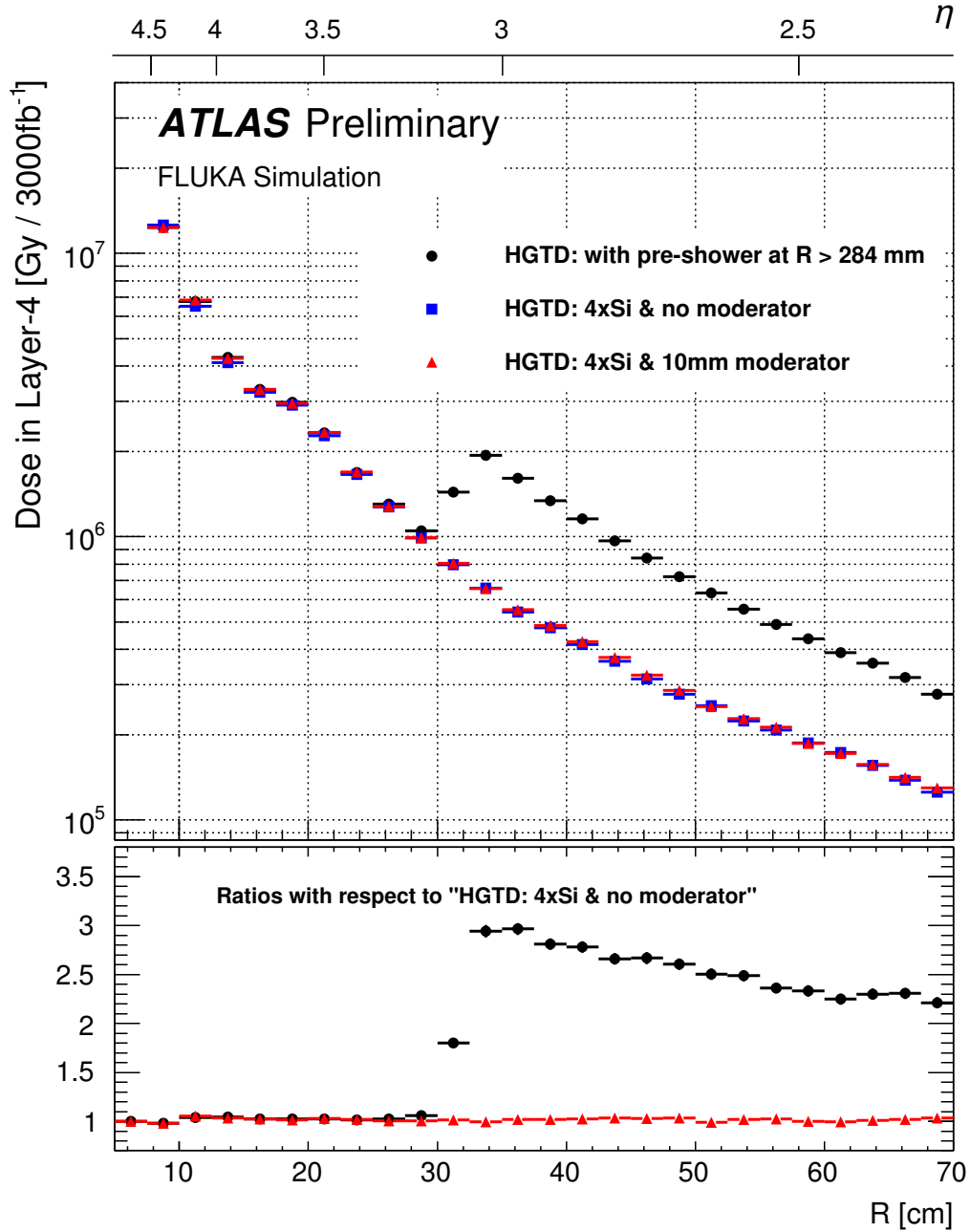


Figure 1: Ionising dose in the readout chips of the HGTD layer closest to the ATLAS endcap calorimeter. The histograms represent the three different HGTD layouts that have been studied: the preshower option (black circles), with 3.5 mm thick borated polyethylene moderator layers from  $R=47$  mm to  $R=284$  mm, continued with tungsten plates of the same thickness from  $R=284$  mm to  $R=700$  mm, an option with the tungsten replaced by borated polyethylene (red triangles), giving a total of 10 mm moderator over the full radial range of the HGTD and an option with no moderator inside the detector (blue squares). While the presence of the tungsten plates increases the dose significantly in the radial range covered by these plates, the borated polyethylene has no influence on the ionising dose. The Z position of the HGTD as described in the FLUKA geometry is:  $Z=\pm[3461,3516]$  mm.

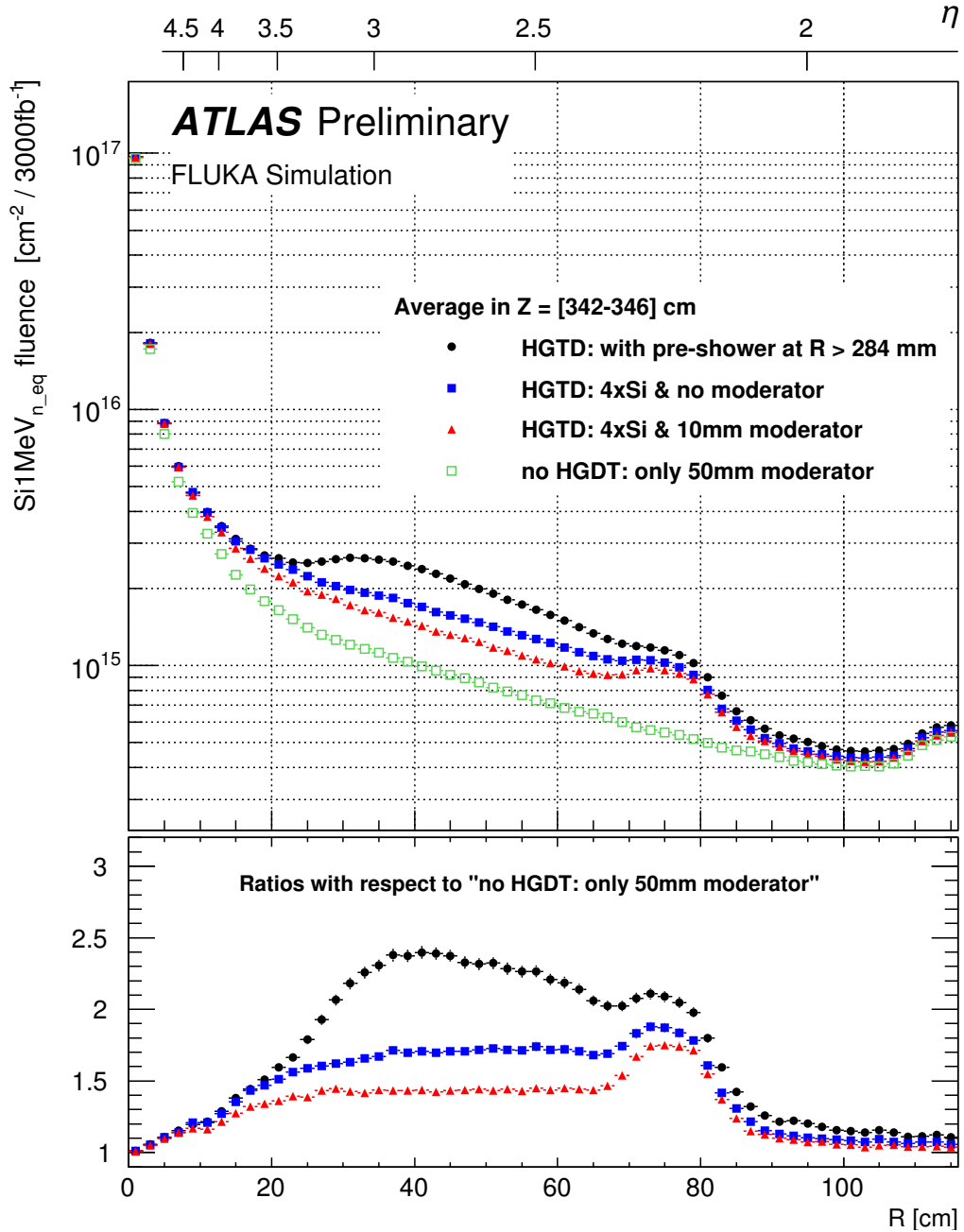


Figure 2: Comparison of the non-ionising energy loss (NIEL) in the ITk region close to the endcap for three alternative HGTD layouts with respect to the baseline configuration without the HGTD, but 5 cm of borated polyethylene all over the calorimeter endcap face. The histograms represent the preshower option (black circles), with 3.5 mm thick borated polyethylene moderator layers from  $R=47$  mm to  $R=284$  mm, continued with tungsten plates of the same thickness from  $R=284$  mm to  $R=700$  mm, an option with the tungsten replaced by borated polyethylene (red triangles), giving a total of 10 mm moderator over the full radial range of the HGTD and an option with no moderator inside the detector (blue squares). From  $R=700$  mm to  $R=800$  mm a gap for service routing is left. In the simulations this region contains only air – the presence of cables is likely to reduce the fluence to some extent. The fourth histogram (green open squares) shows the baseline case with 5 cm moderator and no HGTD. Depending on the layout the NIEL in the ITK volume just next to the endcap increases, with respect to the baseline, by 40–140% in the radial range covered by the HGTD. The Z position of the HGTD as described in the FLUKA geometry is:  $Z=\pm[3461,3516]$  mm.