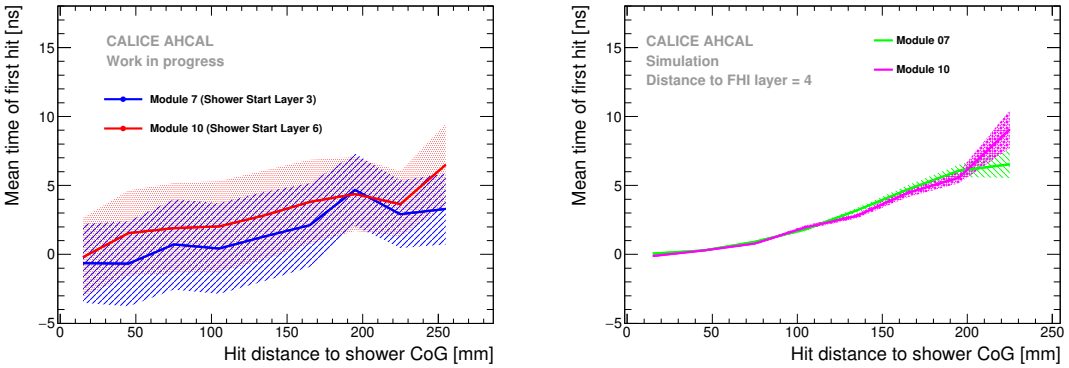
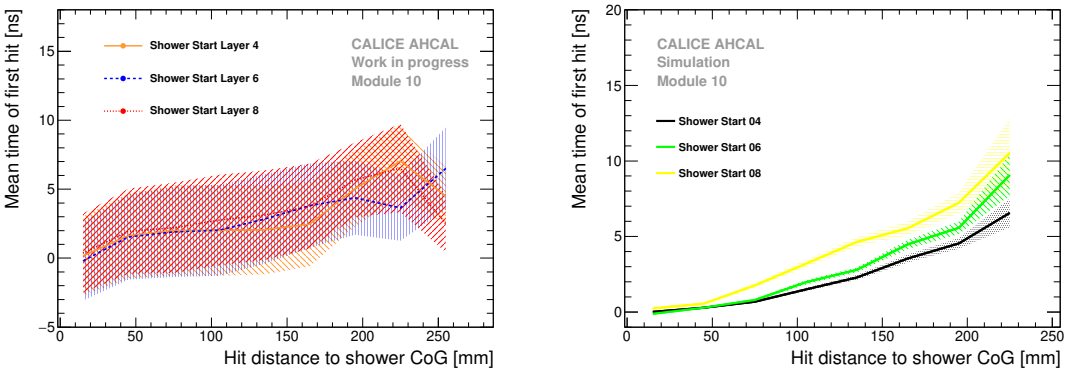
1 Additional Plots First Draft



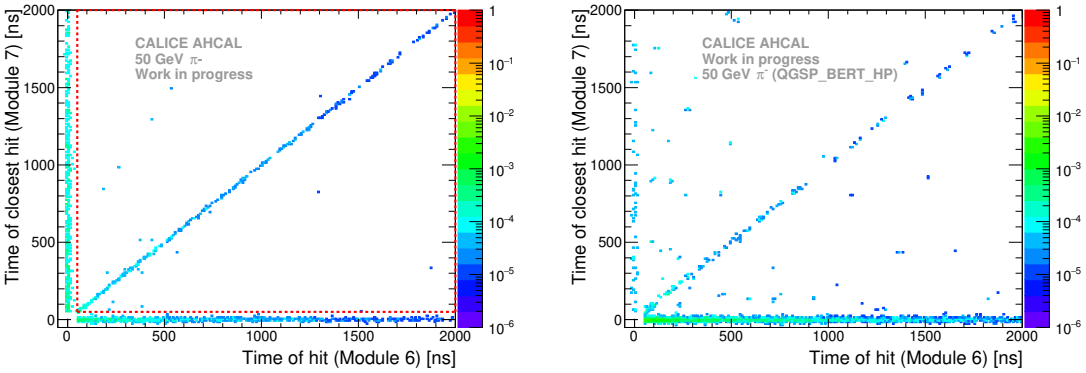
(a) (b)

Figure 1: Mean time of first hit as a function of the hit distance to the shower axis for 50 GeV pions for a fixed distance of 4 between the reconstructed FHI layer and a layer. The left plot shows the radial timing profile of modules 7 and 10 in data. The right plots shows the radial timing profile for the same layers in simulation with the QGSP_BERT_HP physics list.



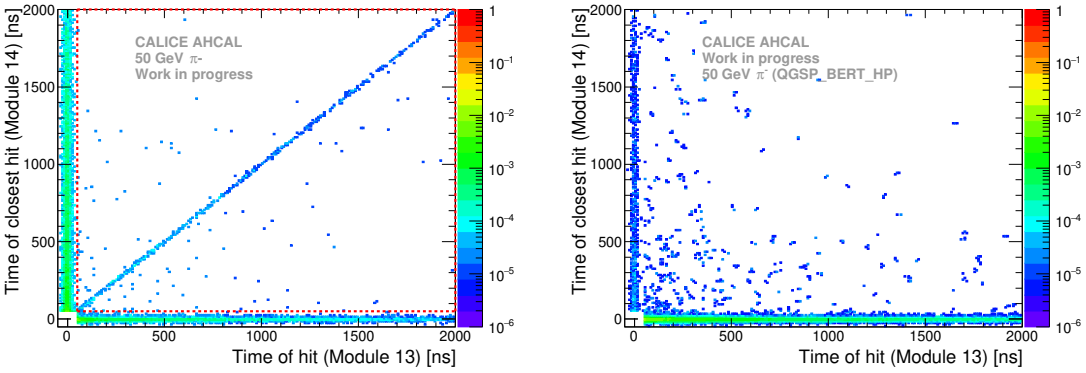
(a) (b)

Figure 2: Mean time of the first hit as a function of the hit distance to the shower axis for 50 GeV pions for different reconstructed FHI layers. In data on the left and in simulation with the QGSP_BERT_HP physics list on the right.



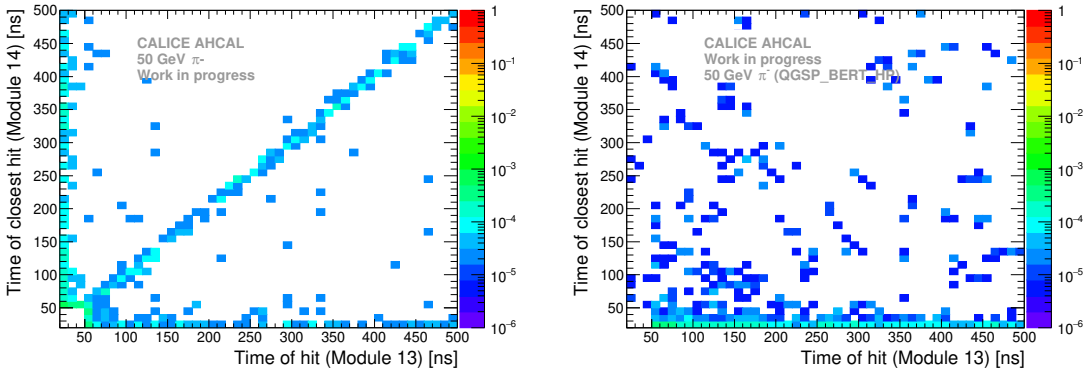
(a) Data (b) Simulation

Figure 3: Hit timing correlations between modules 6 and 7 for data on the left and the DD4HEP simulation with QGSP_BERT_HP on the right, for 50 GeV pions. Each bin is normalized to the total number of entries in the 2D histogram. The red box in the left plot represents the zone investigated to quantify the difference between data and simulation as stated in the text.



(a) Data (b) Simulation

Figure 4: Hit timing correlations between modules 13 and 14 for data on the left and the DD4HEP simulation with QGSP_BERT_HP on the right, for 50 GeV pions. Each bin is normalized to the total number of entries in the 2D histogram. The red box in the left plot represents the zone investigated to quantify the difference between data and simulation as stated in the text.



(a) Data (b) Simulation

Figure 5: Hit timing correlations between modules 13 and 14 for data on the left and the DD4HEP simulation with QGSP_BERT_HP on the right, for 50 GeV pions zoomed in the range [25, 500] ns. Each bin is normalized to the total number of entries in the 2D histogram. The red box in the left plot represents the zone investigated to quantify the difference between data and simulation as stated in the text.

2 Additional Plots Second Draft

Table 1: Fit results of the double exponential for each pion energies.

Pion energy [GeV]	τ_{fast} [ns]	τ_{slow} [ns]	c
10	5.61 ± 0.36	285 ± 52	5.9e-6
30	6.05 ± 0.32	310 ± 41	1.4e-5
50	6.21 ± 0.30	343 ± 39	3.0e-5
70	7.19 ± 0.31	333 ± 35	5.4e-5
90	7.41 ± 0.32	320 ± 33	3.0e-5

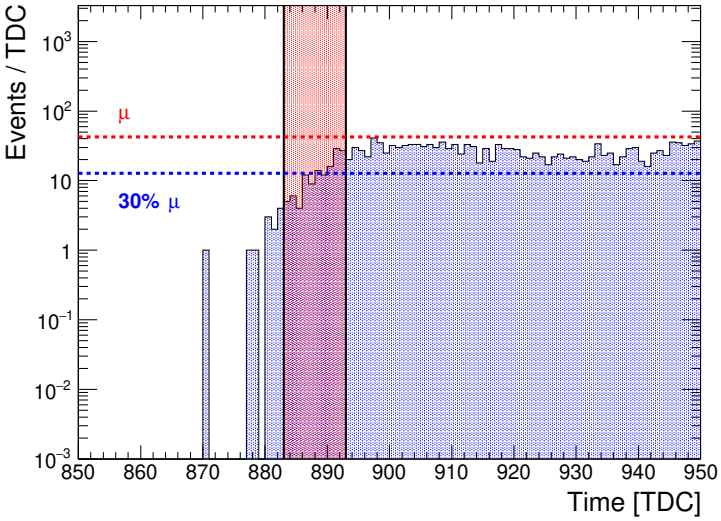
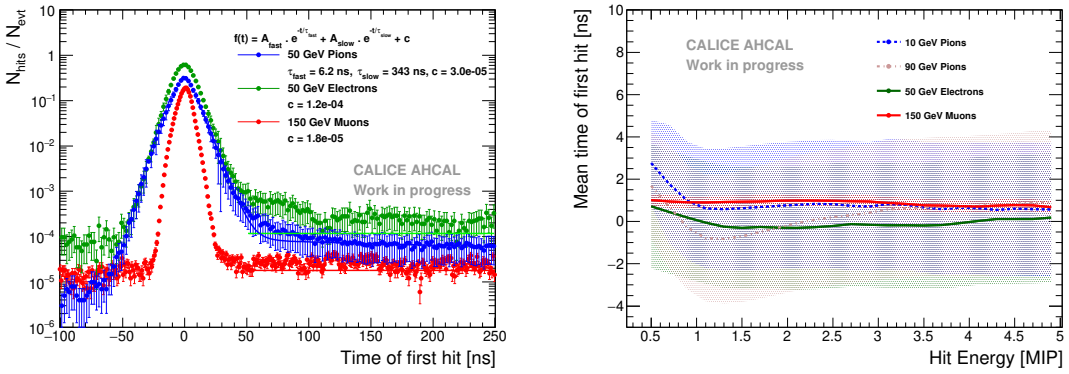
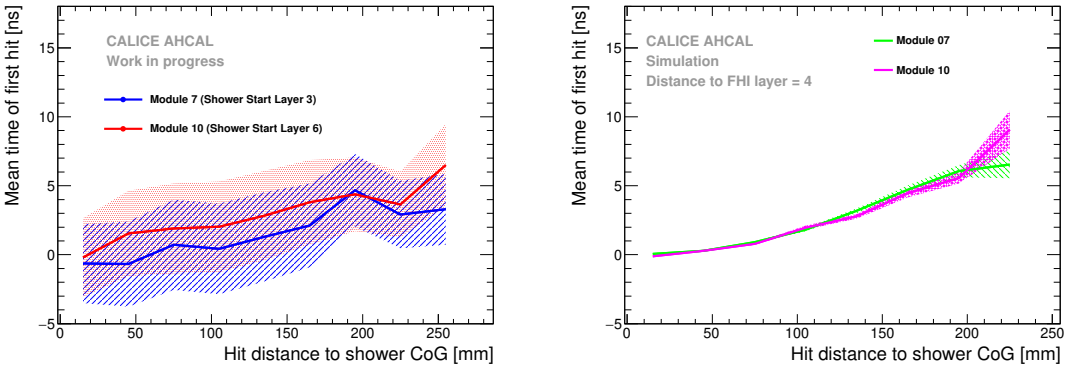


Figure 6: Zoom in the low part of the TDC spectrum of a typical chip. The red line represents the value of μ, the blue line 30% of μ. The value of first bin above the blue line is extracted as pedestal. The red box defines the uncertainty on the extracted pedestal by varying the blue line by ± 1 RMS of μ.



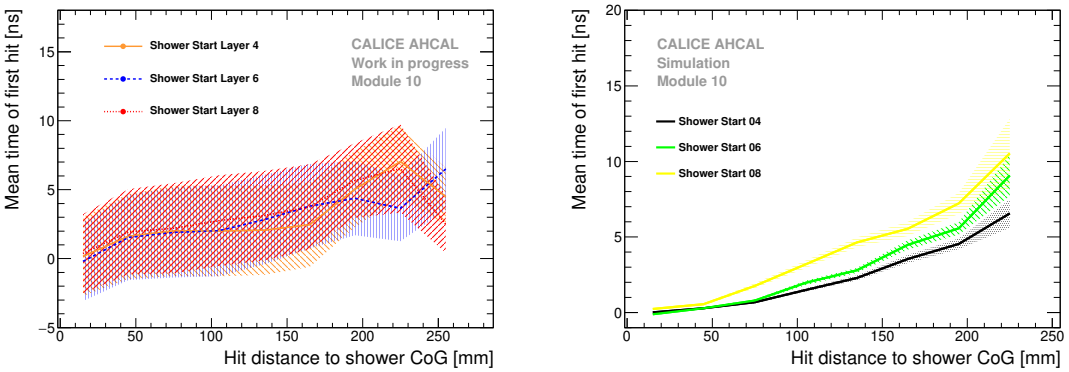
(a) (b)

Figure 7: On the left, Time of first hit for muons, electrons and pions in steel absorber in a range of -100 to 250 ns. The histograms are normalized to the number of events where at least one hit was identified. The errors bars are statistical and systematic uncertainties. On the right, Comparison of the mean time of first hit as a function of the hit energy in data for muons, electrons and pions. The grey band shows the statistical and systematic uncertainties for pions.



(a) (b)

Figure 8: Mean time of first hit as a function of the hit distance to the shower axis for 50 GeV pions for a fixed distance of 4 between the reconstructed FHI layer and a layer. The left plot shows the radial timing profile of modules 7 and 10 in data. The right plots shows the radial timing profile for the same layers in simulation with the QGSP_BERT_HP physics list.



(a) (b)

Figure 9: Mean time of the first hit as a function of the hit distance to the shower axis for 50 GeV pions for different reconstructed FHI layers. In data on the left and in simulation with the QGSP_BERT_HP physics list on the right.