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Simulations for possible future measurements with FOOT setup

Physics meeting

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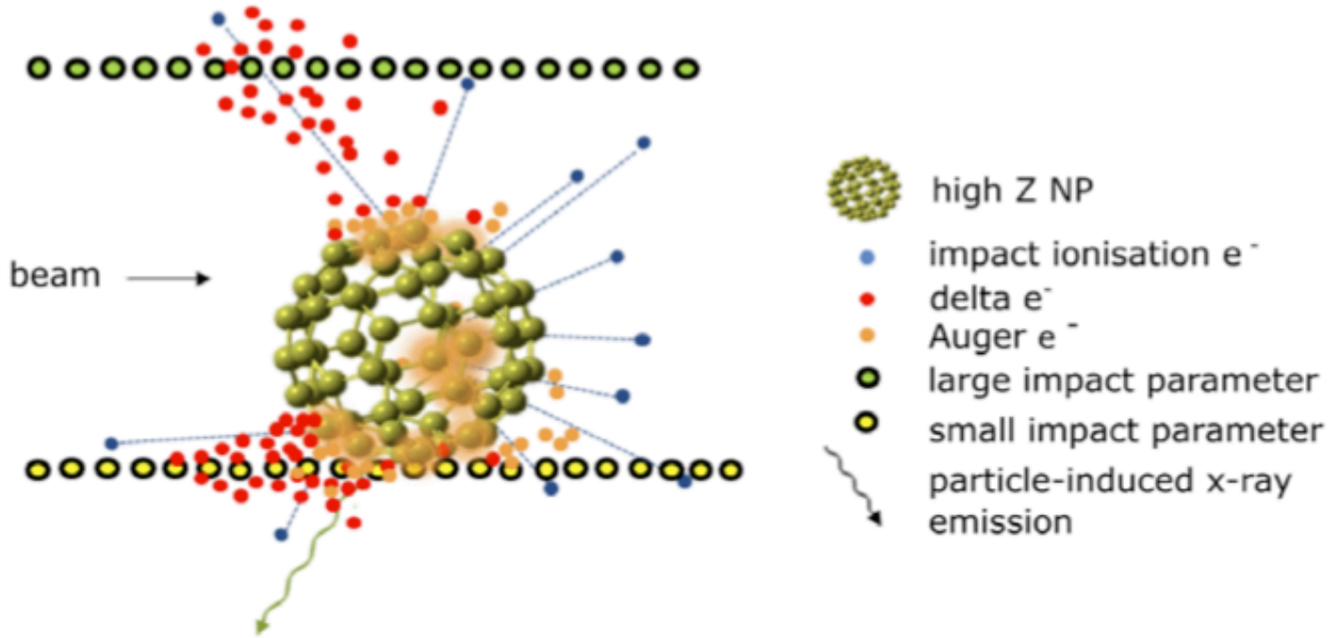
Overview

Studies show that the presence of metal nanoparticles in cells irradiated with photons or hadrons amplify the effect of irradiation.

Handrotherapy treatments



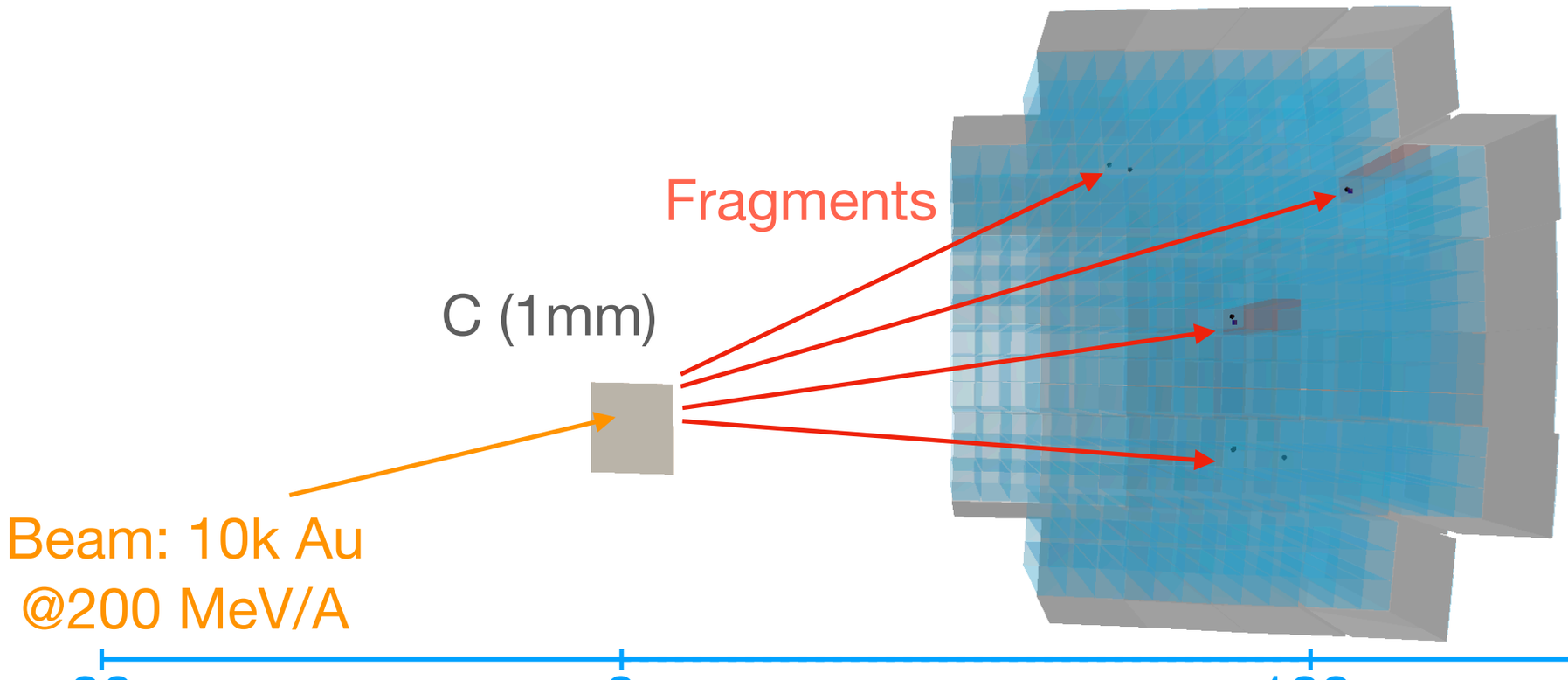
Alpha particles (produced in fragmentation processes) damage cells irreparably?

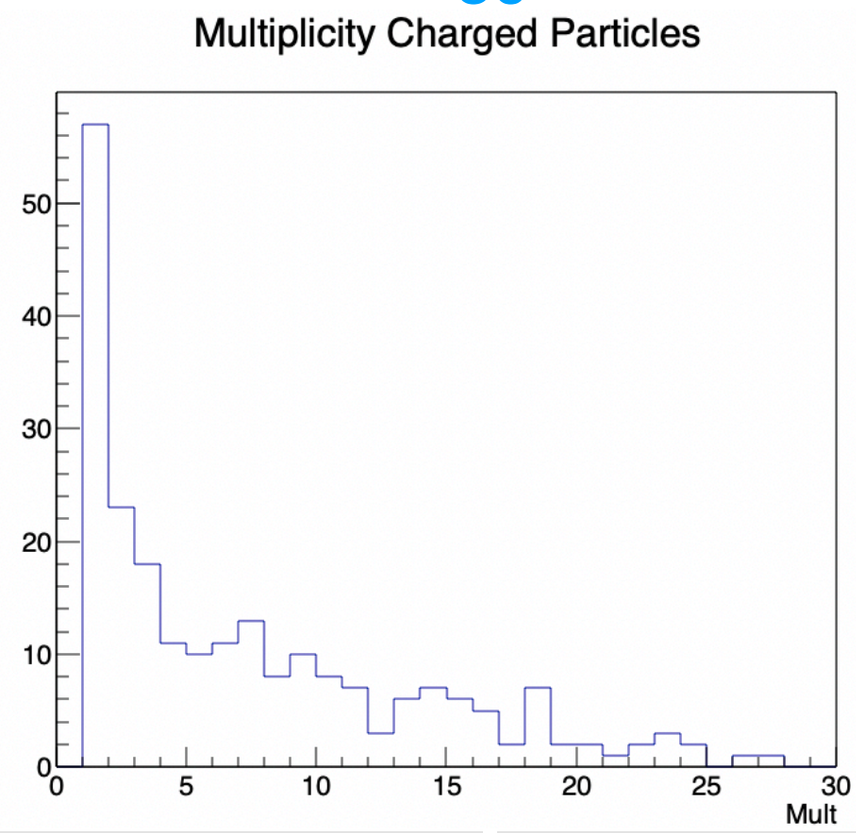
Through the FOOT setup and the inverse kinematics strategy would be possible measure the differential cross sections of ^{4}He.

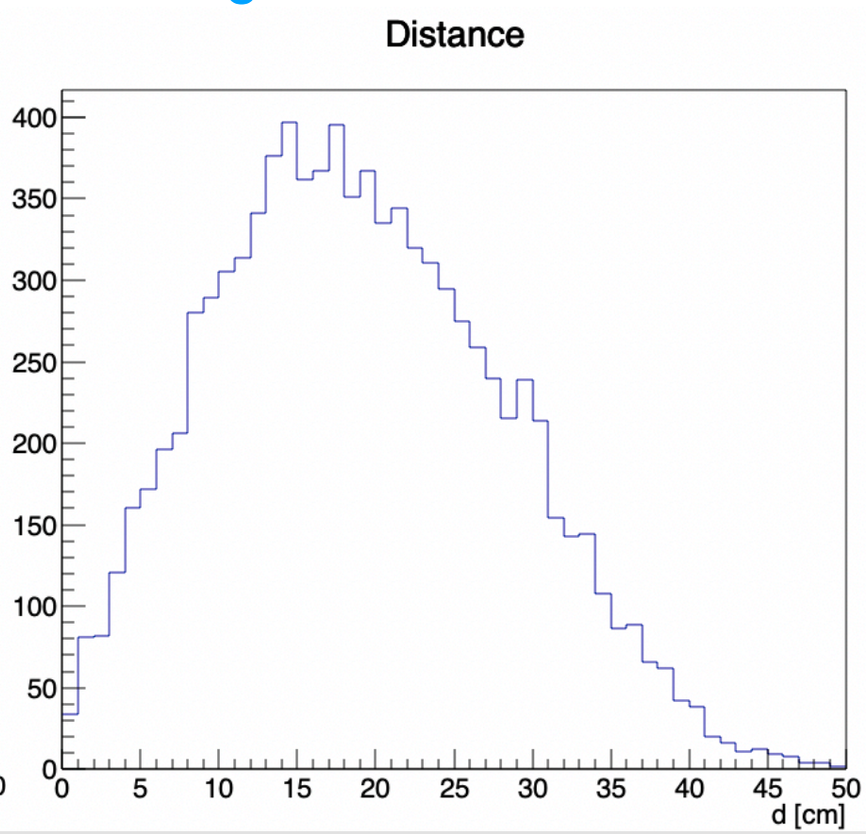
FLUKA Montecarlo simulations are performed in order to measure the angular distribution and the kinetic energy of the fragments:

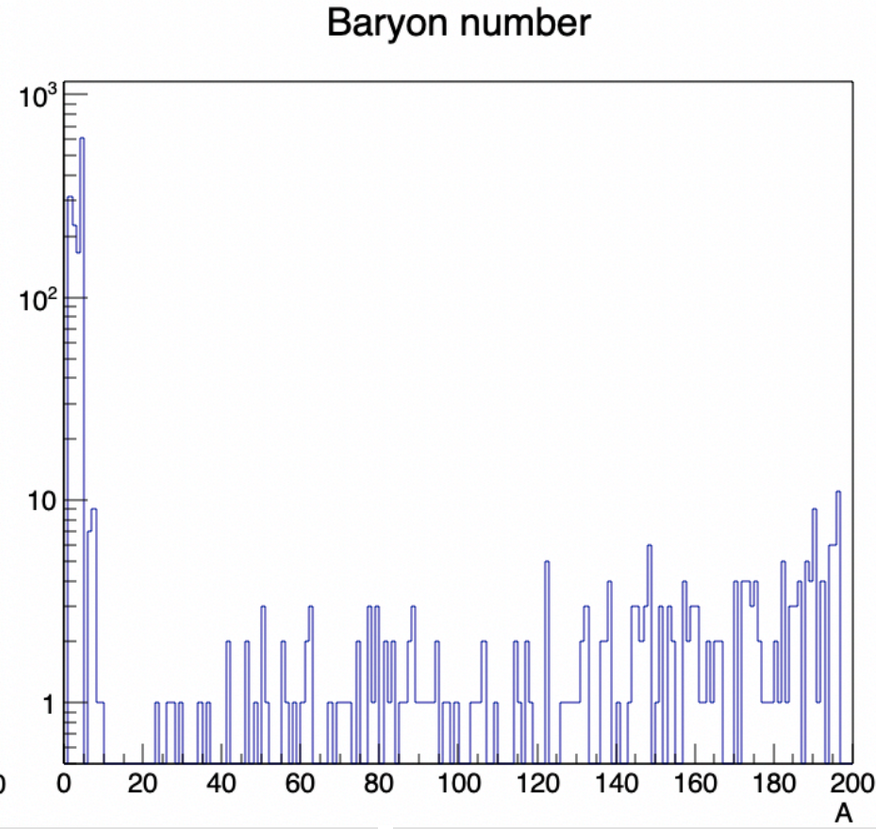
- Au @200 MeV/A beam + C target + FOOT calorimeter
- Au @200 MeV/A beam + C_2H_4 target + FOOT calorimeter

Simulation Geometry



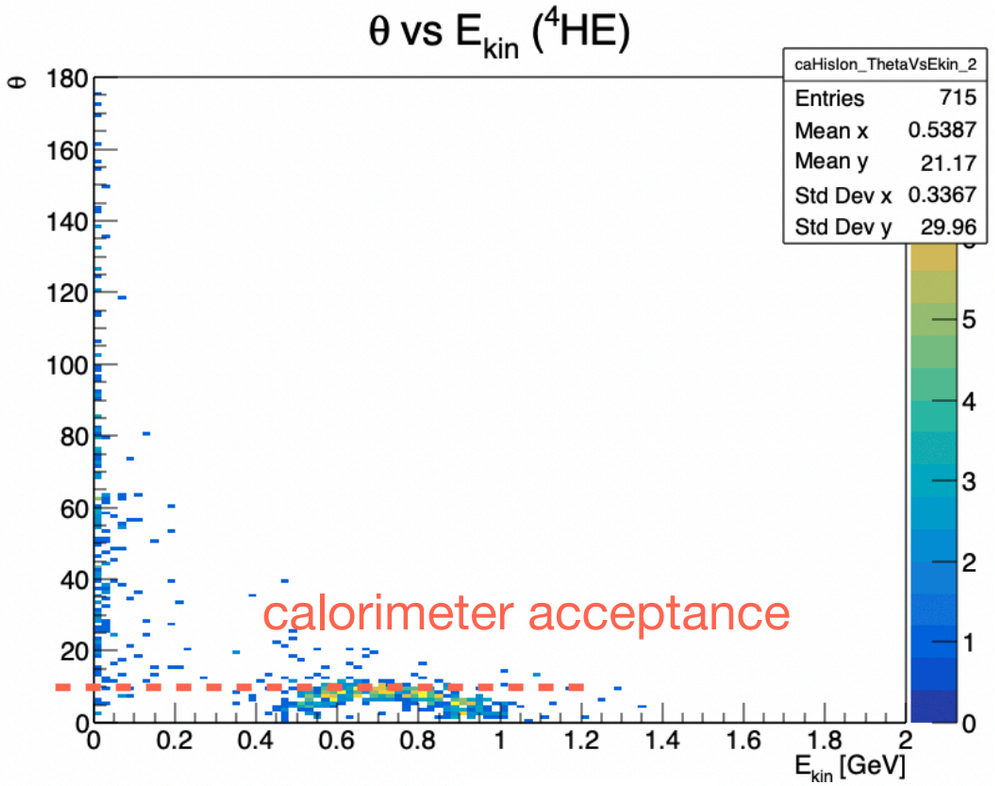


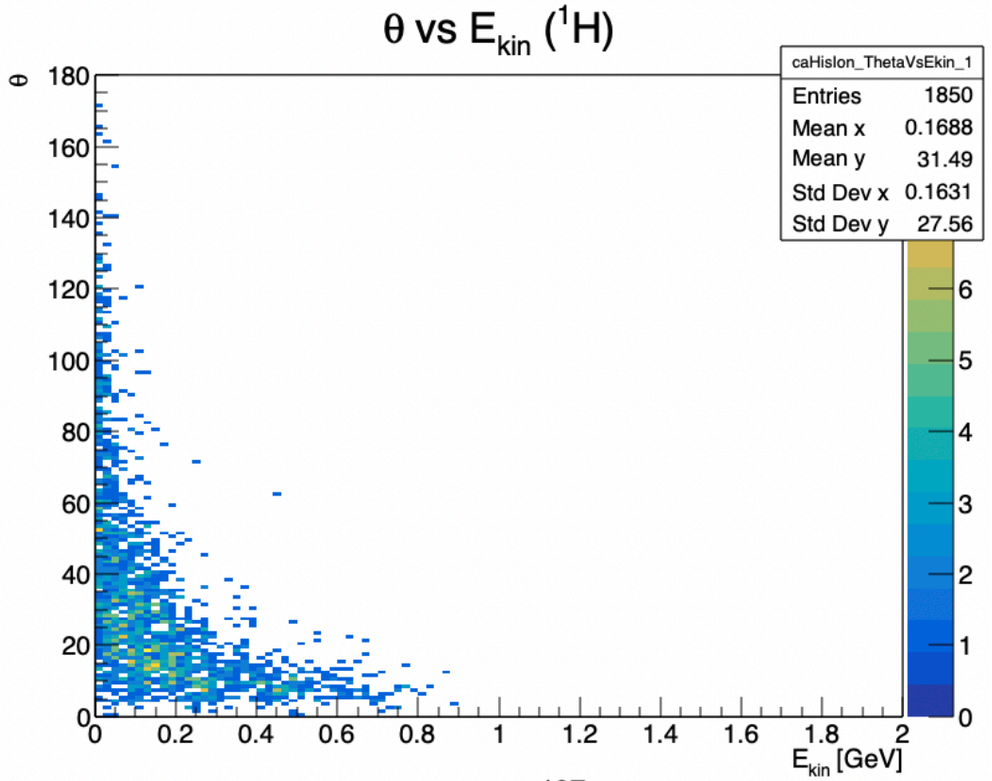


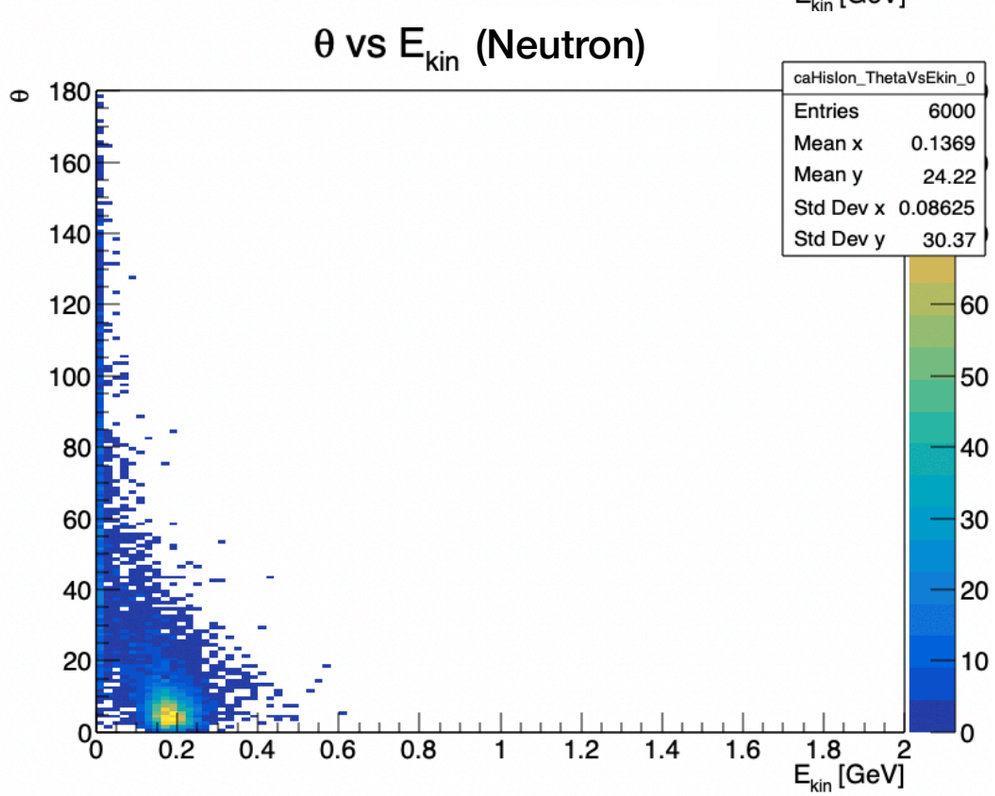


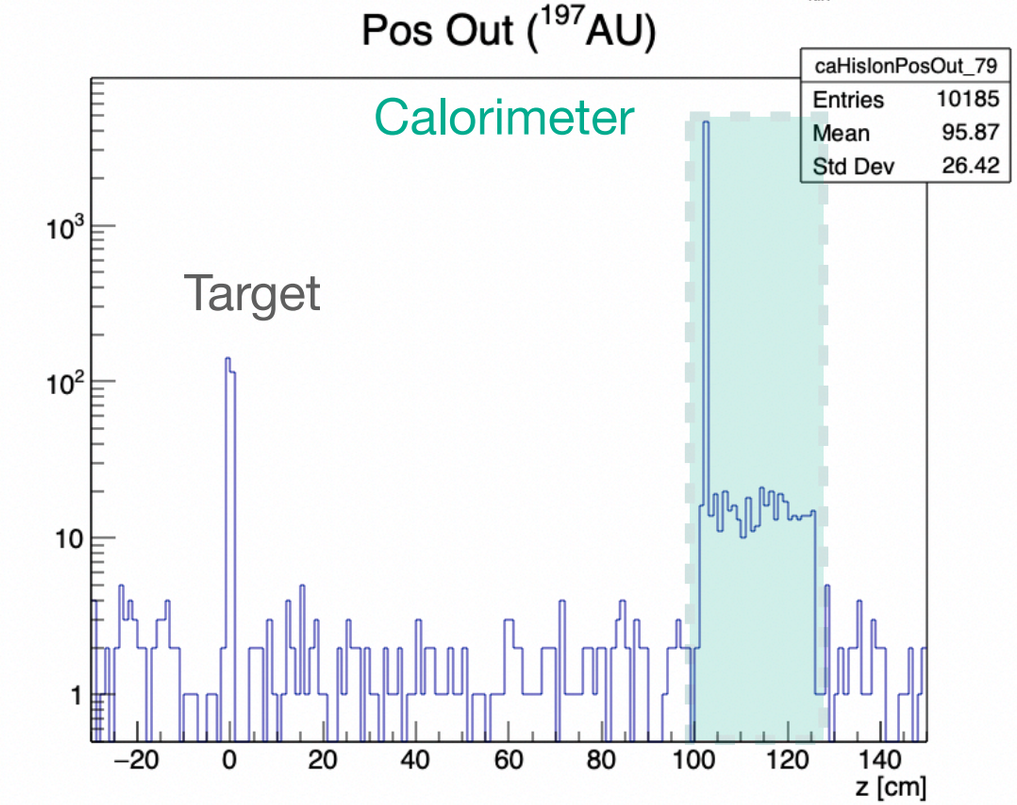
Au @200 MeV/A on C (1mm)

Only fragments created in the target are counted



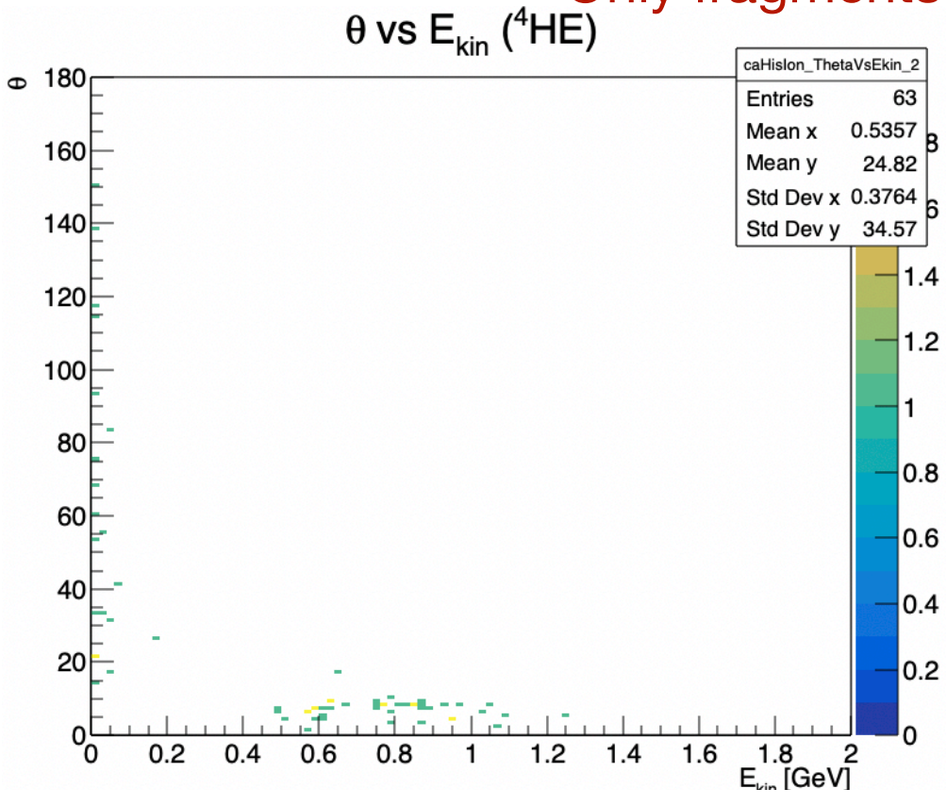


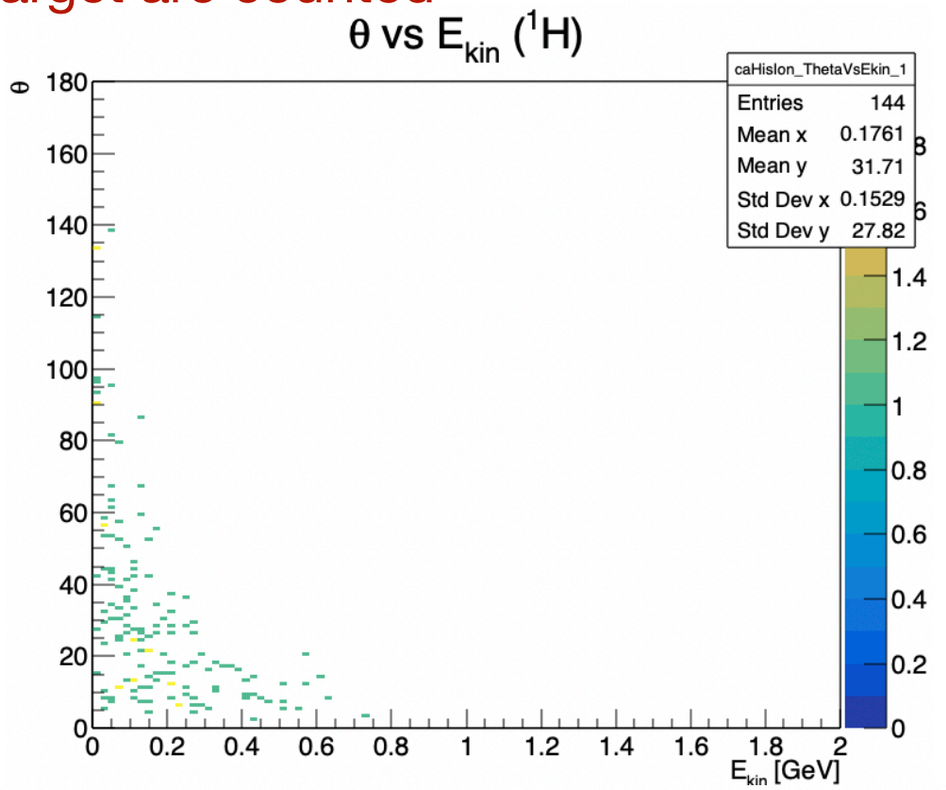


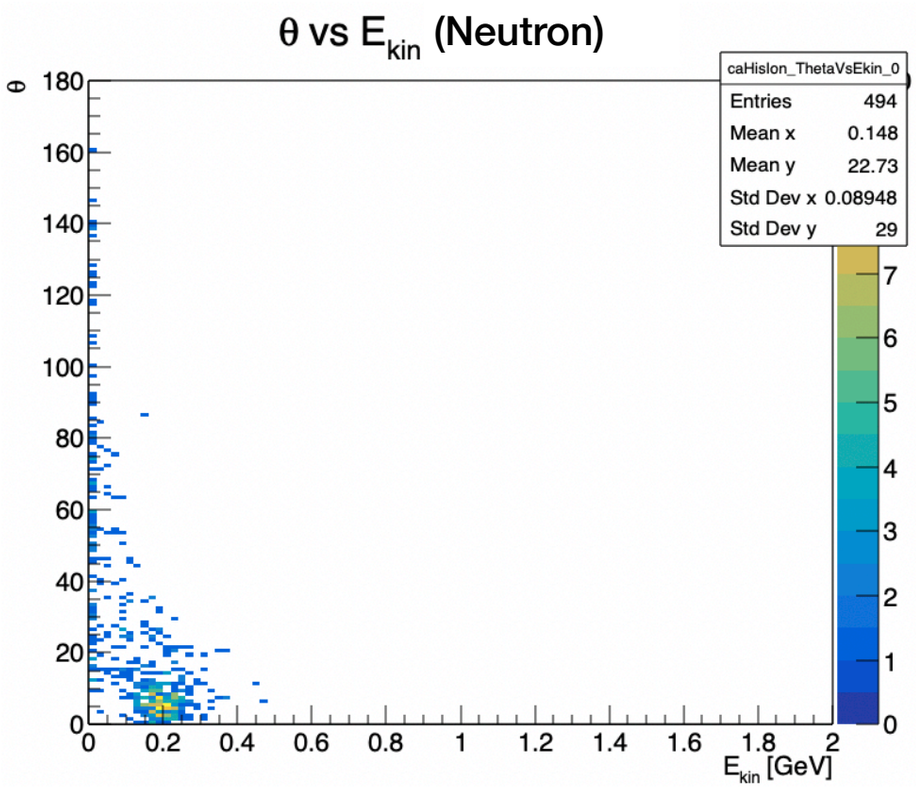


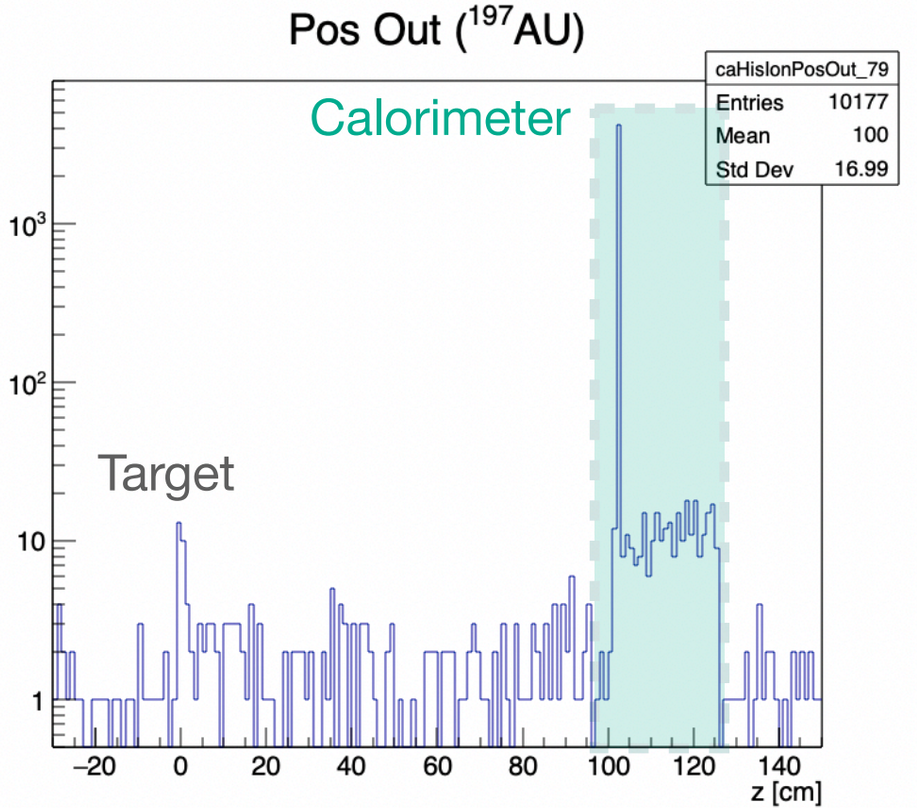
Au @200 MeV/A on C (100μm)

Only fragments created in the target are counted

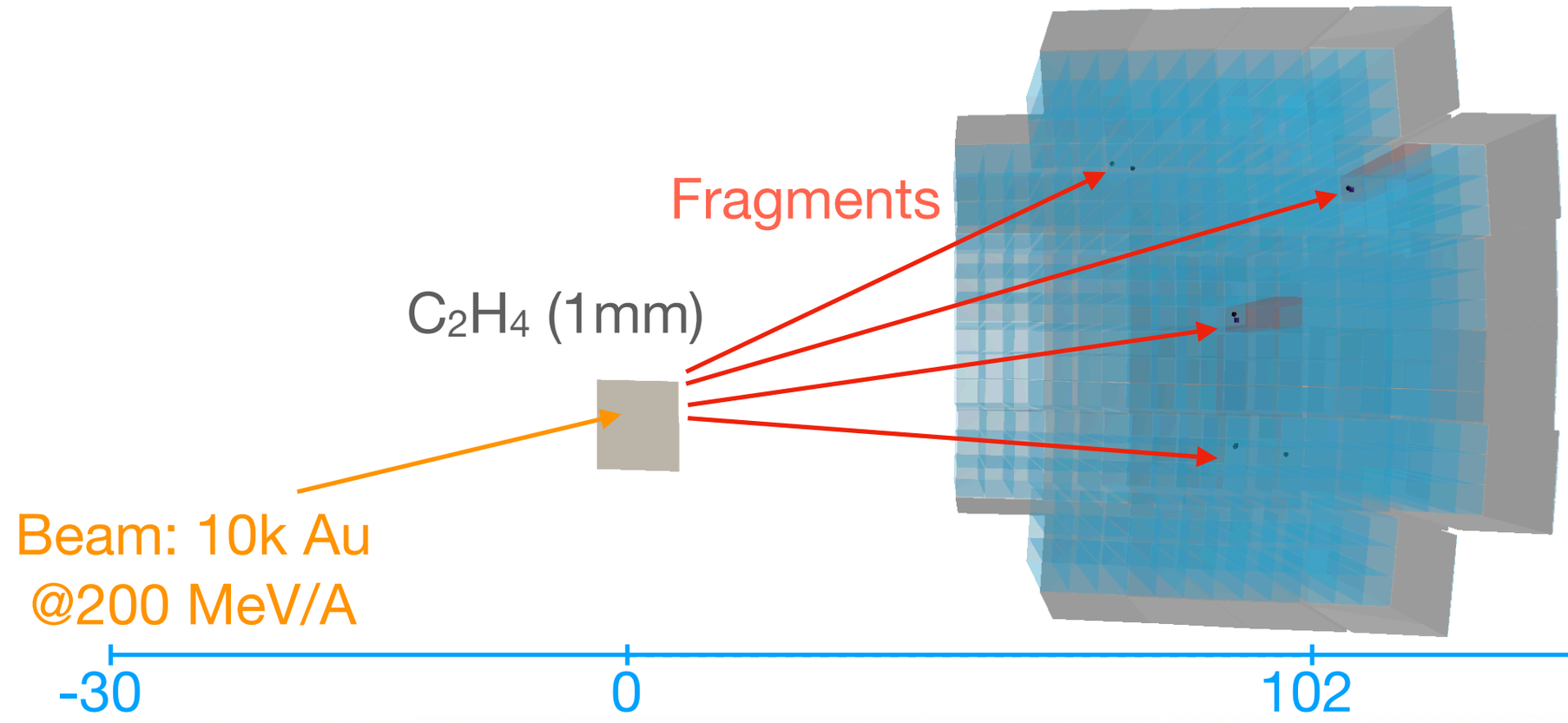


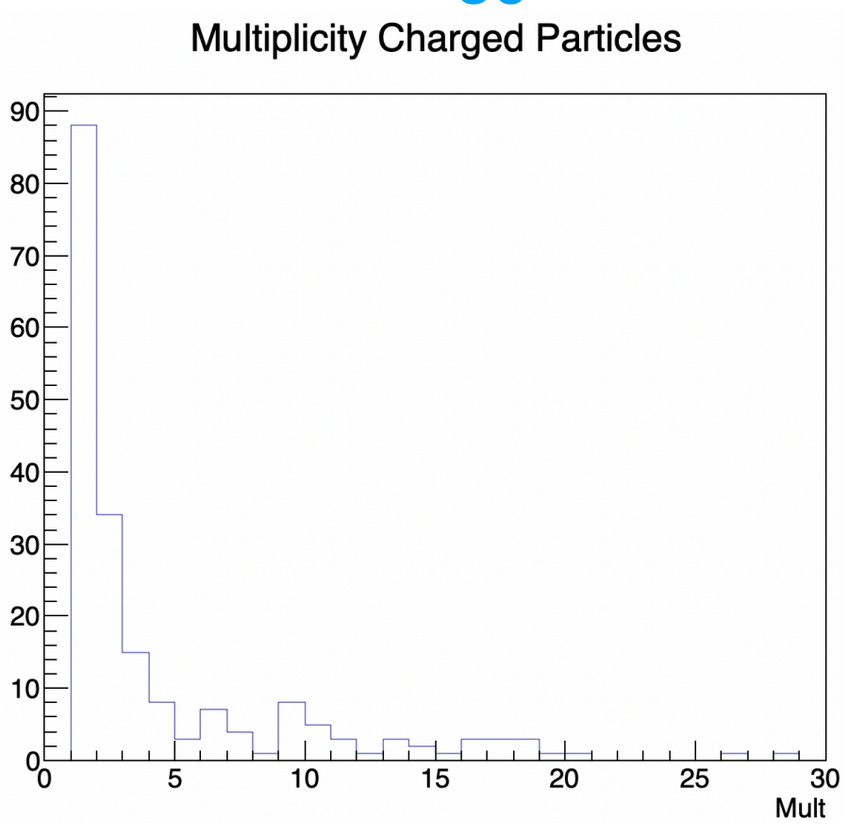


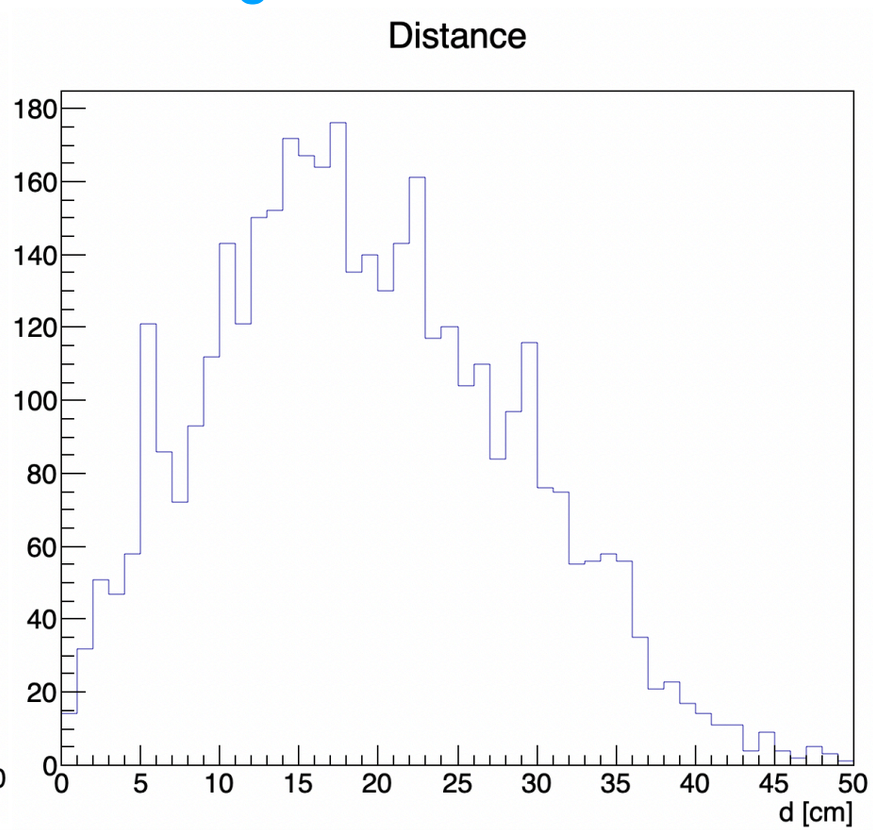


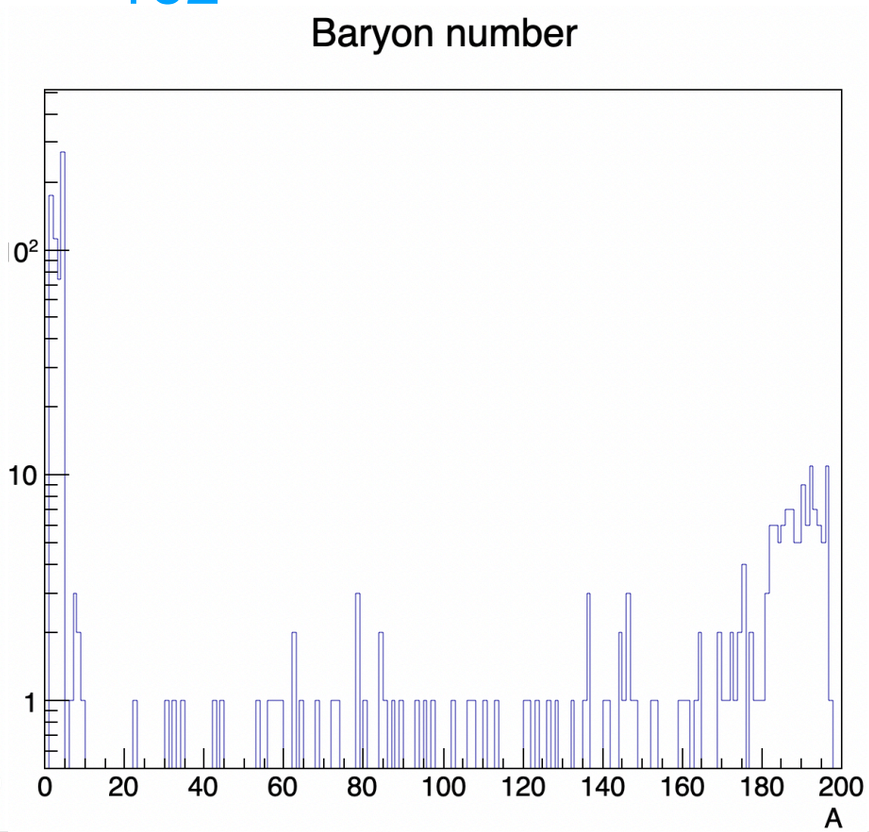


Simulation Geometry



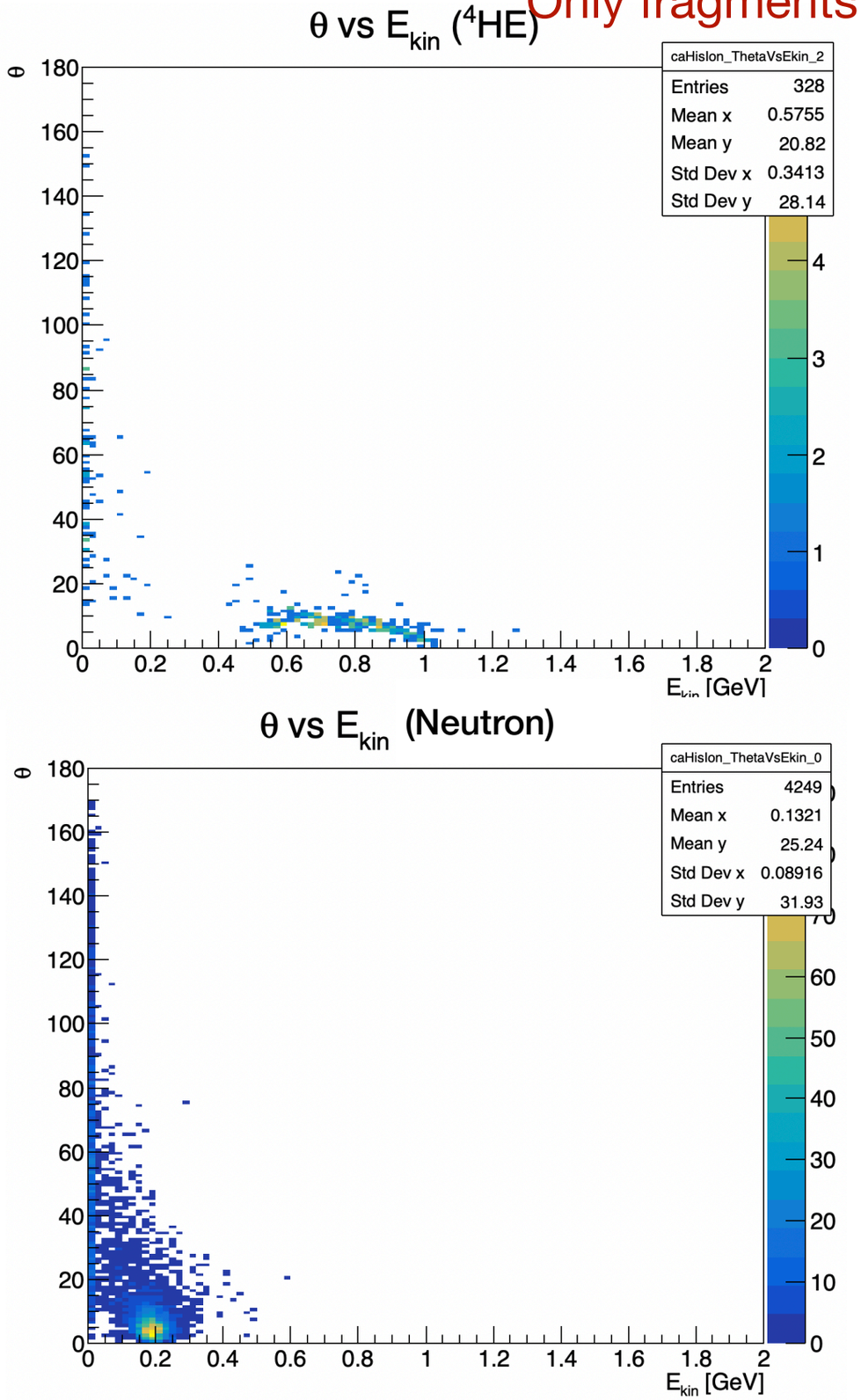


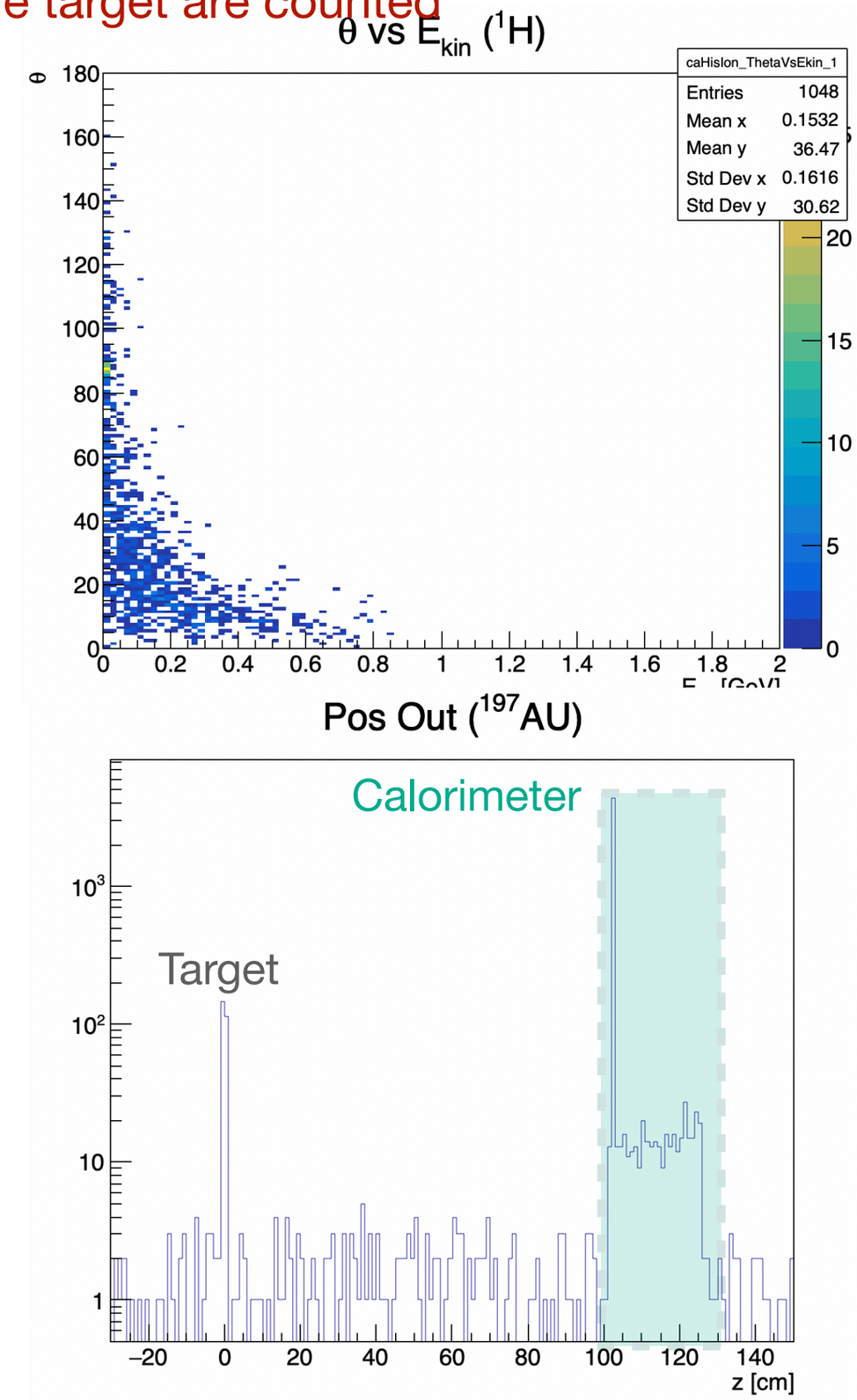




Au @200 MeV/A on C_2H_4 (1mm)

Only fragments created in the target are counted





Conclusions

This study would allow to understand if the alpha particles, created in the fragmentation processes between the hadrons beam and the nanoparticles, are the main responsible of the enhancement of these treatments.

From preliminary simulations the calorimeter seems to be able to identify well the fragments in this configuration as well:

- the average charged particle multiplicity is 1-2 fragments in event with #frag > 0
- the average distance between charged fragments is 15 cm (no problem with pileup)
- The biggest part of alpha particles created in the target are in the forward direction ($\theta \leq 10°$).

More simulations are needed, in particular with the full FOOT setup.

Reference

Kim, *"Enhanced proton treatment in mouse tumors through proton irradiated nanoradiator effects on metallic nanoparticles"*, Physics in Medicine & Biology *(2012)*, 10.1088/0031-9155/57/24/8309