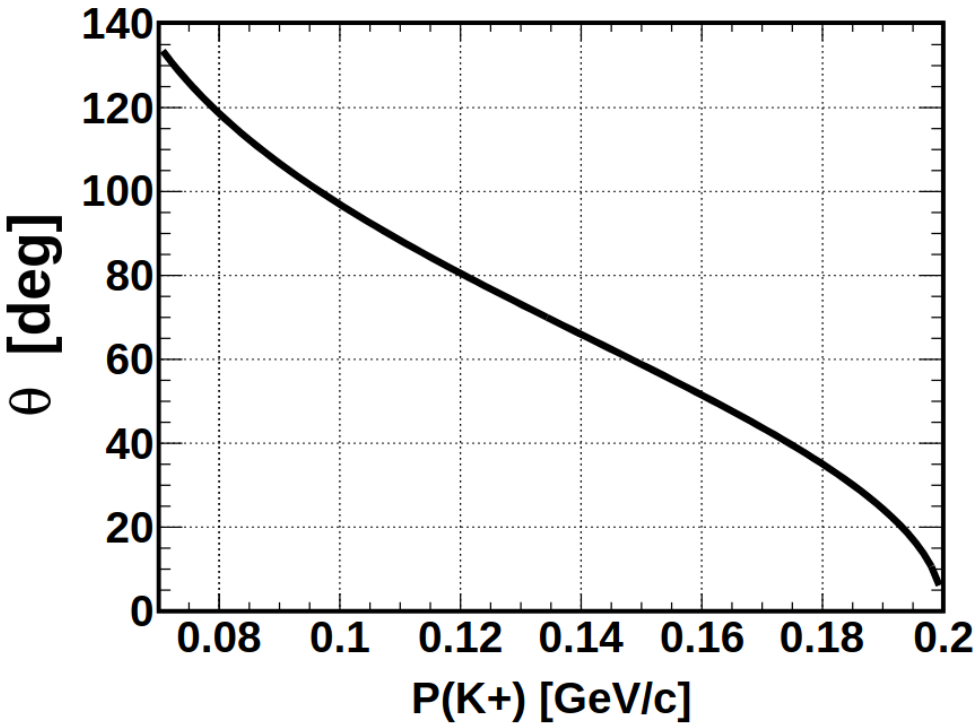
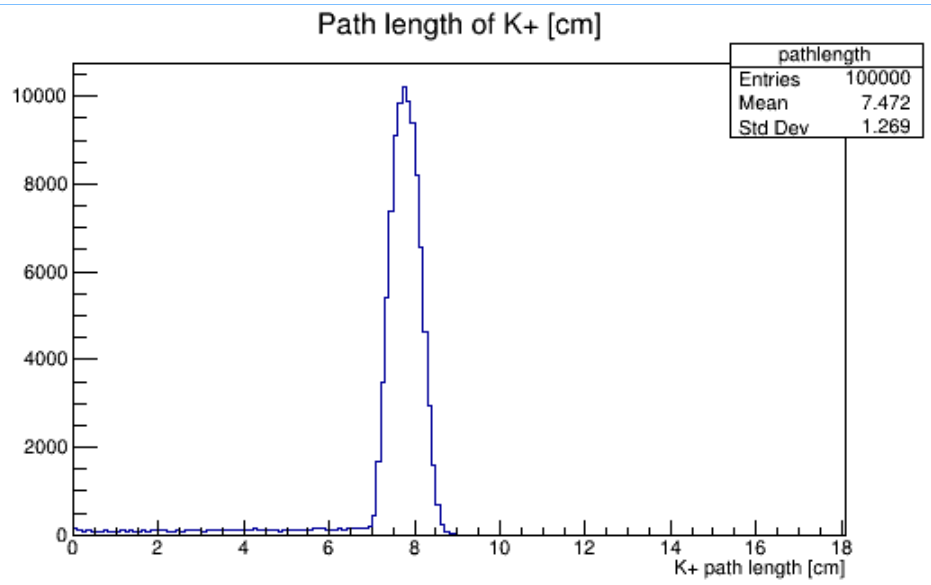
Notes on Klong + proton -> K+ + neutron

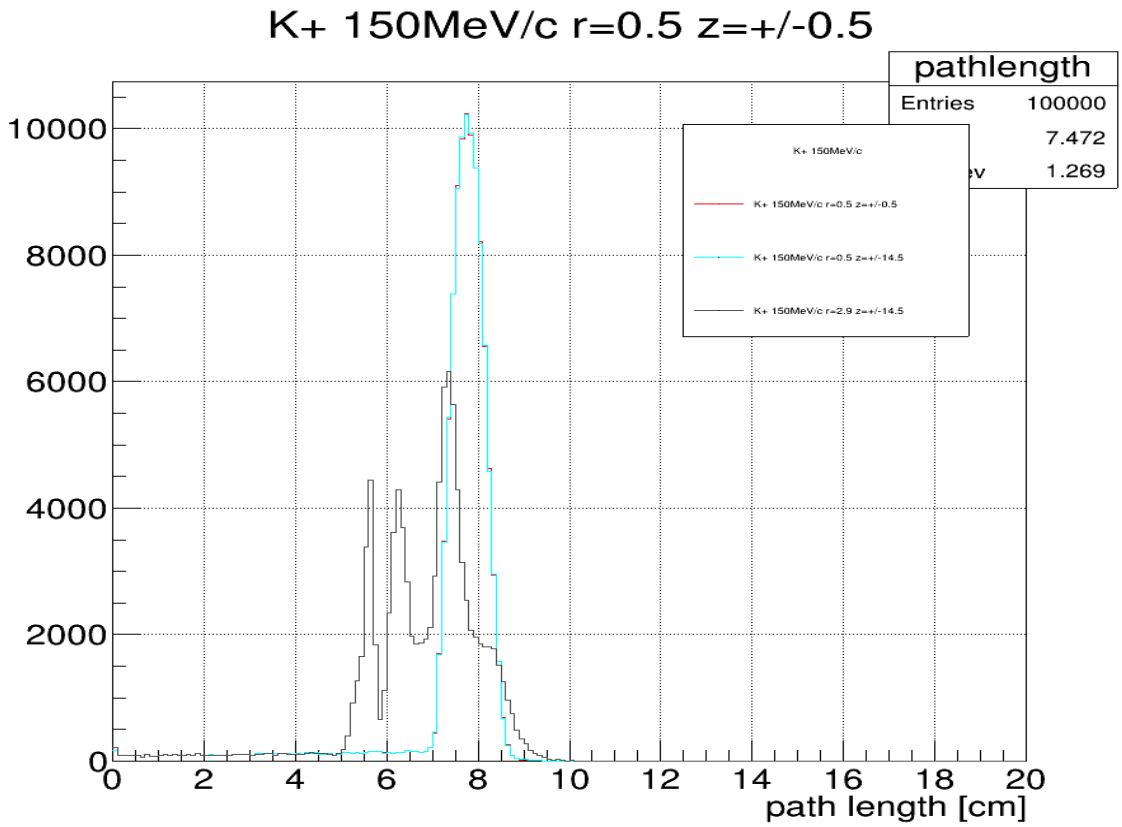
The plot below shows the relation between scattering angle and momentum of the outgoing K+ given an initial Klong beam energy of 200MeV/c. (plot distributed by Moskov 12/4/2023)



Lets assume a 150MeV/c K+ momentum at 60 degree polar angle.
First simulate the K+ originating at the center of a 6cm diameter liquid hydrogen target that is 30cm long. The variation in r is only 5mm and the variation in z also only 5mm.
As can easily be seen from the plot below, such a K+ will never make it even to the start counter. It will always decay before it even reaches this detector. Most likely because it loses momentum and stops before reaching the detector and decays as a consequence of that. This means that non of the hits in the CDC are generated from the K+ but rather from its decay products, either muon or pion. And there are also sometimes neutrinos in the decay. All in all it will very difficult if not impossible to determine the original K+ momentum.

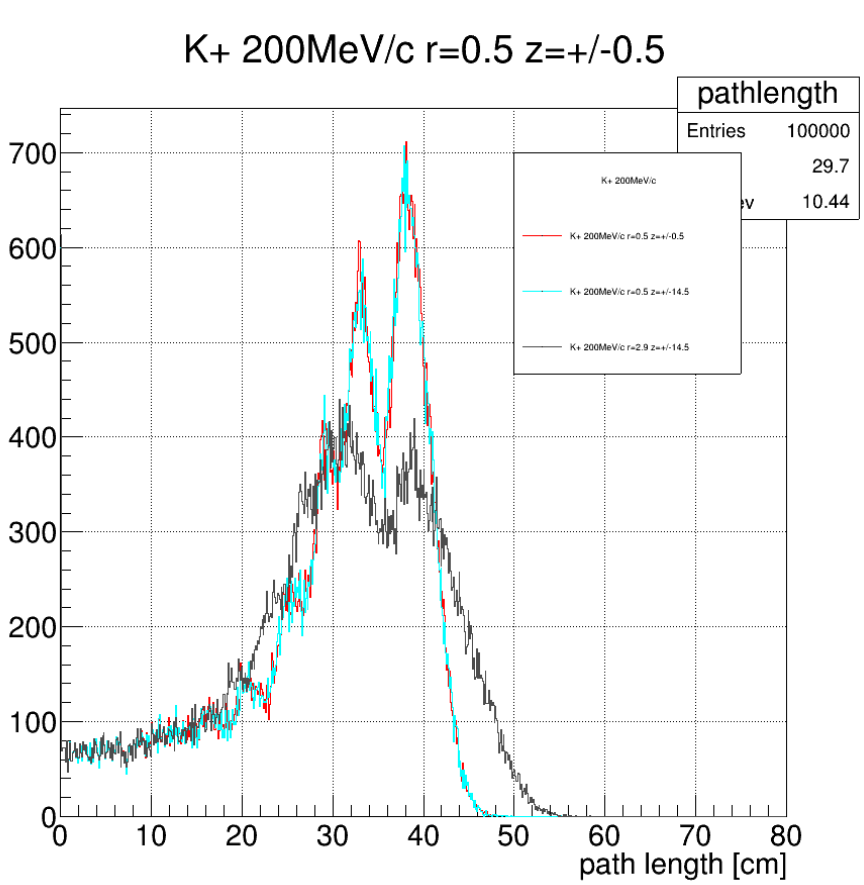


A more real comparison with reality is to generate the K+ particles over the full area and length of the target. This is shown in the following plot comparing it to the previous simulation and to a simulation where the K+ is generated along the full target length but confined to the central radius.



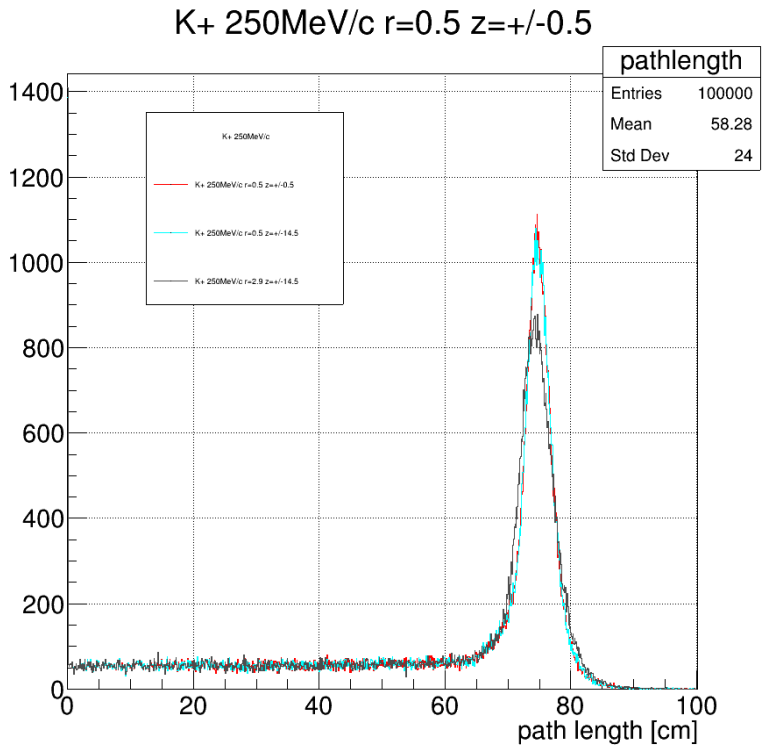
While the magenta and red curves show K+ emanating from the central region the black curve shows K+ generated anywhere withn a 29cm long target with radus 2.9cm. As can be deduced from this no K+ with momentum 150MeV/c at polar angle 60 degree will reach the CDC. A few may reach the Start counter but non will generate hits in the CDC necessary to reconstruct a track and determine its momentum.

Even if one considers a momentum of 200MeV/c for the same polar angle of 60 degree the situation is not much better as the K+ will decay mostly in the volume of the CDC itself as shown below.



Note in the plot above there are about 600 events in bin zero. This means there are a few K+ which do not decay. However, this represent 0.6% of the generated K+ particles. The majority of these K+ decay within 20cm and 50cm which is the main volume of the CDC and reach a radius of not more than 43cm which is well within the CDC volume.

To see at what momentum a K+ will have a good chance to pass through the CDC producing at reconstructable track K+ with momentum of 250MeV/c were genrated also at a polar angle of 60 degree generated and the center of the target and throughout. These K+ particles indeed will make it all the way through the CDC into the BCAL and produce tracks that can be reconstructed. What can not be seen very well is that about 1.4% of the K+ do not decay.



The conclusion from these simulations is that a K+ must have a momentum of at leaset 250MeV/c in order for it to pass through the CDC and reach the BCAL thereby guarantee that it will not decay within the CDC volume.