Performance of an ideal mTPC

GEM planes with pad area proportional to radius. 21 rings. 2584 pads.

GEM planes 0.5 mm each.

HV planes 0.0 mm each.

mTPC length 50.5

40 cm target, centered in mTPC.

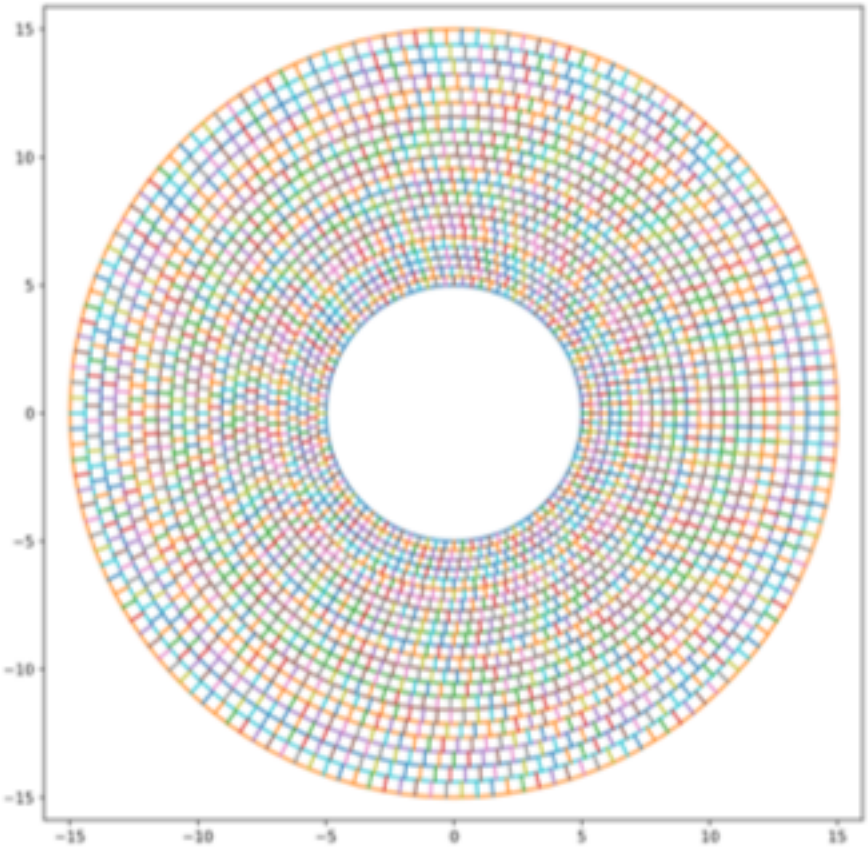
Events originate @ x,y=0,0, along z.

No energy loss in gas or HV Plane.

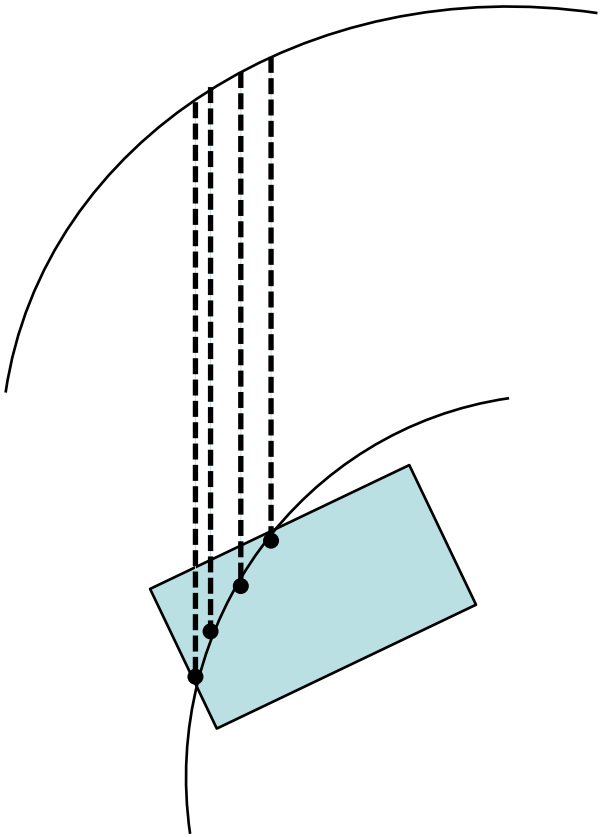
GEM planes stop tracks.

PAD time resolution = 20 ns

Goals: Understand geometrical efficiencies, ideal z_targ resolution, ideal t_targ resolution.



“Digitization”



Step track in 0.05 mm steps (as projected onto XY plane.)

Each step:

$$t = t\_origin + t_{propagate} + t_{drift}$$

TDC = <t> + 20 ns resolution fuzz

Hit:

Pad X, Y, X coordinates
TDC value

Fitting

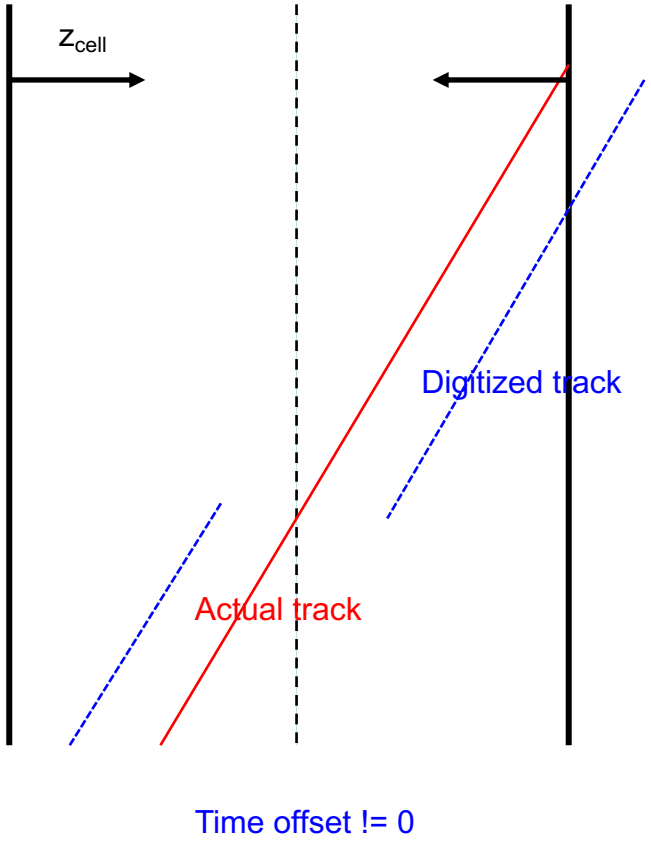
Digitization gives a set of hits.
(x, y, t)

x and y are center cords of hits pads
t is tdc value.

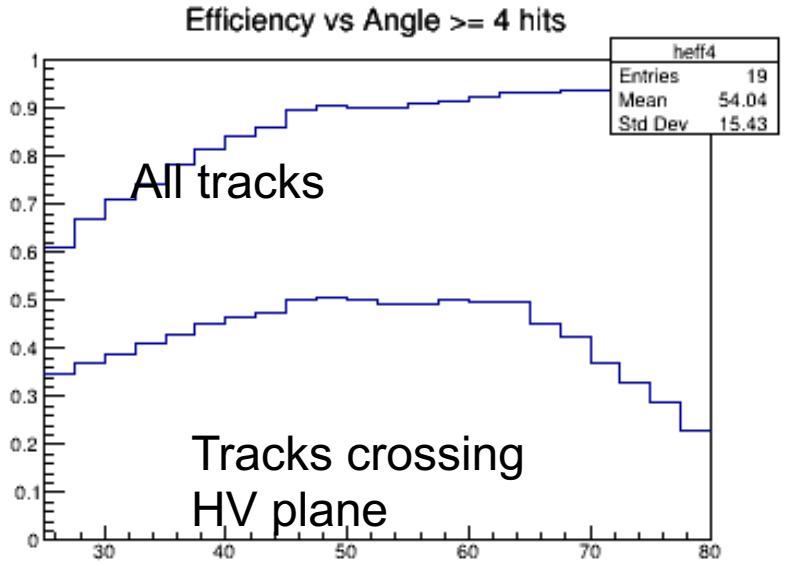
1. Fit a circle (in 2D) to the location of the hit pads with the constraint that circle intersects (0,0). This gives $P_{\perp}$

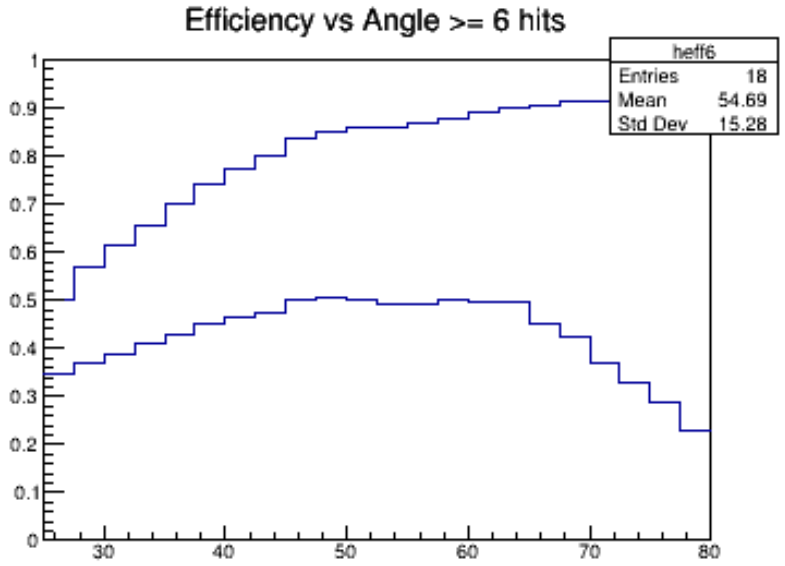
2. Fit scattering angle, z_{targ}, and time offset.
   a. Tracks that cross HV plane
   b. Tracks that don't cross HV plane
      If second cell in pair, force $z_{cell} = 0$ for hit with smallest TDC.

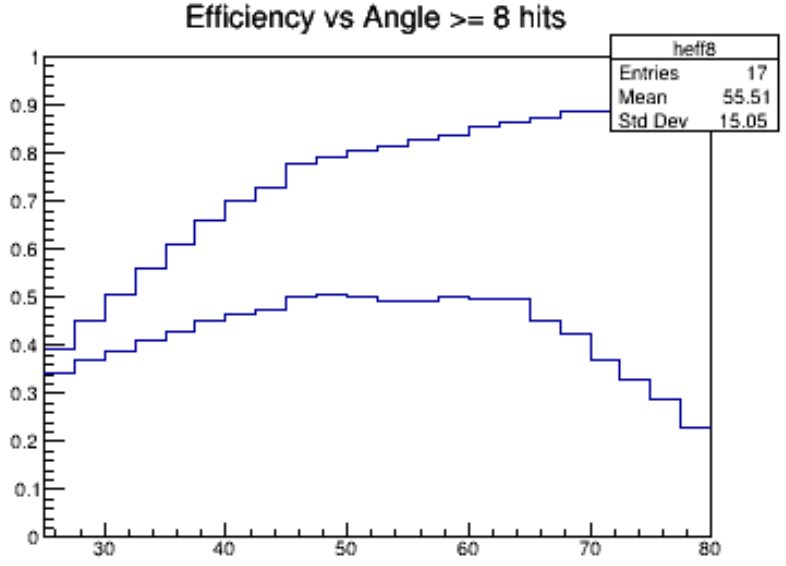
      If hits in first cell in pair (rare) force average of hits with smallest and largest TDC to have $z_{cell} = 2.5$ cm

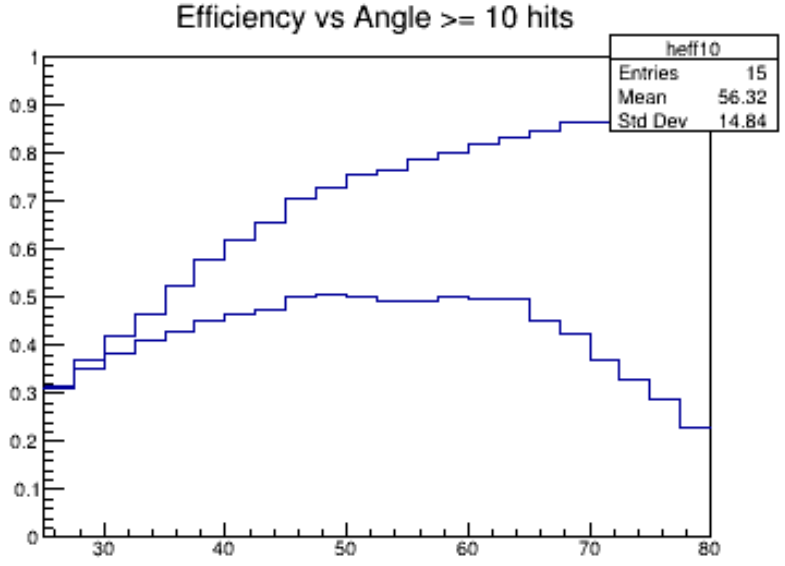


Efficiency vs Angle

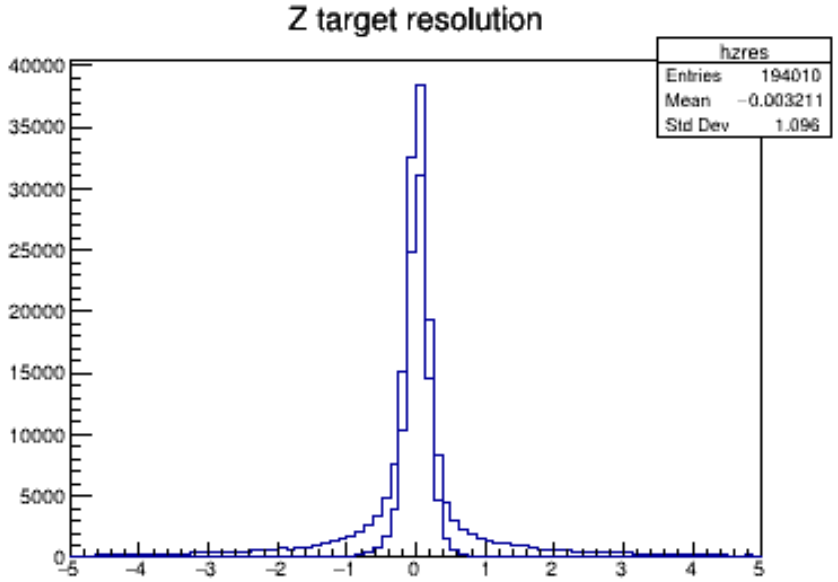


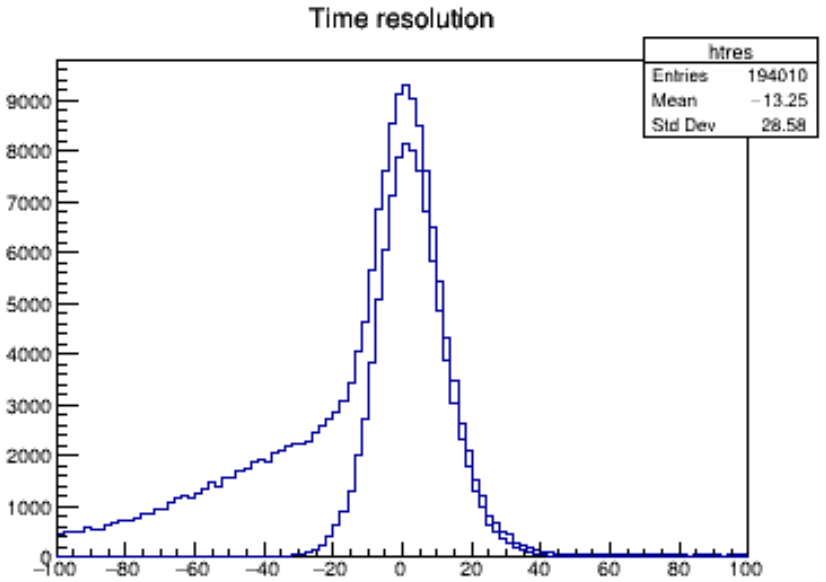


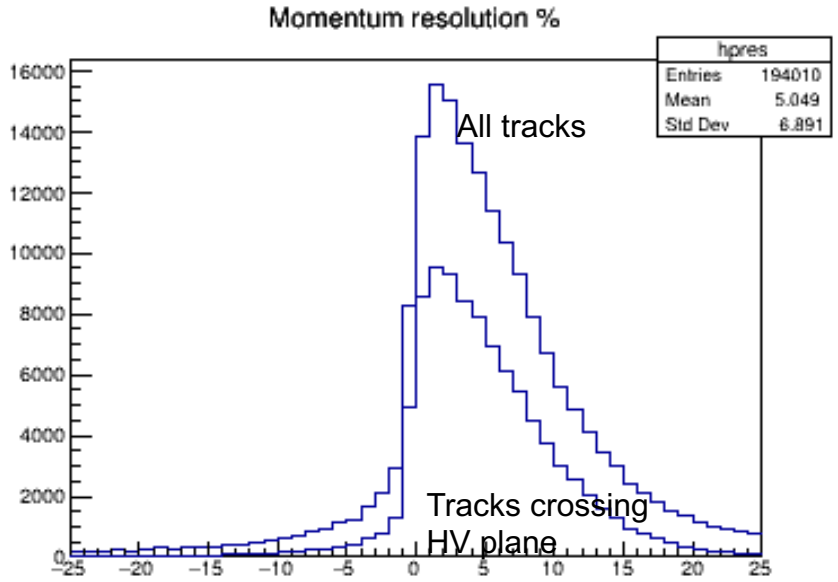


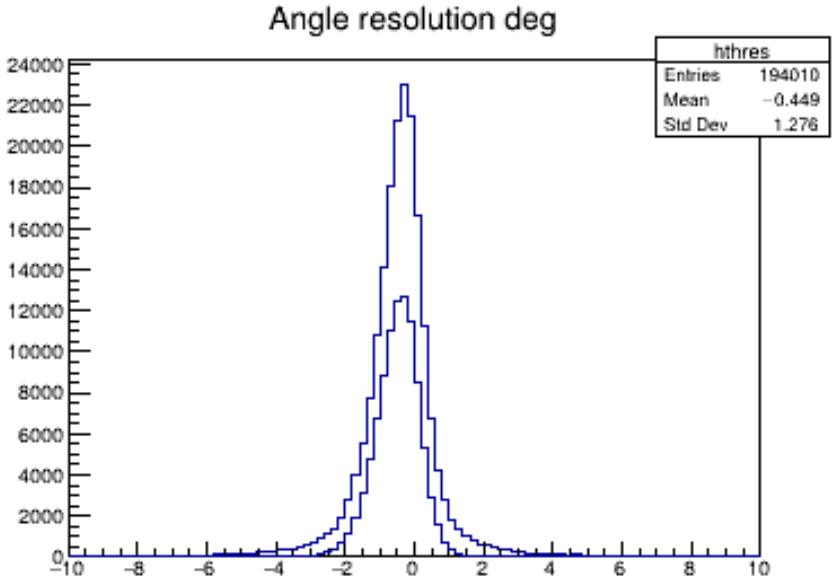


Resolution


Z target resolution
hzres
Entries 194010
Mean −0.003211
Std Dev 1.096


Time resolution
htres
Entries 194010
Mean −13.25
Std Dev 28.58


Momentum resolution %
hpres
Entries 194010
Mean 5.049
Std Dev 6.891
All tracks
Tracks crossing
HV plane


Angle resolution deg
hthres
Entries 194010
Mean −0.449
Std Dev 1.276