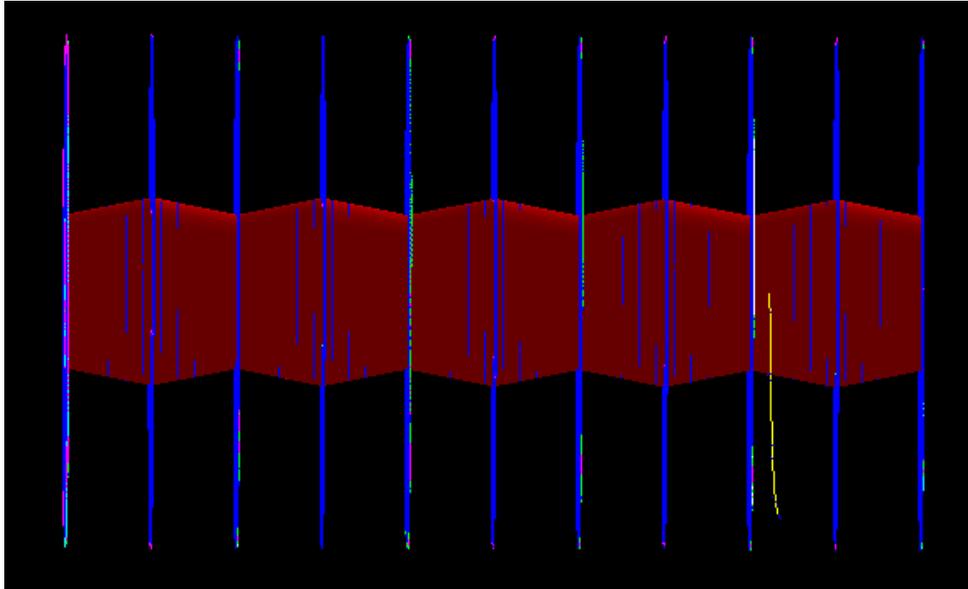
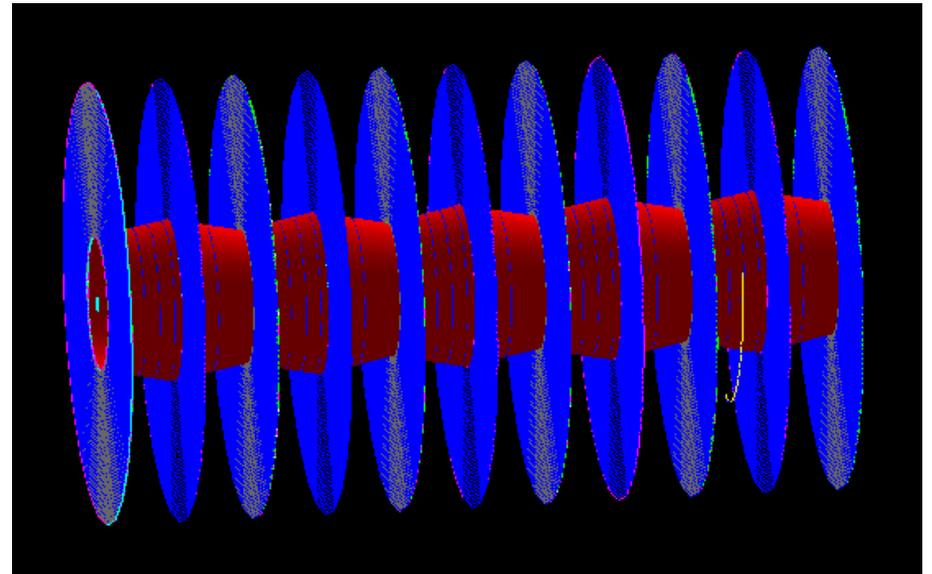
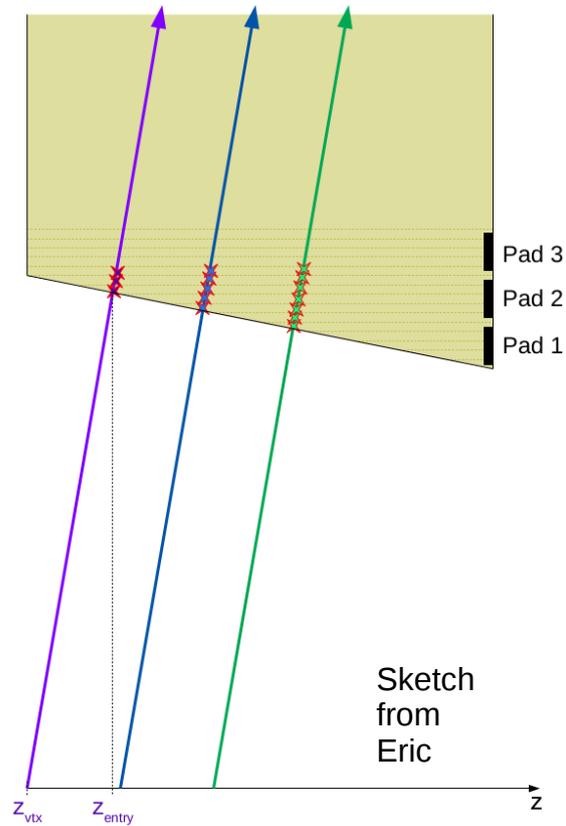


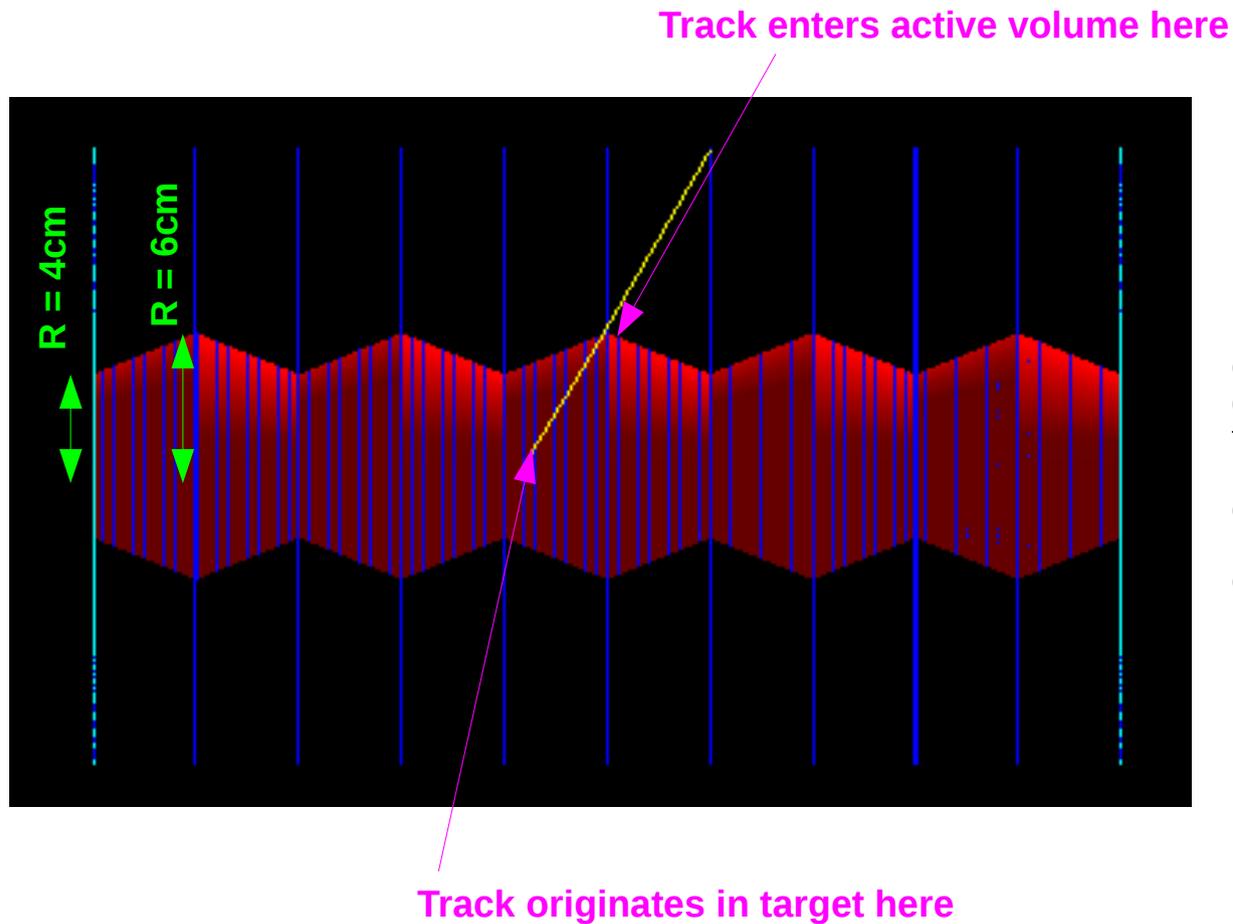
Reminder Conical Design



Aim is to improve knowledge of z-position of track vertex



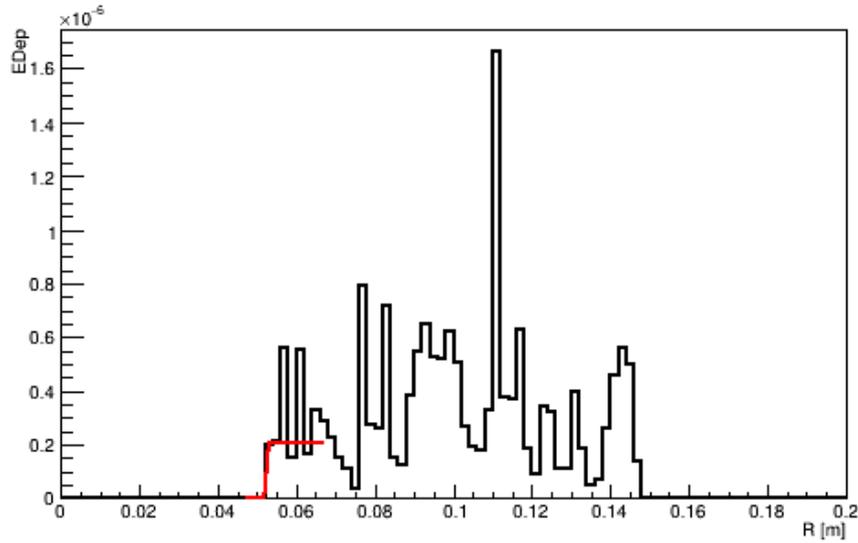
Tracks and Conical Dimensions Used for Studies Shown



n.b.: only results from one estimated conical dimensions and one track kinematic shown in these slides – optimisation of proposed geometry could improve results

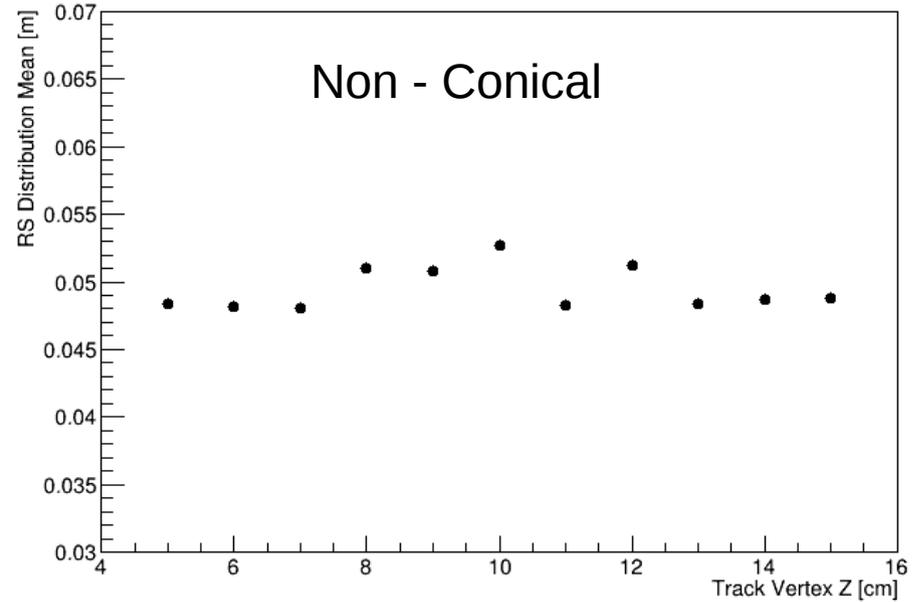
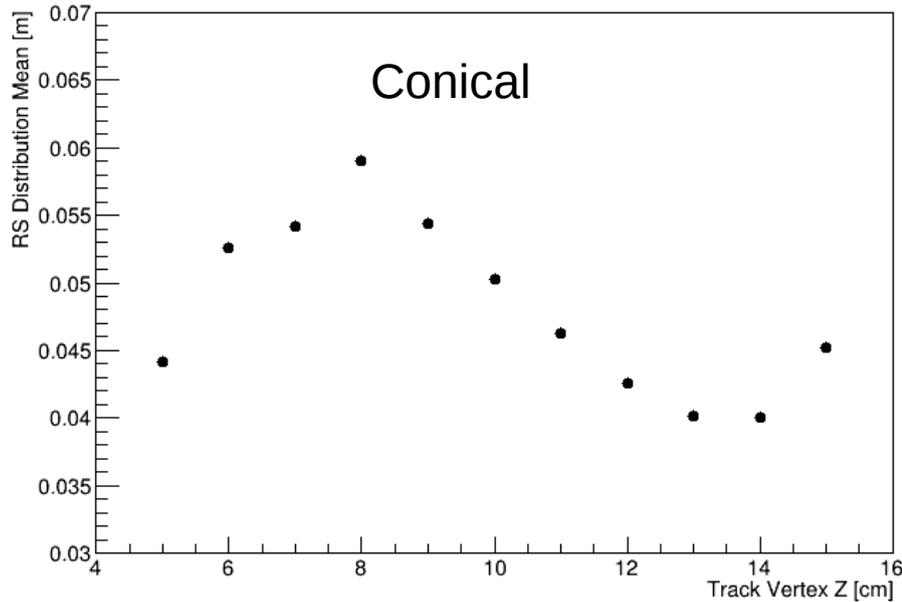
Track: momentum = $400\text{MeV}/c$; Theta = 70degrees ; Phi = 45 degrees ;
Z of vertex scanned along target

Reminder of Track Starting Radii Studies Shown Previously

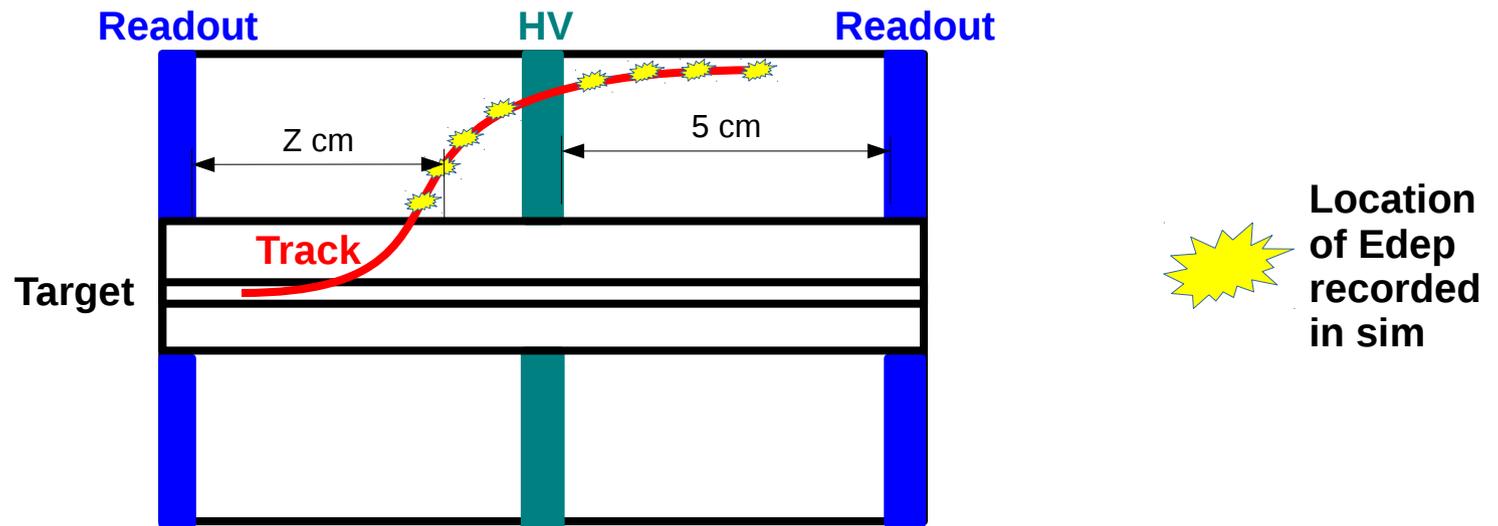


For each track travelling in mtpc gas volume, Edep against R was plotted and fitted to find location of step (ie roughly radius where track enters mtpc):

$$f(r) = \frac{S}{1 + \exp\left(\frac{RS - r}{D}\right)}$$



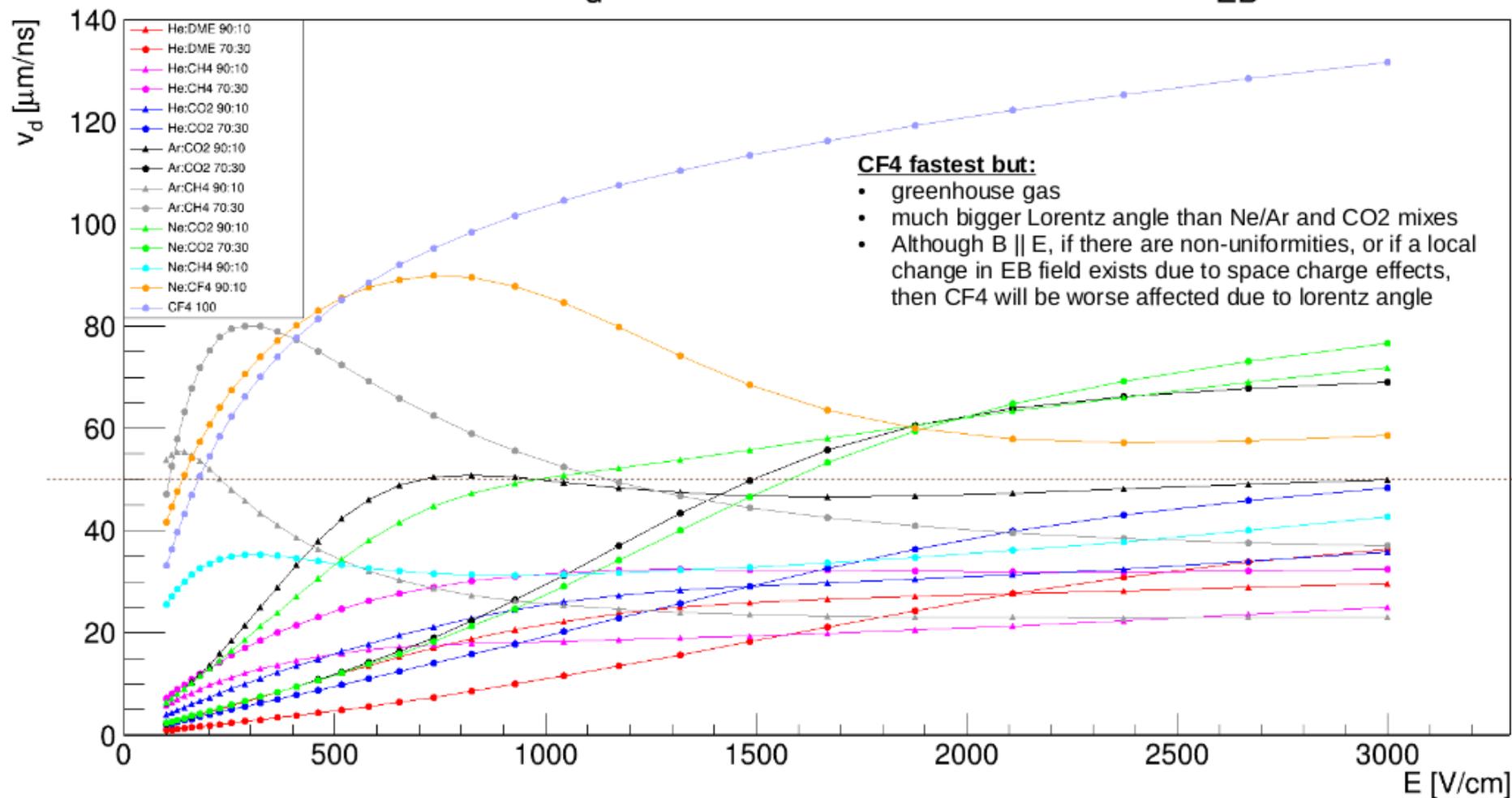
Next Step - Estimate of Readout Hit Time



- Assume drift time of $2\mu\text{s}$ over 5cm achievable (see next slide for reminder on magboltz simulations)
- Track starts at vertex in target at $t_0 = 0$
- Time at point of Edep after $t_0 = t_{\text{edep}}$
- $t_{\text{drift}} = (Z/5) * 2.0\mu\text{s}$
- Time that drift assumed to hit readout plane = $t_{\text{readout}} = t_{\text{edep}} + t_{\text{drift}}$
- (this is more of a back of envelope estimation/calculation right now, not including diffusion of drift/shaping of electronics/digitisation etc, simply geometrical hit of charge on readout plane)

- Garfield++ used as interface to Magboltz to study drift properties of several gases
- Set up: $B=4.7 \parallel E$, E varied, STP

Drift Velocity v_d [$\mu\text{m}/\text{ns}$] along E ($B=4.7\text{T}$, $\theta_{EB} = 0^\circ$)



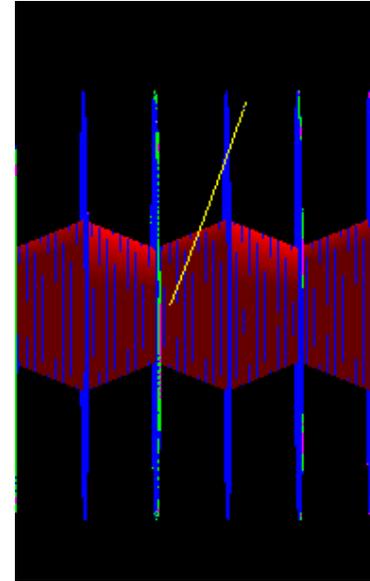
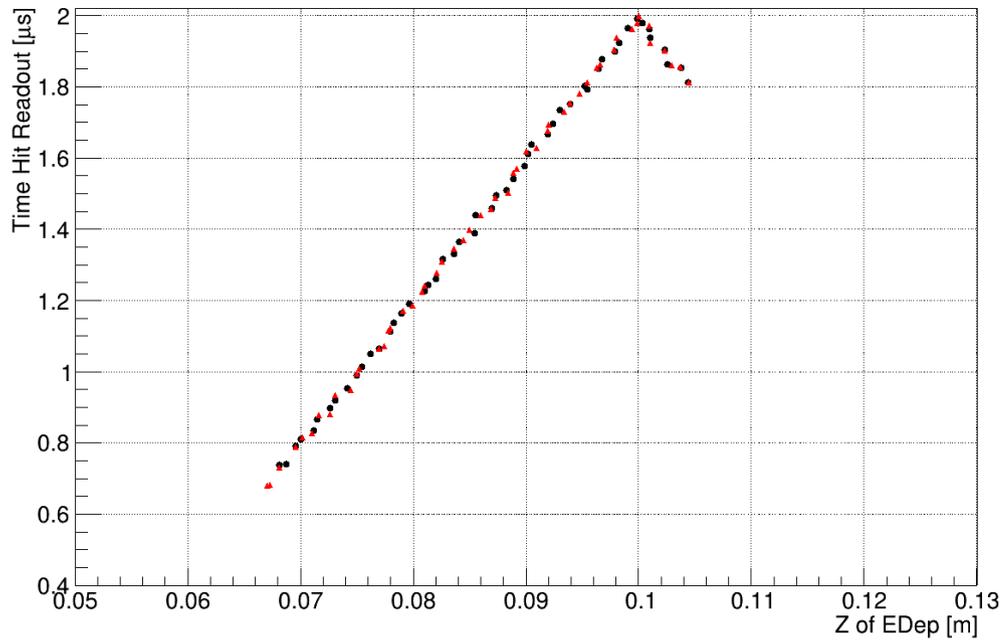
- Max possible drift distance in mTPC 5cm
- $v_d \sim 50 \mu\text{m}/\text{ns}$ desirable for 1 μs drift time over 5cm
- Assume mTPC E-field 1kV? \rightarrow Ar:CO₂, Ne:CO₂ 90:10 mixes
- Reducing pressure allows for faster drift velocities at lower E-fields – v_d scales as E/p

2

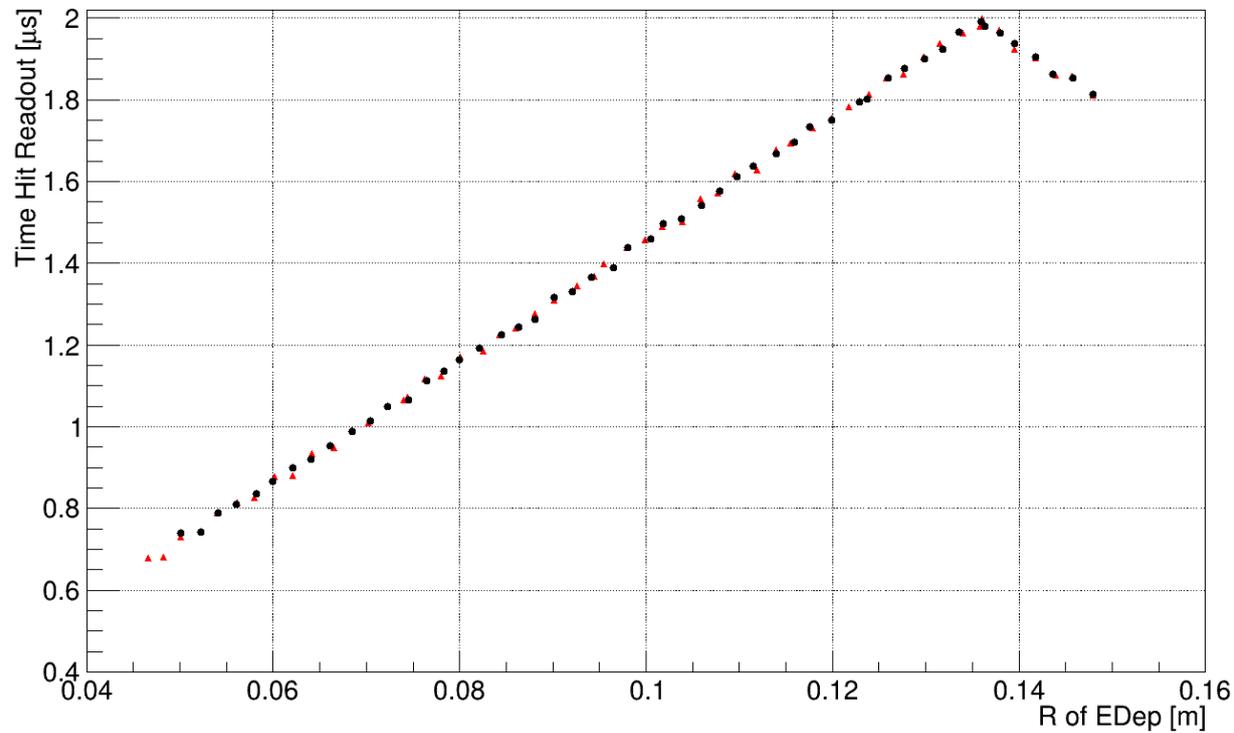
From previous magboltz/garfield++ studies for static E-Field \parallel solenoid field – assume a value of about 2 μs over 5cm drift would still be achievable with correct E-field set up in conical case

5

Example Track



In this case track passes through HV plane

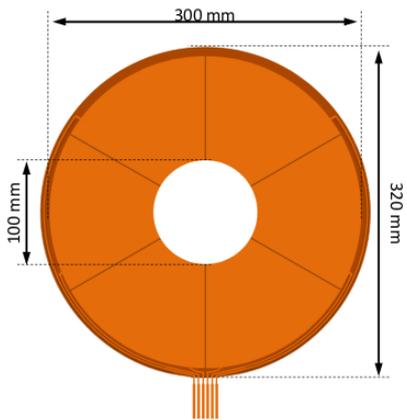


Vertex
Z=5cm

Red conical
Black non-
conical

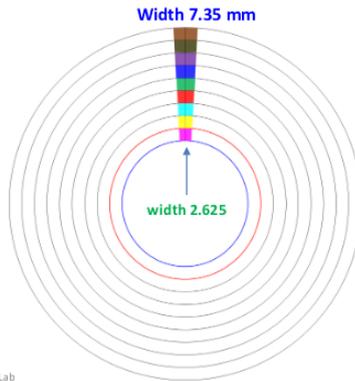
Projection onto Readout Plane

mTPC Design: Preliminary design



Pad readout foil design

- 20 concentric rings of 126 pads each
- Trapezoidal-shape pads with height of 5cm
- width from 2.625 mm in inner ring to 7.325 mm in the outer ring
- higher occupancy in the inner region of the TPC



GEM foil design: divided into 6 to 12 HV sectors on bot top and bottom electrodes

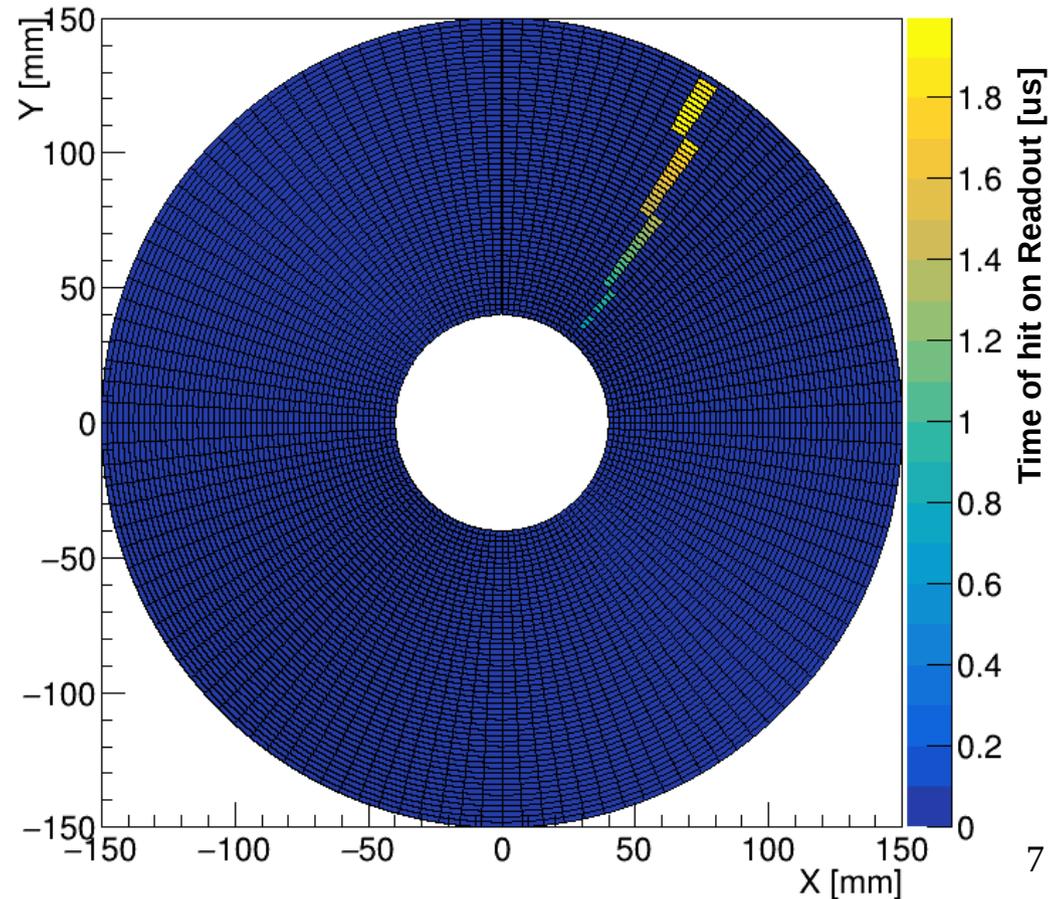
01/31/2019

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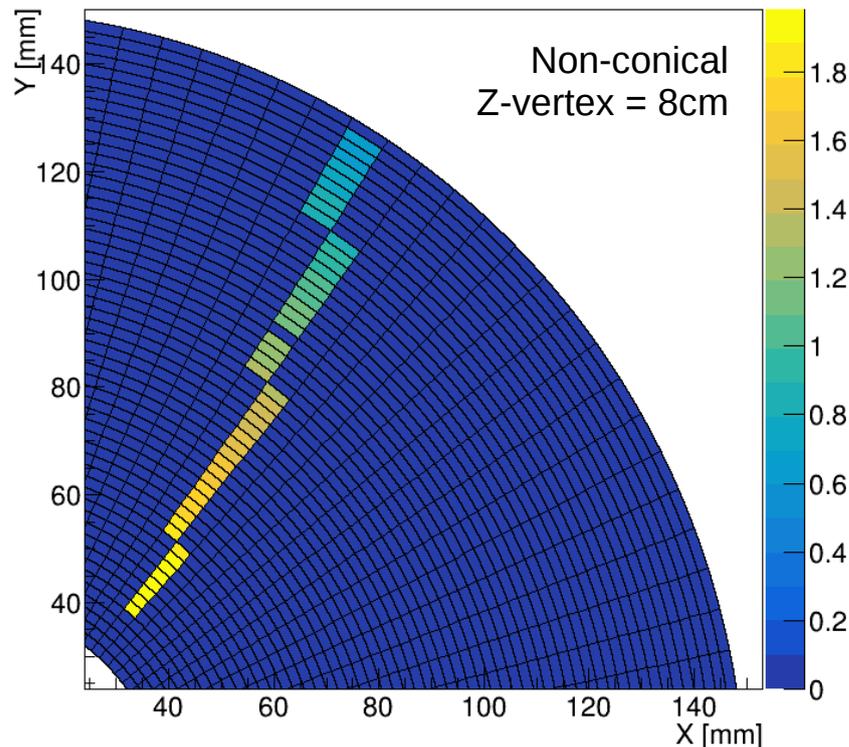
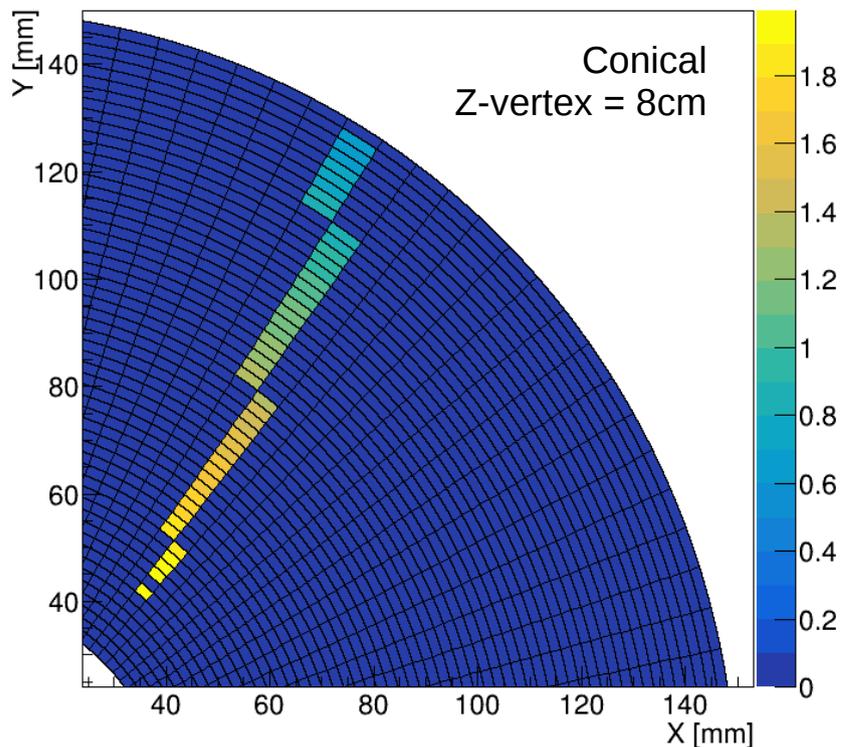
Example track for z-vertex 5cm

Used preliminary readout pad dimensions from K. Gnanvo talk, except rings are 2mm not 5mm

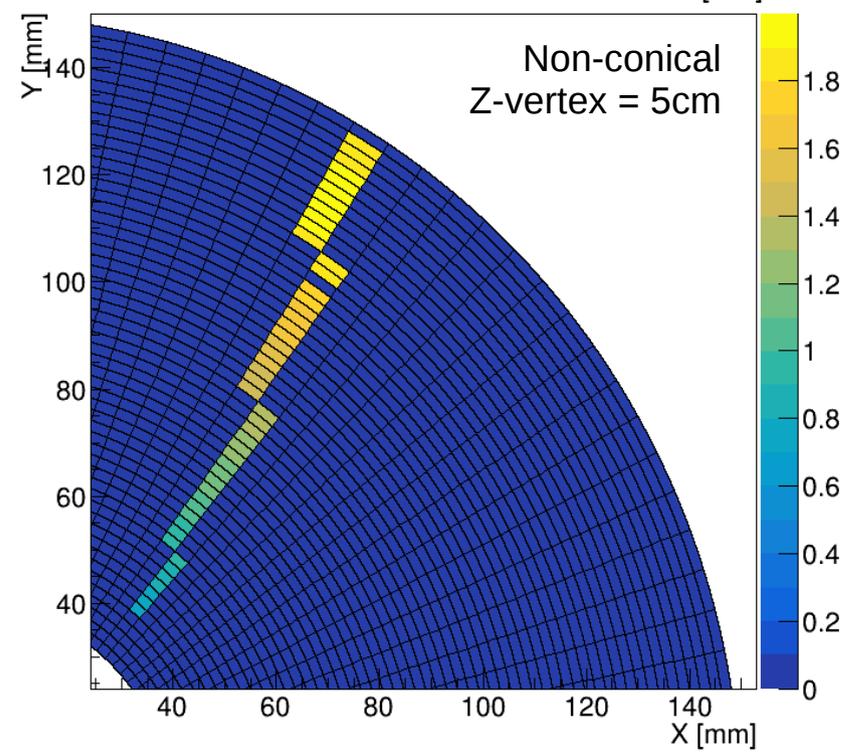
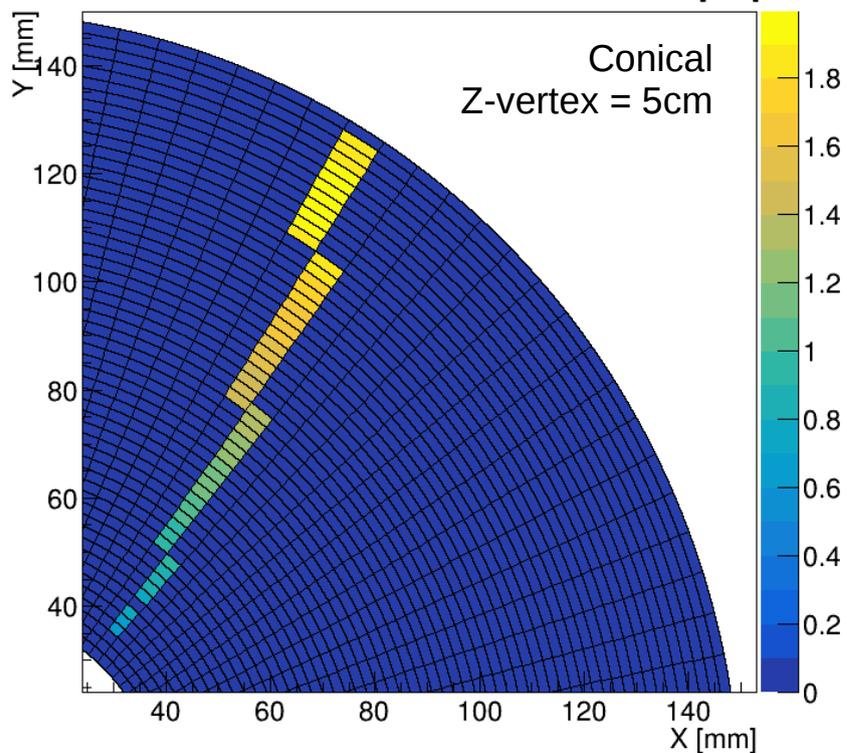
Projected readout plane hit times (shown by colour fill below)



Projection onto Readout Plane - Examples

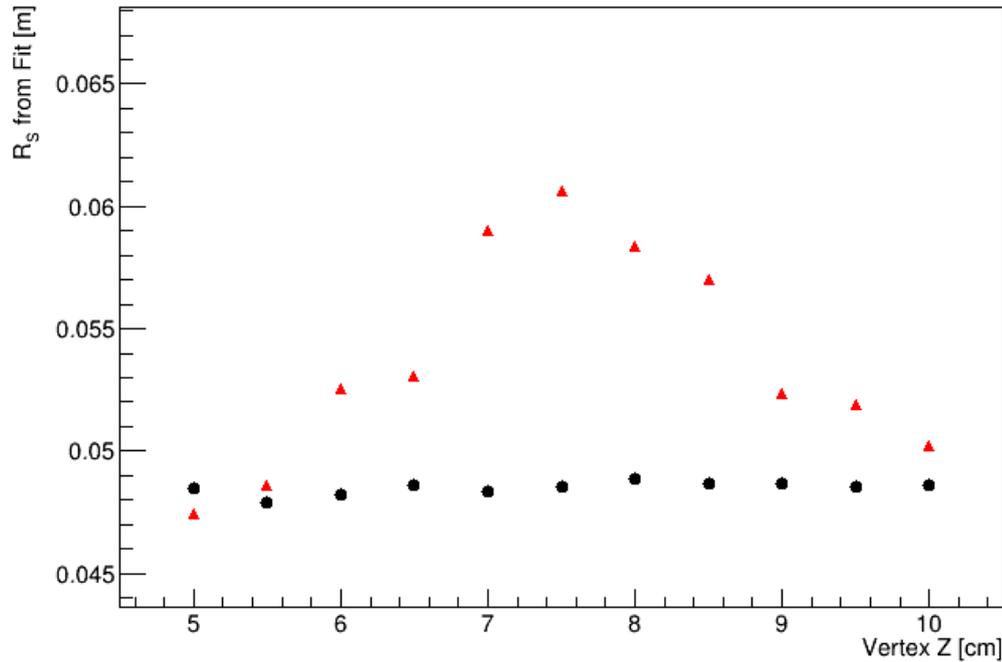


Track enters mtpc close to $r=6\text{cm}$ end of conical shape. Couple of pads difference in start of track

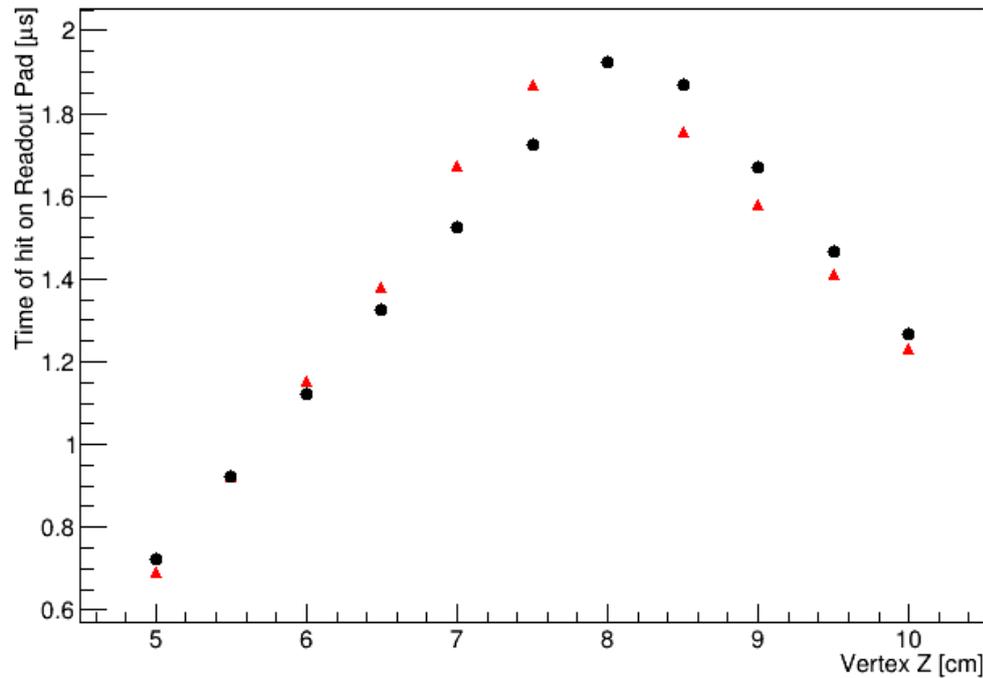


Track enters mtpc close to $r=4\text{cm}$ end of conical shape. Couple of pads difference in start of track

Scan of Z in vertex in 0.5cm steps along target



R_S from fit to Edep V R distributions (upon inspection anomalies down to poor fitting at those point – re-fit with improved starting parameters may improve)



Projected time on readout plane at point corresponding to R_S

Behaviour does seem to reflect geometry

Close to extremity of cone shape difference >100's of ns – could resolve with timing resolution