

Positron Tracker

Back to the drawing board

muEDM meeting in Pisa
4-5/04/2024

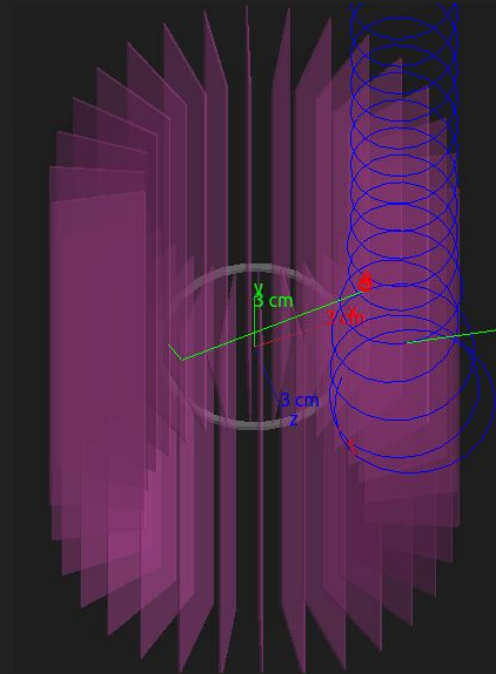
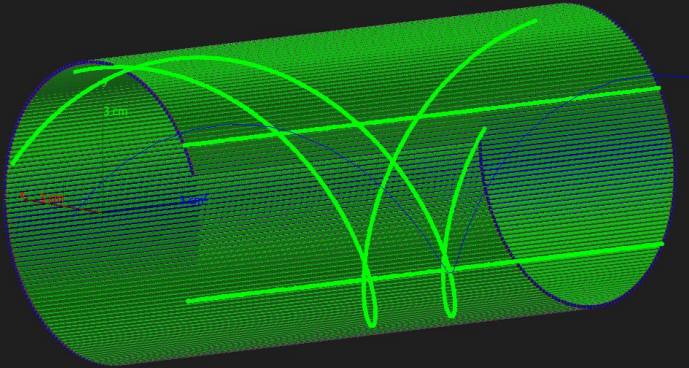
Cool... but why?

CHeT is an interesting design but produces too few hits for being the only tracker in the experiment

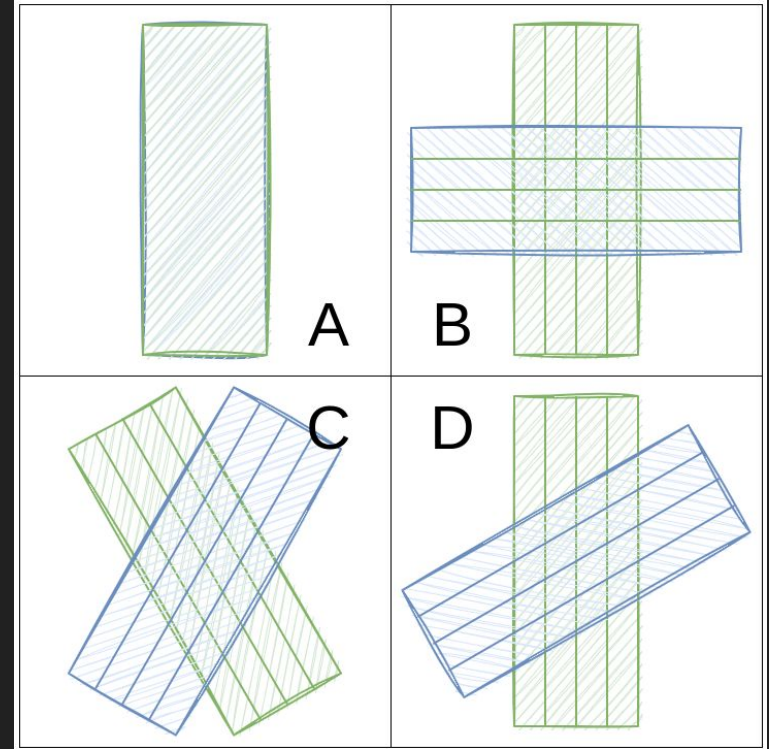
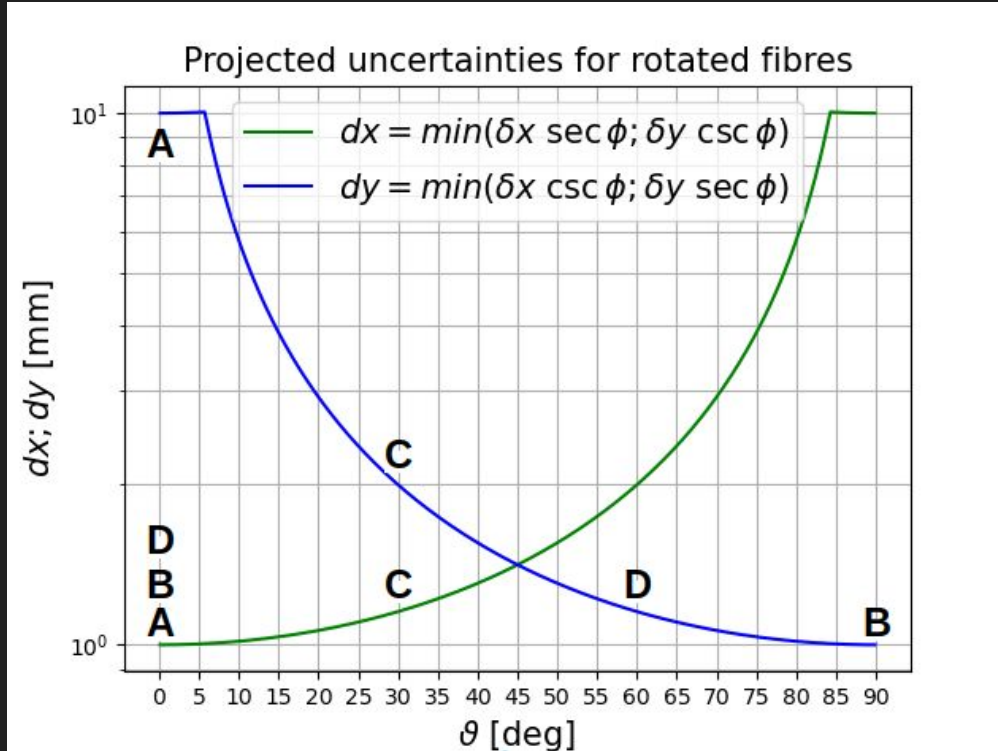
If we need more hits and we can:

- Increase the length of the tracker
- Use concentric cylinders (-> CHeT x N ?)
- Use radial detectors -> Today's presentation

Run 0 (1 event, 1 kept)

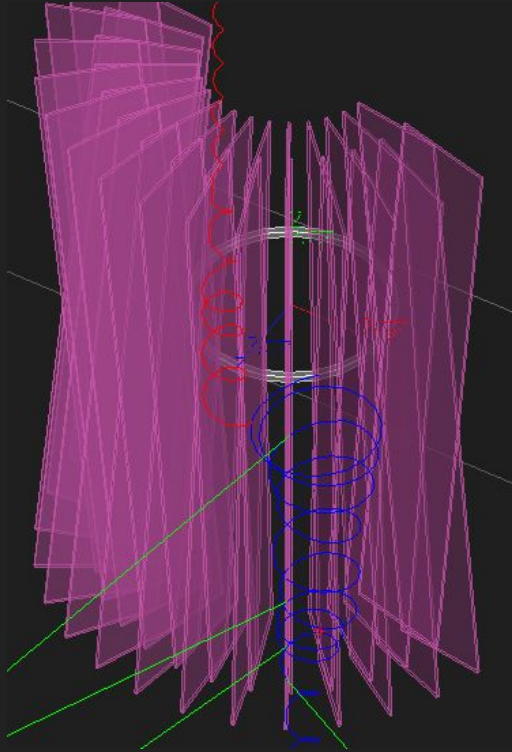


Resolution along Y: a reminder



Important for scintillating fibers, but let's focus on the geometry -> **Let's use VD**

A note on crossed radial ribbons



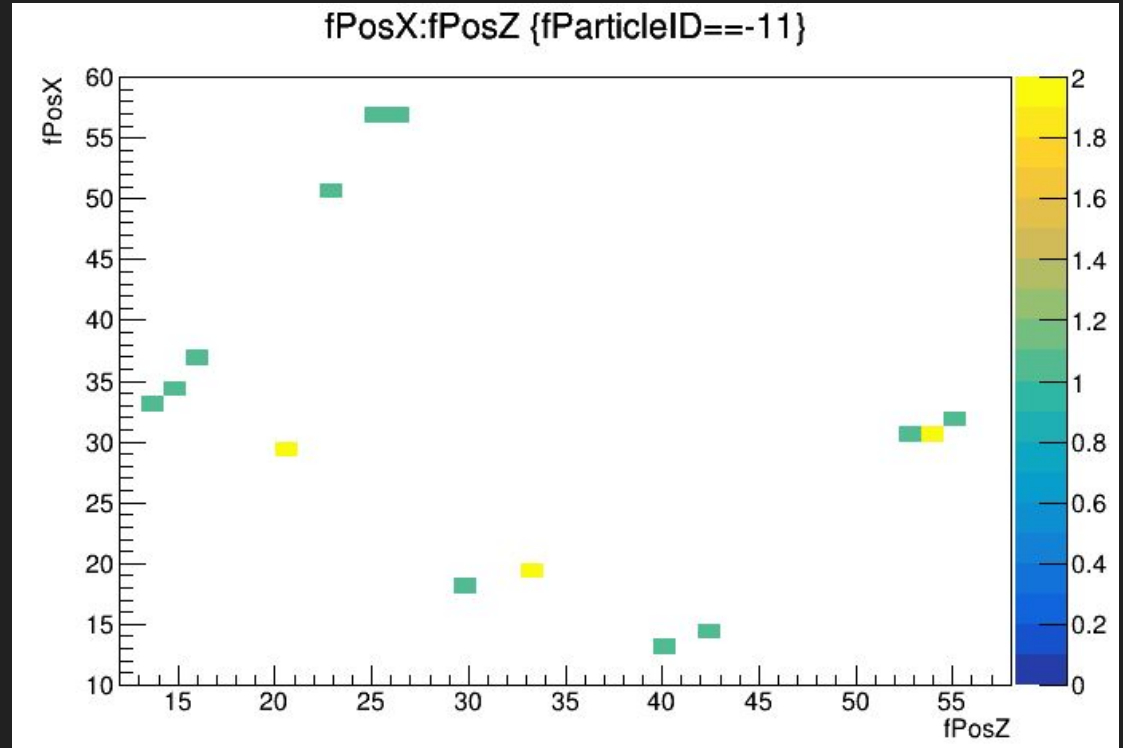
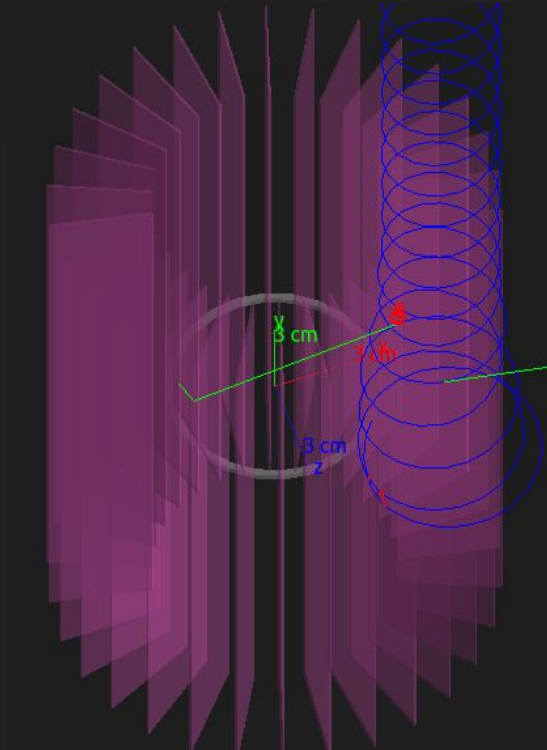
Using longitudinal fibers we can improve the resolution using crossing fibers

This Impacts:

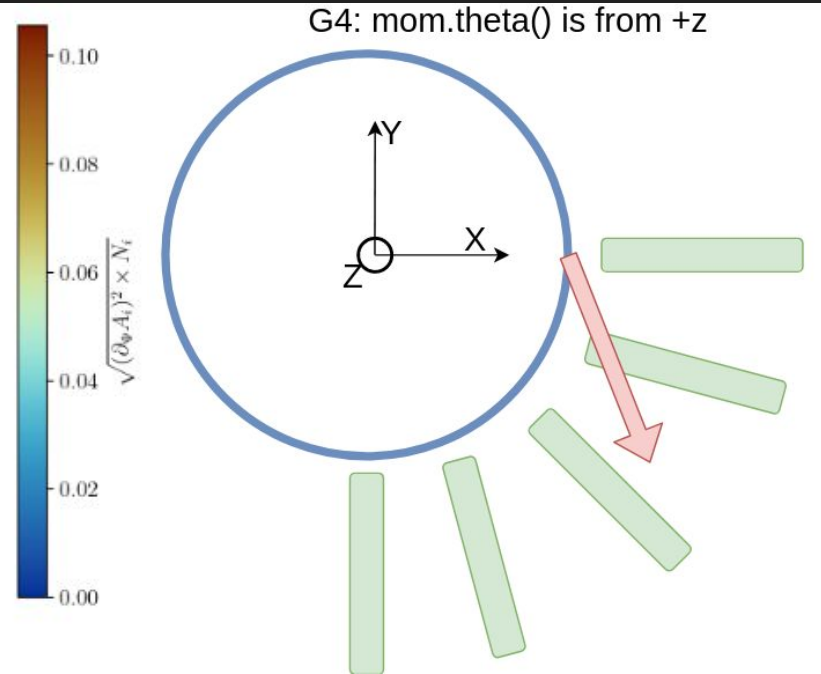
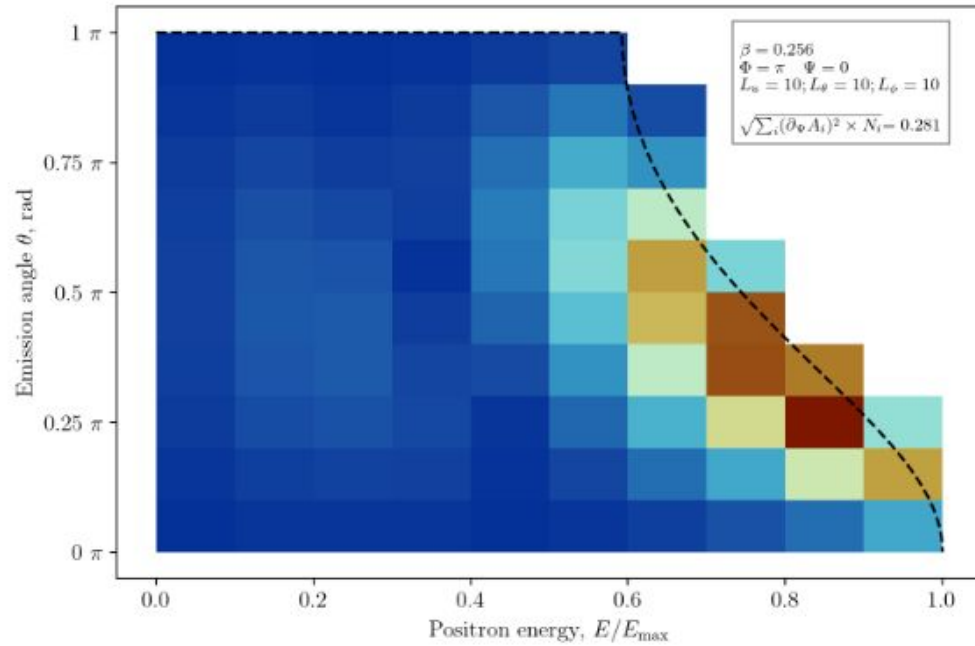
- space needed top/bottom
- area of y resolutions
- 'double' scattering

Let's use plane VD and understand better the requirements before optimizing the readout

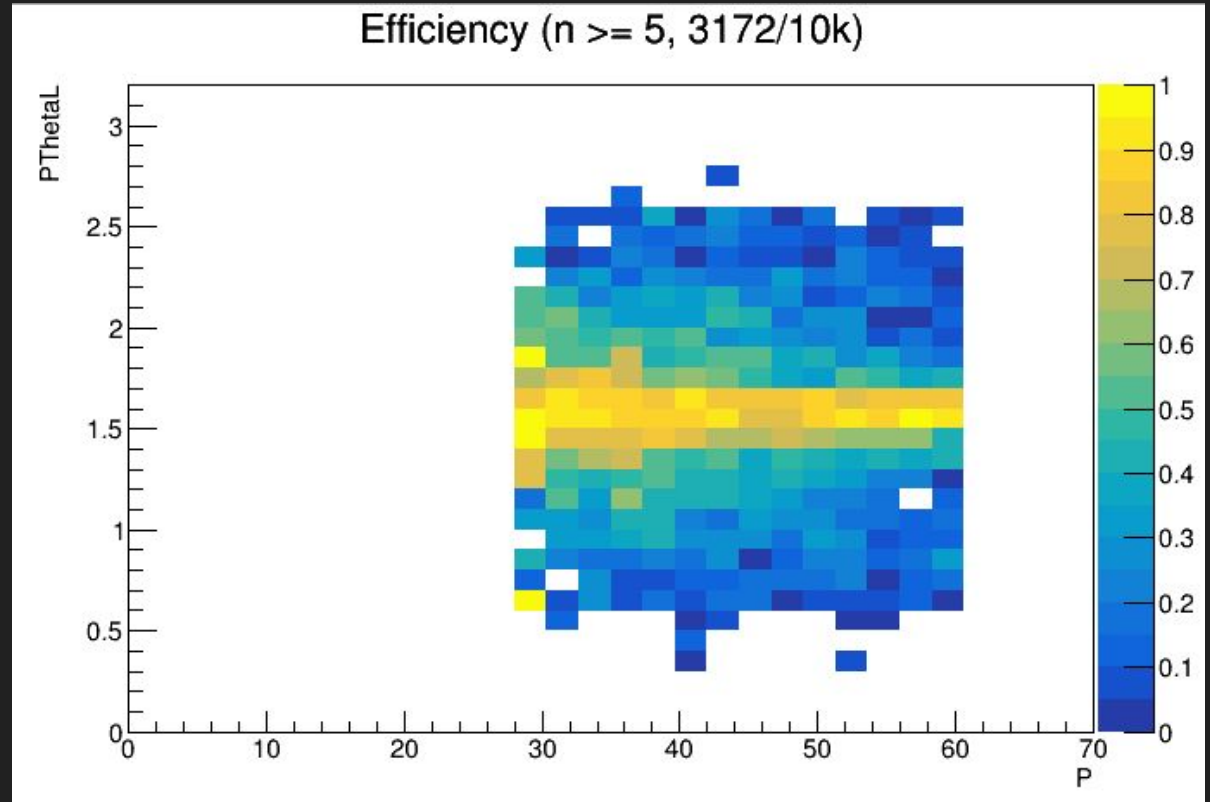
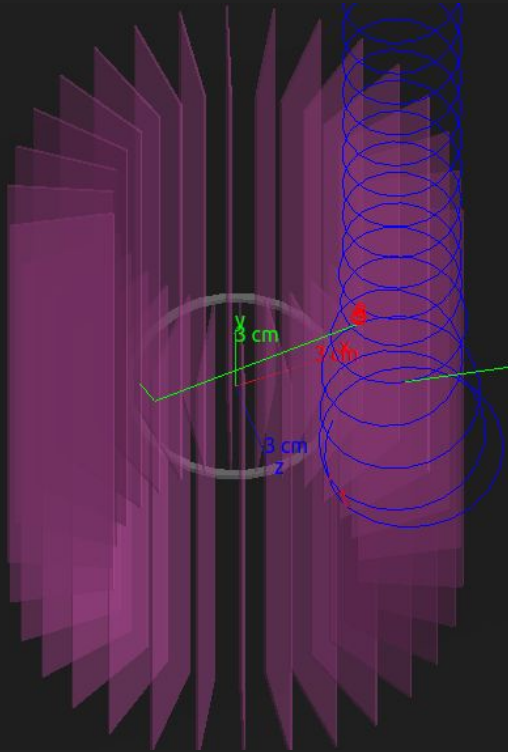
We start from a 'simple' geometry



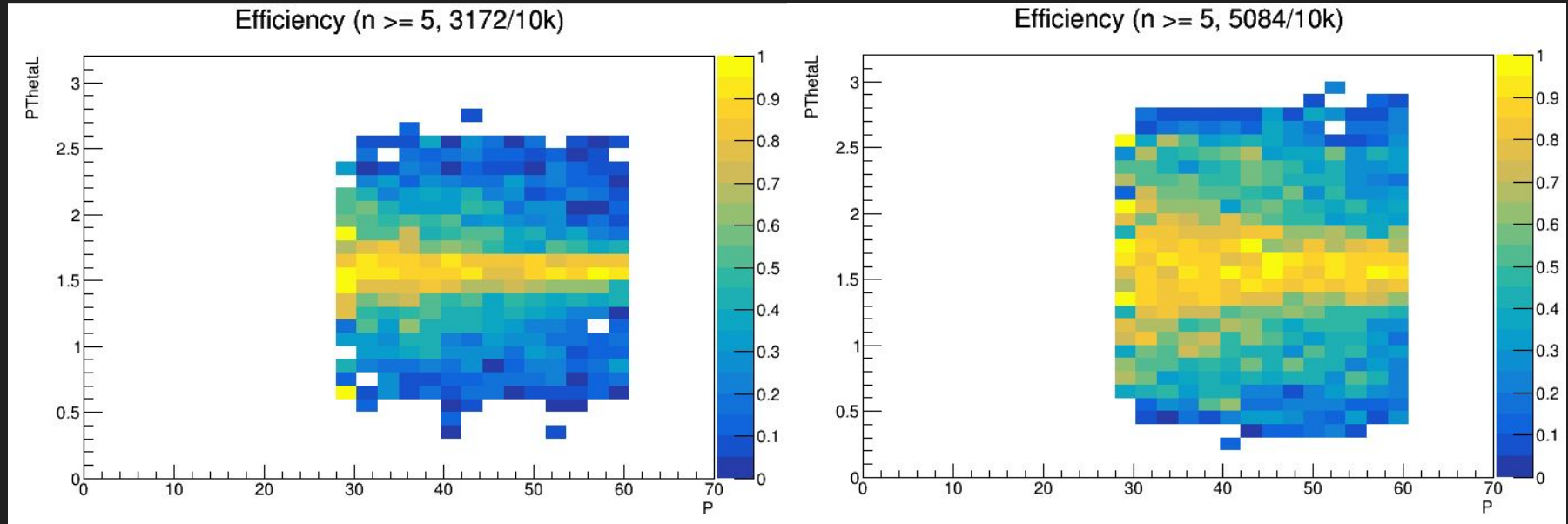
Let's understand the variables



Short near narrow petals (20cm, 5mm, 30mm)

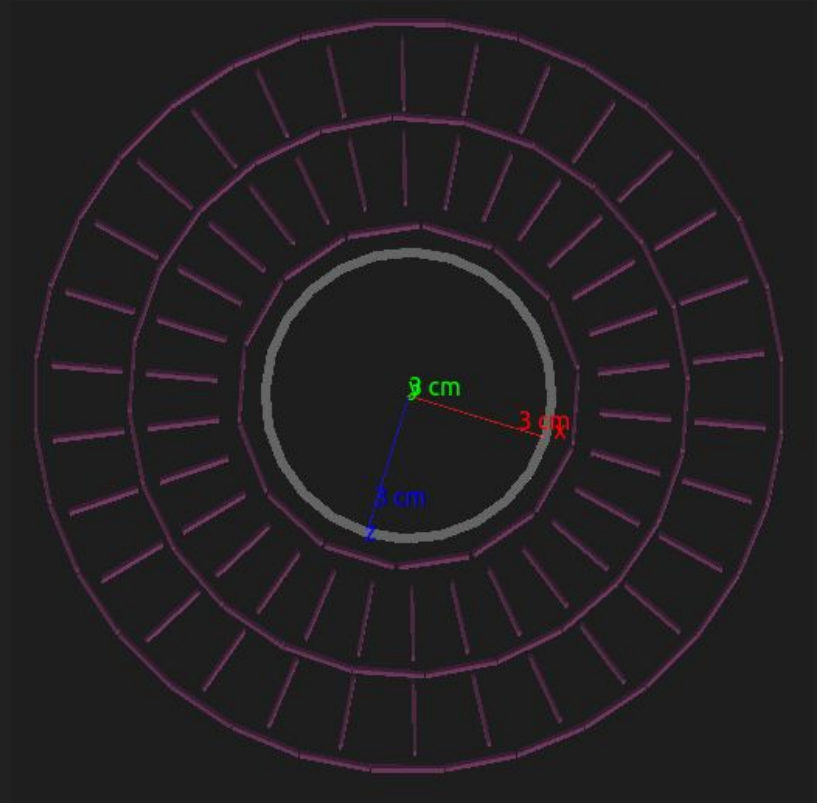
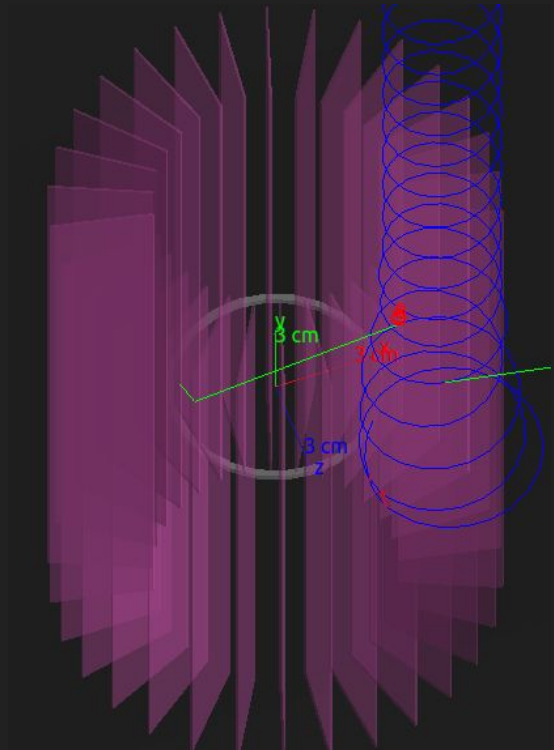


If we make them longer (20->40cm)

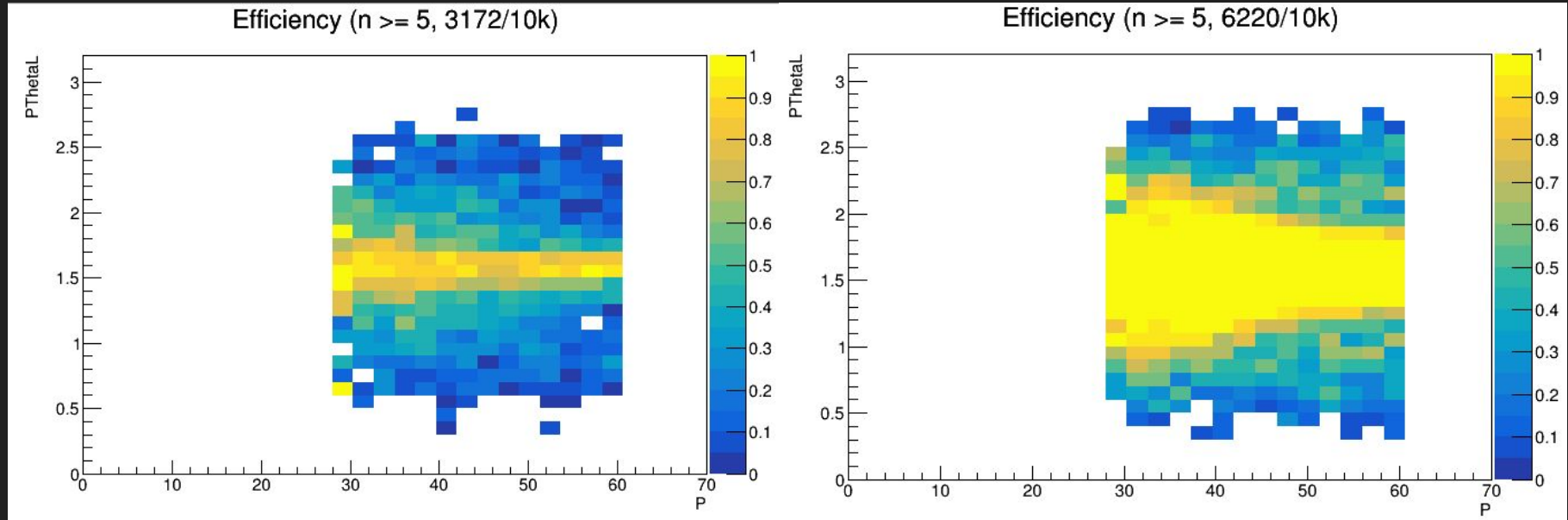


Improves the count at higher angles (mostly for lower momenta)

We can add 'cylinders' to increase the hit count

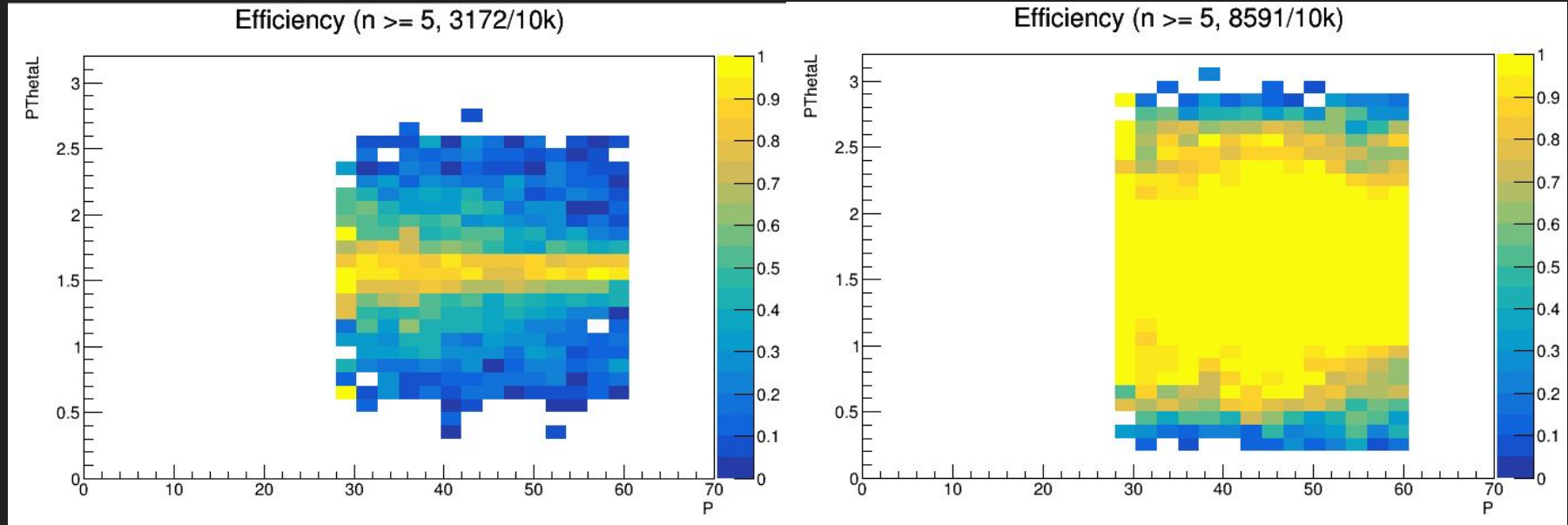


If we add 3 Cylinders



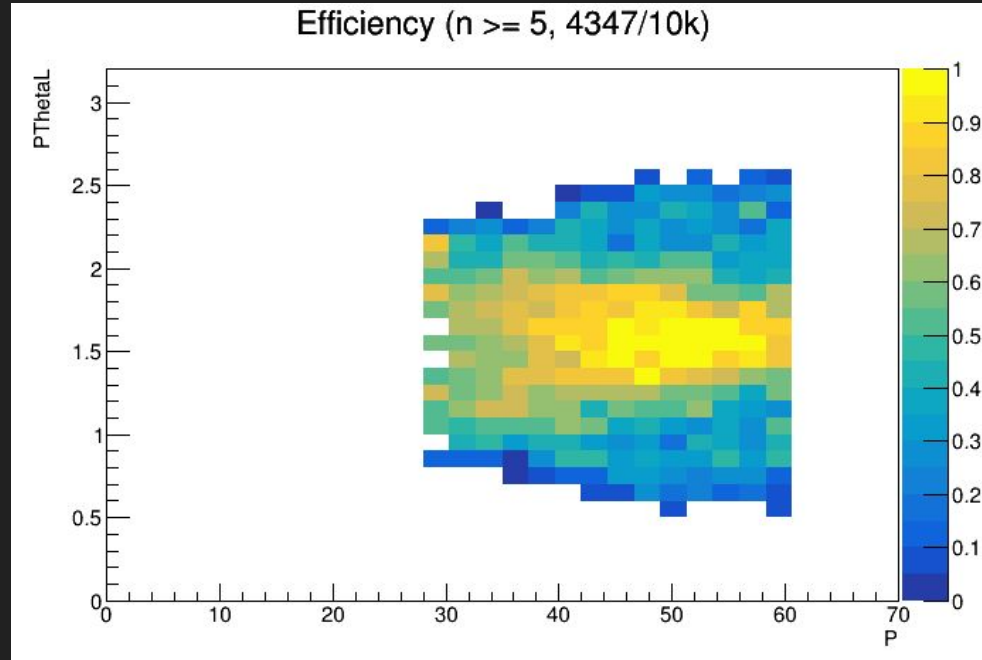
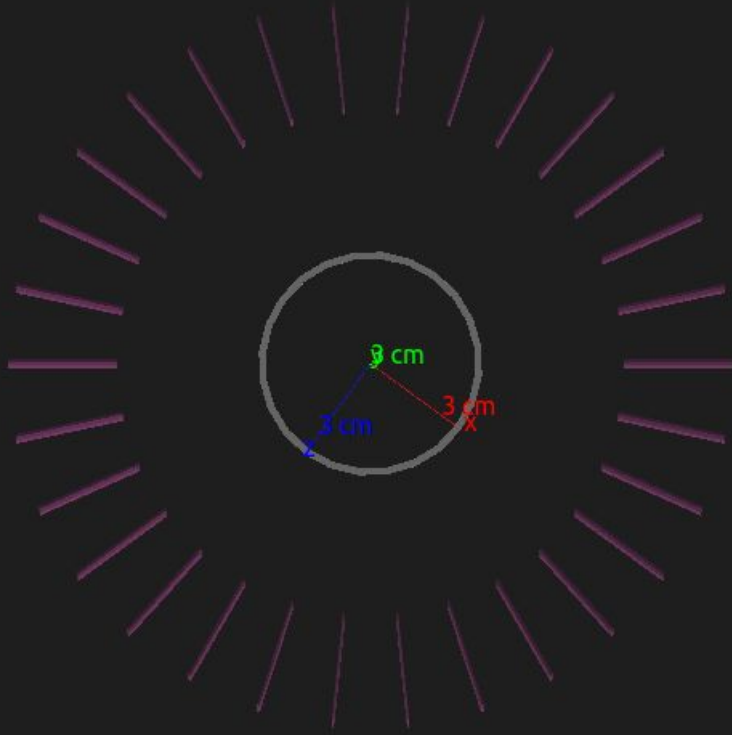
Improves significantly the count at higher angles (mostly for lower momenta)

Both: Long near narrow petals + 3 C (40cm, 5mm, 30mm)



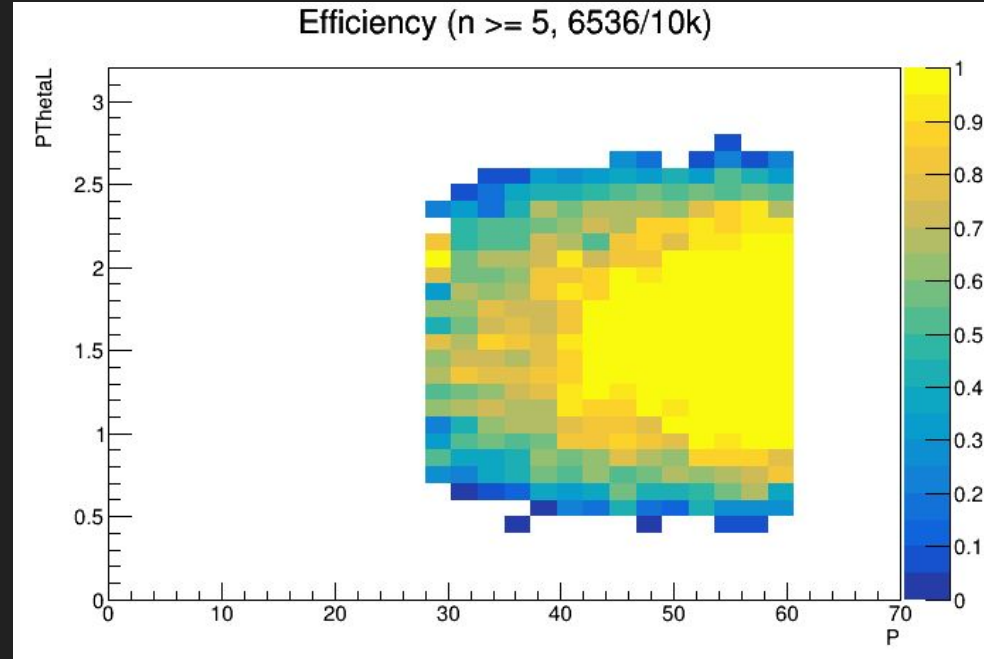
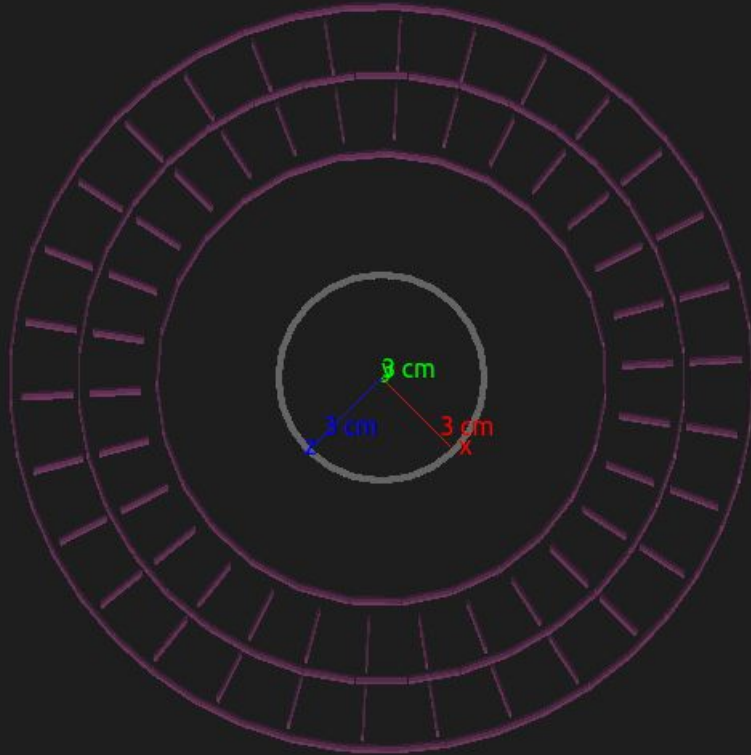
Improves significantly the count, but we want to focus on higher momenta

Long distant narrow petals (40cm, 30mm, 30mm)



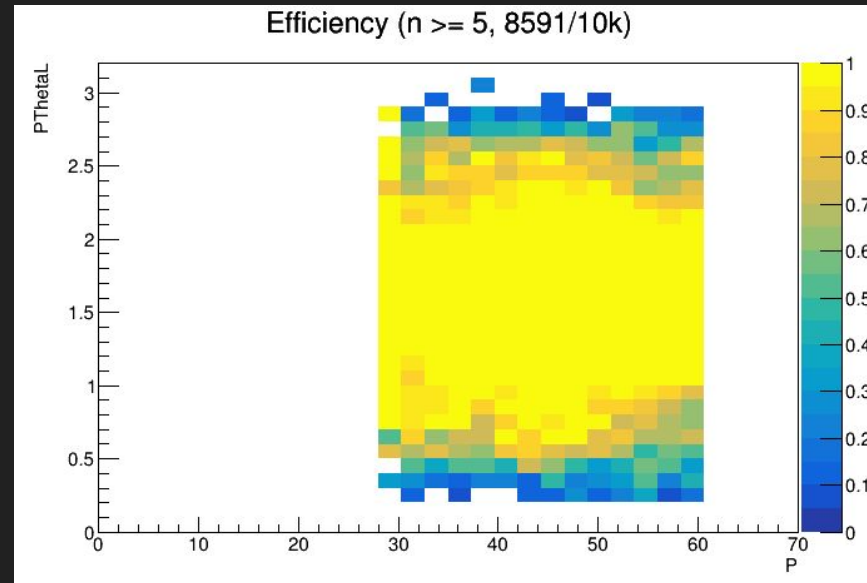
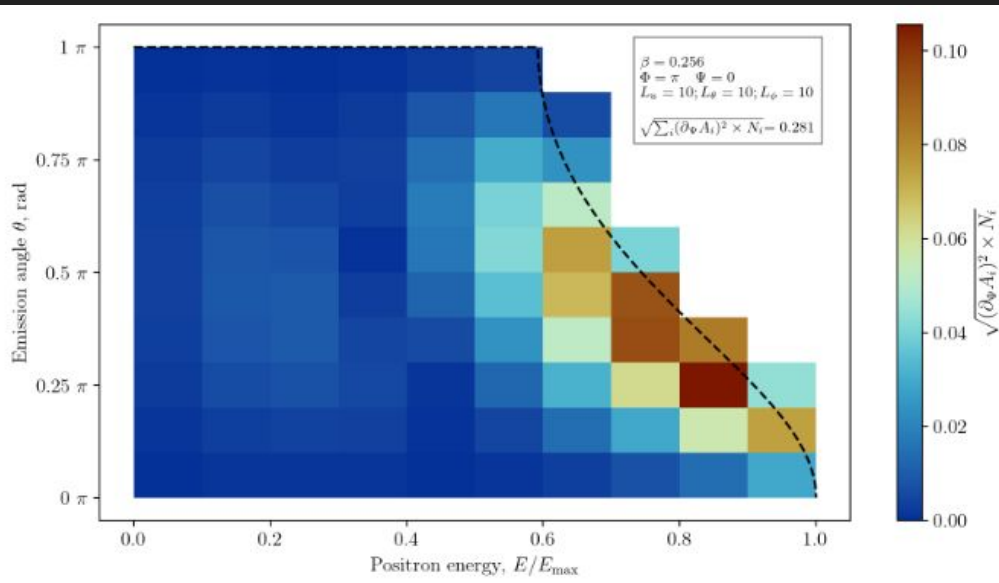
The focus moves to higher P

Long distant narrow petals +3C (40cm, 30mm, 30mm)

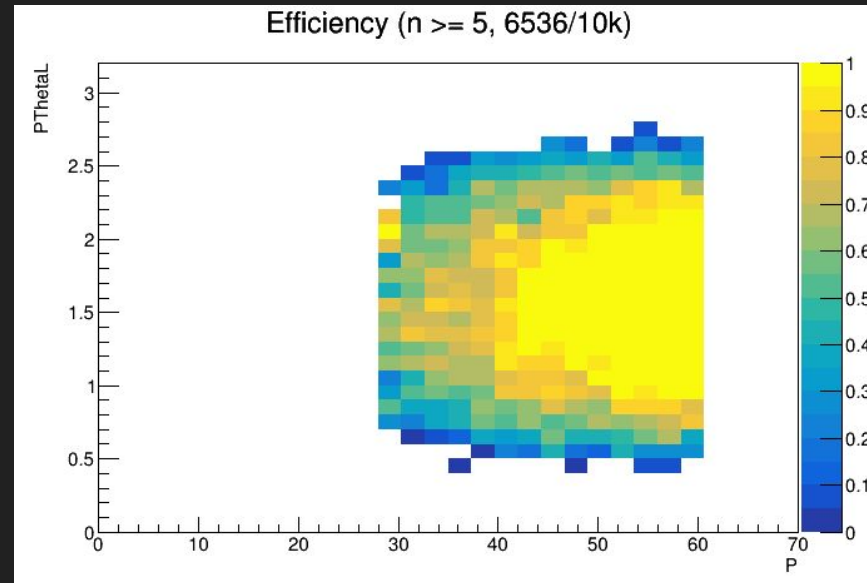
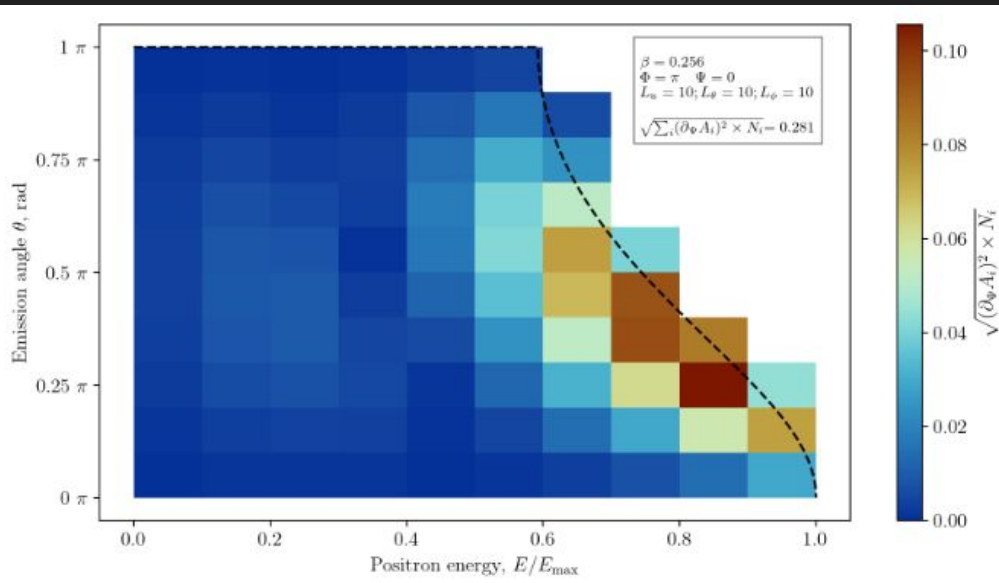


The cylinders help quite a bit

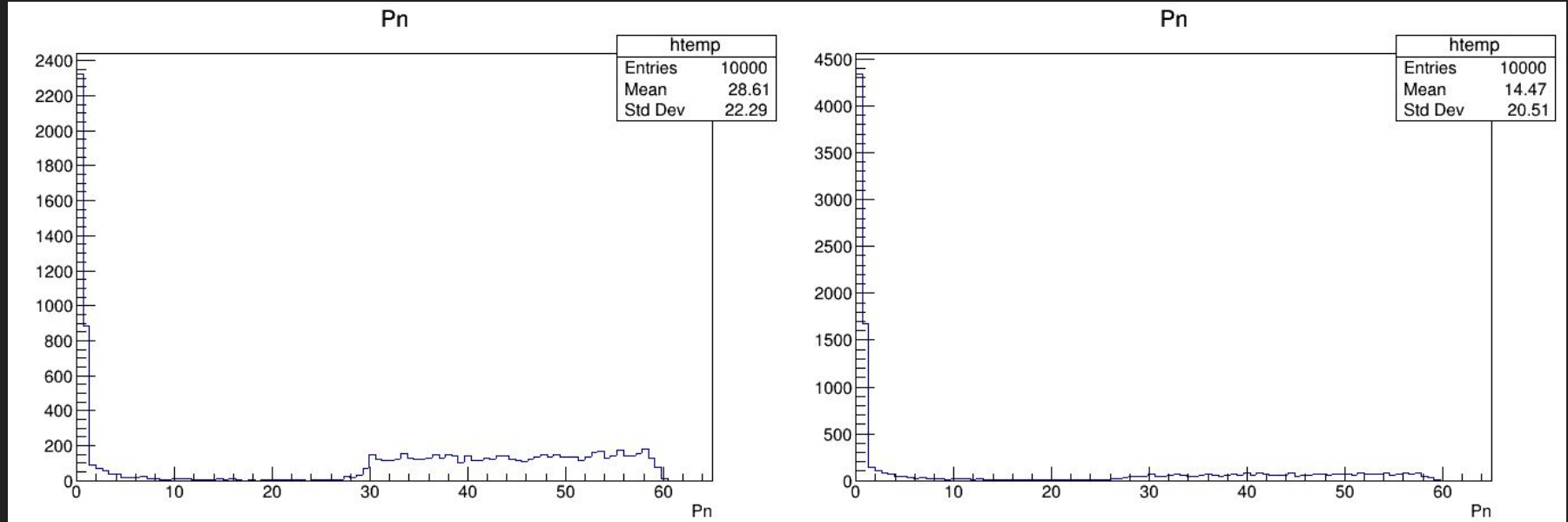
Our interest vs close 3C petals



Our interest vs distant 3C petals



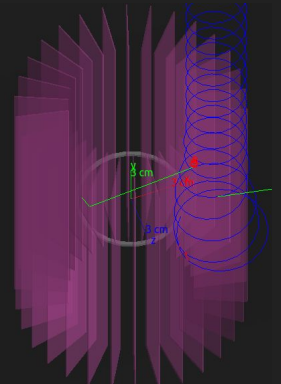
This is all nice, but what if the particles are stopped?



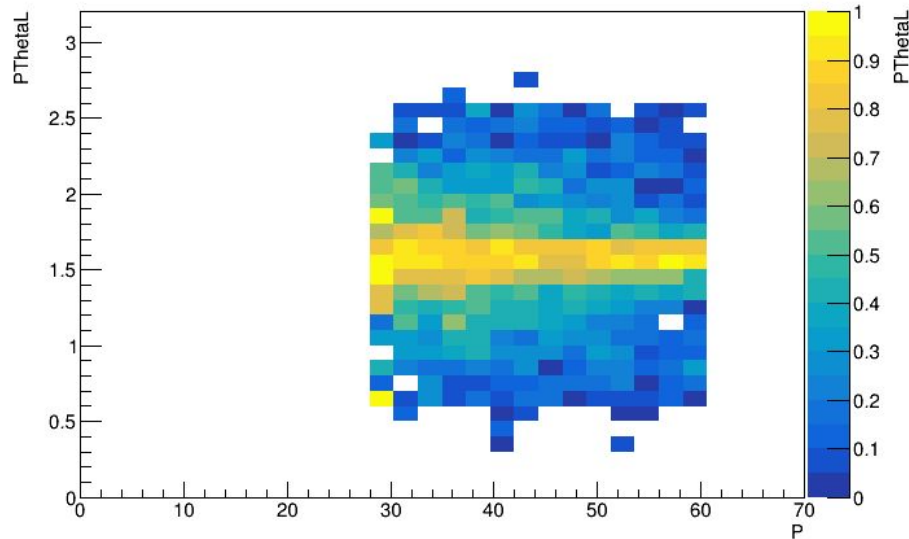
From `new_30_20cm` to `new_30_40cm_3out` clearly the fraction of 'stopped' particles changes, let's add a $P_n > 20$ MeV (and ignore how to actually veto this)

*Short near narrow petals (20cm, 5mm, 30mm)

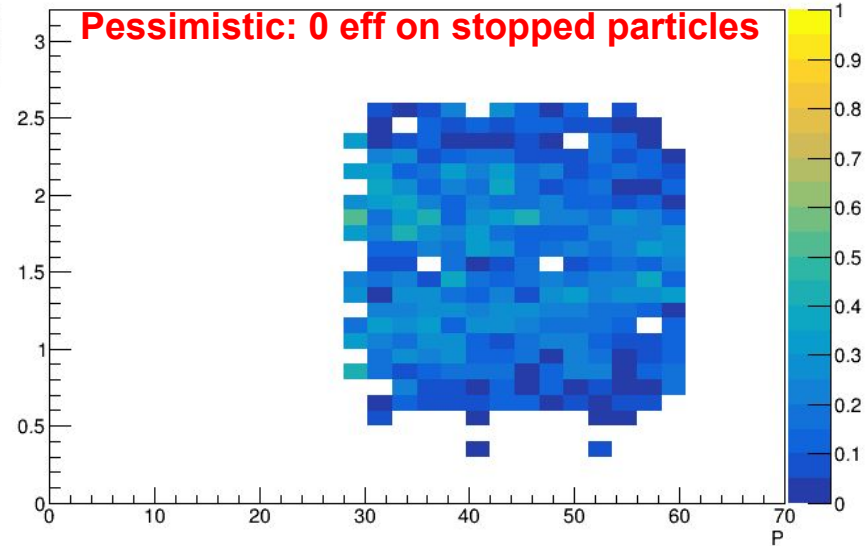
Many good candidates lose a lot of energy after many hits
Do we veto? Ignore? Reconstruct? Do we want to stop them faster?



Efficiency ($n \geq 5$, 3172/10k)

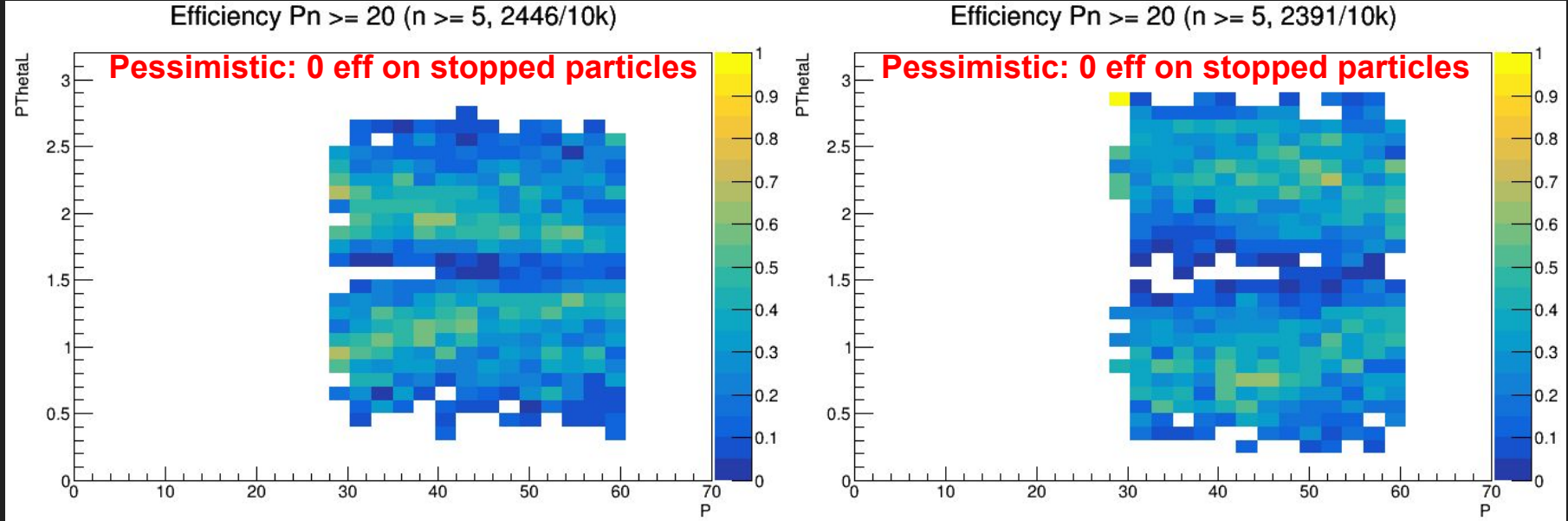


Efficiency $P_n \geq 20$ ($n \geq 5$, 1389/10k)



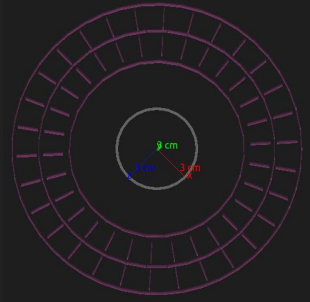
*Short/Long near petals +3C (20/40cm, 5mm, 30mm)

Requiring $P_n > 20$ MeV we still have the 'broadening' effect for the longer detector
We lose the improvement in statistics

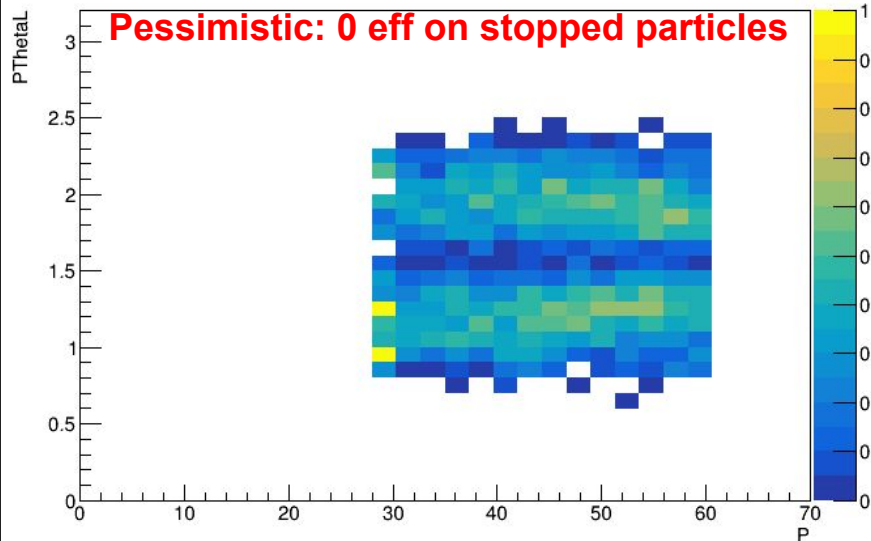


*Move them away +3C (20/40cm, 30mm, 30mm)

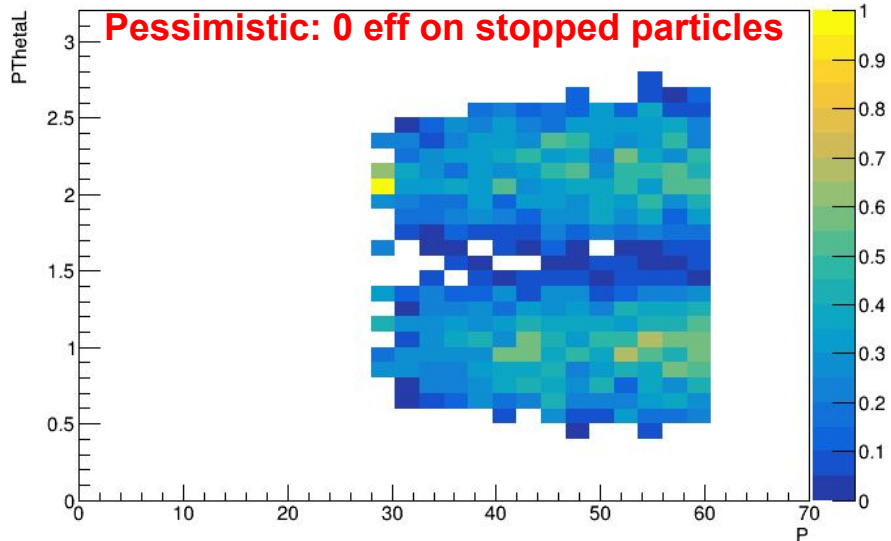
Distancing the detector moves the focus to higher momenta
With this new requirement seems not an improvement



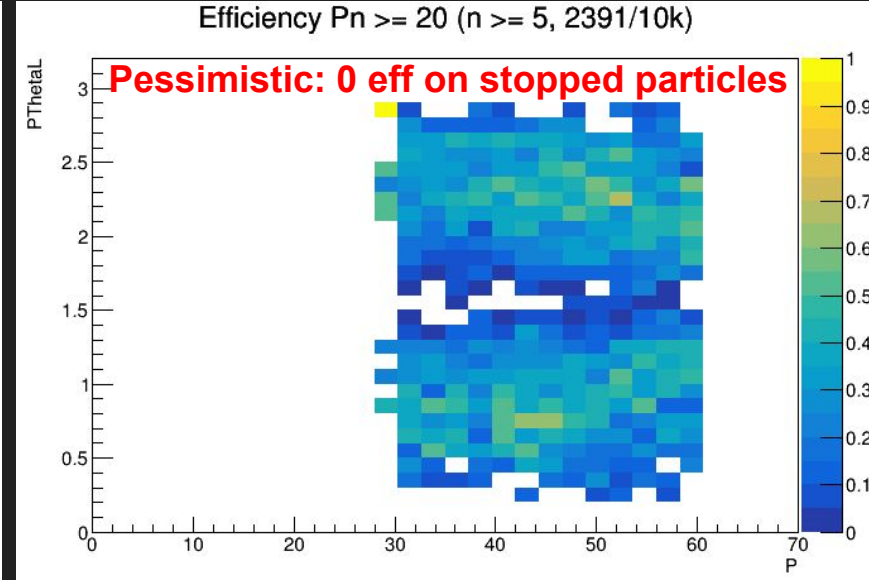
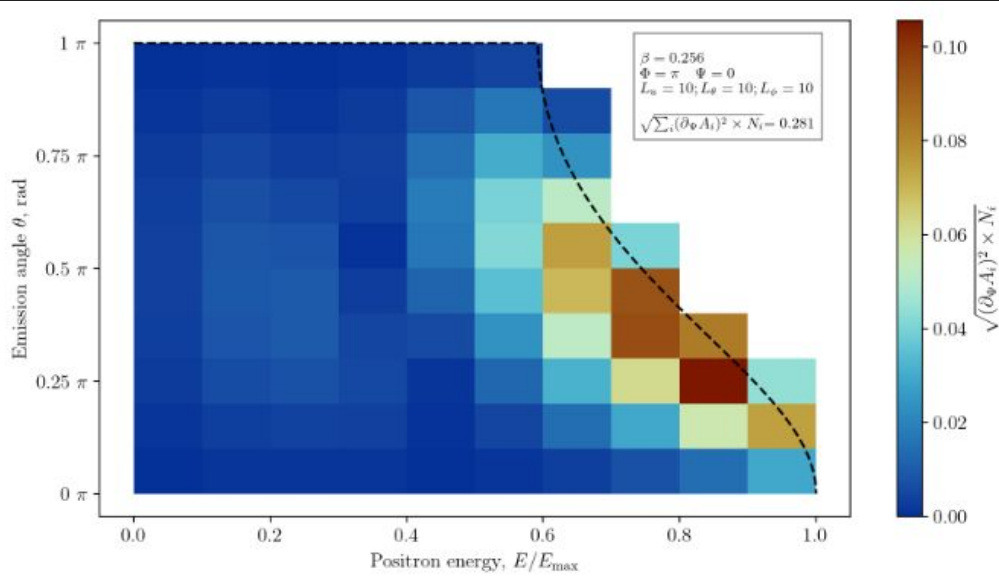
Efficiency $P_n \geq 20$ ($n \geq 5$, 2033/10k)



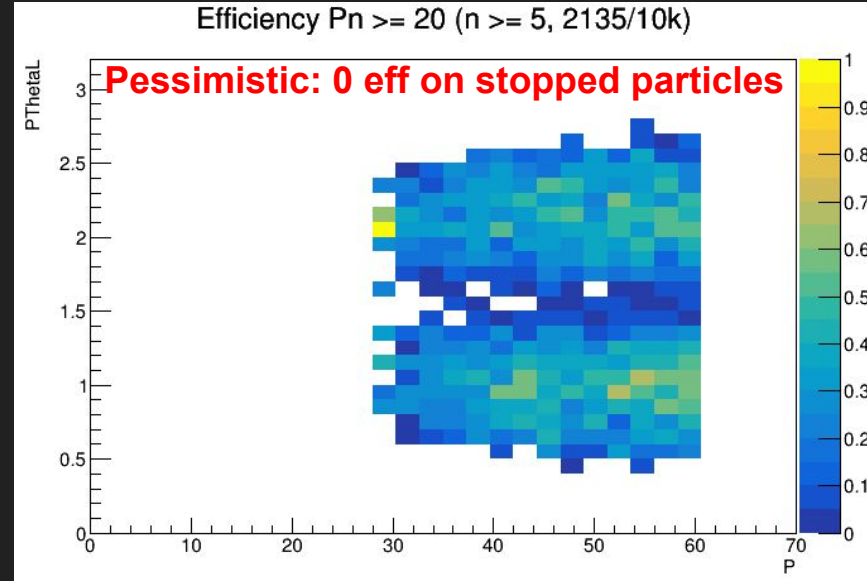
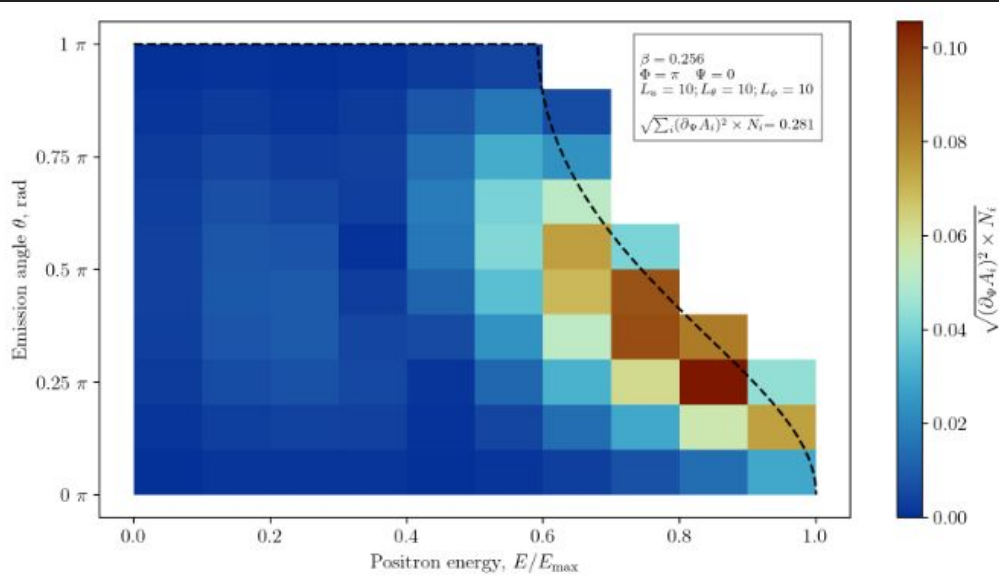
Efficiency $P_n \geq 20$ ($n \geq 5$, 2135/10k)



Our interest vs close 3C petals (Pn>20)



Our interest vs distant 3C petals (Pn>20)



Let's sum what we have

A fixed starting point and flat distributions

- XYZ (3cm, 0, 0)
- P flat 30-60 MeV and random direction

We want to optimize for the reconstruction not only at a specific EDM value and for both CW and CCW

From these plots:

- Hard to pick the distance
- Cylinders clearly add hits
- 20 cm seems too short

To simplify the problem we are looking at VD but we need to keep the number of channels $\sim 1k$

Let's sum what we have

A fixed starting point and flat distributions

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Rough channels count

If there is a ch per mm, 1 cm of fibers corresponds to 20 chs.

- Radial petals with longitudinal fibers: 30 x 30 mm < 1 m ~ 2k ch
- Cylinder with transverse fibers: 3 x 200 mm (or 400 mm) ~ 1 m ~ 2k ch

From these plots:

- Hard to pick the distance
- Cylinders clearly add hits
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To simplify the problem we are looking at VD but we need to keep the number of channels ~ 1k

To dos

Some exchange with Joe and Chavdar:

- People were assuming 3 hits to construct a circle, we probably need > 5
- ThetaL is the polar angle of the positron momentum to the B direction

Particles at $\vartheta \sim \pi/2$:

- Have many hits but stop
- Do we keep them? How?

Perhaps a focus should be the reconstruction code, to better understand the requirements

What needs to be added

- Magnet to kill the too wide positrons
- Proper spectrum (-> Common code)
- Optimize the geometry
- Understand how to arrange the fibers

That's all, folks!