Magnet Stations for LHCb

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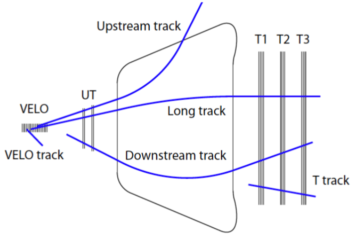
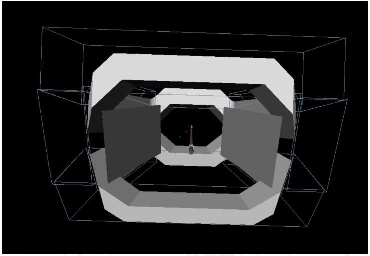
Where our tracks are?





⇛ The upstream tracks have rather poor momentum resolution: $\frac{\Delta p}{p} \sim 15\%$.

⇛ The particles die after short and sad (for physics) life in the magnet yoke.

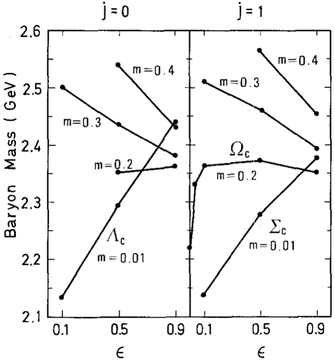
⇛ If one put chambers in the magnet stations, one could record the particles before they death.

⇛ This will not increase the material budget of the rest of the detector.

Physics interest

$\Rightarrow$ We have enormous amount of channels where we have slow particles:

- $D^* \to D\pi$.
- $\Lambda_c(2595, 2625) \to \Lambda_c\pi\pi$.
- All the B^{**} decays! $\longleftarrow$ huge community interests!!!
- As well other states: $\Sigma_b \to \Lambda_b\pi$.
- Little is known about the excited B_s^0 states as well.
- $\tau \to 3\mu$.



τ production

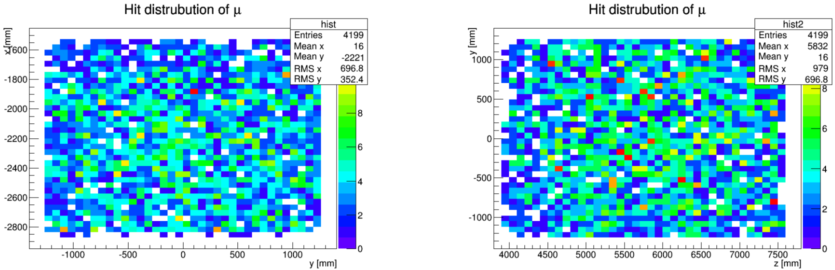
- τ's in LHCb come from five main sources:

Mode	7 TeV	8 TeV
Prompt $D_s \to \tau$	$71.1 \pm 3.0\,\%$	$72.4 \pm 2.7\,\%$
Prompt $D^+ \to \tau$	$4.1 \pm 0.8\,\%$	$4.2 \pm 0.7\,\%$
Non-prompt $D_s \to \tau$	$9.0 \pm 2.0\,\%$	$8.5 \pm 1.7\,\%$
Non-prompt $D^+ \to \tau$	$0.18 \pm 0.04\,\%$	$0.17 \pm 0.04\,\%$
$X_b \to \tau$	$15.5 \pm 2.7\,\%$	$14.7 \pm 2.3\,\%$

$\Rrightarrow$ For this study I simulated the τ's coming from c

τ simulation

$\Rrightarrow$ $9\ \%$ of the τ that are produced in LHCb acceptance ($\eta < 5$) have a muon that ends in the magnet tracking stations!



$\Rrightarrow$ Rather uniform distribution.

τ simulation

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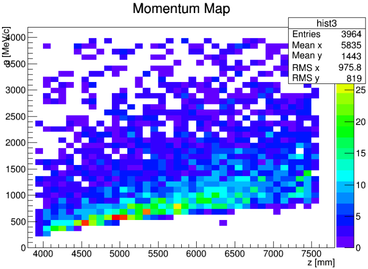
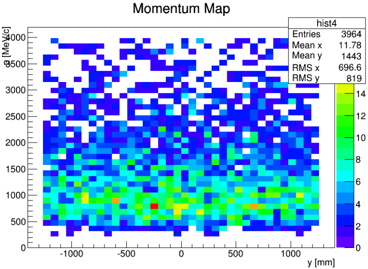
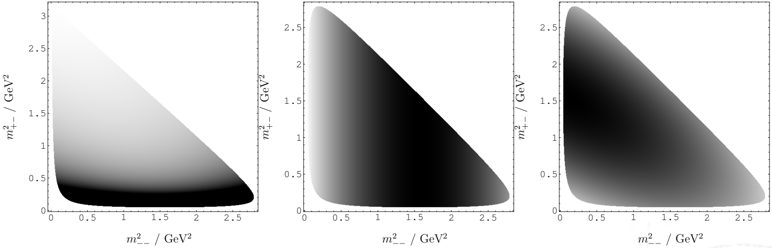




$\Rrightarrow$ If we exclude the $\pm 150\mathrm{cm}$ regions we loose 14%.

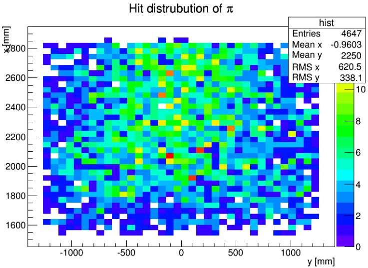
τ decay model

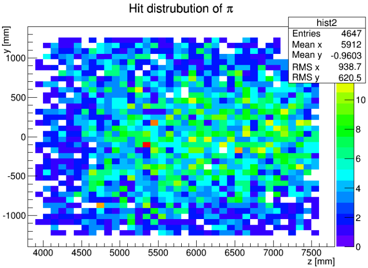
- ⇛ τ are decayed with PHSP.
- ⇛ Might be worth in looking at the specific models:



D^* simulation

$\Rrightarrow$ $10~\%$ of the τ that are produced in LHCb acceptance have a muon that ends in the tracking stations!





$\Rrightarrow$ Clearly different behaviour than μ.

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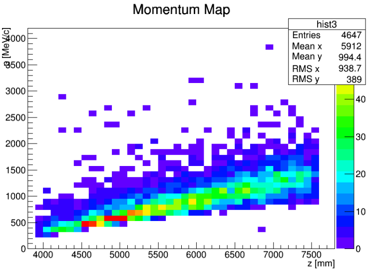
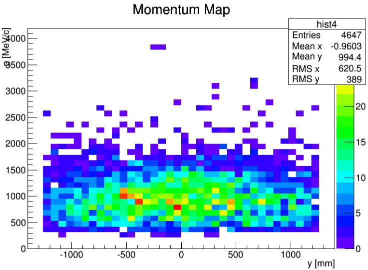
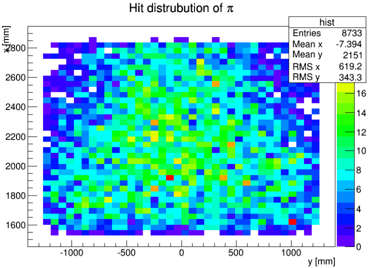


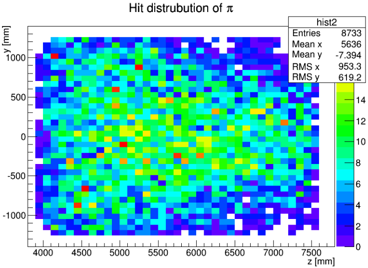


$\Rrightarrow$ If we exclude the $\pm 150\mathrm{cm}$ regions we loose 17%.

Λ_c^* simulation

$\Rrightarrow$ $19\ \%$ of the τ that are produced in LHCb acceptance have a muon that ends in the tracking stations!





$\Rrightarrow$ Clearly different behaviour than μ.

$\Rrightarrow$ We have two slow pions. The efficiency looks like factorizes :)

Λ_c^* simulation

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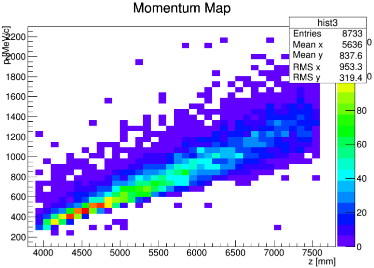

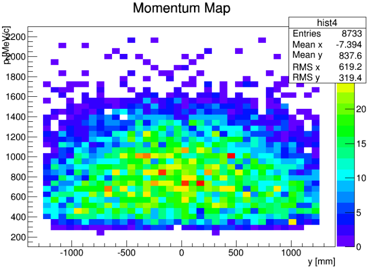

$\Rrightarrow$ If we exclude the $\pm 150\text{cm}$ regions we loose 16%.

Summary

$\Rrightarrow$ Using 3 benchmark channels we see there is quite a lot to be gain!
$\Rrightarrow$ This is just tip of the ice berg.
$\Rrightarrow$ We need to strengthen the physics program: ex. $\Lambda_c^+(2595)$ decays via intermediate states like Σ_c which allows polarization measurements.
$\Rrightarrow$ Will add multi bodies to the studies.
$\Rrightarrow$ $B^{**} \to KB$ will allow constrained the final state measurements.
$\Rrightarrow$ The length of this detector can be optimised based on our "golden channels".

Backup