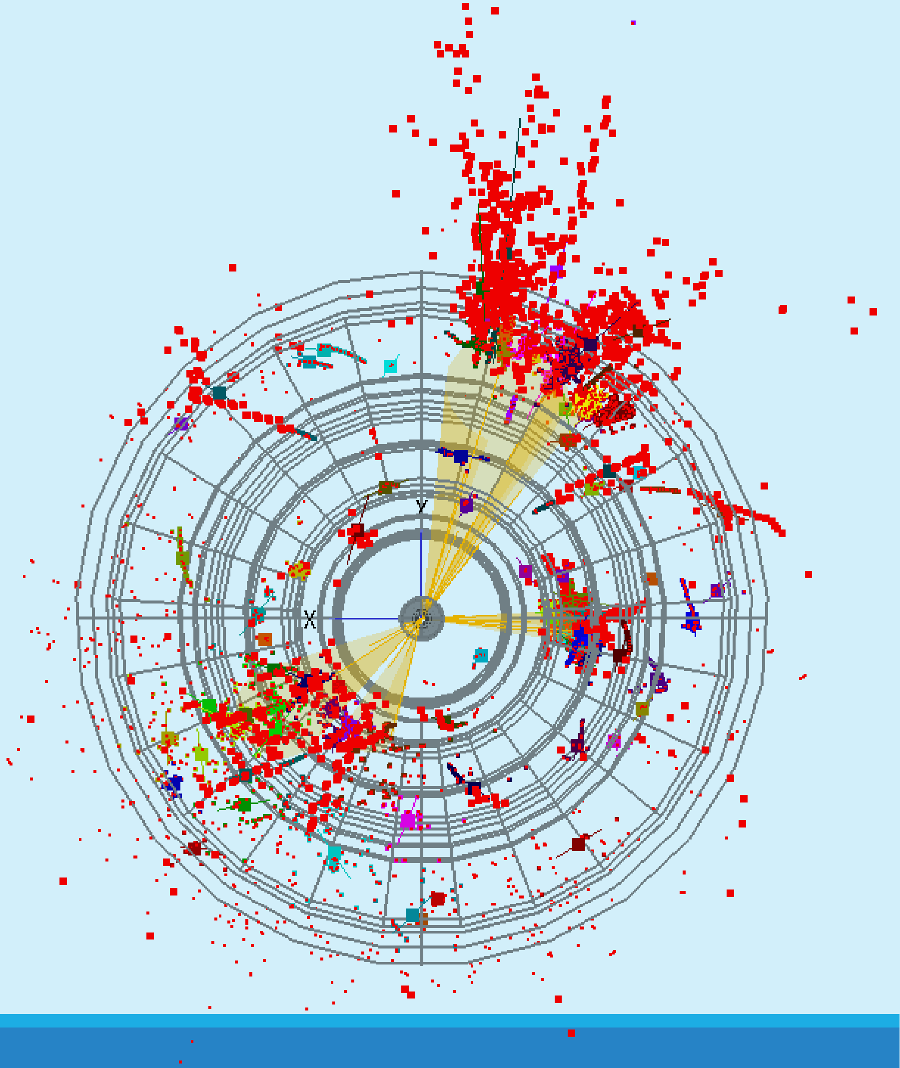
Studies on tracking perfomance with particle gun samples



Alessandro Montella, Massimo Casarsa

January 19, 2021

Samples

- Samples with production vertex at the origin

Particle	vertex	$\theta \in U[10°, 170°]$	$p_T \in U[0.1, 100]$ GeV/c	n.events/sample
$\mu^{\pm}$	$(0, 0, 0)$	$p = 1, 10, 100$ GeV/c	$\theta = 13°, 30°, 89°$	100000
$\pi^{\pm}$	$(0, 0, 0)$	$p = 1, 10, 100$ GeV/c	$\theta = 13°, 30°, 89°$	20000
$e^{\pm}$	$(0, 0, 0)$	$p = 1, 10, 100$ GeV/c	$\theta = 13°, 30°, 89°$	20000

- Samples with realistic beamspot

Particle	vertex	$\theta \in U[10°, 170°]$	$p_T \in U[0.1, 100]$ GeV/c	n.events/sample
$\mu^{\pm}$	$(0, 0, N(0, 10))$	$p = 1, 10, 100$ GeV/c	$\theta = 13°, 30°, 89°$	100000

- Samples with displaced production vertex

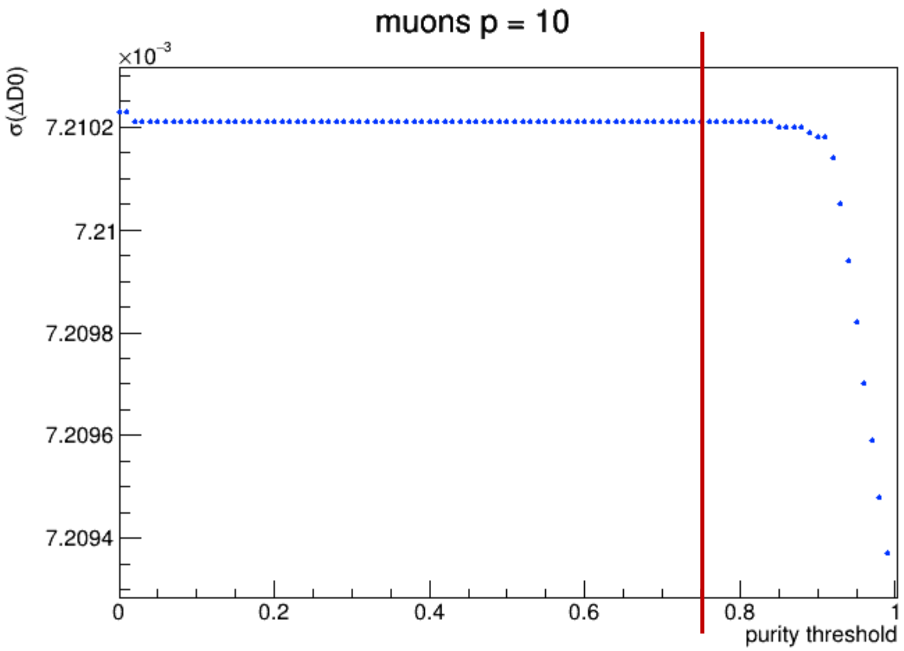
Particle	vertex	$\theta \in U[10°, 170°]$	$p_T \in U[0.1, 100]$ GeV/c	n.events/sample
$\mu^{\pm}$	uniformly distributed inside a sphere centered in $(0, 0, 0)$ with radius $R = 20$ mm	$p = 1, 10, 100$ GeV/c	$\theta = 13°, 30°, 89°$	100000
$\pi^{\pm}$	uniformly distributed inside a sphere centered in $(0, 0, 0)$ with radius $R = 20$ mm	$p = 1, 10, 100$ GeV/c	$\theta = 13°, 30°, 89°$	20000

Track matching and selection

We defined the "purity" of a track as the ratio between the number of superlayers with at least one hit matched with the MC particle and the total number of superlayers with at least one hit

- Superlayer: in the VXD it consists of a pair of layers, and it is counted if at least one of the two layers has at least one hit; in the IT and OT it coincides with the single layer

- A track is matched with the MC particle if its purity is above a given threshold P_{th}

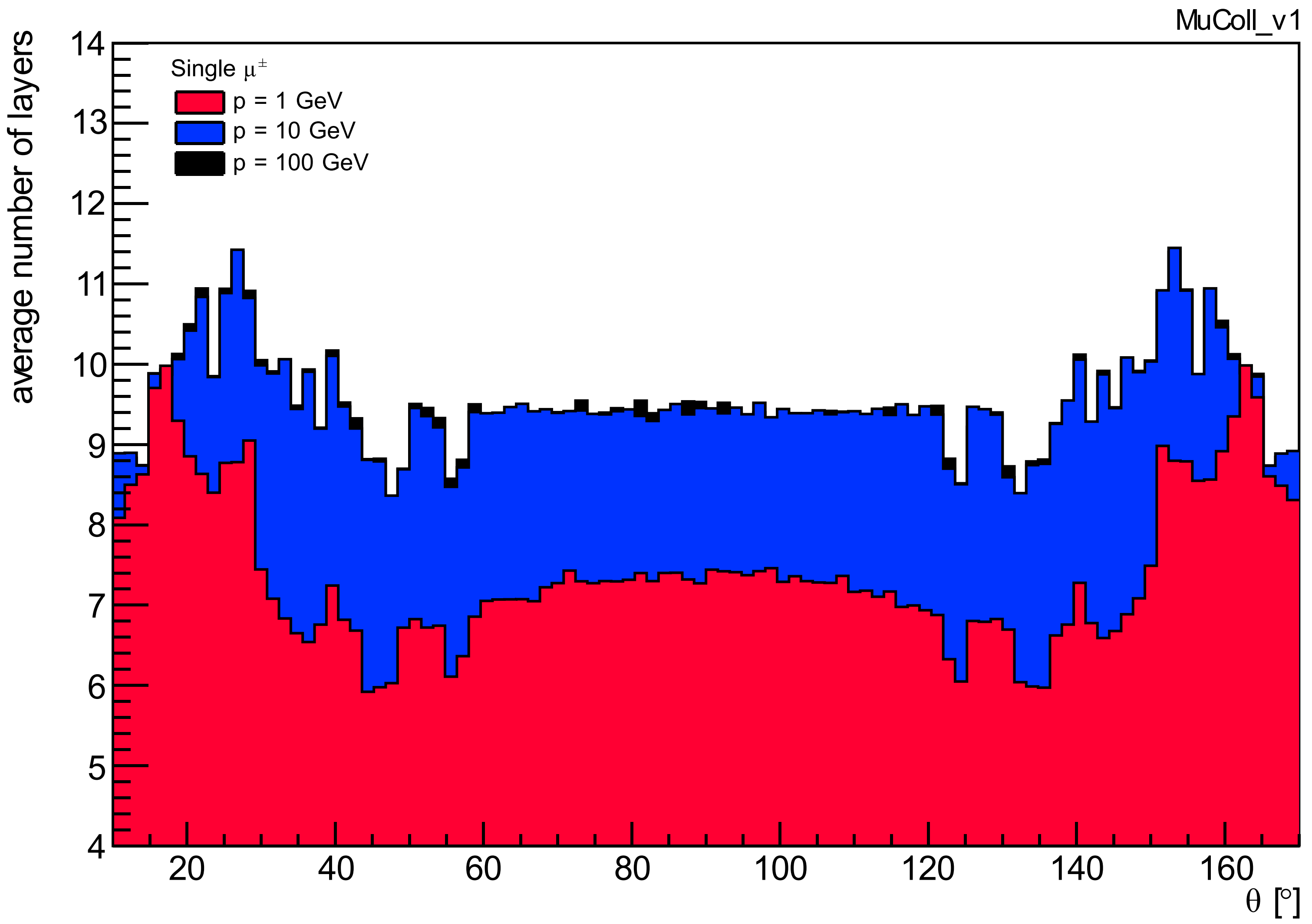


$P_{th} = 75\%$

TRACK QUALITY SELECTION

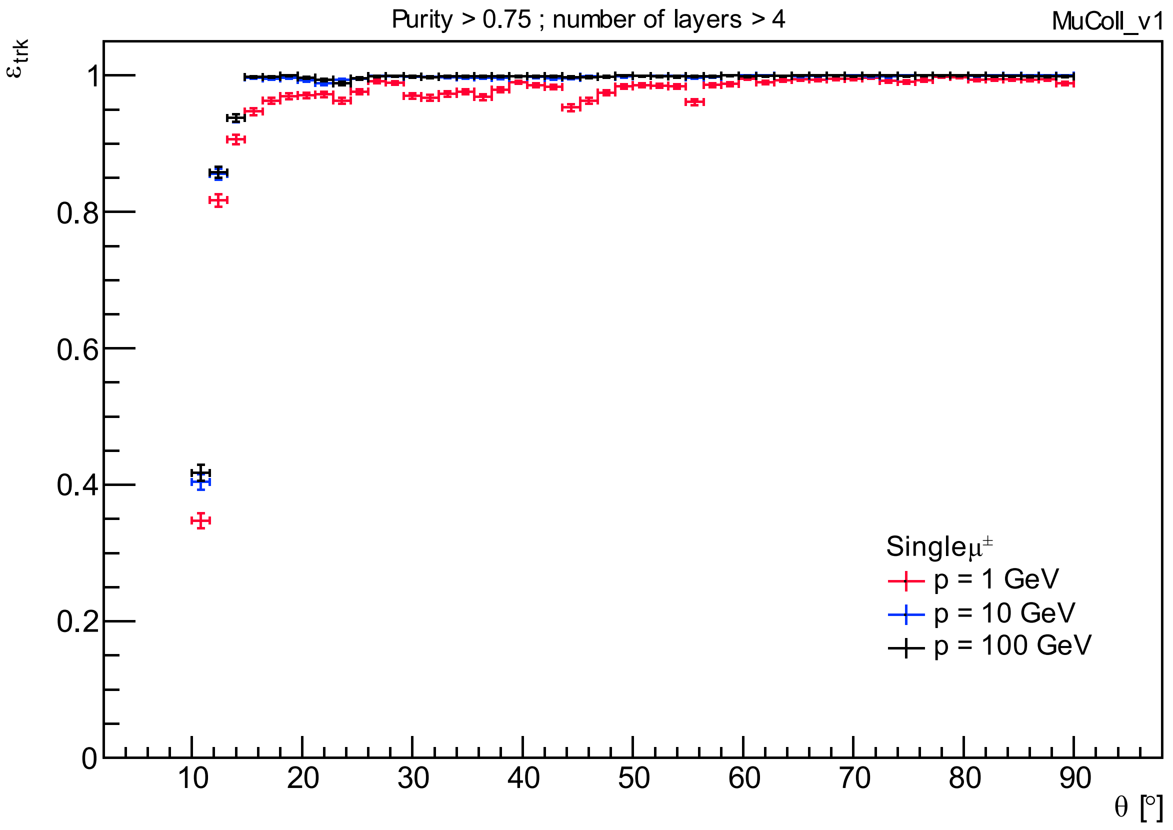
- A track must have at least 4 superlayers with at least one hit

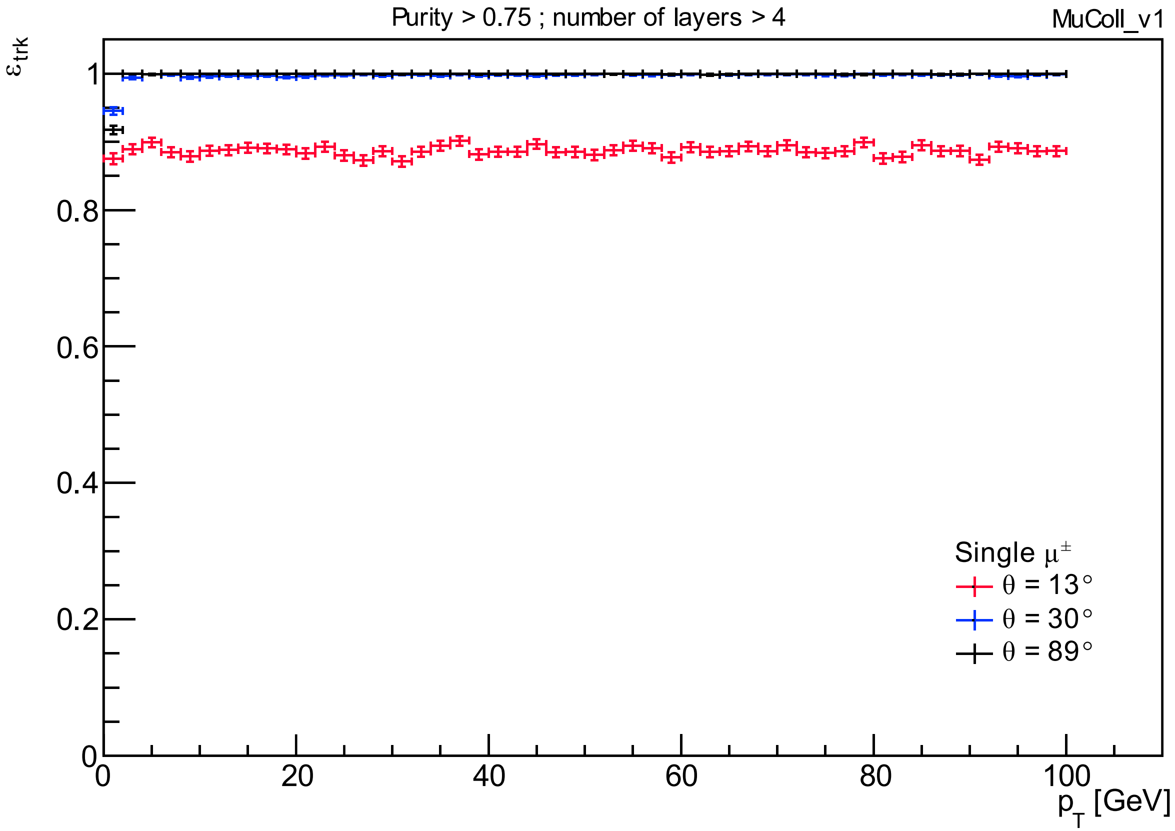
Average number of superlayers



Tracking efficiency as a function of θ and p_T

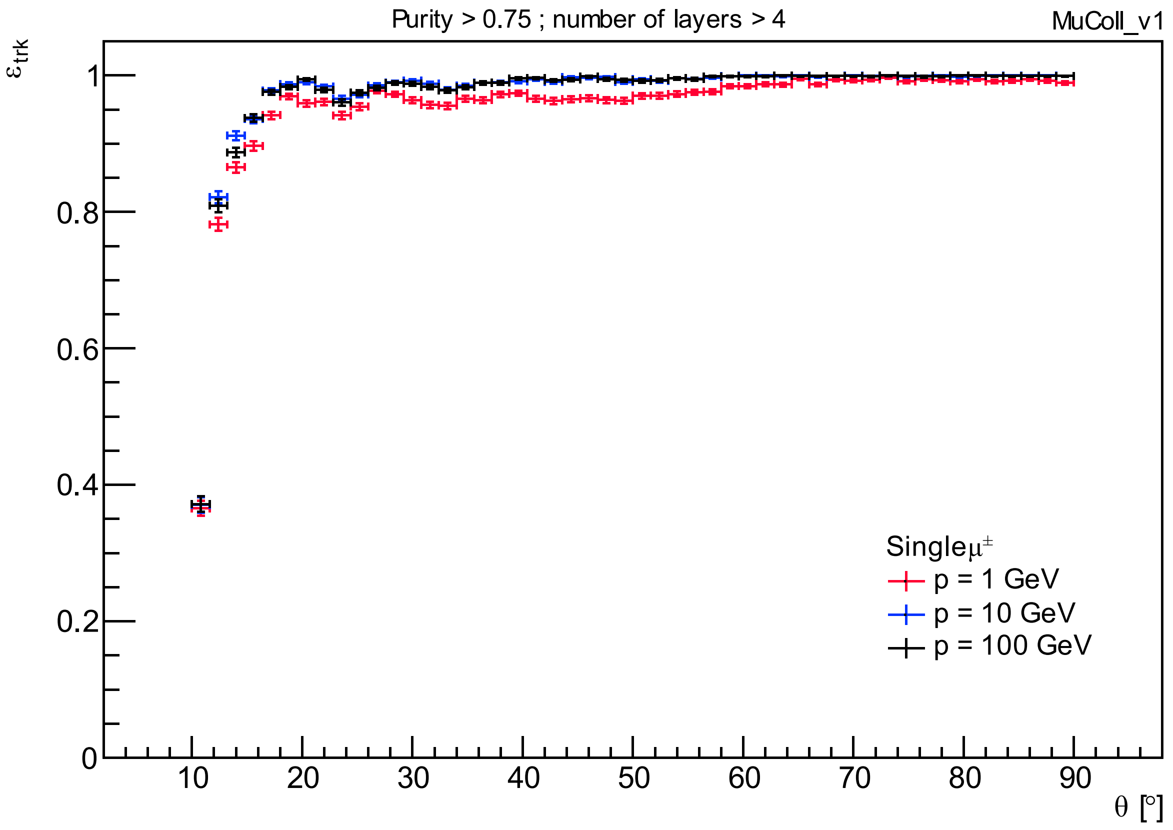
- Muons with vertex at the origin

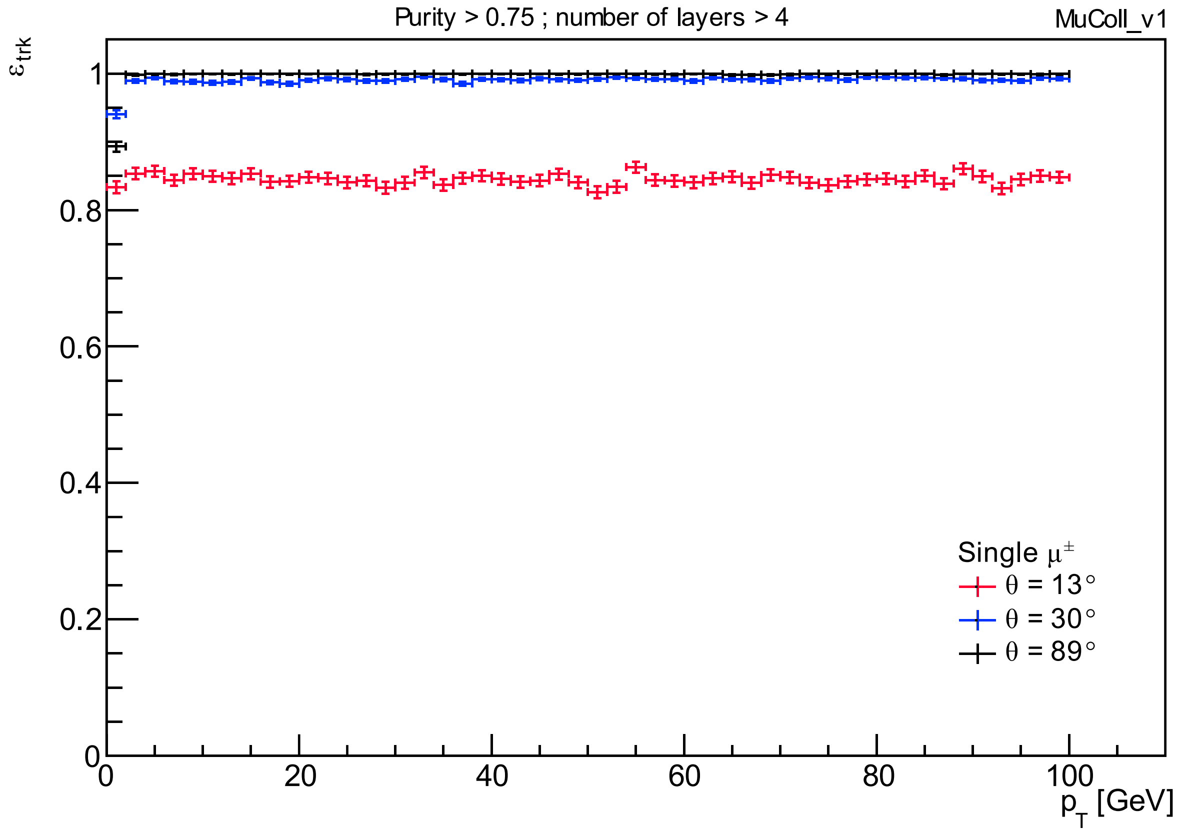




Tracking efficiency as a function of θ and p_T

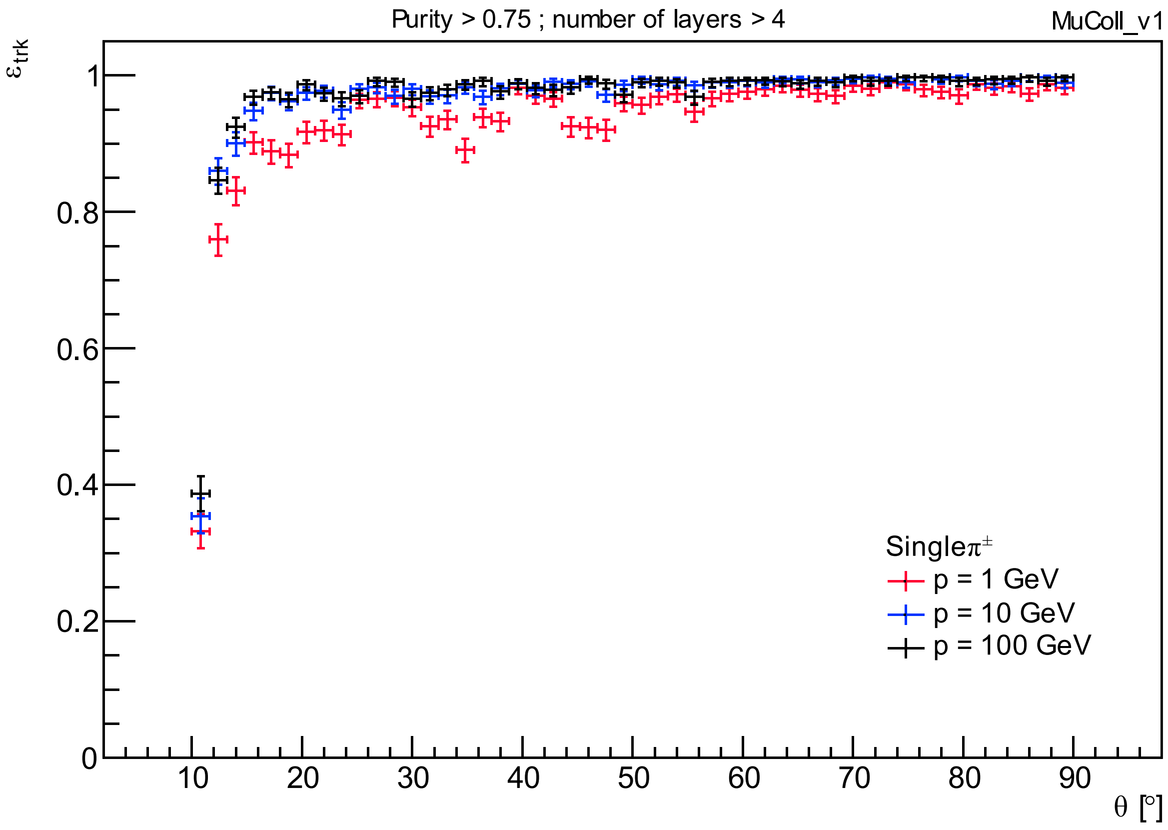
- Muons with realistic beamspot

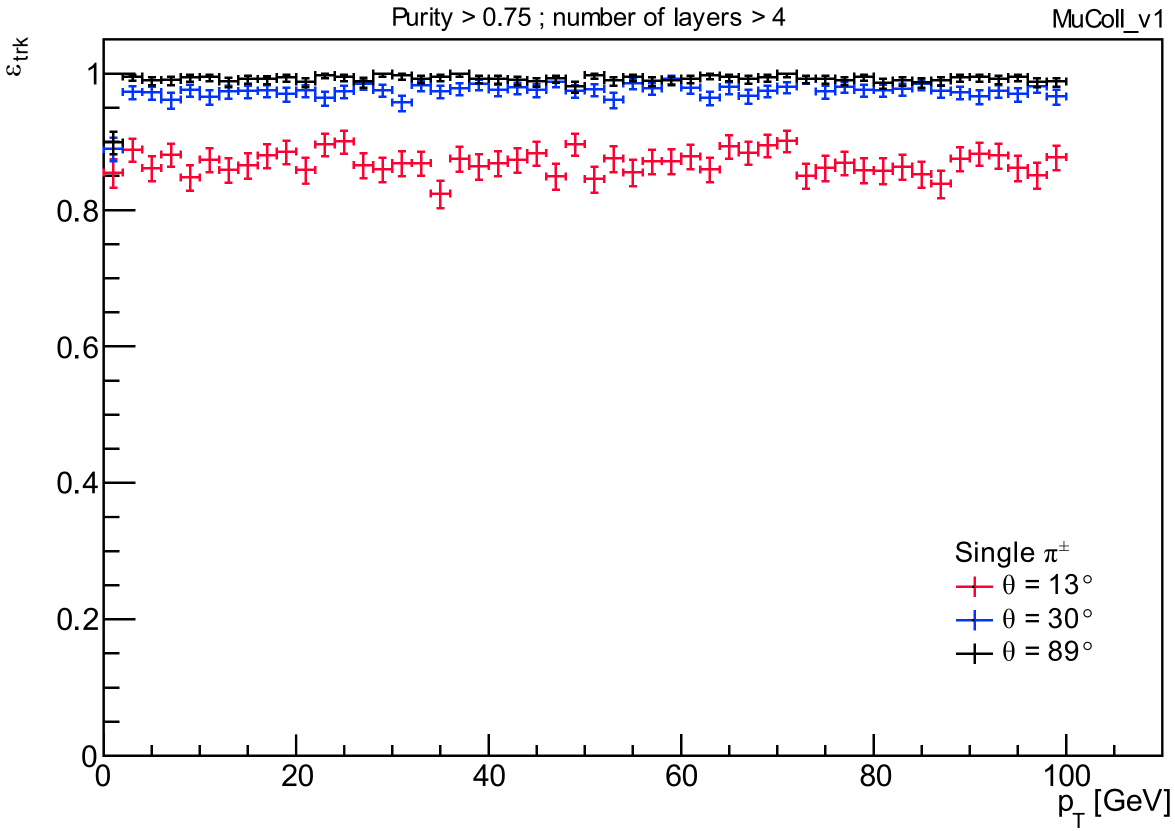




Tracking efficiency as a function of θ and p_T

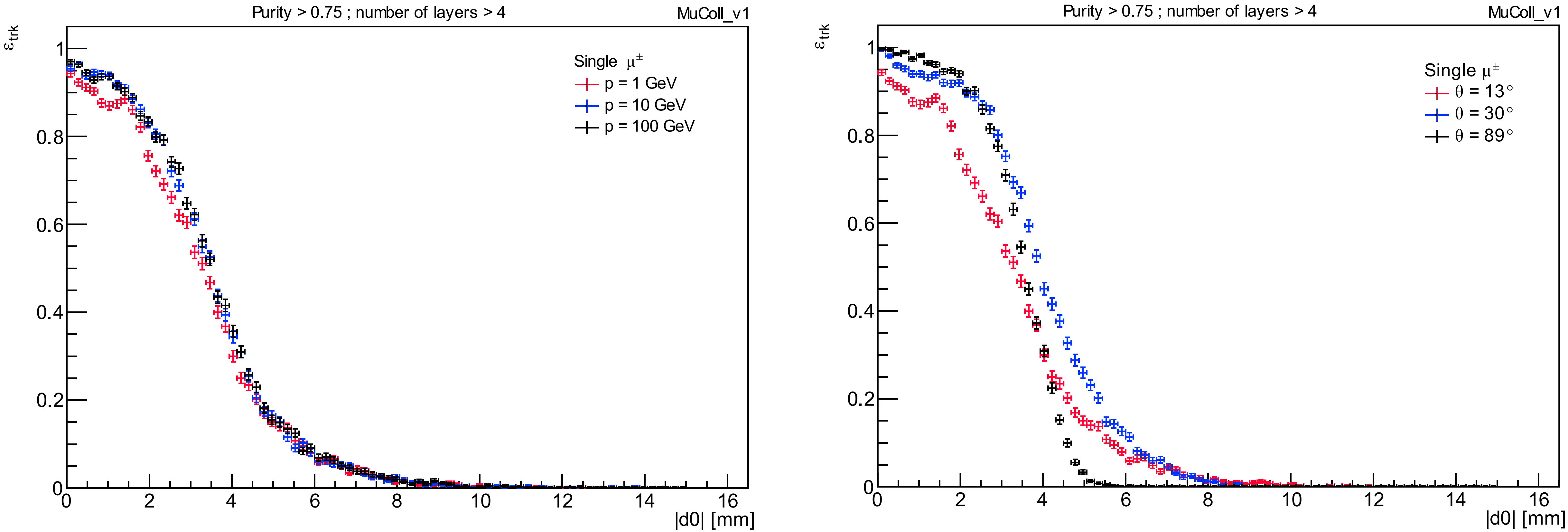
- Pions with vertex at the origin





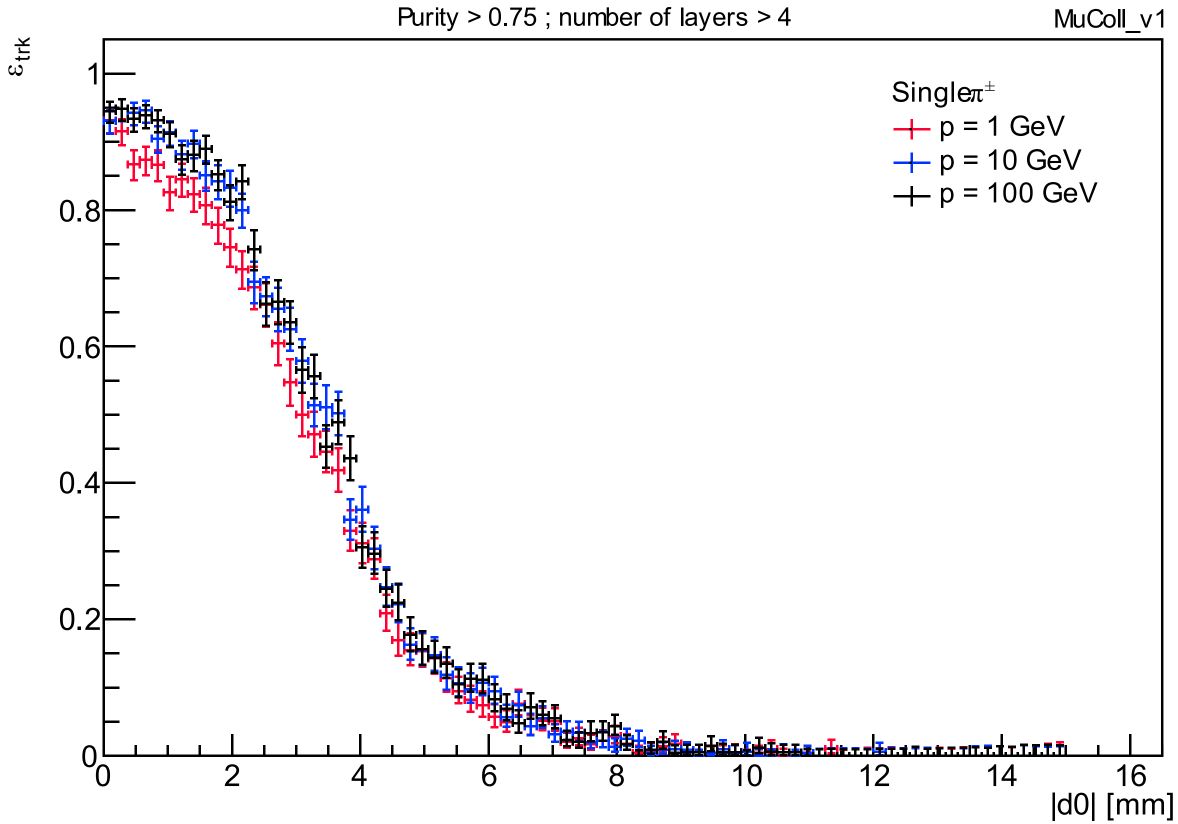
Tracking efficiency as a function of d_0

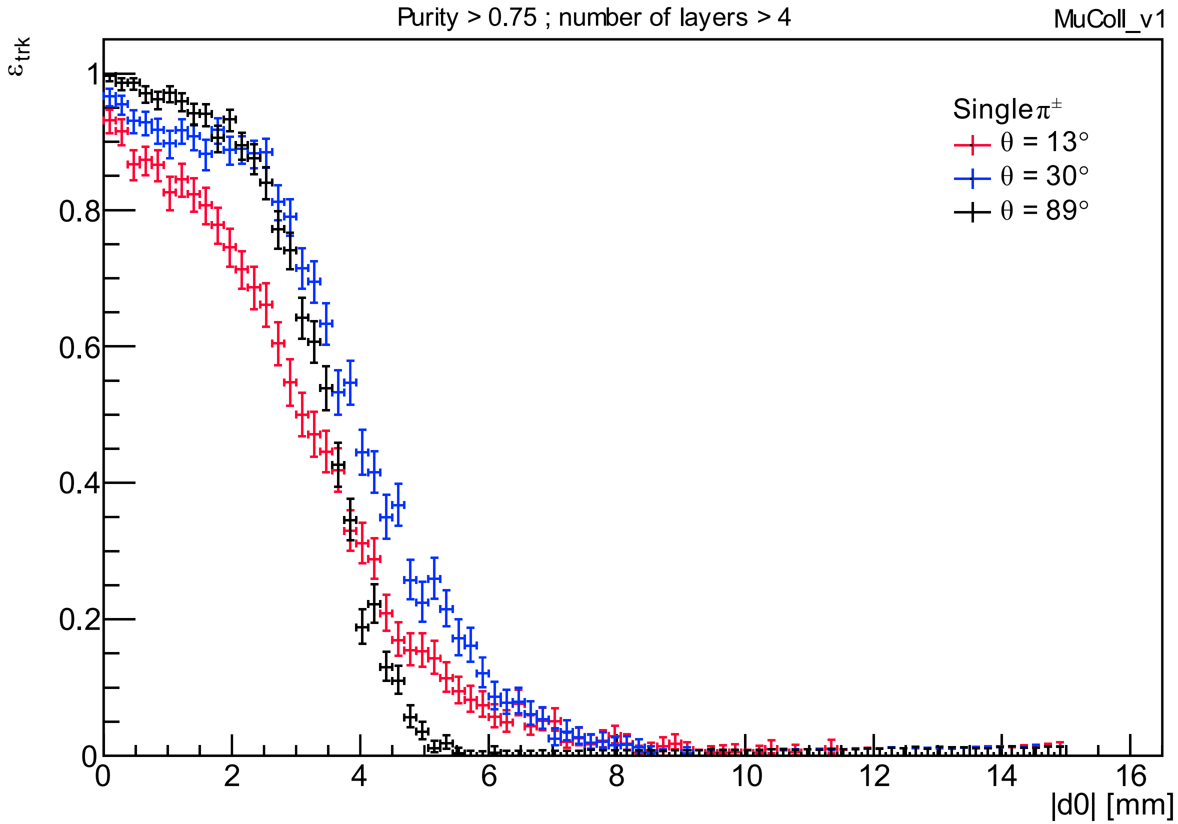
- Muons with displaced vertex



Tracking efficiency as a function of d_0

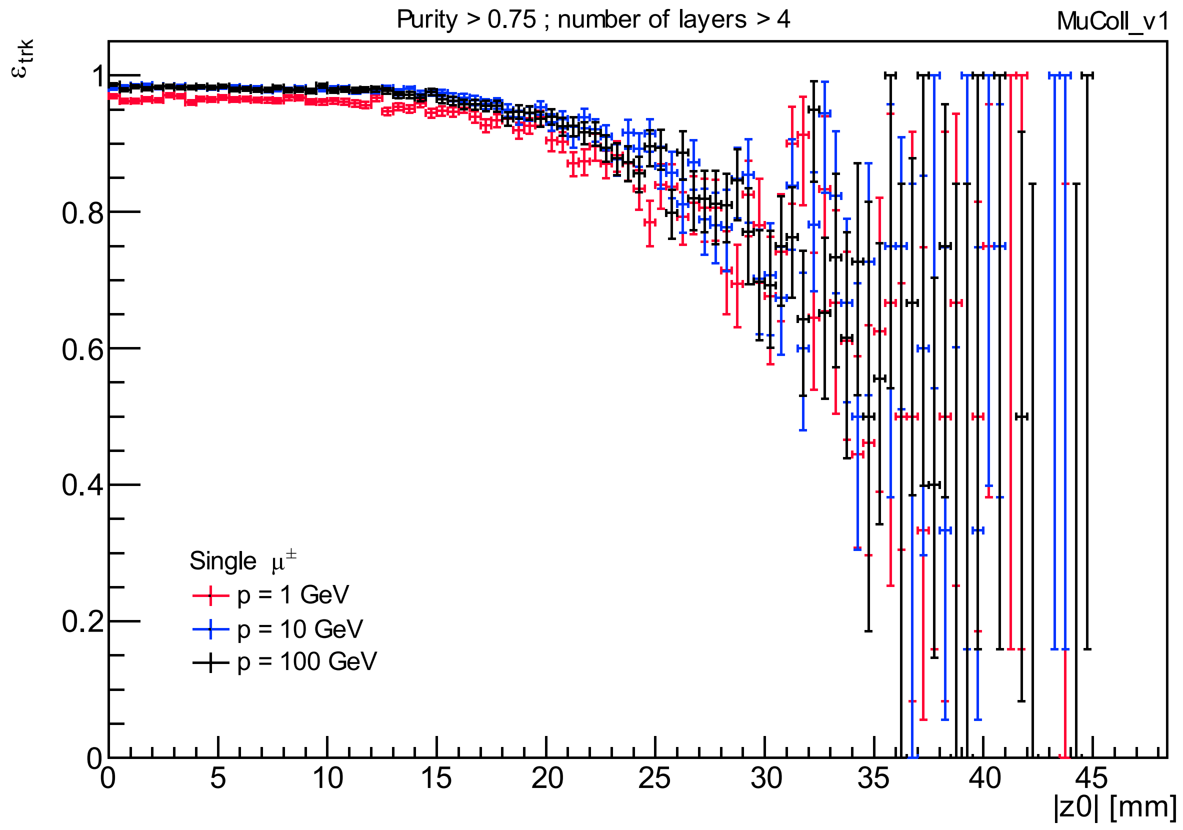
- Pions with displaced vertex

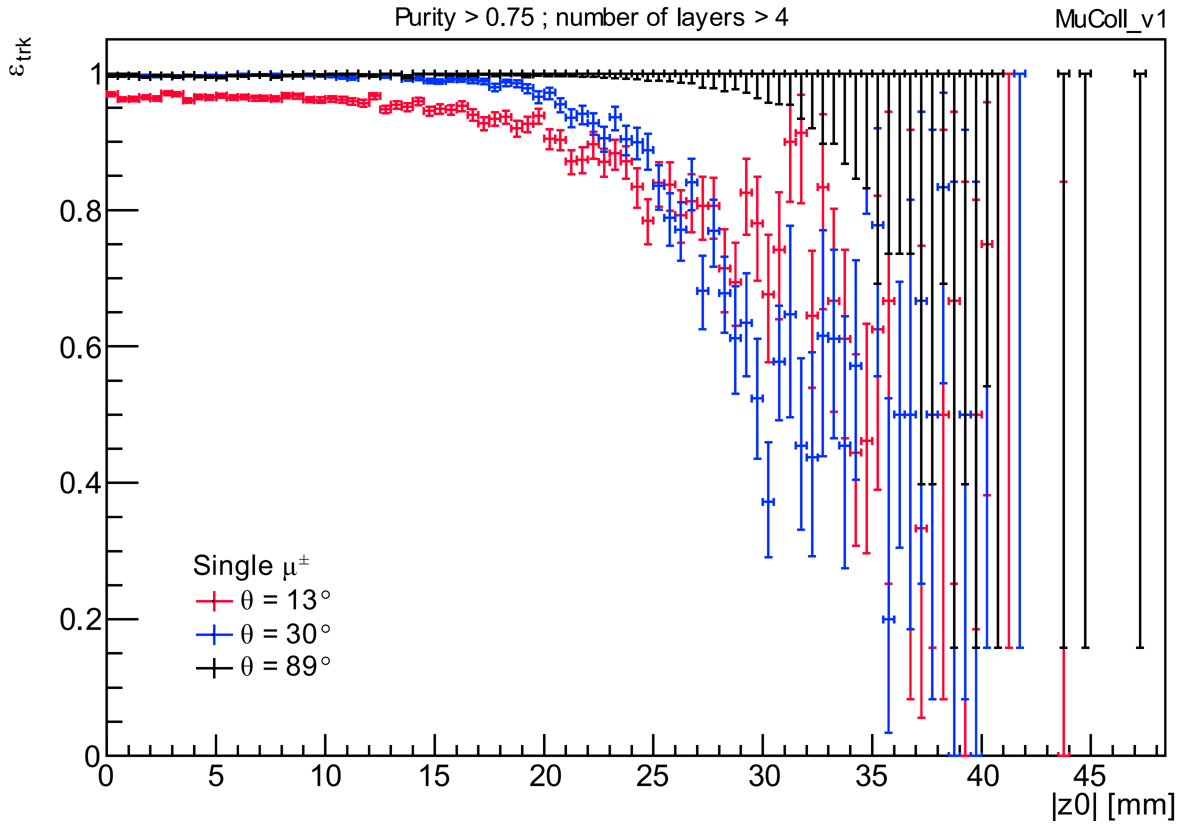




Tracking efficiency as a function of z_0

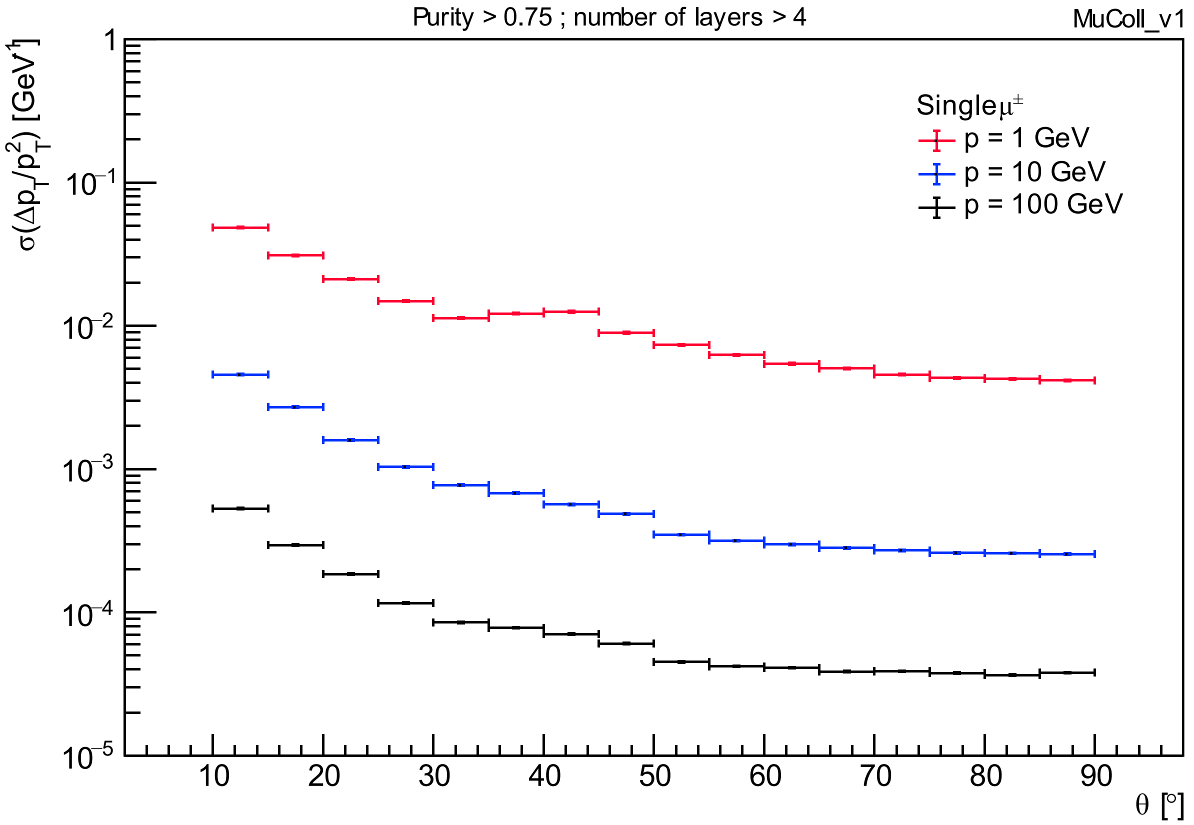
- Muons with realistic beamspot



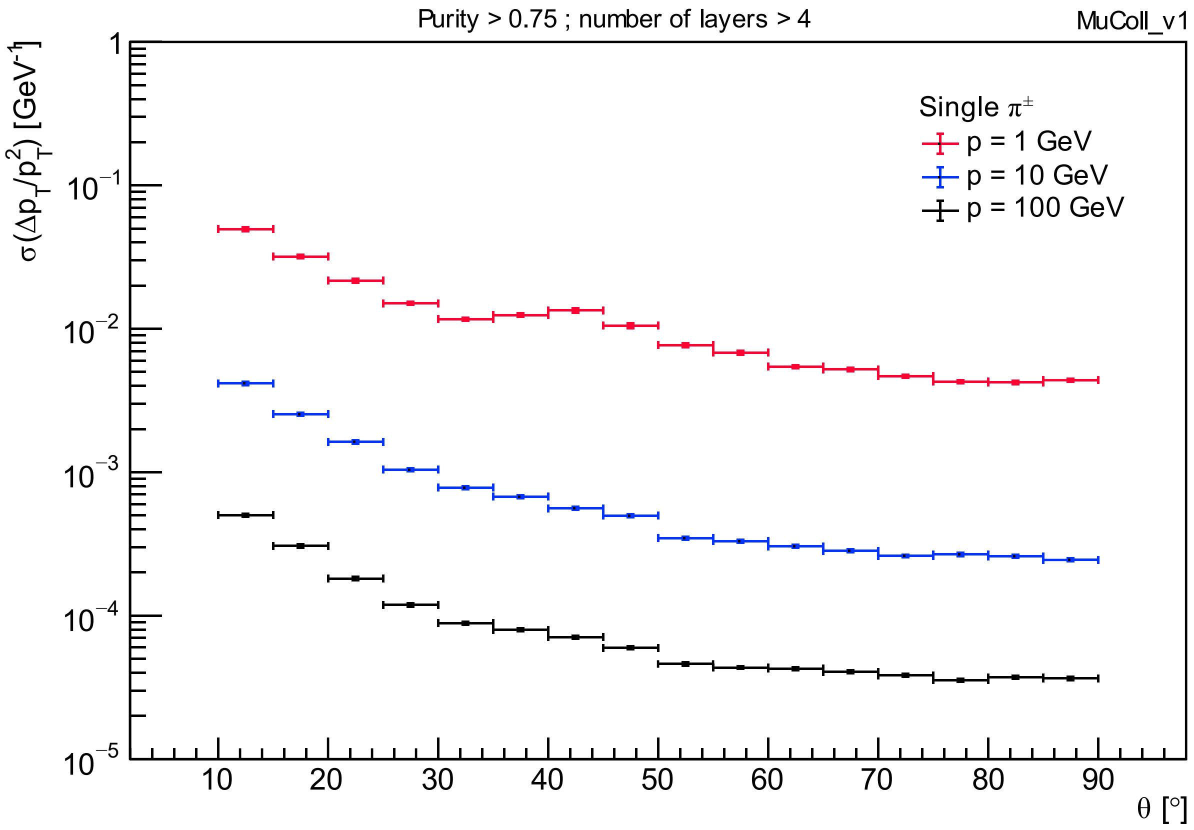


Resolution in p_T as a function of θ

- Single muons

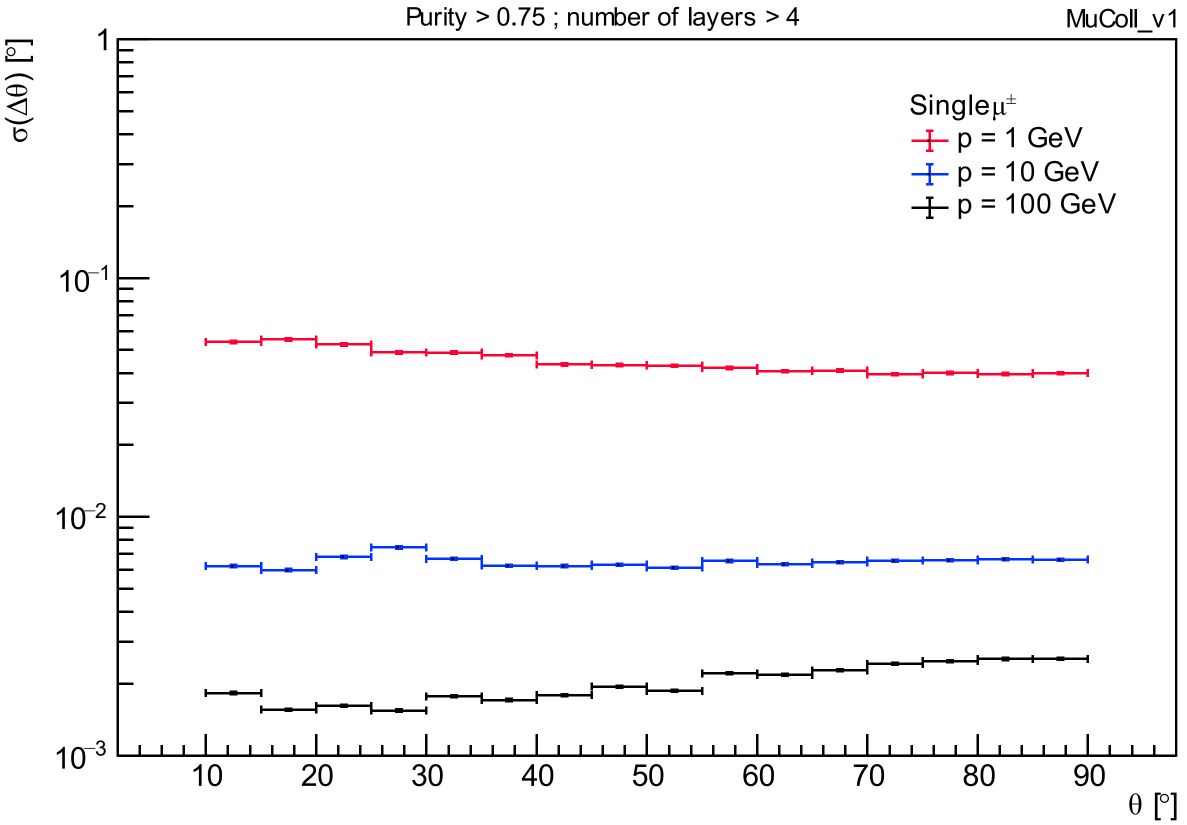


- Single pions

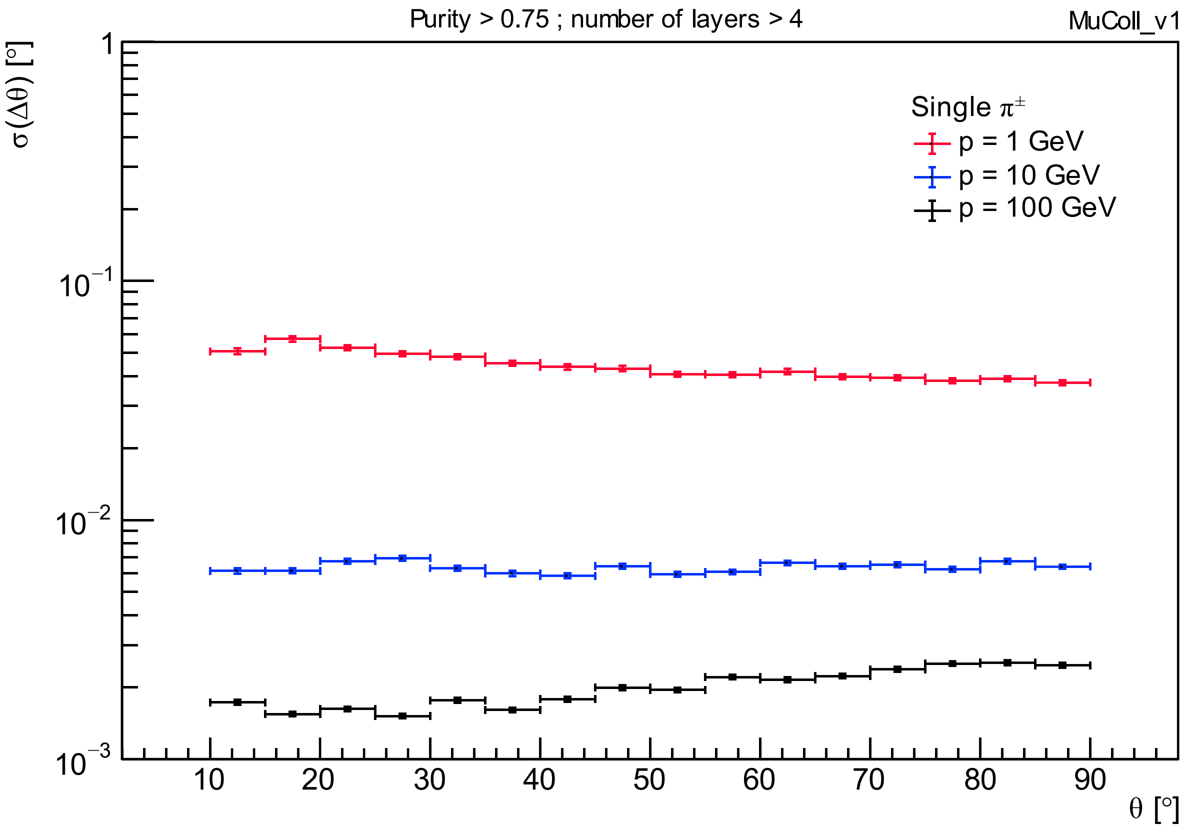


Resolution in θ as a function of θ

- Single muons

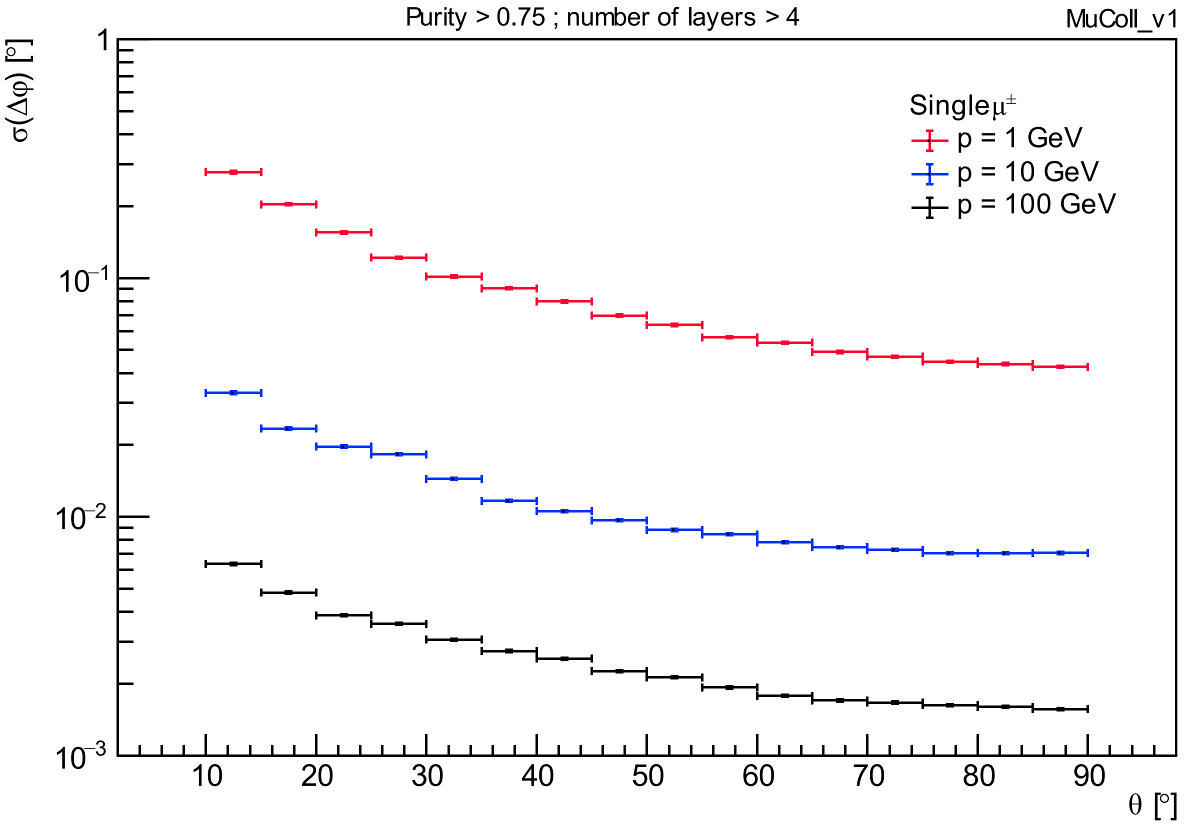


- Single pions

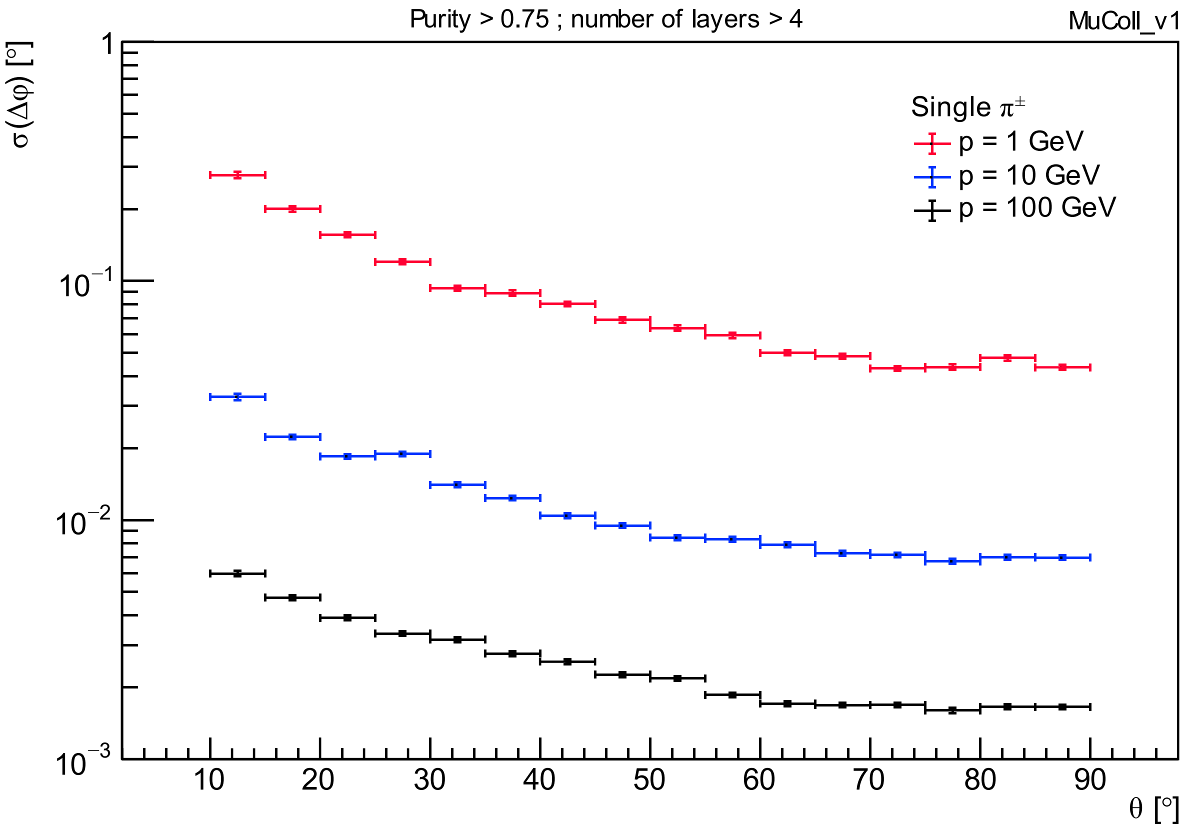


Resolution in ϕ as a function of θ

- Single muons

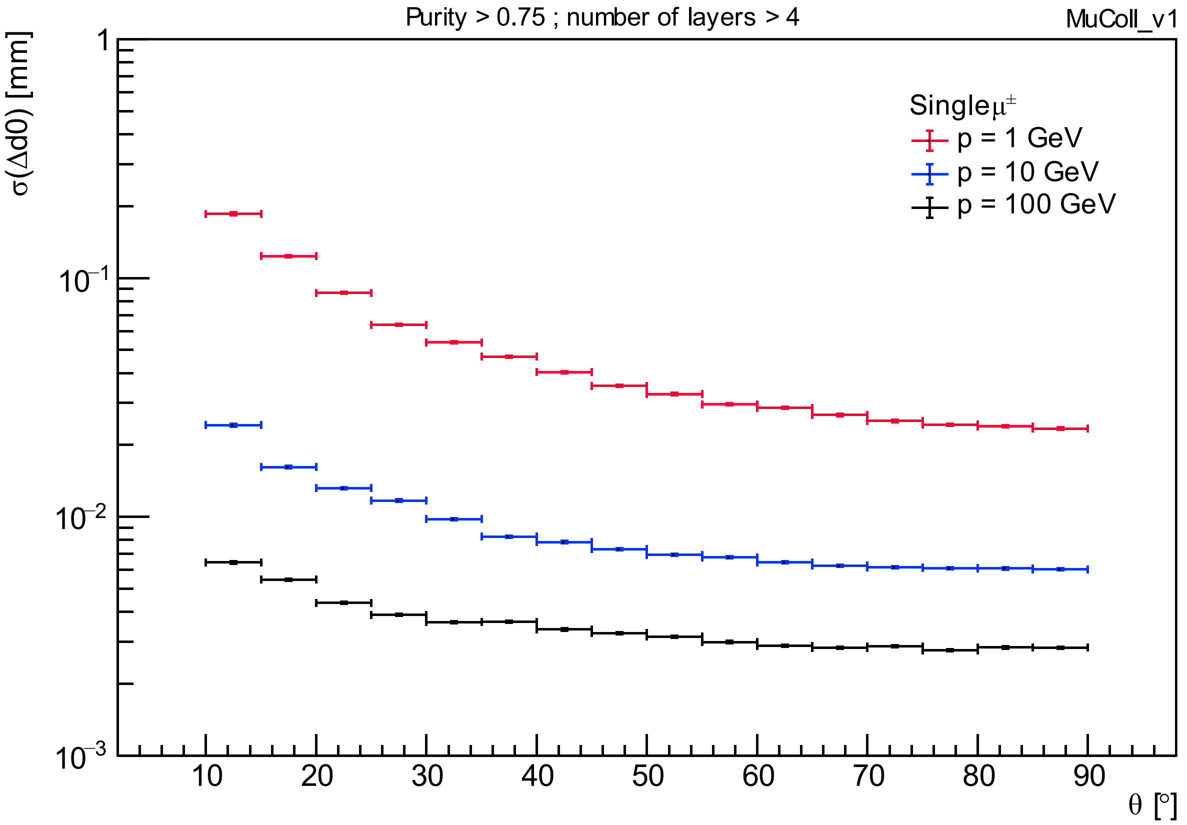


- Single pions

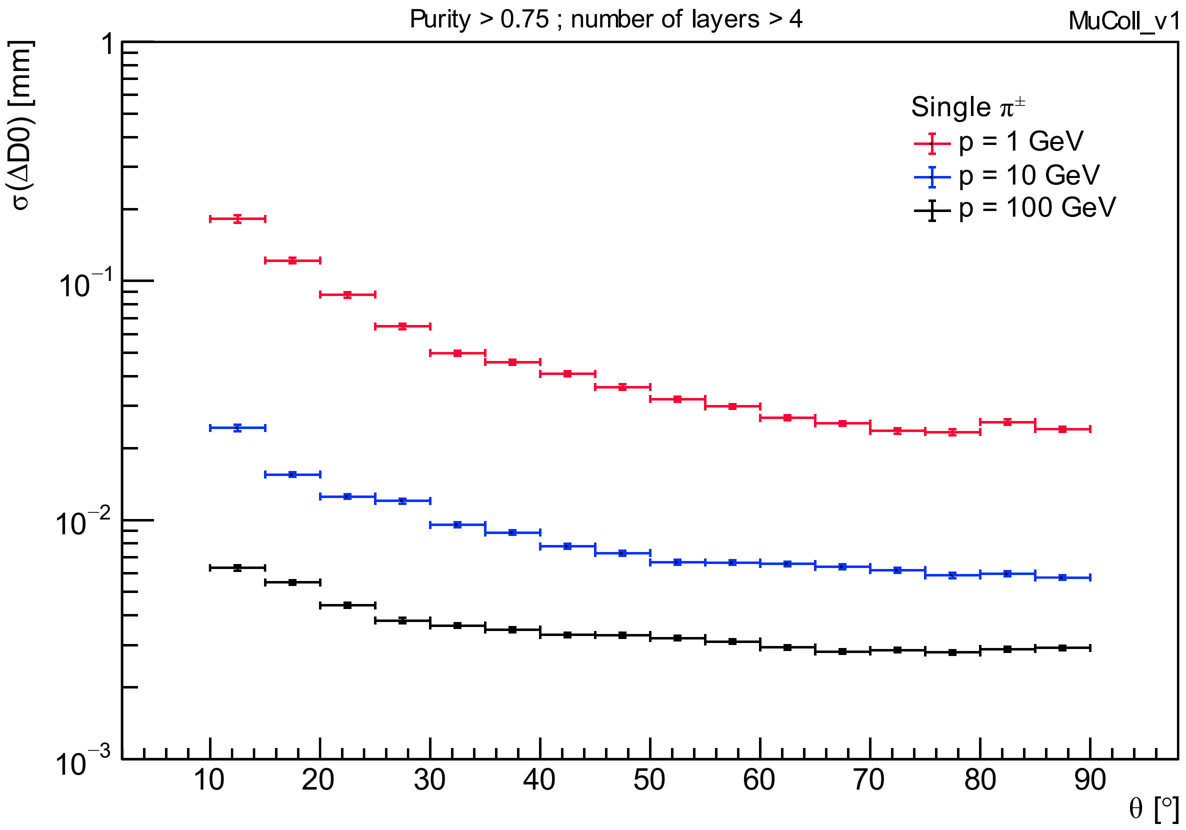


Resolution in d_0 as a function of θ

- Single muons

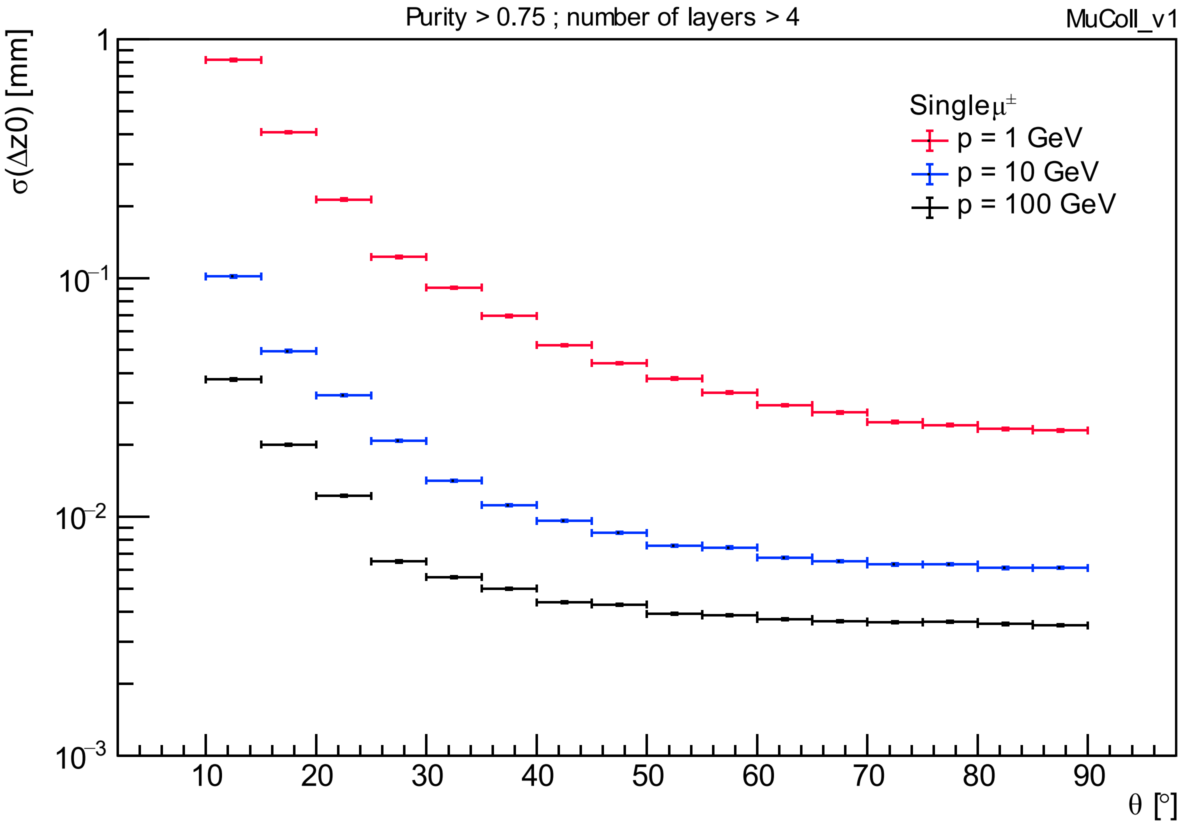


- Single pions

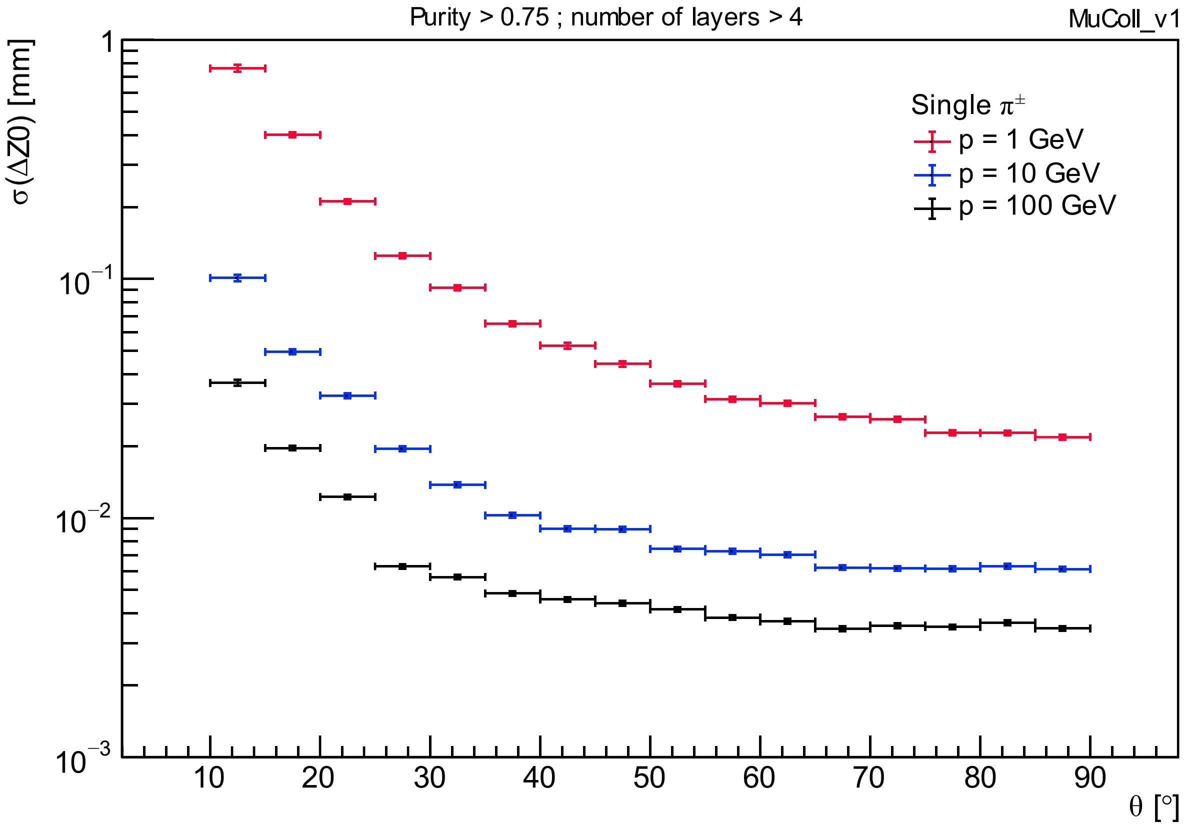


Resolution in z_0 as a function of θ

- Single muons

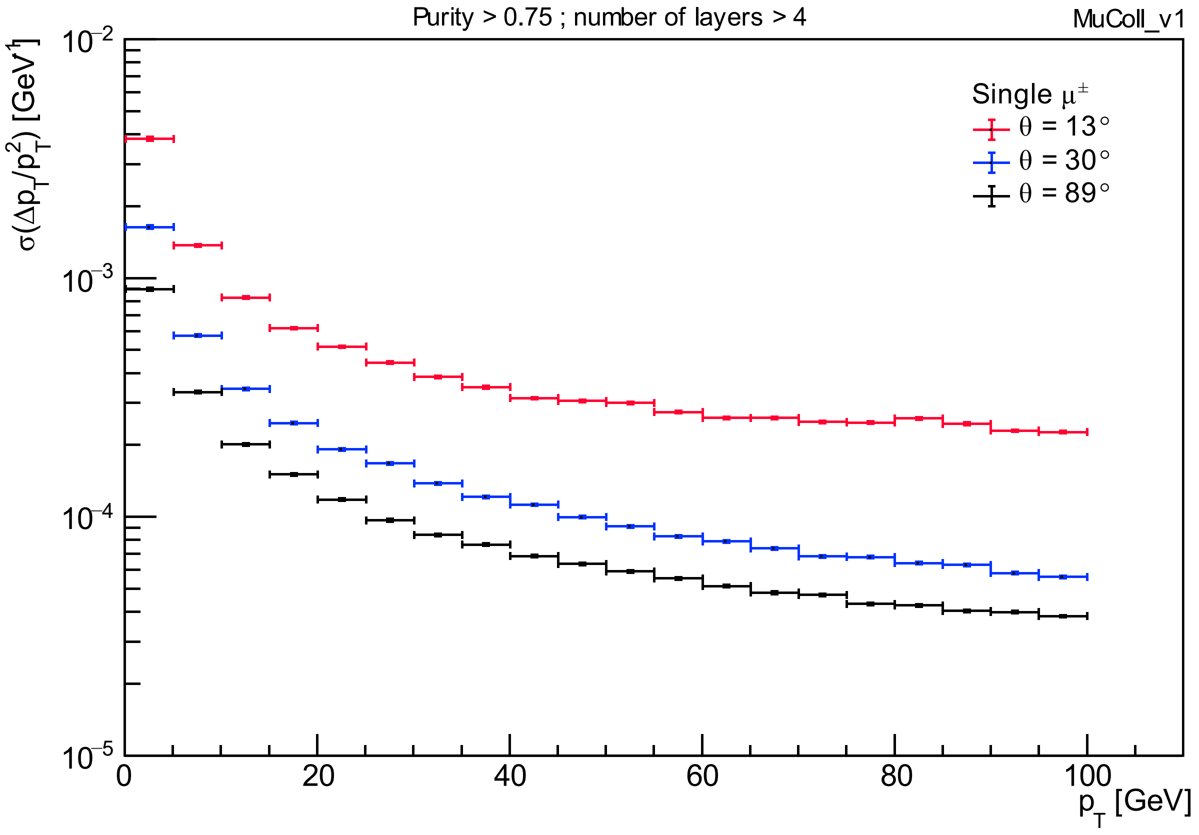


- Single pions

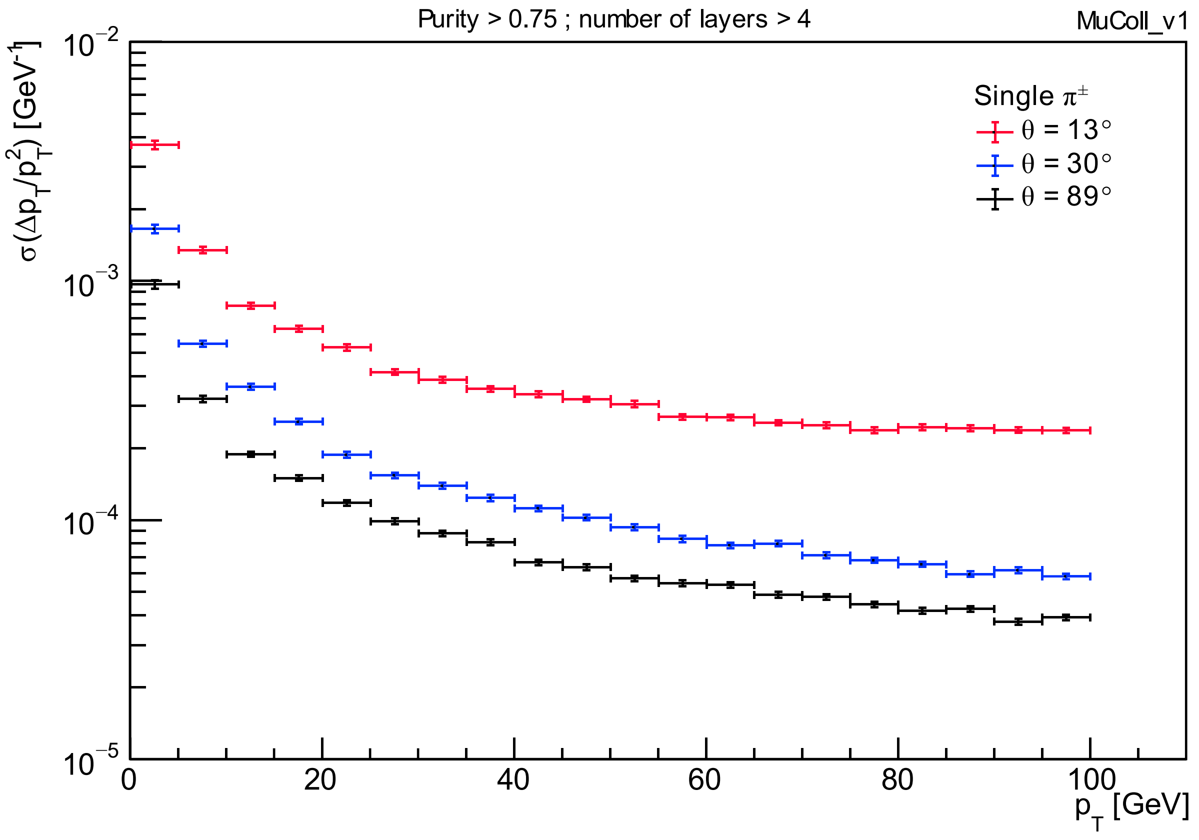


Resolution in p_T as a function of p_T

- Single muons

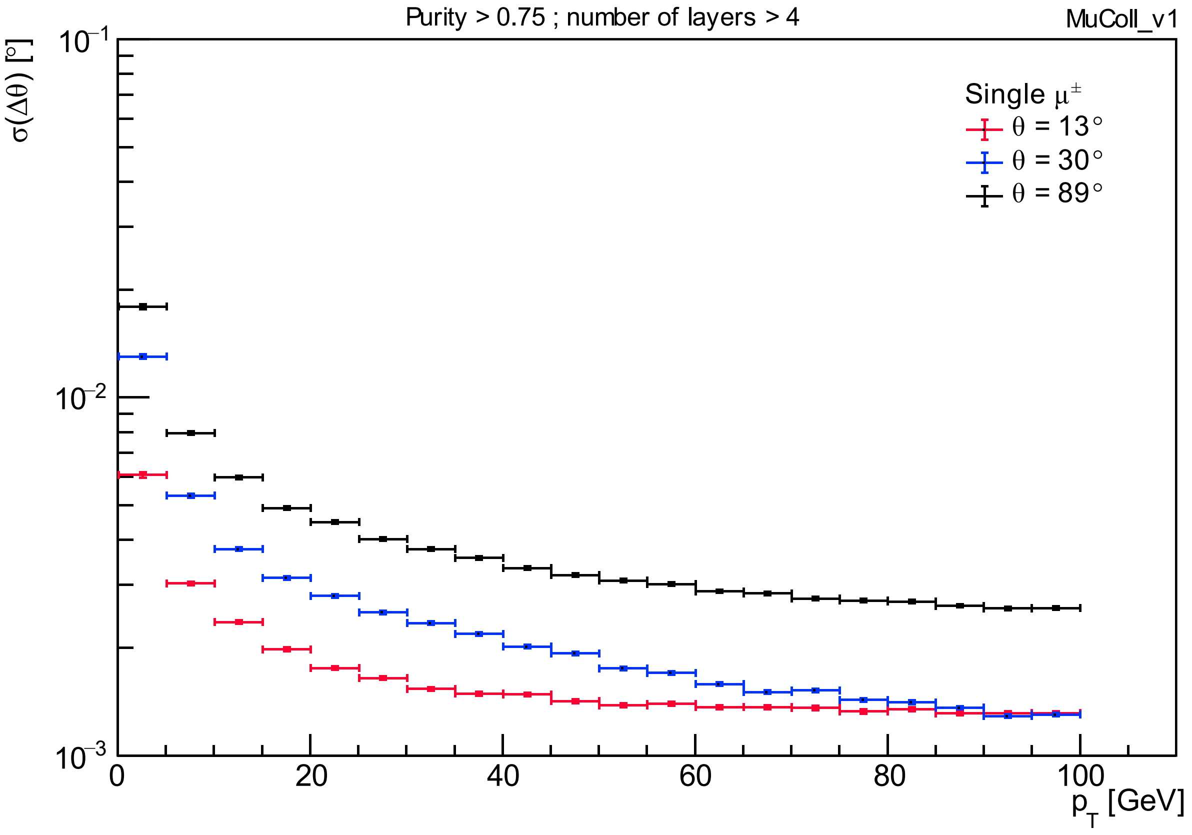


- Single pions

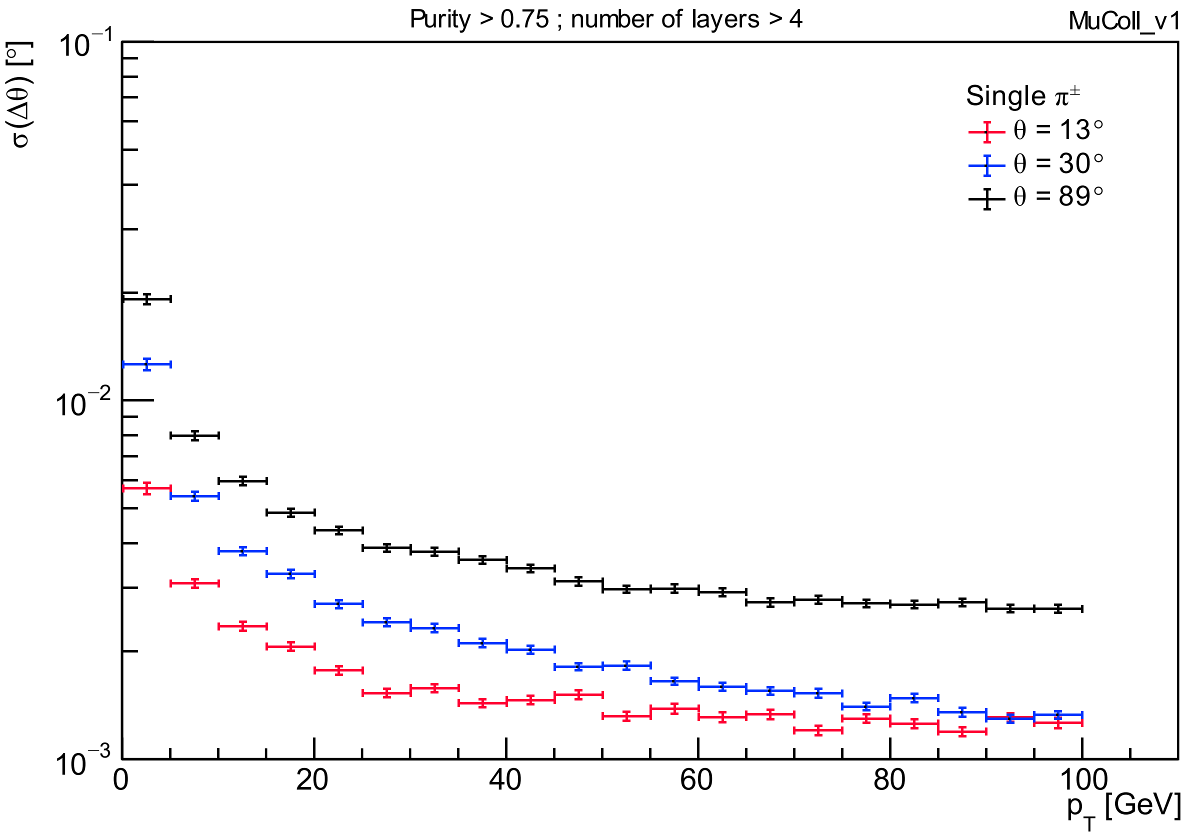


Resolution in θ as a function of p_T

- Single muons

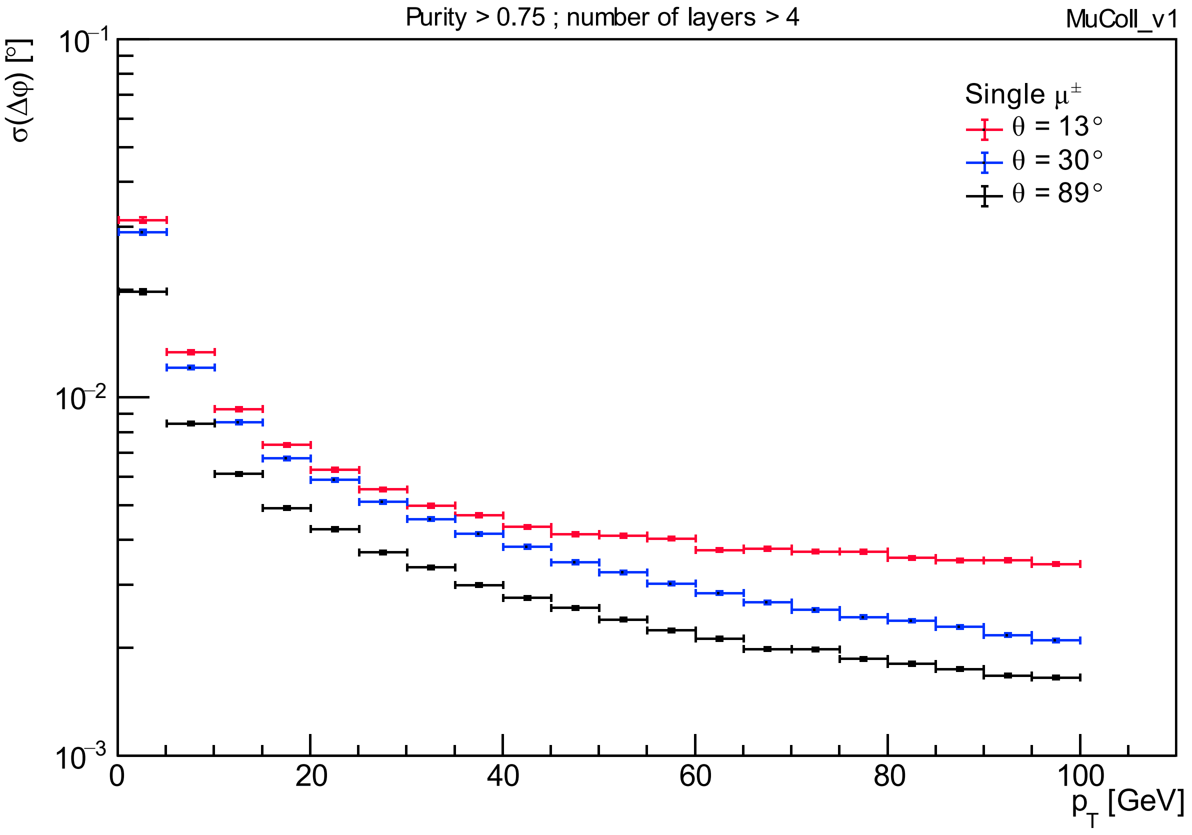


- Single pions

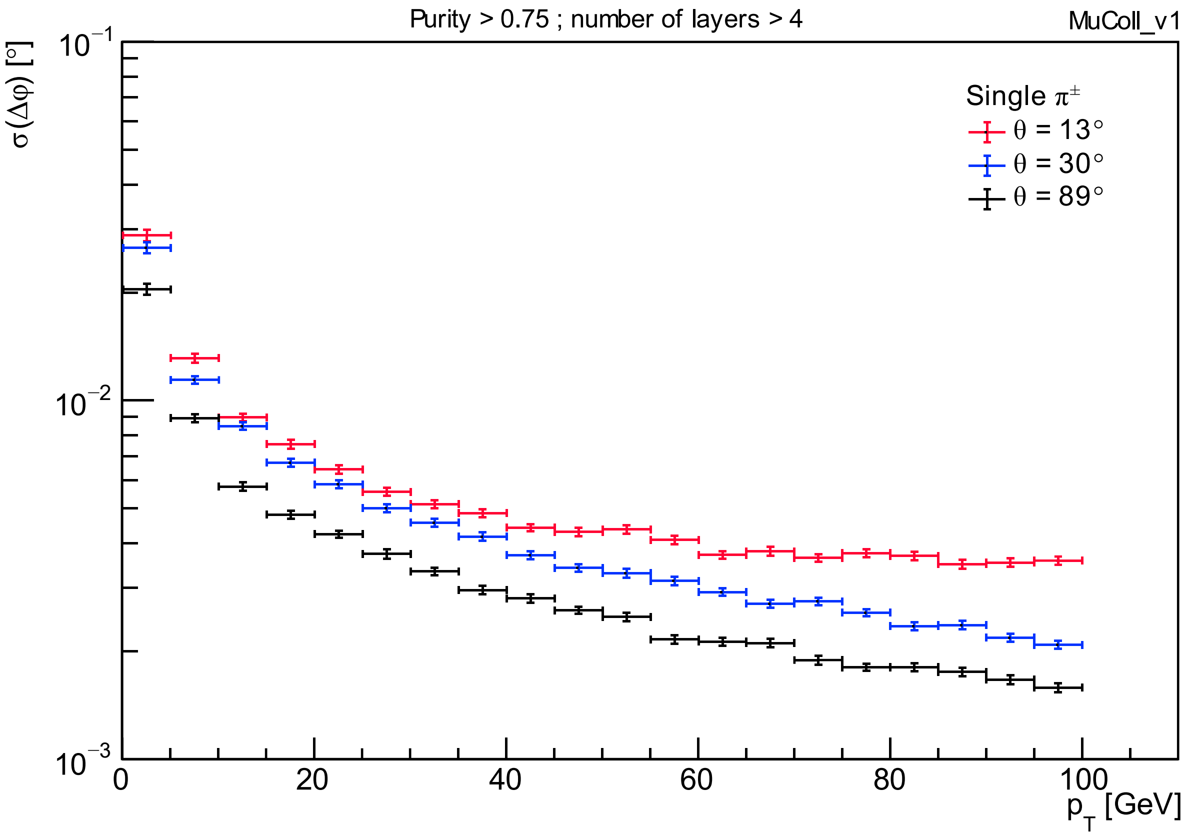


Resolution in ϕ as a function of p_T

- Single muons

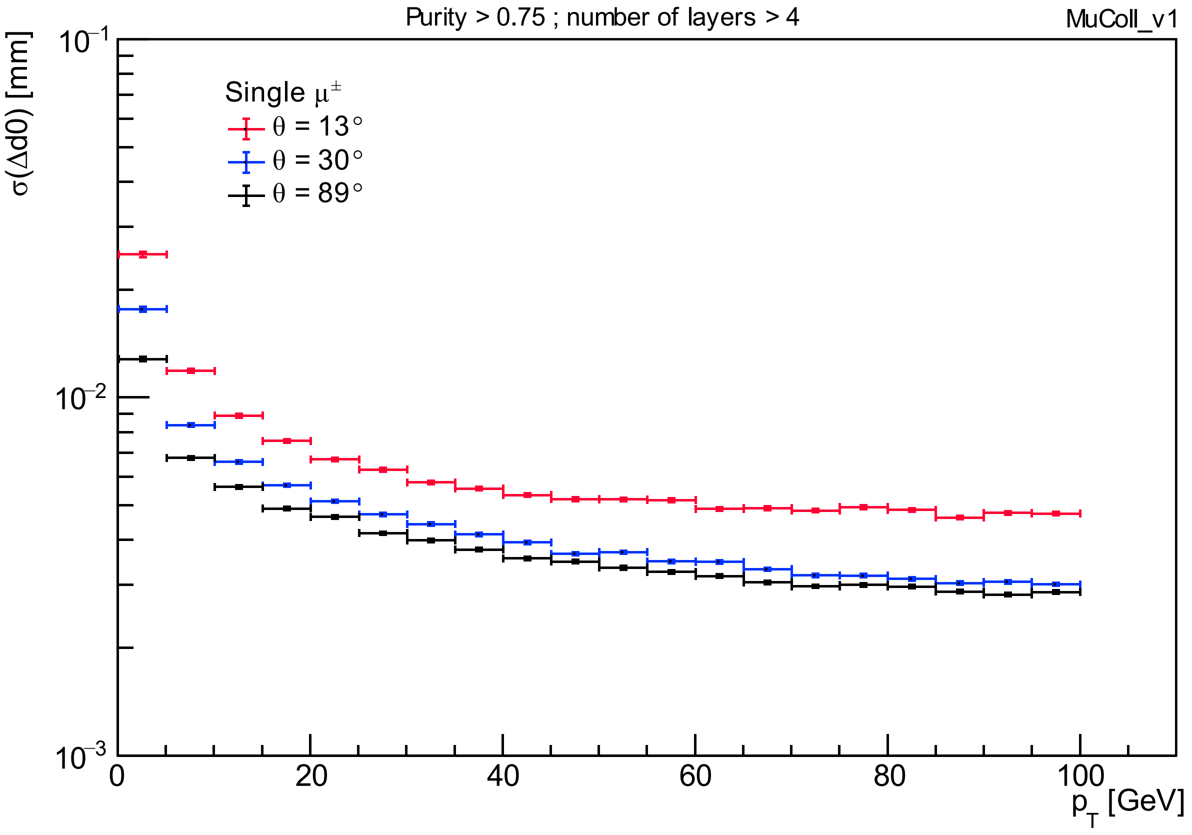


- Single pions

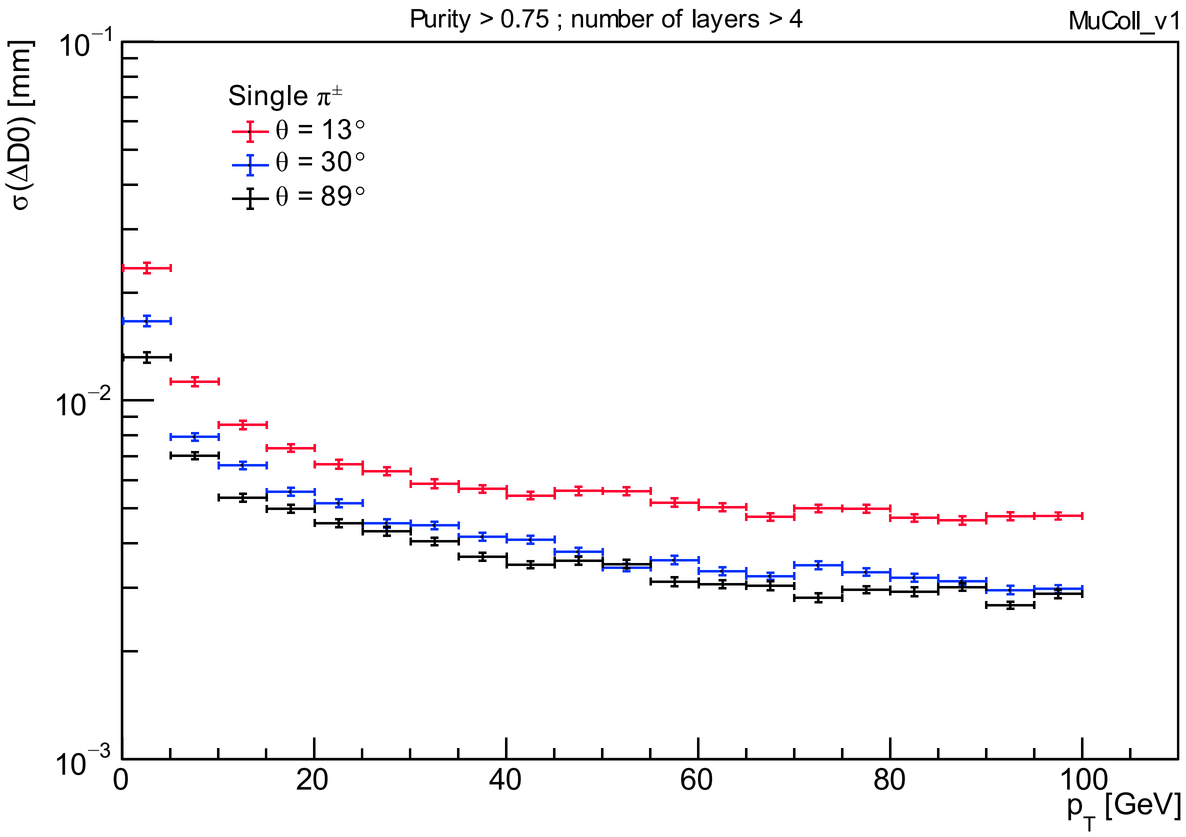


Resolution in d_0 as a function of p_T

- Single muons

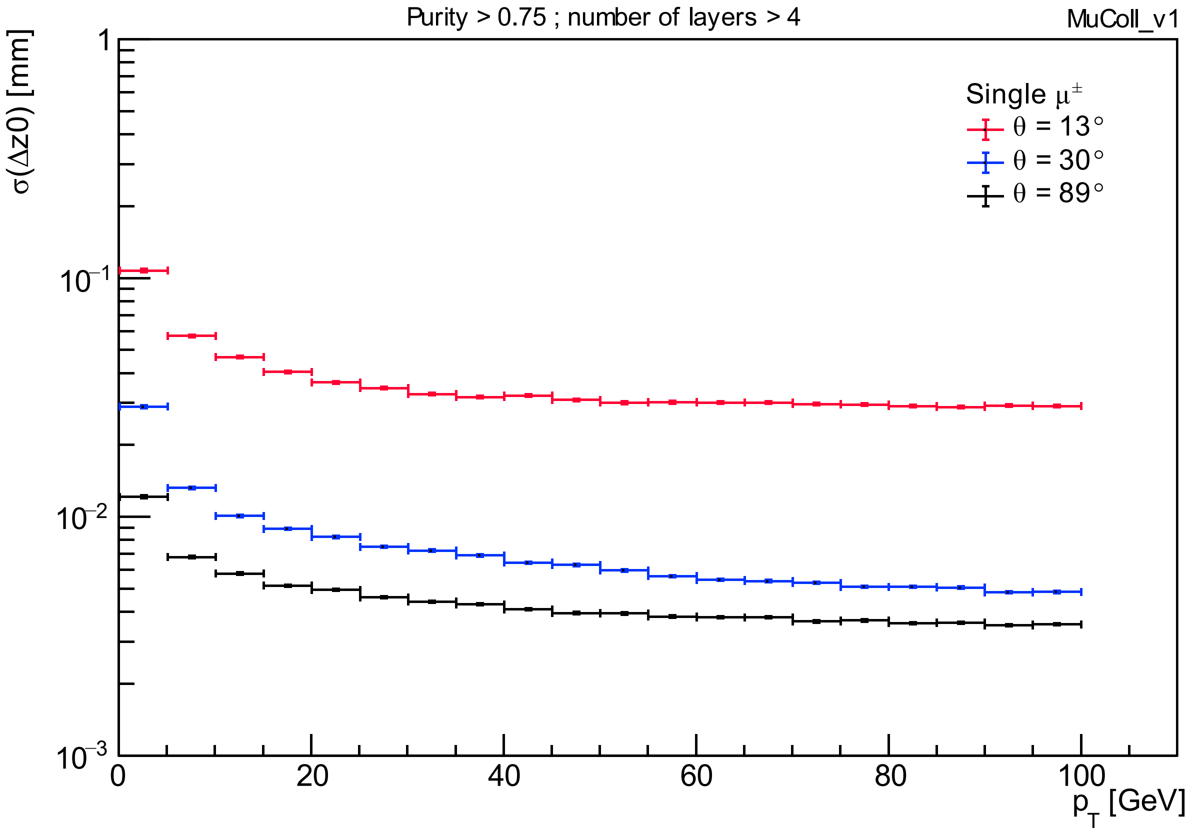


- Single pions

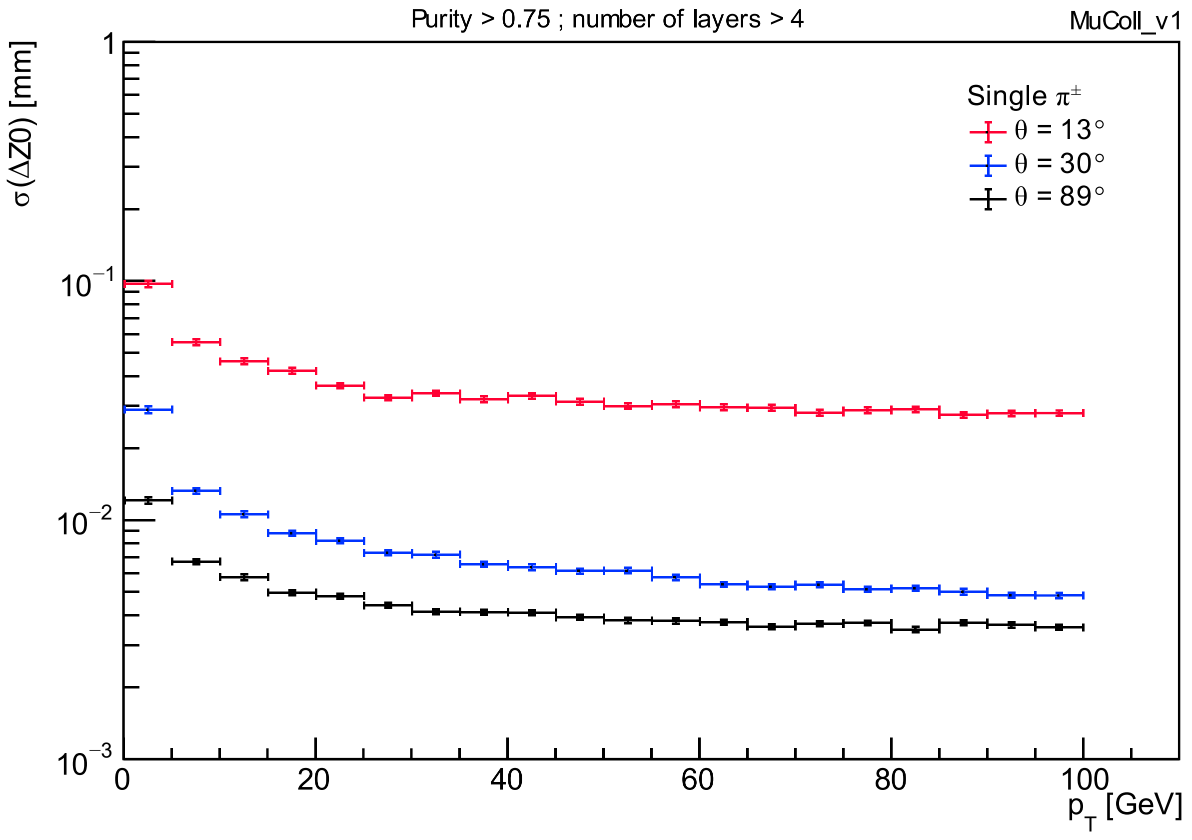


Resolution in z_0 as a function of p_T

- Single muons

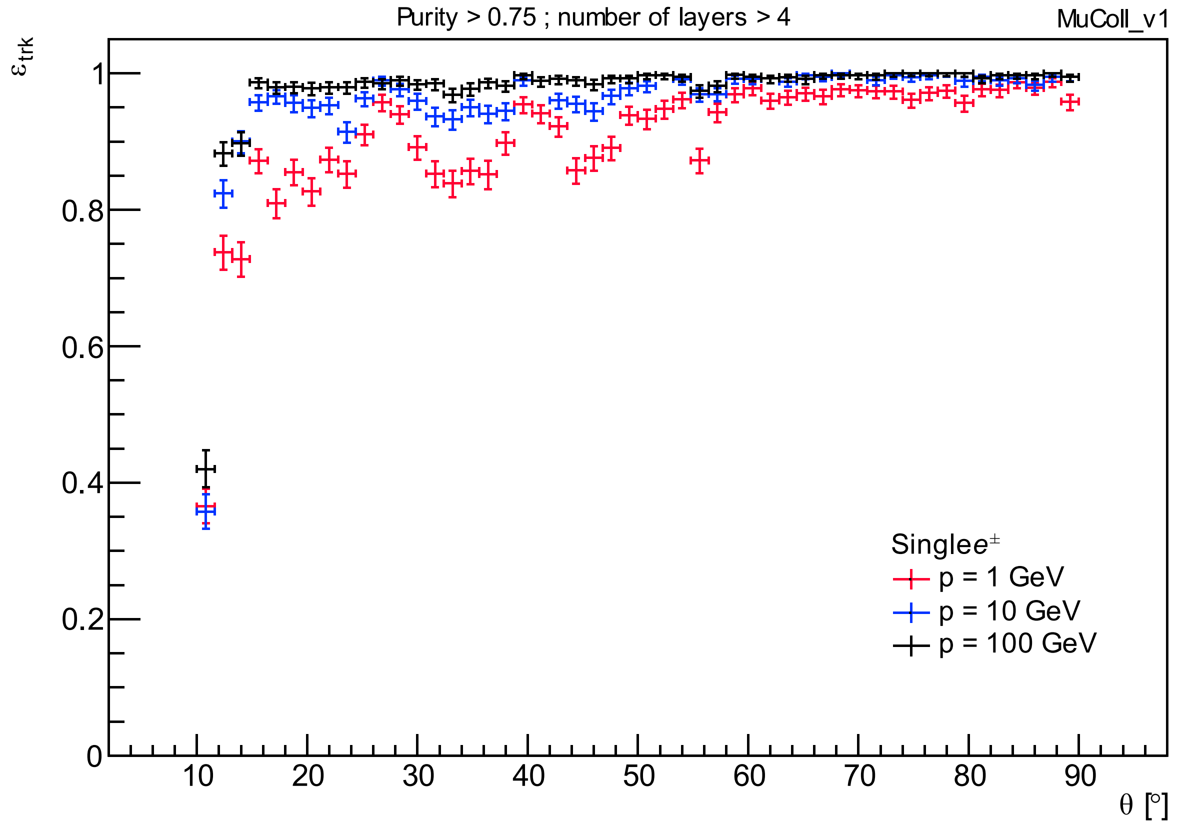


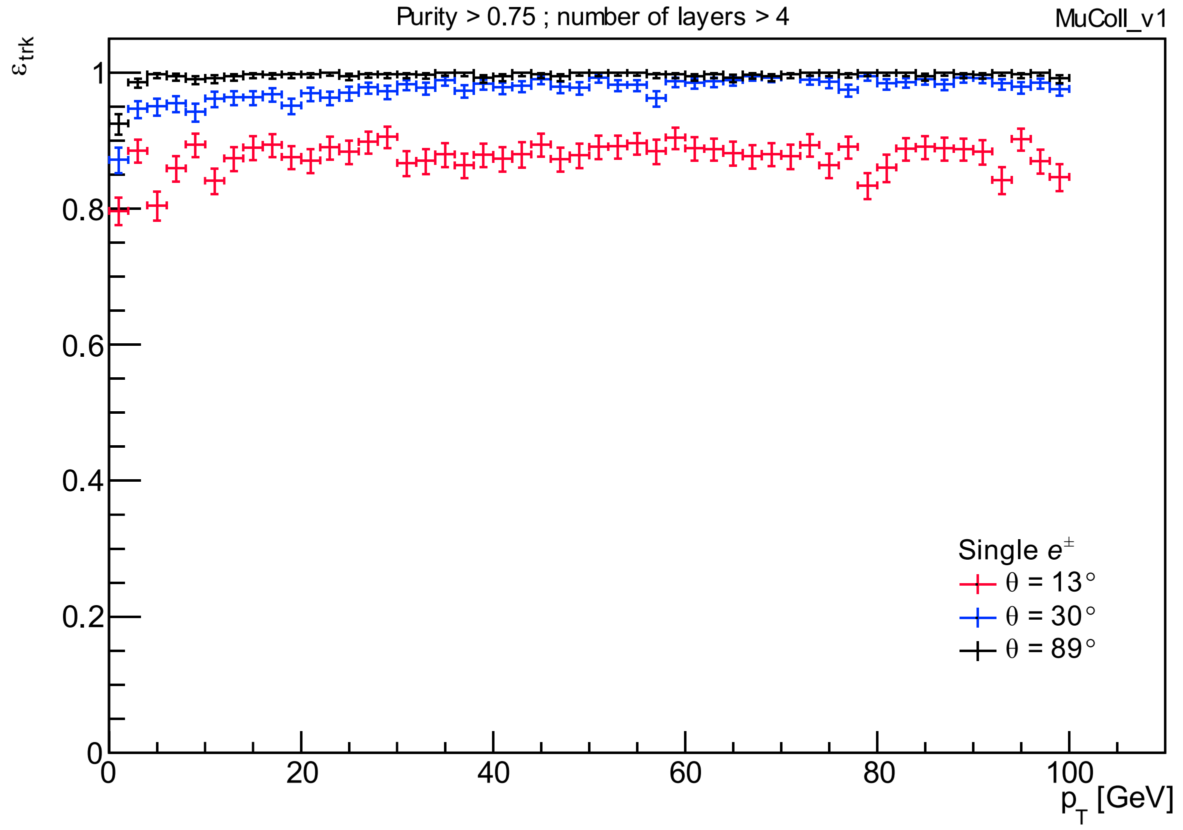
- Single pions



First look at electrons

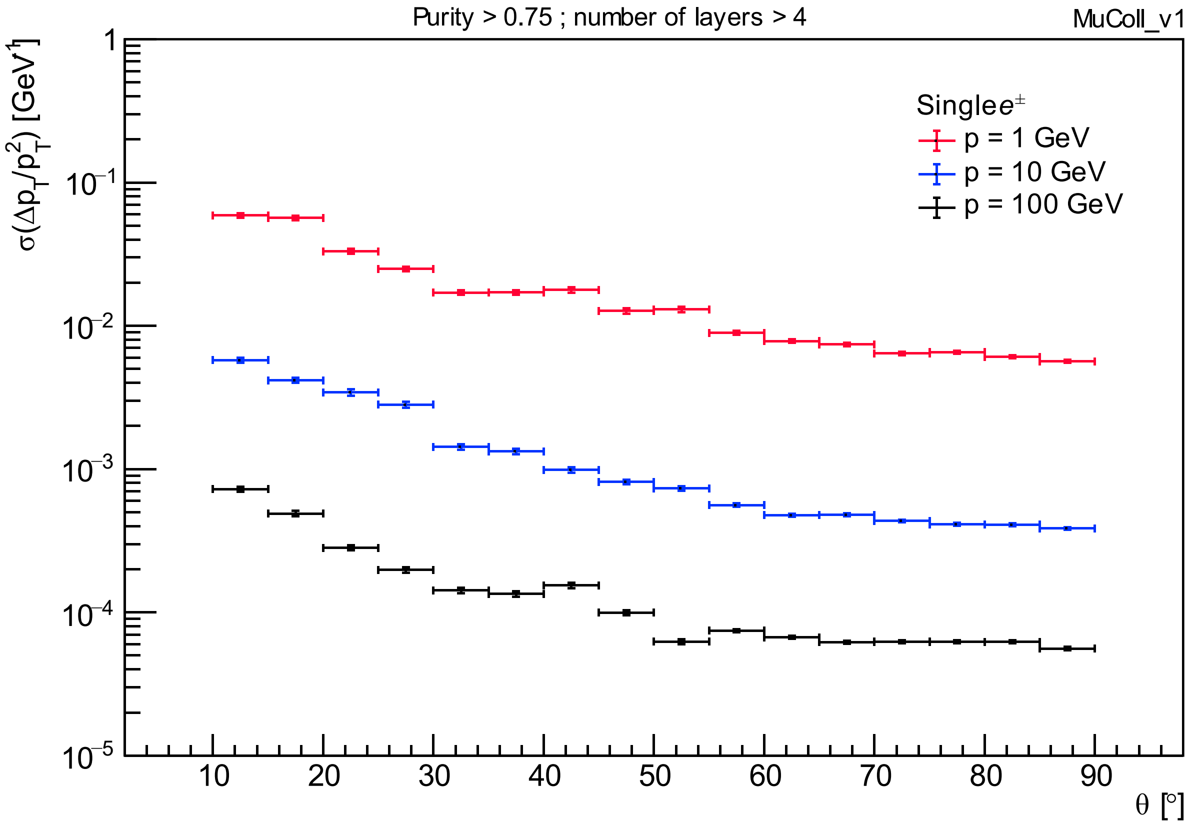
- Tracking efficiency as a function of θ and p_T

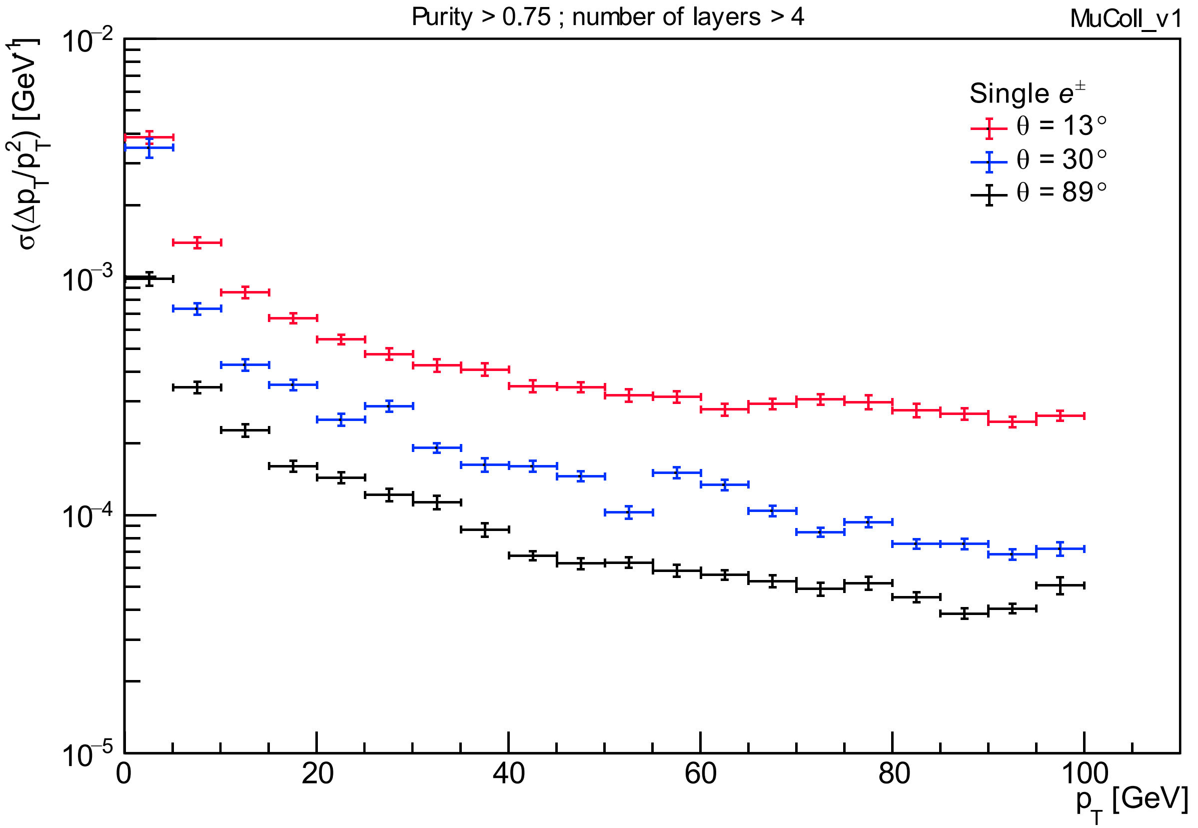




First look at electrons

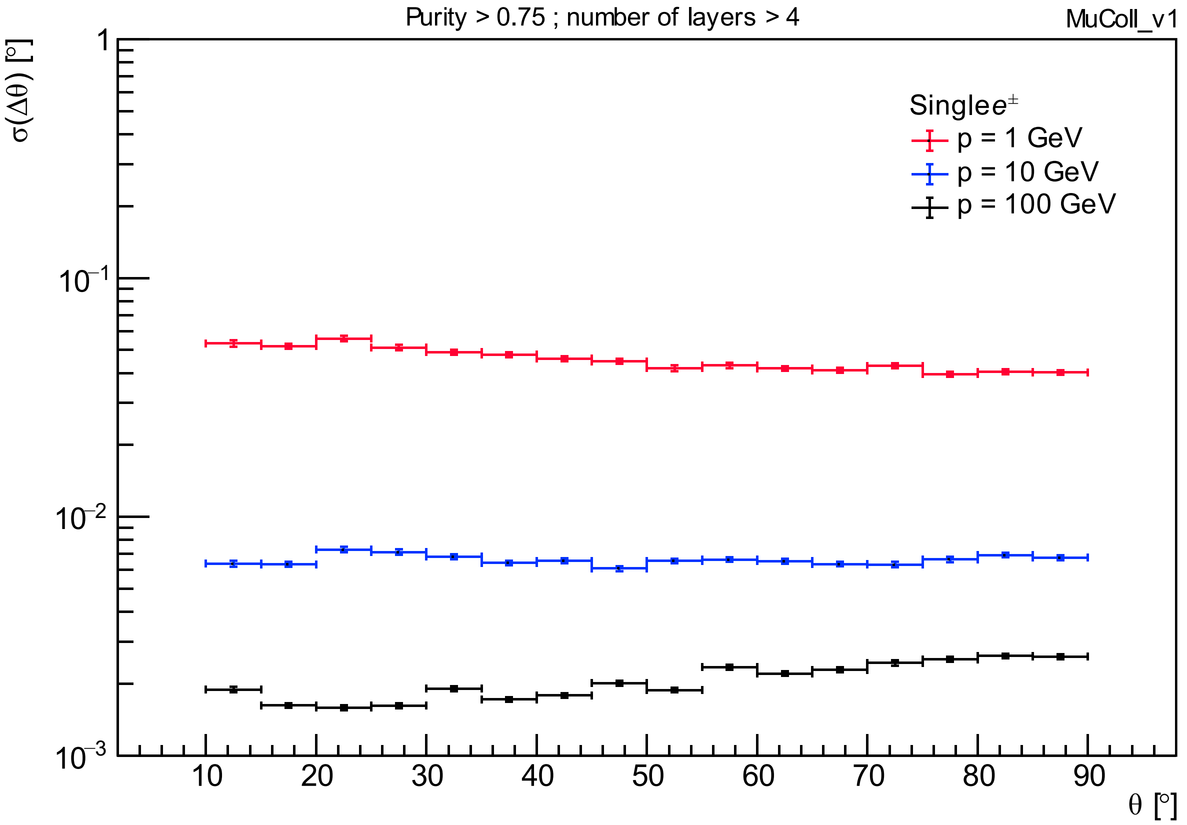
- Resolution in p_T as a function of θ and p_T

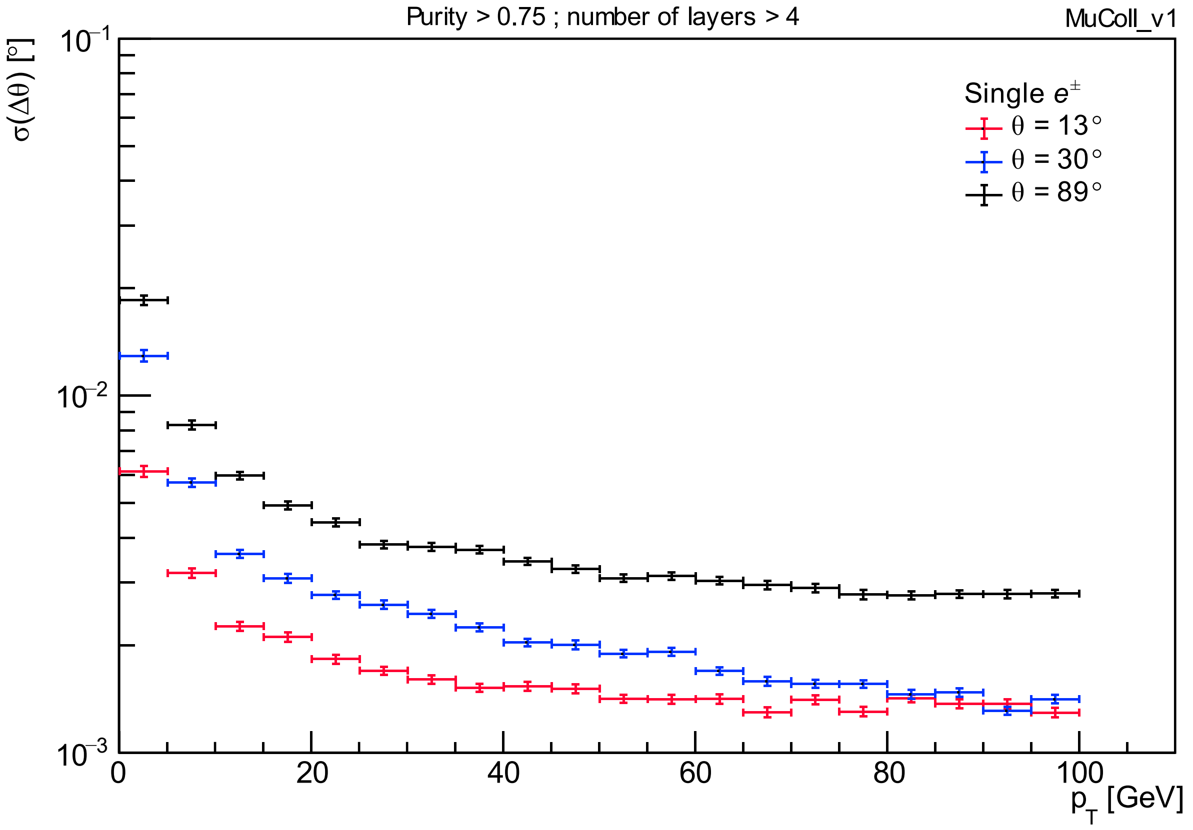




First look at electrons

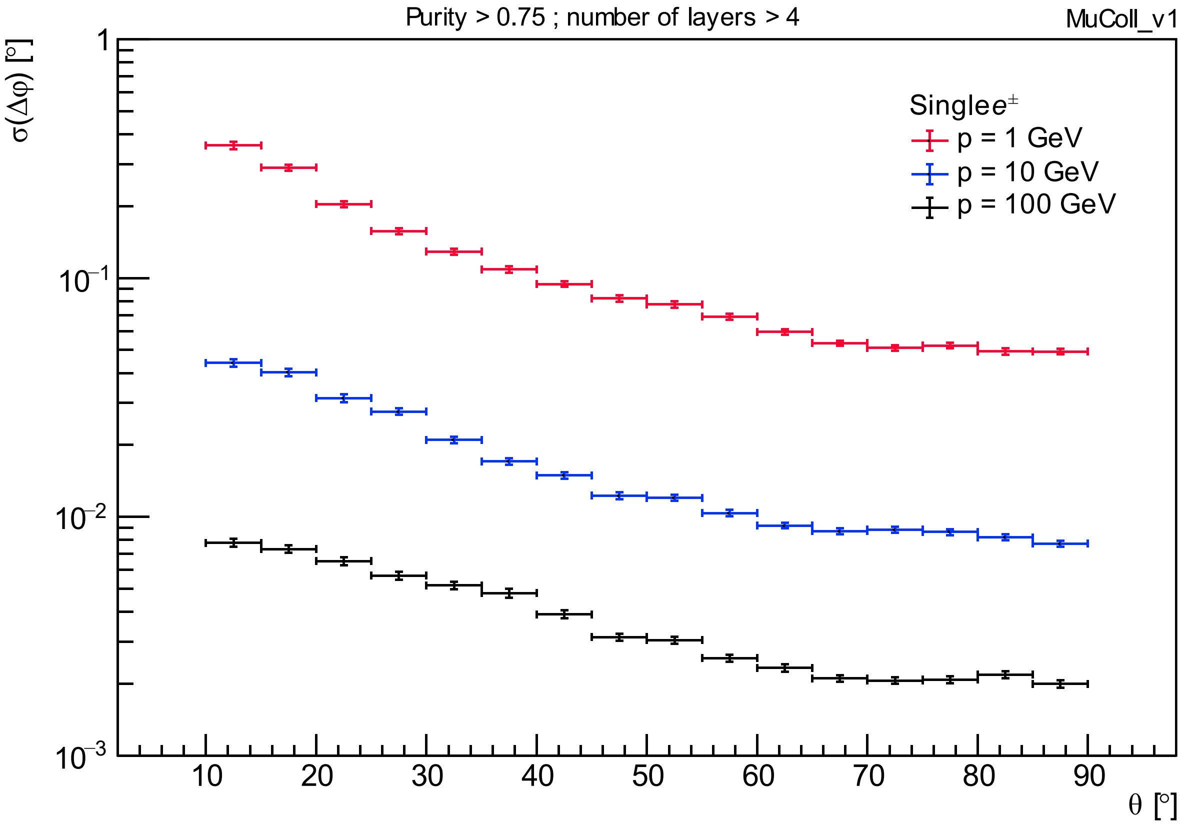
- Resolution in θ as a function of θ and p_T

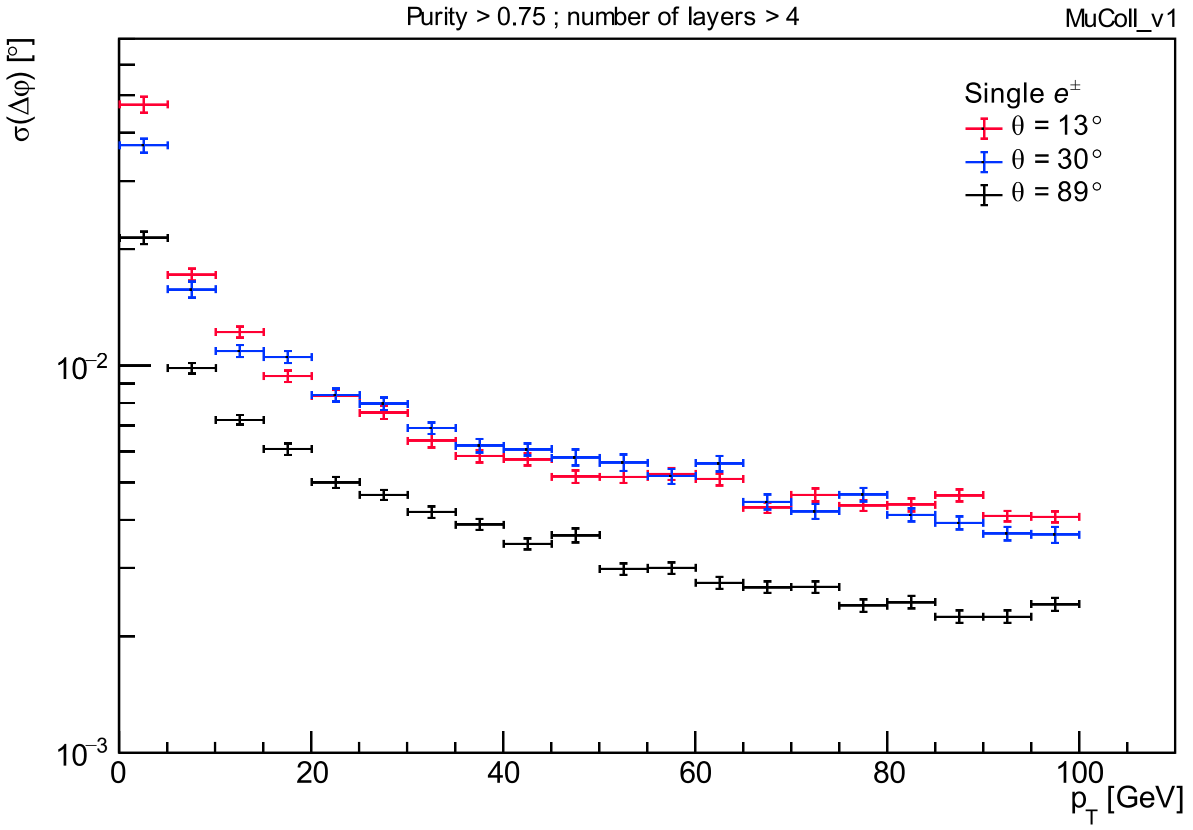




First look at electrons

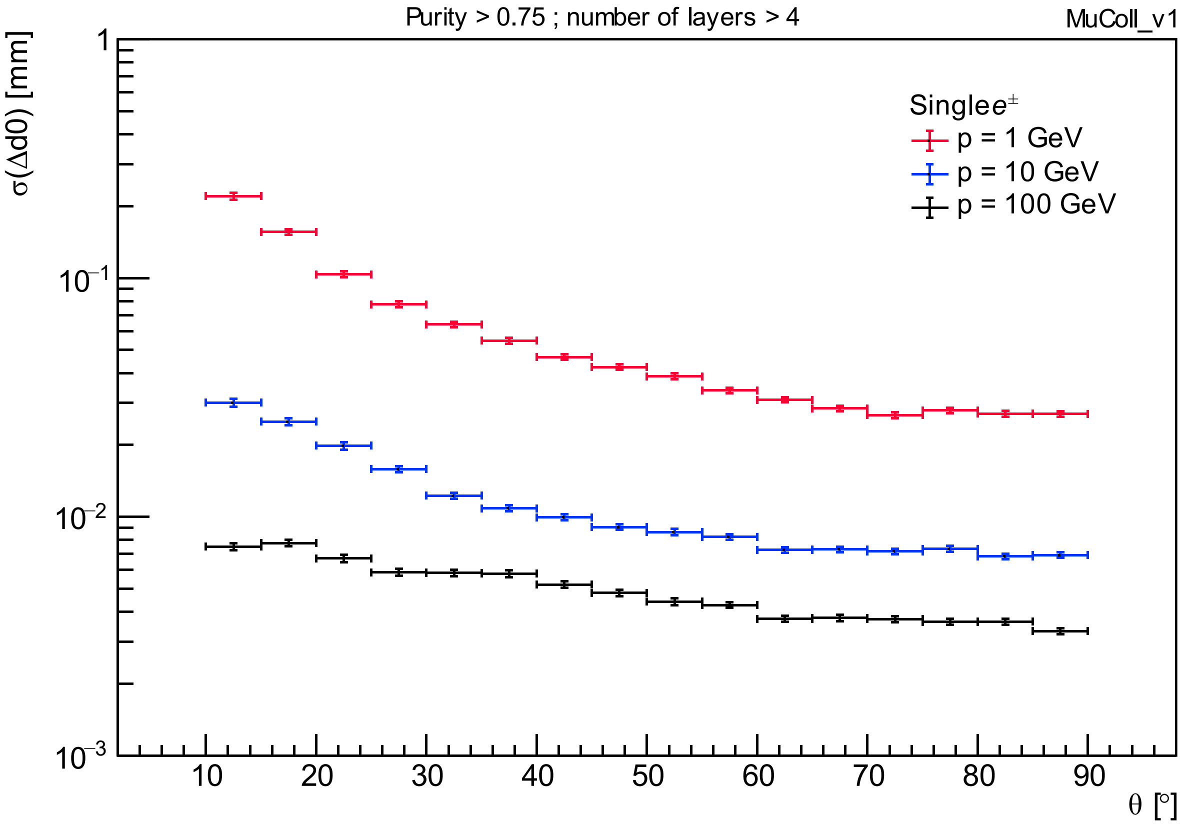
➤ Resolution in ϕ as a function of θ and p_T

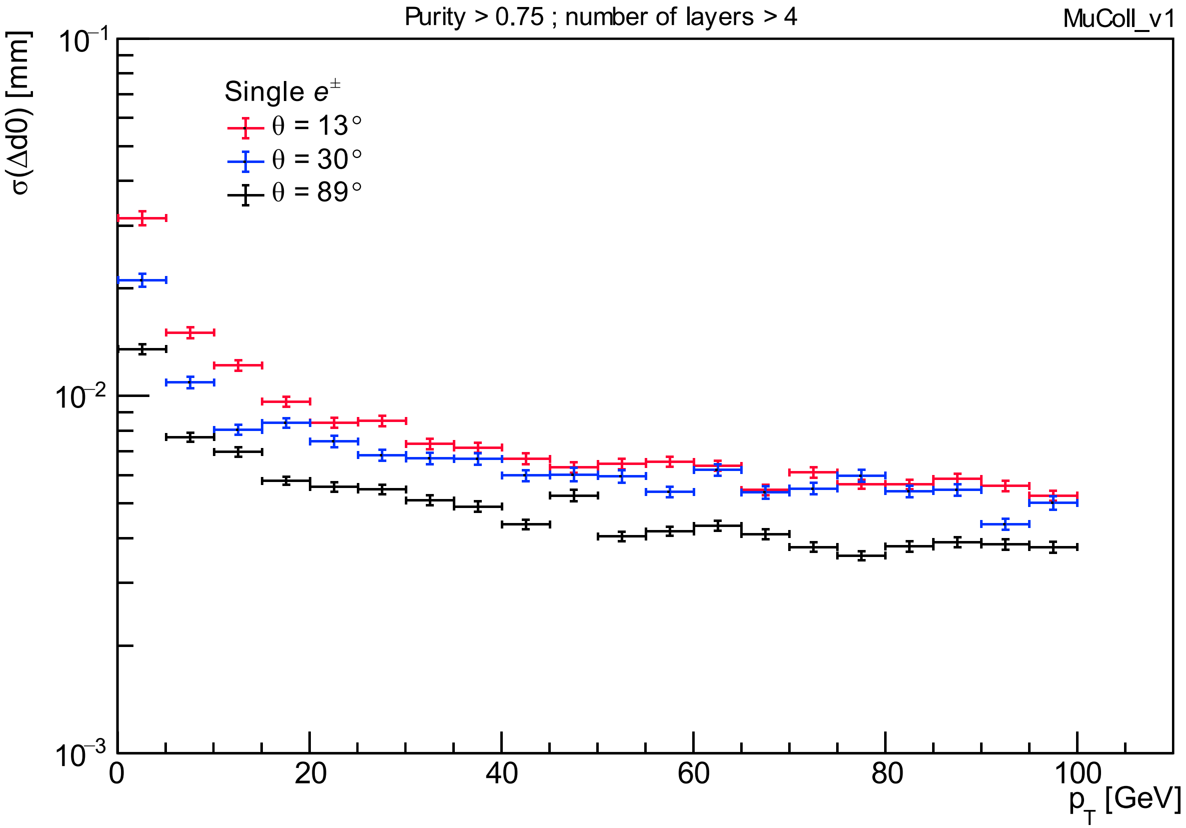




First look at electrons

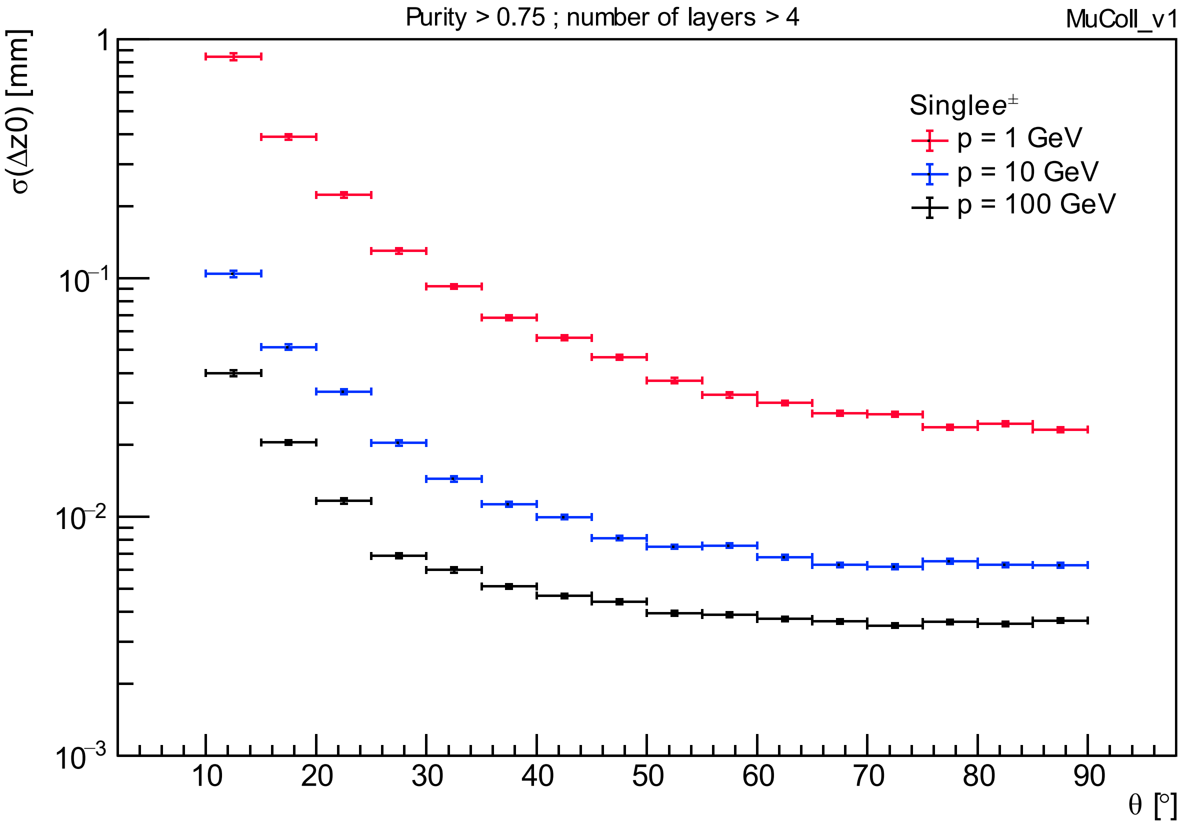
- Resolution in d_0 as a function of θ and p_T

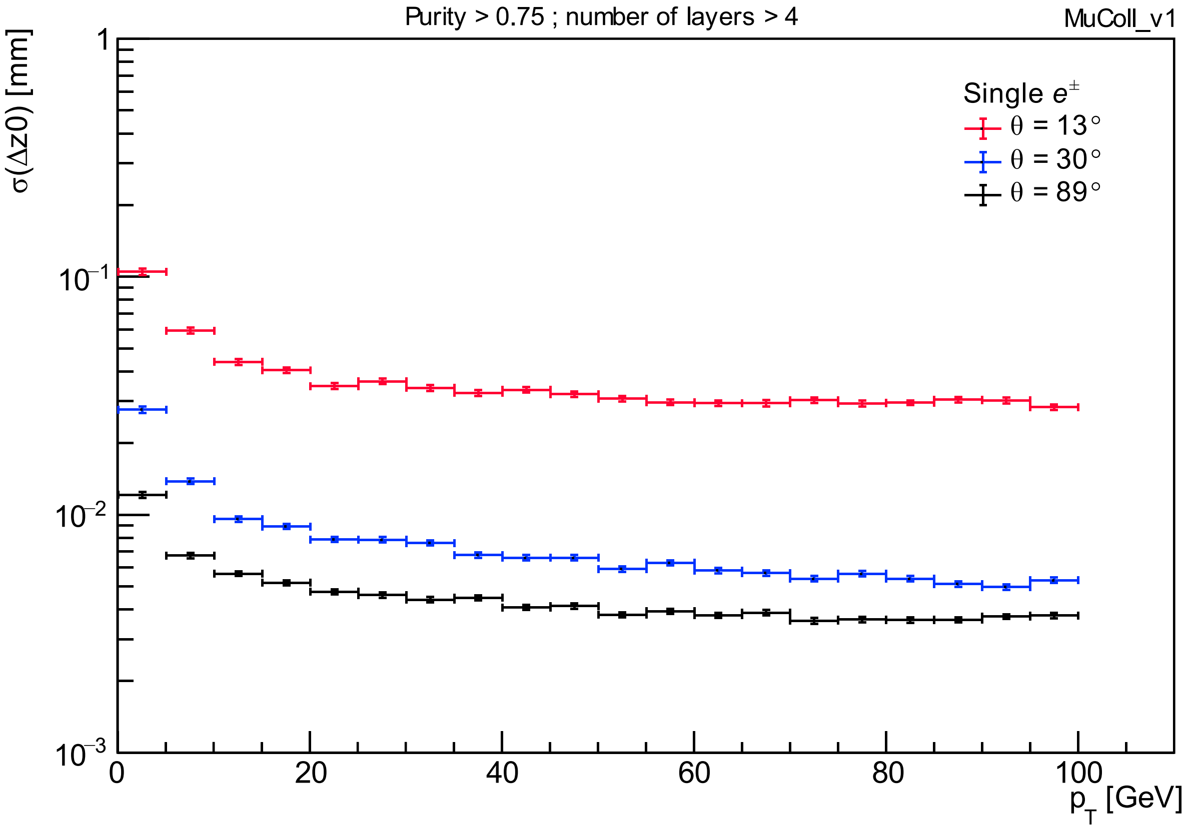




First look at electrons

- Resolution in z_0 as a function of θ and p_T





Next steps

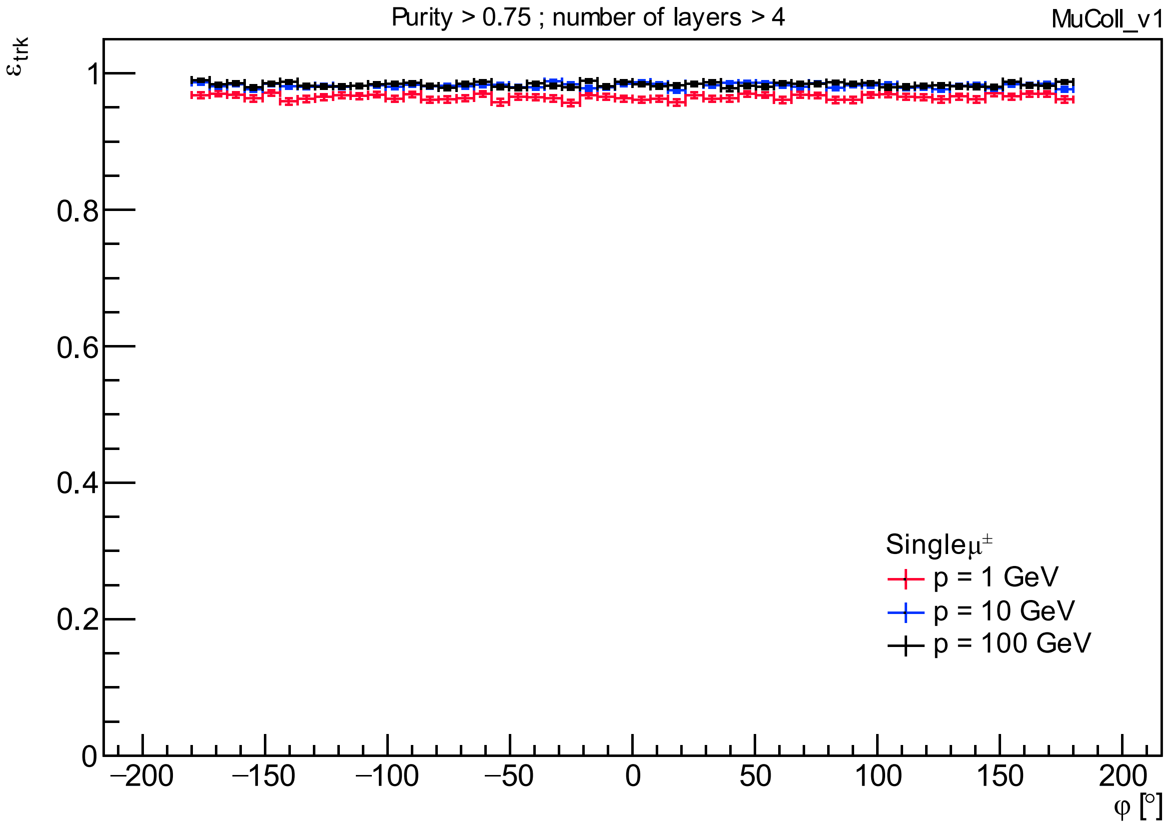
- Performance studies with complex events (e.g. $t\bar{t}$ and $b\bar{b}$ events)

- Performance studies with the BIB overlay

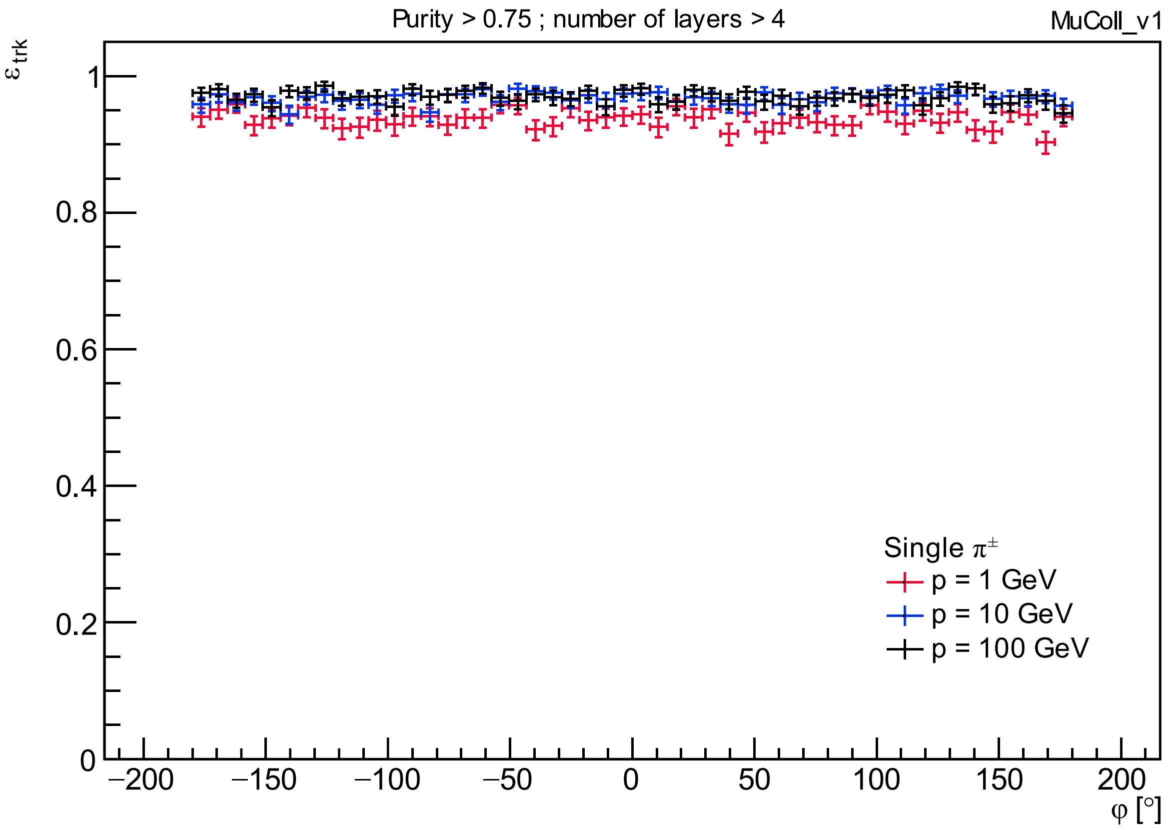
BACKUP

Tracking efficiency as a function of φ

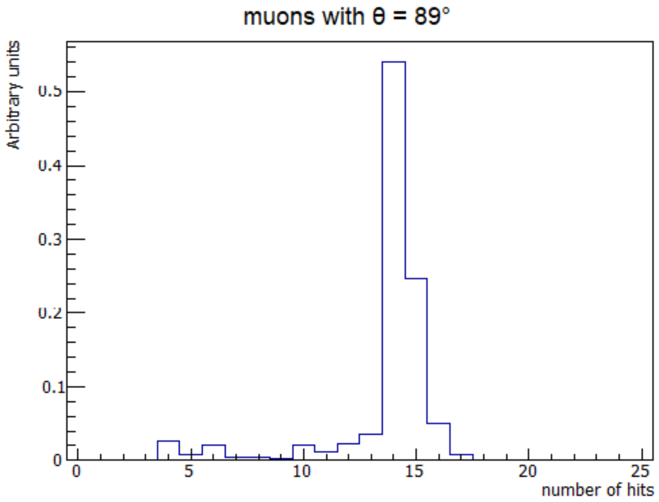
- Single muons

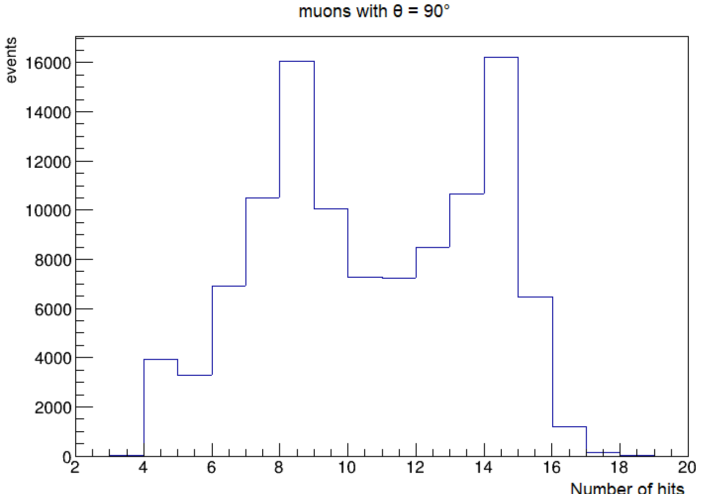


- Single pions

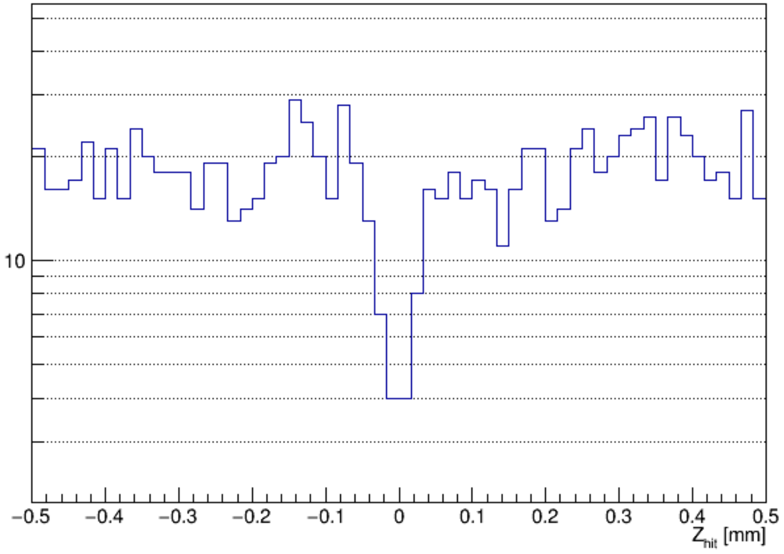


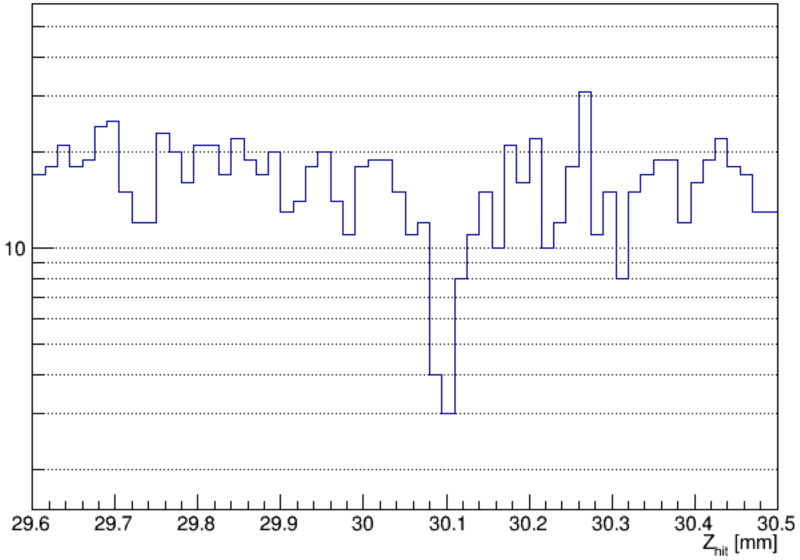
Why θ=89° and not θ=90°?





About half of the tracks from muons with $\theta = 90°$ are associate with a smaller number of hits

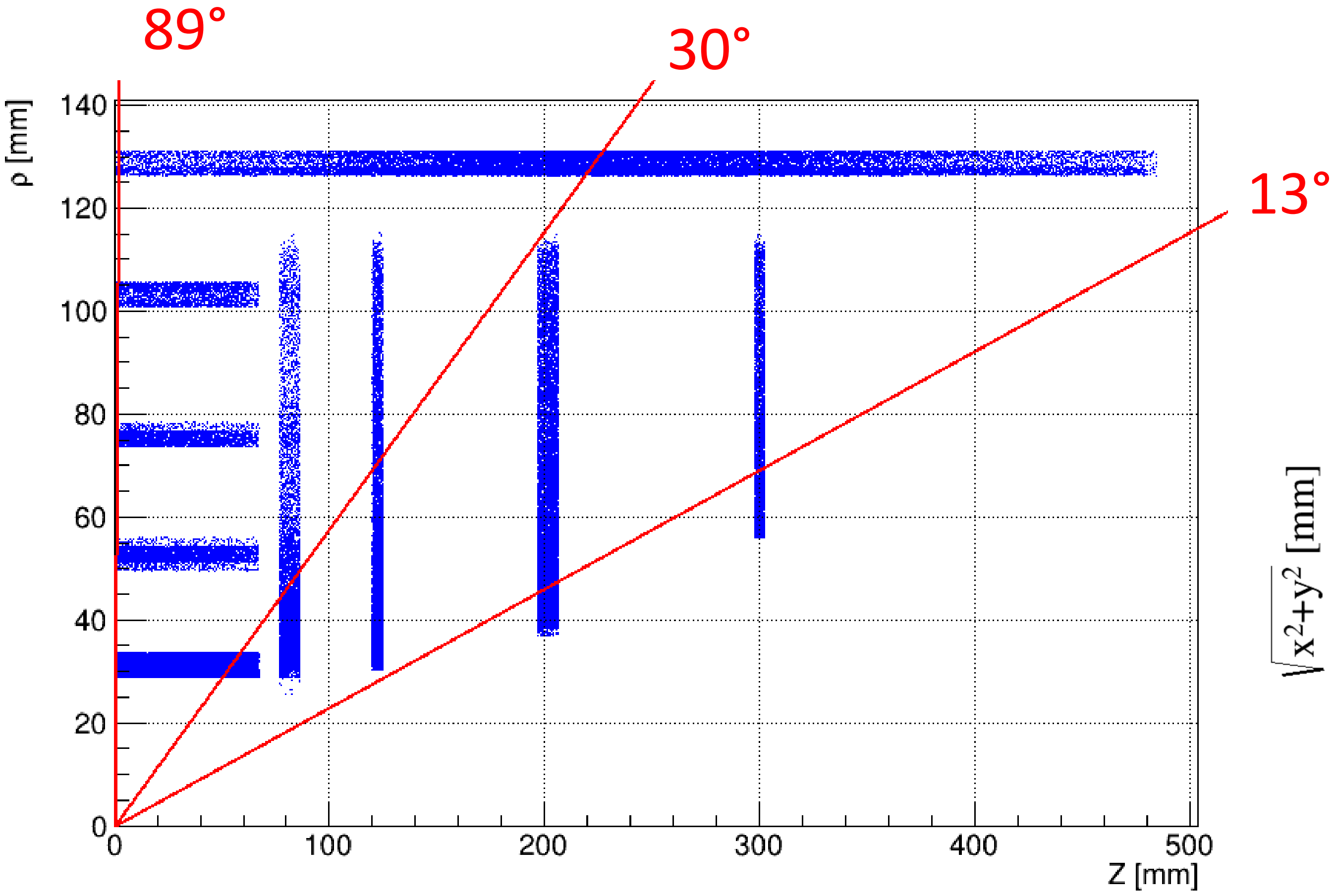


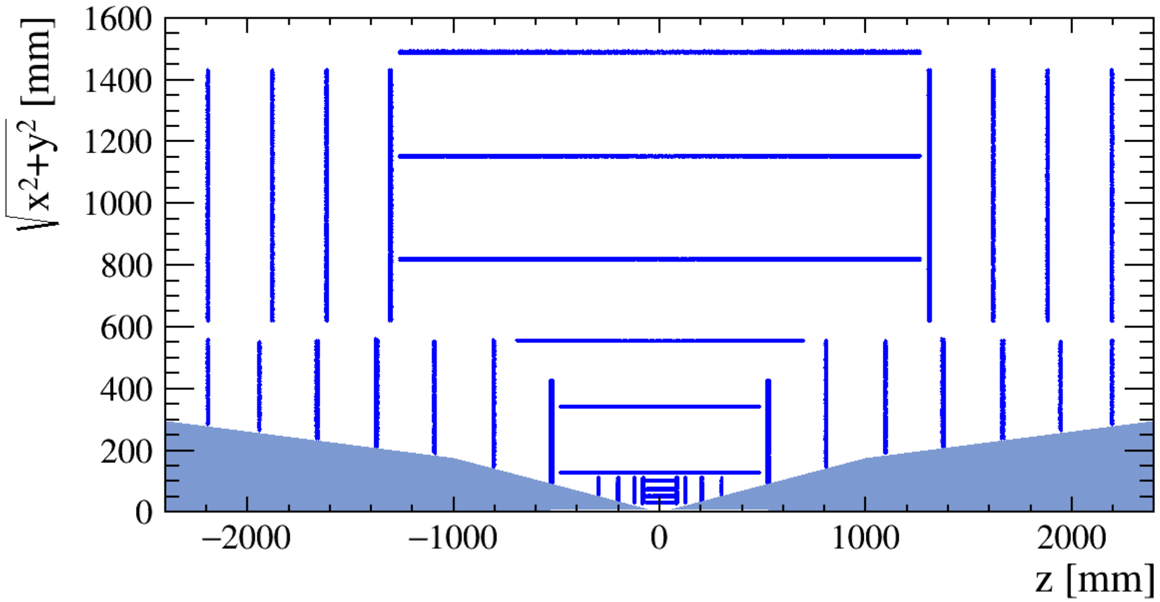


BIB hits in the ITB

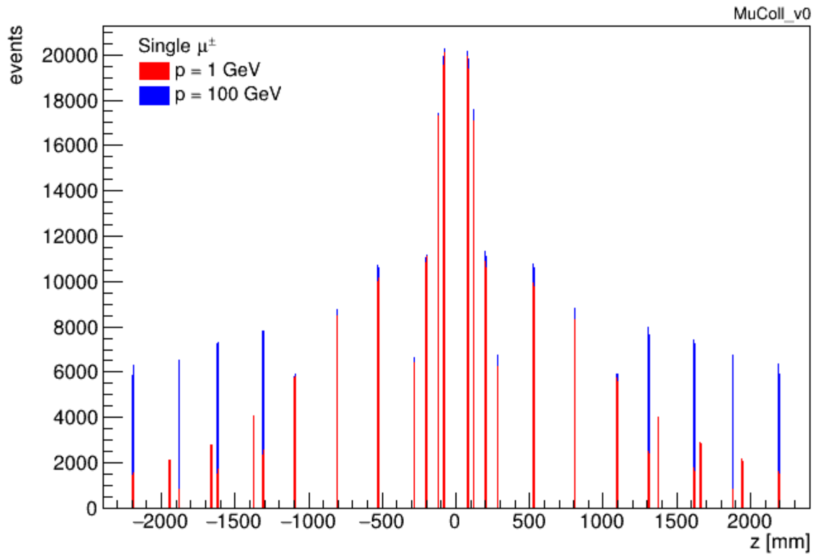
The distribution of the z coordinate of the hits shows a "hole" at the borders of the sensors

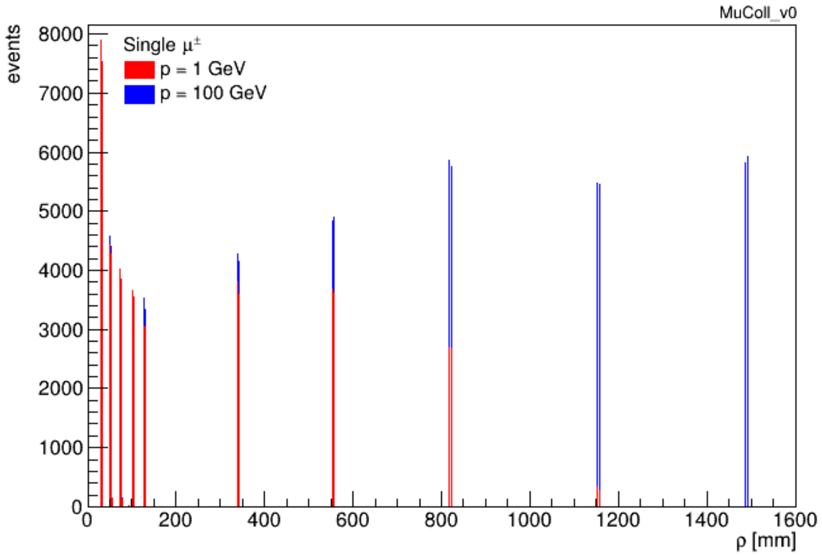
Fixed θ samples

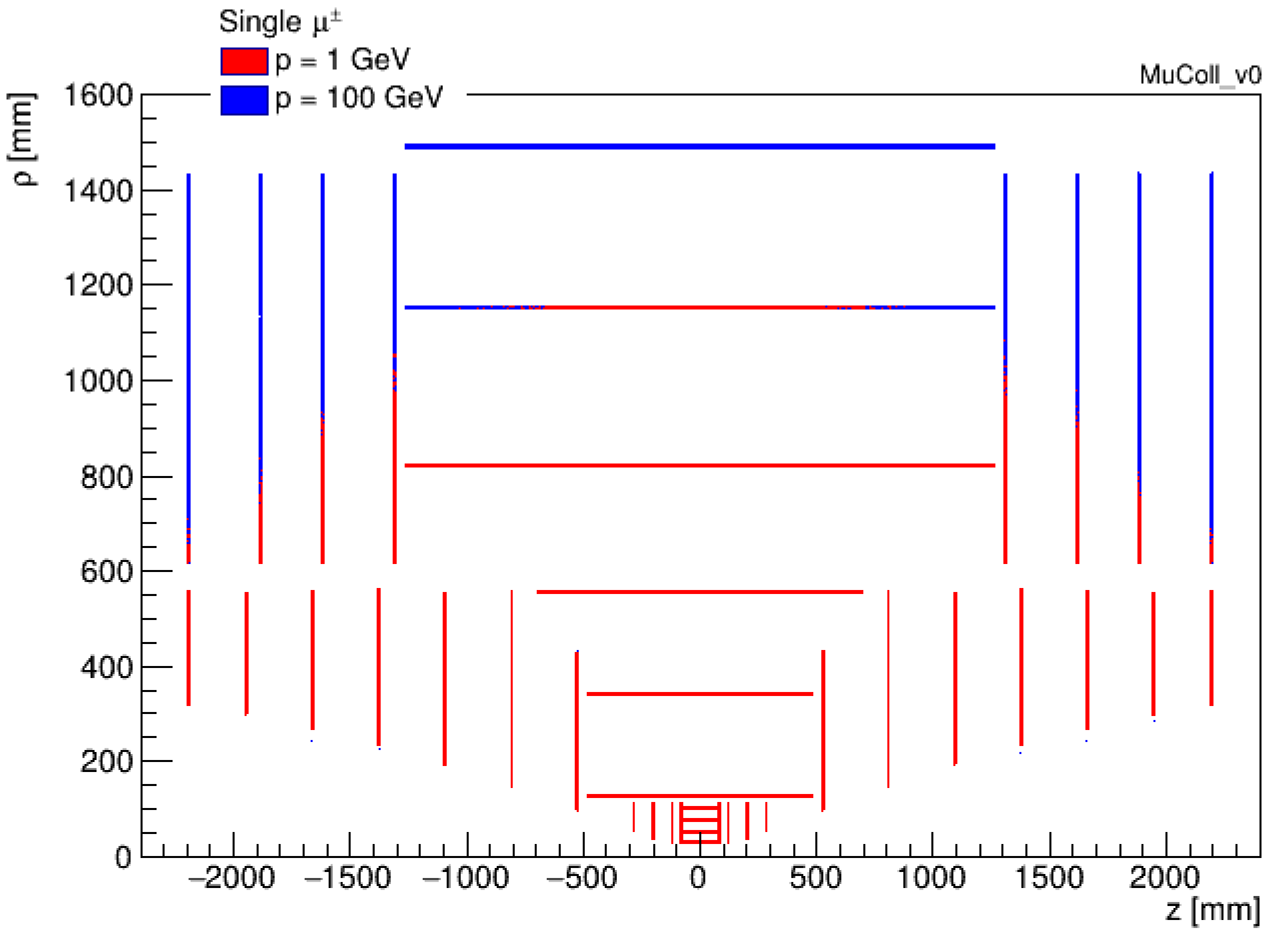




Hits distribution on tracker layers

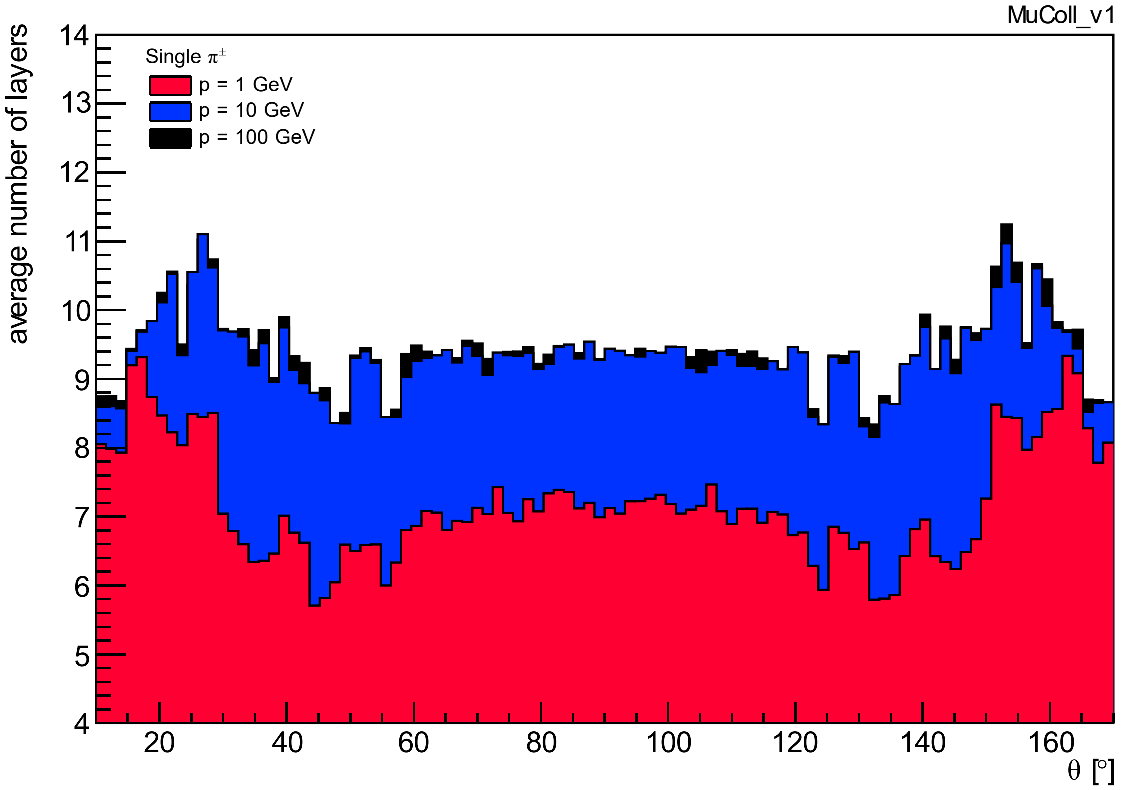


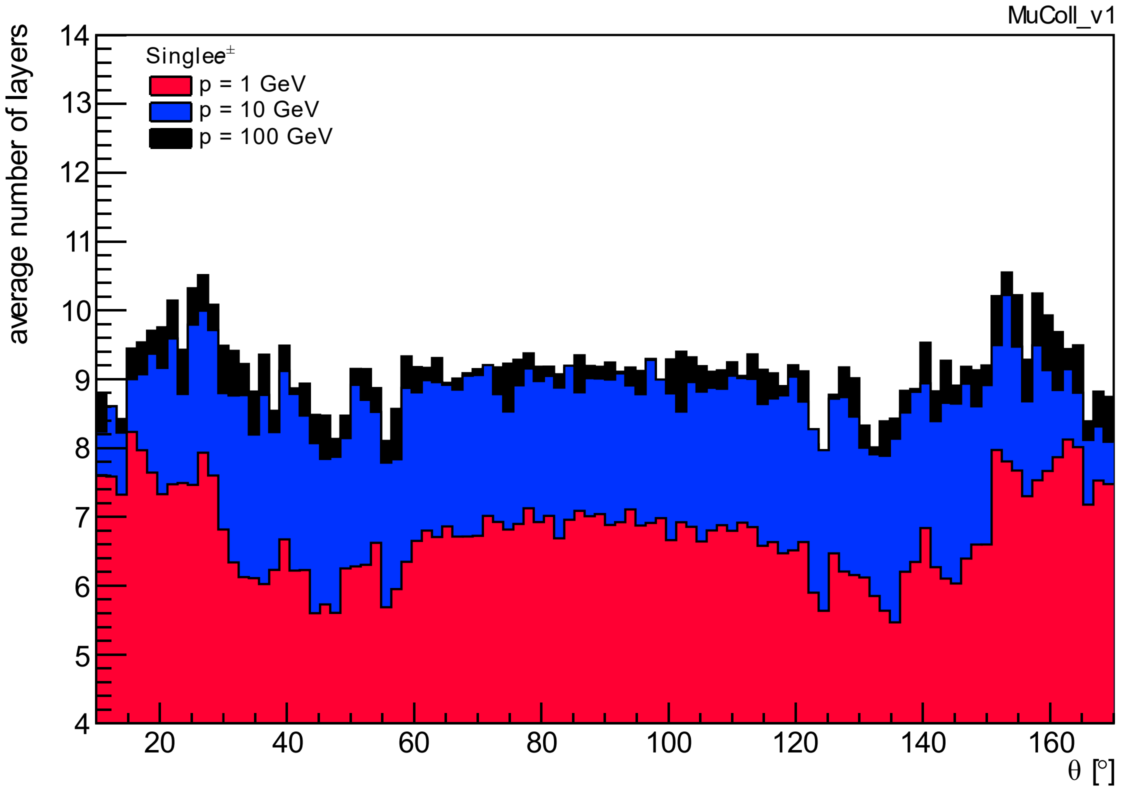




Low momentum muons leave fewer hits in the external layers

Average number of superlayers – pions and electrons





Purity threshold plots