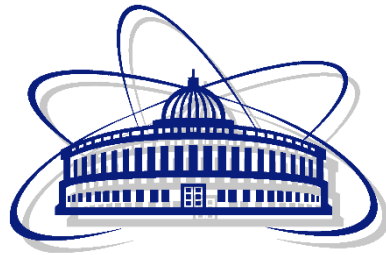


Drell-Yan in SPD

Artem Ivanov



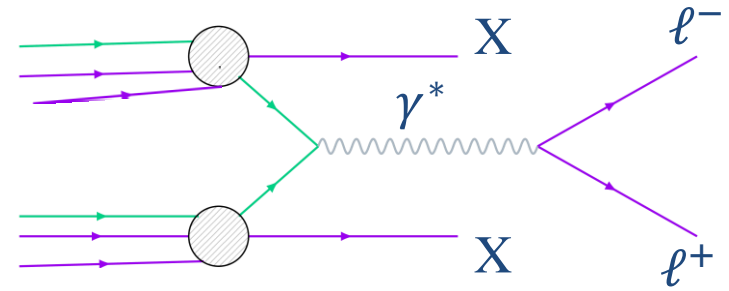
**Joint Institute for Nuclear Research
(Dubna, Russia)**



NICA-SPD

Drell-Yan process

- Drell-Yan process: $p + p \rightarrow \mu^+ + \mu^- + X$



- Main source of background to DY – muons from π and K decays

Comparison Pythia 6 and Pythia 8

“pure” pythia

$\sqrt{s} = 26 \text{ GeV}$

total cross-section		
Type process	Pythia 6	Pythia 8
DY ([4 - 9] GeV)	0.077 (nb)	0.061 (nb)
MB1	23.47 (mb)	23.93 (mb)
MB2	39.67 (mb)	39.68 (mb)

Pythia 6

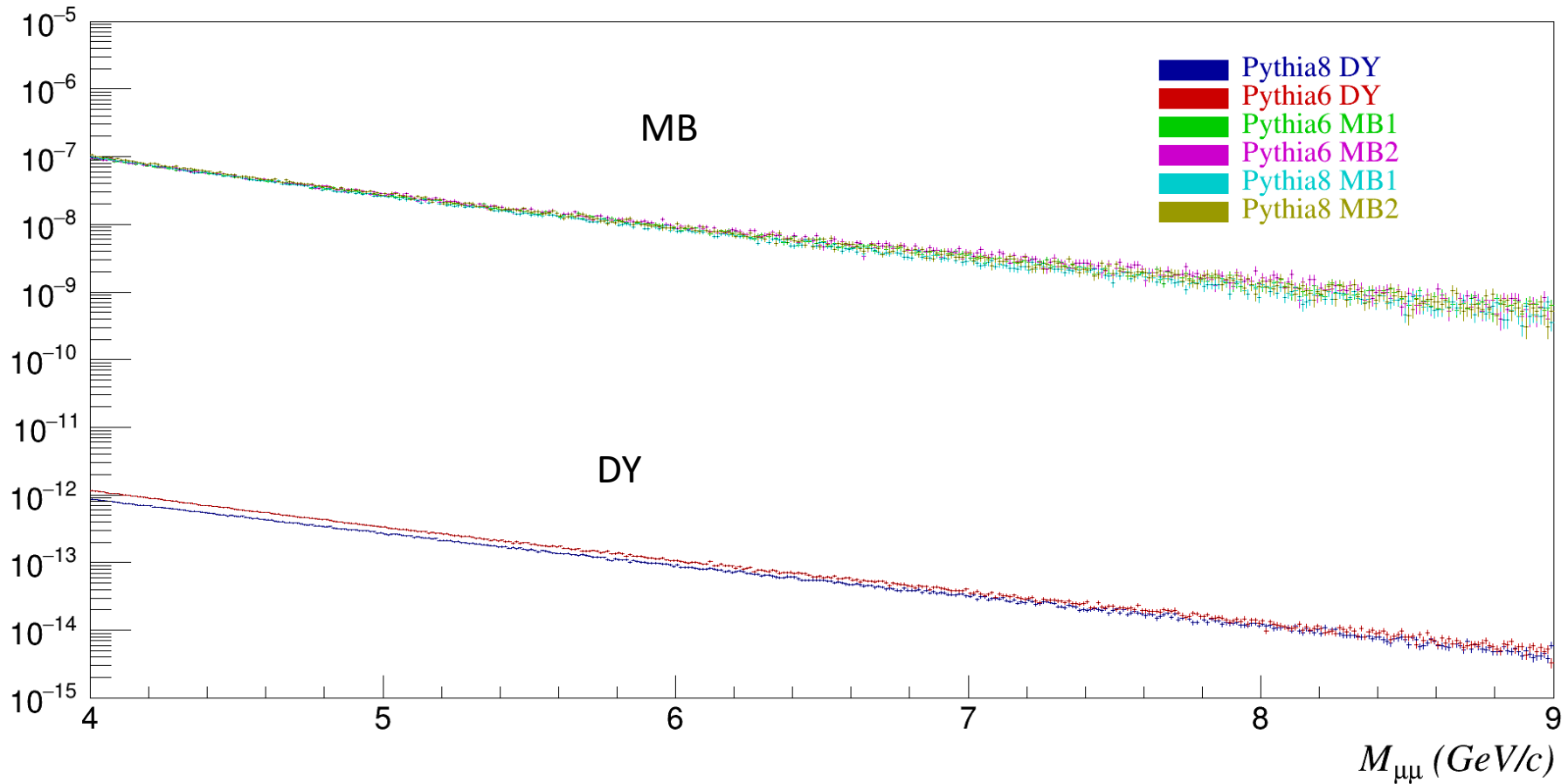
Pythia 8

MB1	MSEL = 1	SoftQCD:nonDiffractive = on
MB2	MSEL = 2	SoftQCD:all = on
DY	MSEL = 0 MSUB = 1, 1 MSTP = 43, 1 CKIN = 1, 4.0 MDME = 184, 1 (only to muons)	WeakSingleBoson:ffbar2ffbar(s:gmZ) = on WeakZ0:gmZmode = 1 PhaseSpace:mHatMin = 4.0 PDF:pSetB=5 23:onMode = off 23:onifAny = 13 (only to muons)

Comparison Pythia 6 and Pythia 8

“pure” pythia

without cuts



$$\text{scale} = \frac{\text{total cross section}}{\text{number of generated events}}$$

$$N_{DY,gen} = 1 \text{ million events}$$

$$N_{MB,gen} = 1 \text{ billion events}$$

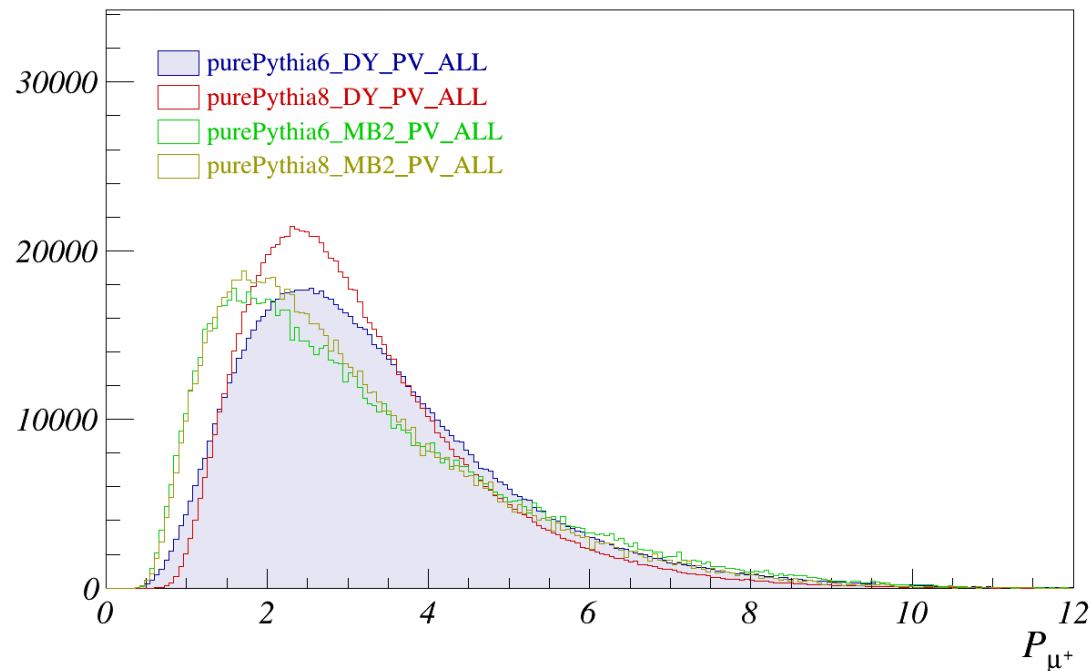
Comparison Pythia 6 and Pythia 8

“pure” pythia

MB2	BG/DY	
	Pythia 6	Pythia 8
without cuts	84279	107786
$P > 1$ GeV (due to RS)	75885 (3.1% rejected DY)	96529 (0.7% rejected DY)

G. Alexeev, SPD at NICA-2019

“It resolves muons and hadrons with $\sim 100\%$ efficiency (\sim zero hadron contamination) above ~ 1 GeV by obviously different response pattern.”



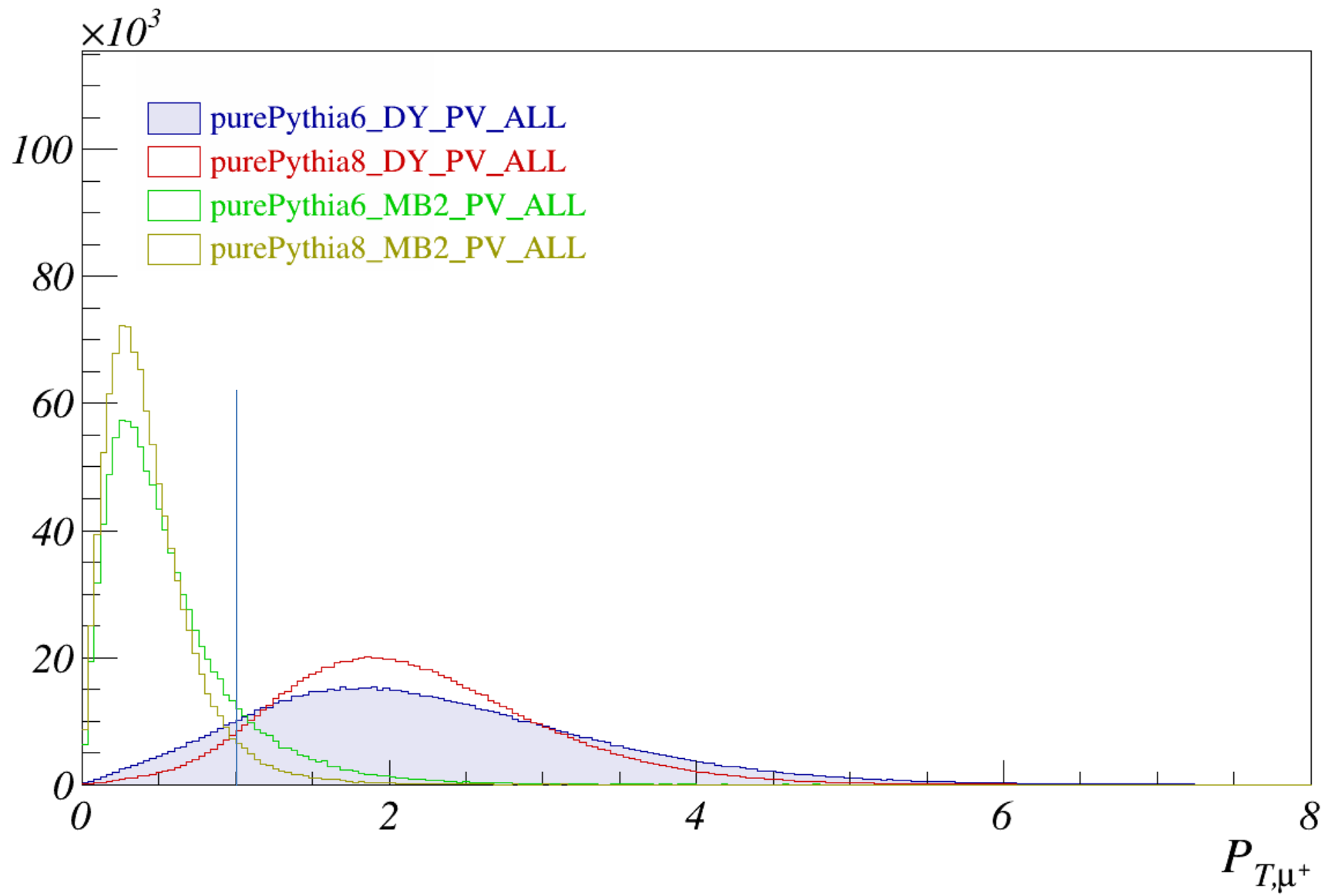
Comparison of muon pairs location

$P > 1$ GeV (due to RS)

	[4 - 9] GeV		all
	DY	MB	MB
RS	97.0 %	100 %	100 %
RS-BB	27.6 %	0.09 %	0.7%
RS-EE	16.2 %	97.3 %	87.7 %
RS-BE	53.2 %	2.5 %	11.5 %

RS - Range System
B - Barell
E - Endcap

SpdRoot + Pythia 6
MB2



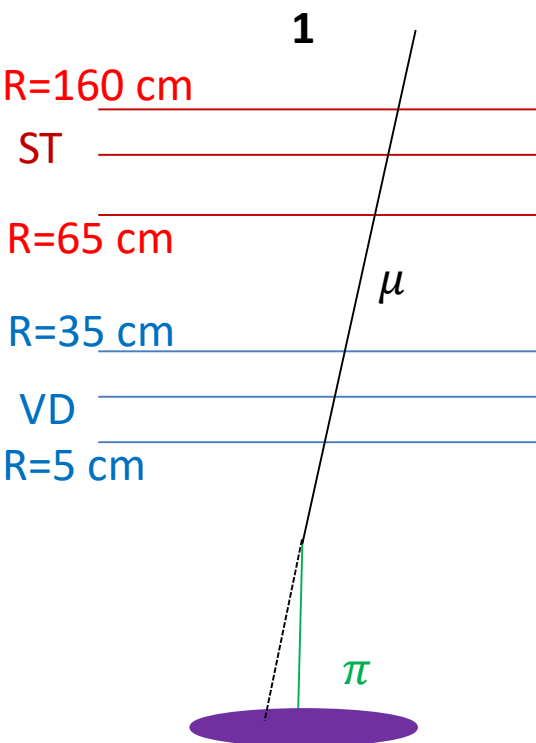
Comparison Pythia 6 and Pythia 8

“pure” pythia

MB2	BG/DY	
	Pythia 6	Pythia 8
without cuts	84279	107786
$P > 1$ GeV (due to RS)	75885 (3.1% rejected DY)	96529 (0.7% rejected DY)
$P > 1$ GeV + $P_T > 1$ GeV	1813 (21.9% rejected DY)	521 (13.0% rejected DY)

Decay $\pi^\pm \rightarrow \mu^\pm$

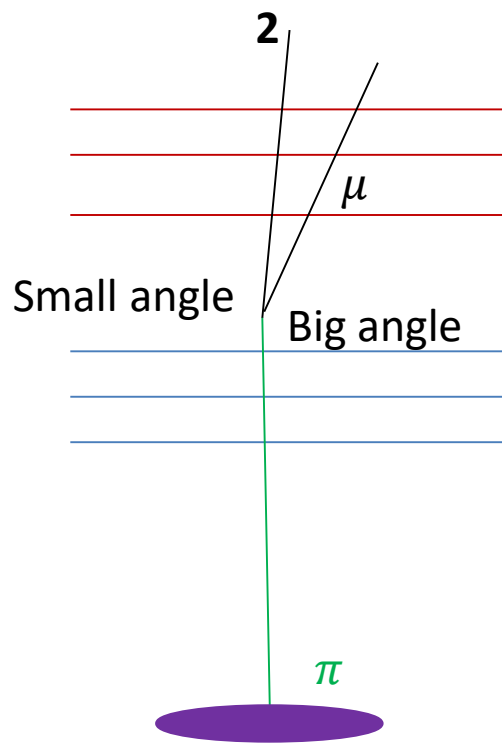
Possible reconstruction influences



Vertex program can tie in μ with Primary Vertex

Question. How much does the size of the problem depend from resolution of VD?

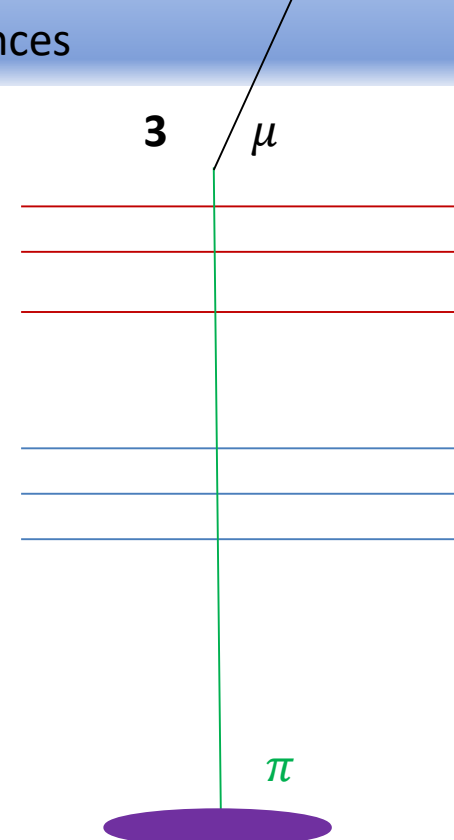
Question. How much does it depend from size of the angle and size of PV?



Small angle: Fit program can misidentify μ and π as one track.

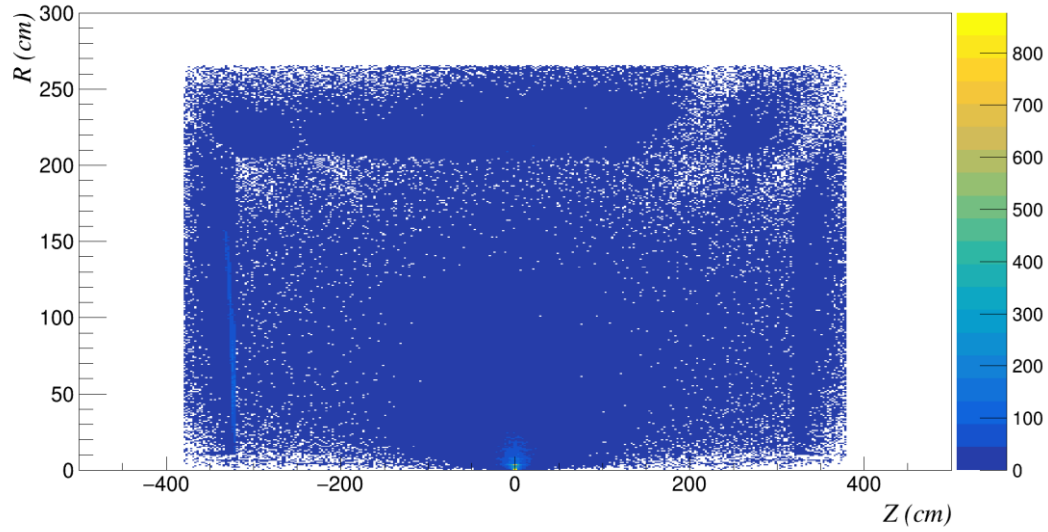
Question. Starting from which angle?

Big angle: Fit program can identify μ and π as two track. So we can easily reject it from analysis.

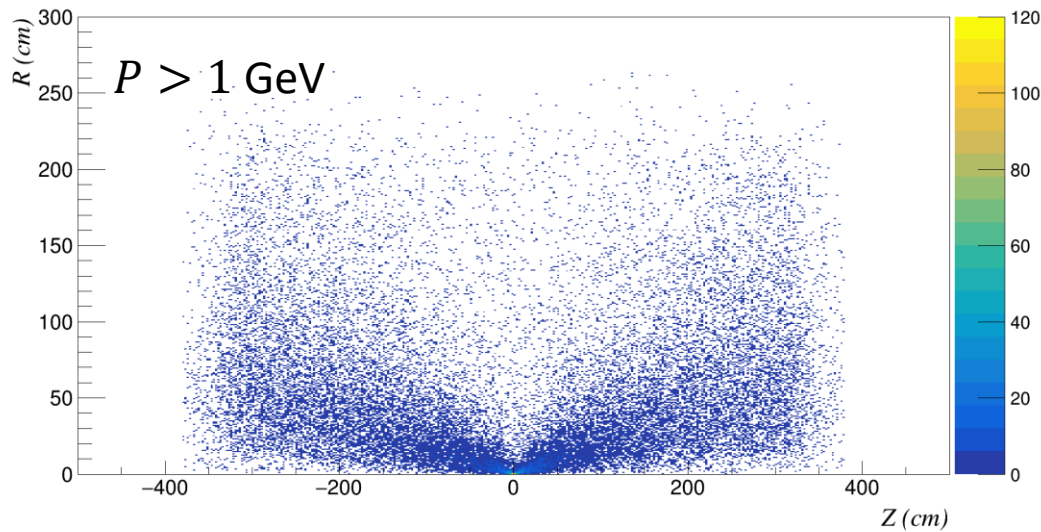


Muons from decay after Straw.

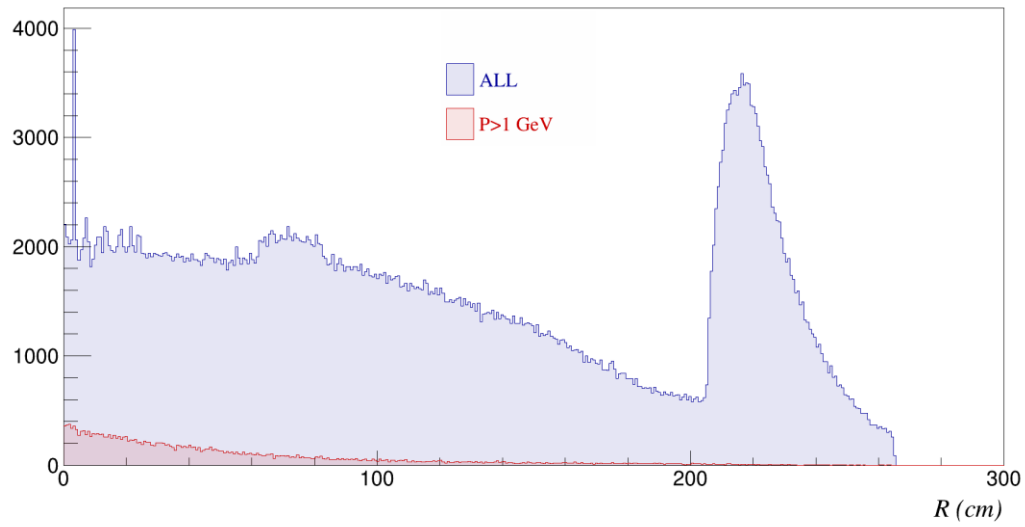
Decay $\pi^\pm \rightarrow \mu^\pm$



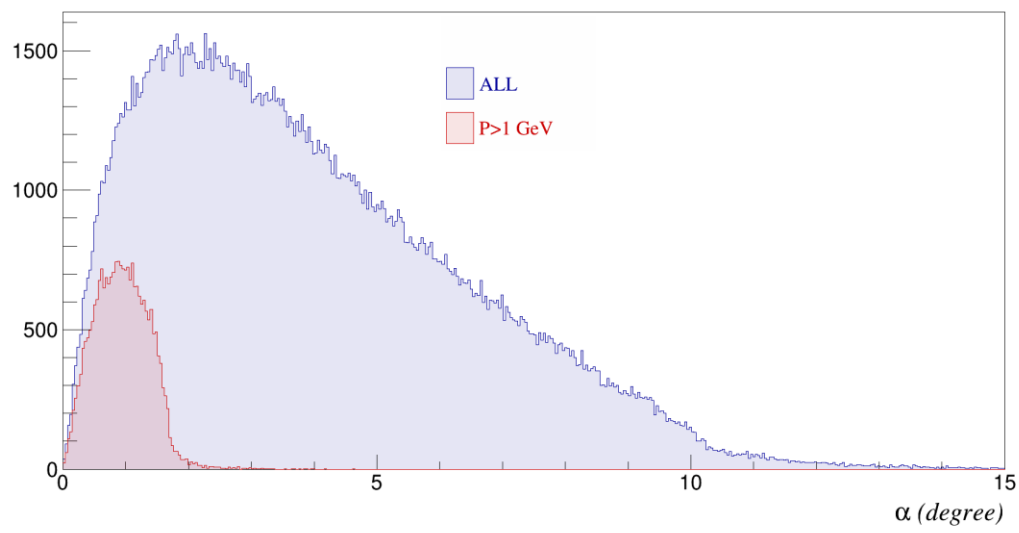
SpdRoot + Pythia 6
MB2



Decay $\pi^\pm \rightarrow \mu^\pm$



SpdRoot + Pythia 6
MB2

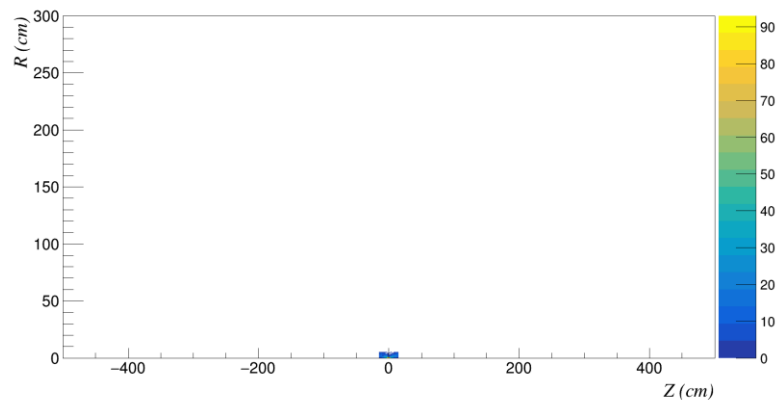


1. Before Vertex Detector:

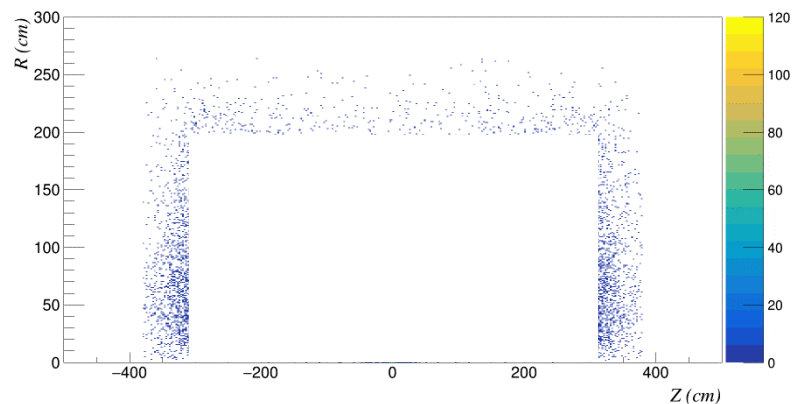
N. Zamyatin, SPD at NICA-2019

$-10 \text{ (cm)} < Z < 10 \text{ (cm)}$

$R < 5 \text{ (cm)}$



2. After Straw



$P > 1 \text{ GeV}$

Muon location	%
Before Vertex Detector	4.0
After Straw	7.0

Backup

