Update on the ν_μ Systematics

Guilherme Soares
gmachado@cern.ch

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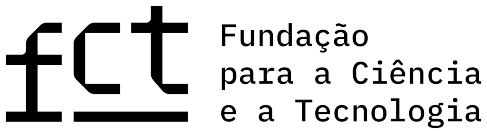


Index

Updating ν_μ Candidates

Applying [-0.5 ;1.2] Clk cycle filter to Scifi Hits removes the following candidates :

Run	Event	Failed Cut
4976	64882391	DOCA < 3 cm
5132	49831153	DOCA < 3 cm
6593	274413521	Min 35 Scifi Hits

From 33 to 30 ν_μ candidates

RunNumber Cris	EventNumber Cris	RunNumber our	EventNumber our
		4705	48821614
4752	51384014	4752	51384014
4809	6626367	4809	6626367
4815	3511466		
4819	49014045	4819	49014045
4976	64882391	4976	64882391
4992	10724635	4992	10724635
5013	42493532	5013	42493532
5056	101849600	5056	101849600
5099	75339702	5099	75339702
5120	99612370	5120	99612370
5132	49831153	5132	49831153
5152	40781267	5152	40781267
5171	18810277	5171	18810277
5180	30578821	5180	30578821
5389	50929436	5389	50929436
		5888	49645511
5981	18071685		
		6018	19118383
		6018	68172148
6050	177763312	6050	177763312
6069	73227538		
		6246	72535282
6250	41301634		
6252	142468058	6252	142468058
6268	38637101	6268	38637101
6279	63954103	6279	63954103
6286	178922363	6286	178922363
6290	116495522		
6295	119394005	6295	119394005
6296	4544667		
6296	9764224	6296	9764224
6568	256040759	6568	256040759
6590	49084534	6590	49084534
		6593	274413521
6596	192065981	6596	192065981
6610	59826348	6610	59826348
6640	72255465	6640	72255465
		7045	16244451

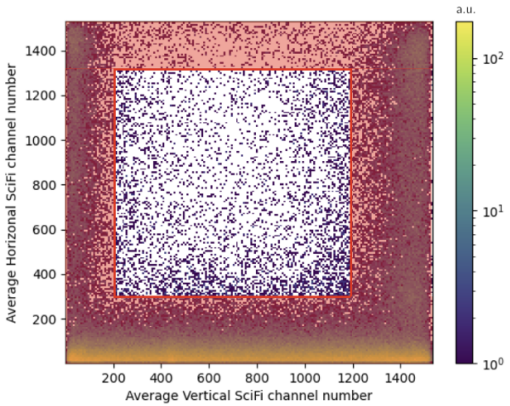
Estimating Systematic ν_μ Errors

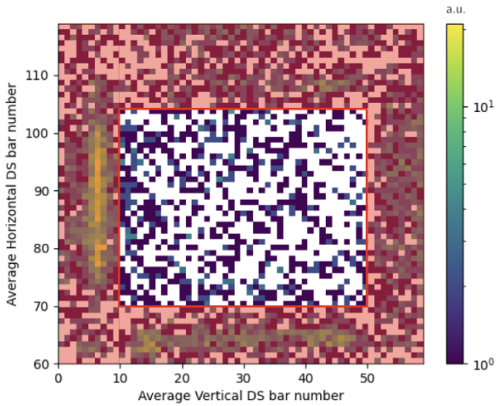
ν_μ event selection goes through the following cuts :

- **Fiducial Volume**
  - SciFi : Vertical [+200 ;-336] ; Horizontal [+300 ;-200]
  - DS : Horizontal Bars 70-105 and Vertical 10-50
- Track requires intercepting the first Scifi plane
- **Sum of DOCA between track and hits < 3 cm**
- > 35 Scifi Hits
- QDC for Upstream Muon System > 600
- Maximum of 10 hits in the Downstream Muon System

Used partition 0 through 50 from */eos/experiment/sndlhc/MonteCarlo/Neutrinos/Genie/sndlhc_13TeV_down_volTarget_20fb-1_SNDG18_02a_01_000/*, with a total of 40272 ν events

Fiducial Volume Systematic Errors





Fiducial Volume Cut Set			Surviving Events	Selection Efficiency (%)	Relative Baseline Error (%)
	Vertical	Horizontal			
Baseline	[200,-336]	[300,-200]	1367	3.39	-
SciFi	[220,-366]	[330,-220]	1260	3.13	-7.7
	[180,-306]	[270,-180]	1458	3.62	6.8
	[300,-436]	[400,-300]	966	2.40	-29.2
	[100,-236]	[200,-100]	1626	4.04	19.2
Baseline	[70,105]	[10,50]	1367	3.39	-
DS	[74,101]	[14,46]	1158	2.88	-15.0
	[66,109]	[6,54]	1476	3.67	8.3

Sum of DOCA < 3 cm

- Check for DS track in the event
- Extrapolate to Scifi stations
- Check for Distance of Closest Approach to hits on Scifi (Closest hit considered)
- Average over all planes for each projection

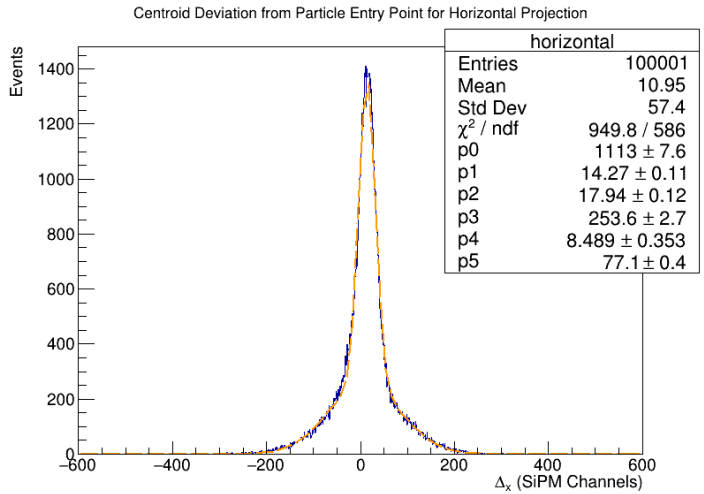
Plan to vary based on the average deviation between the shower centroid on the first Scifi plane after the interaction and the entry point in the previous Scifi plane

Use 2024 Testbeam data

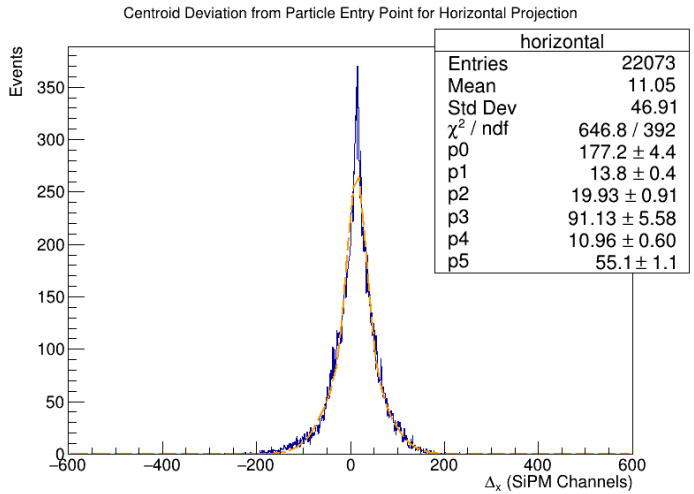
MC sample with 10^5 events with Tungsten setup vs Run 100953 (180 GeV π)

Use shower tagging (3 hits) and select events with at least 1 hit on the previous Scifi plane (tried requiring only 1 hit but MC had low statistics)

Testbeam



Monte Carlo



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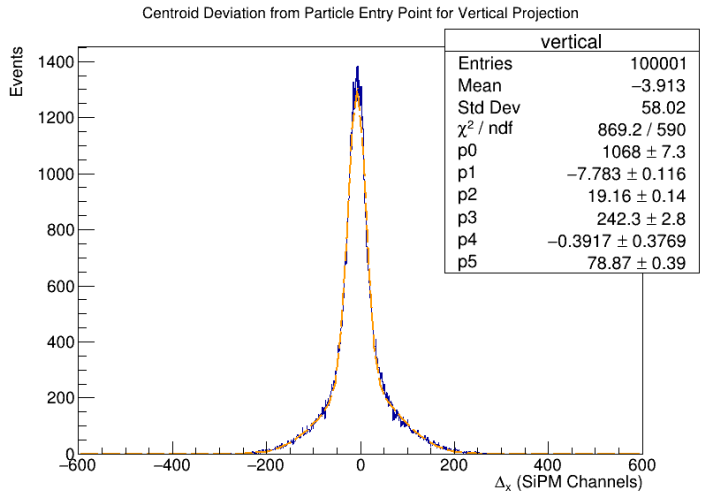

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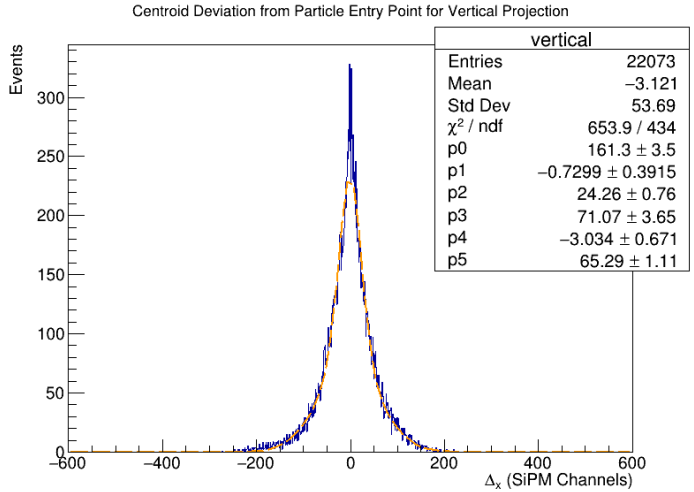
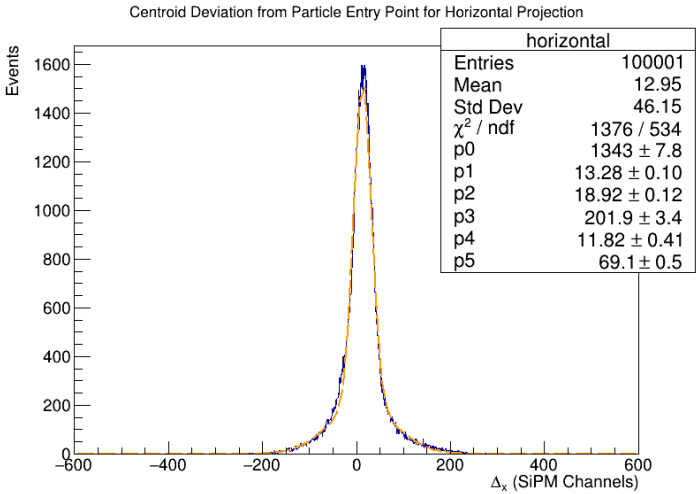


Sum of DOCA < 3cm

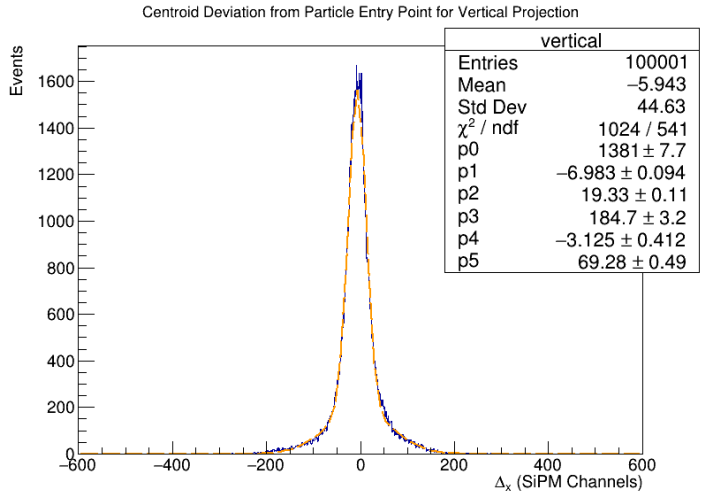
Double Gaussian Fits

Projection	Sample	σ_1 (SiPM Ch)	σ_2 (SiPM Ch)	Δ_{σ_2} (cm)
Horizontal	Testbeam	17.94 ± 0.12	77.1 ± 0.4	0.55 ± 0.04
	Monte Carlo	19.9 ± 0.9	55.1 ± 1.1	
Vertical	Testbeam	19.16 ± 0.14	78.9 ± 0.4	0.34 ± 0.04
	Monte Carlo	24.3 ± 0.8	65.3 ± 1.1	

Horizontal with exclusively 1 entry hit



Vertical with exclusively 1 entry hit



Plans for Activity Requirement Cuts Systematics Estimation

Cuts :

- > 35 Scifi Hits
- QDC for US > 600

Use each filter criteria on Testbeam data to obtain profile of the other

Compare Monte Carlo with data

Continue to use Tungsten setup or switch to Iron ? ? ?

Any idea on how to test impact of variations on data efficiently ? (Loosening cuts may imply having to run over the whole 2022/2023 data set)