Report of activities

Mario Rodríguez Cahuantzi
Autonomous University of Puebla, México
(FCFM-BUAP,MX)

Outline

- PWG-UD meeting
- Cosmic's PAG
- Final comments

HEP Puebla meeting
March 23th. 2013

⌘ Introduction

Participation in 3 meetings this week:

- PWG-UD (March Alice Week)
- Cosmics PAG (weekly meeting)
- UPC (weekly meeting) → contribution given related with luminosity computation for 2011 data

There are two sets of data sample that can be used for cosmic ray physics analysis:

- NO BEAM RUNS (dedicated cosmic runs) → finished
- BEAM RUNS (cosmic trigger during pp collisions) → work in progress.

In this talk, we present the results for:

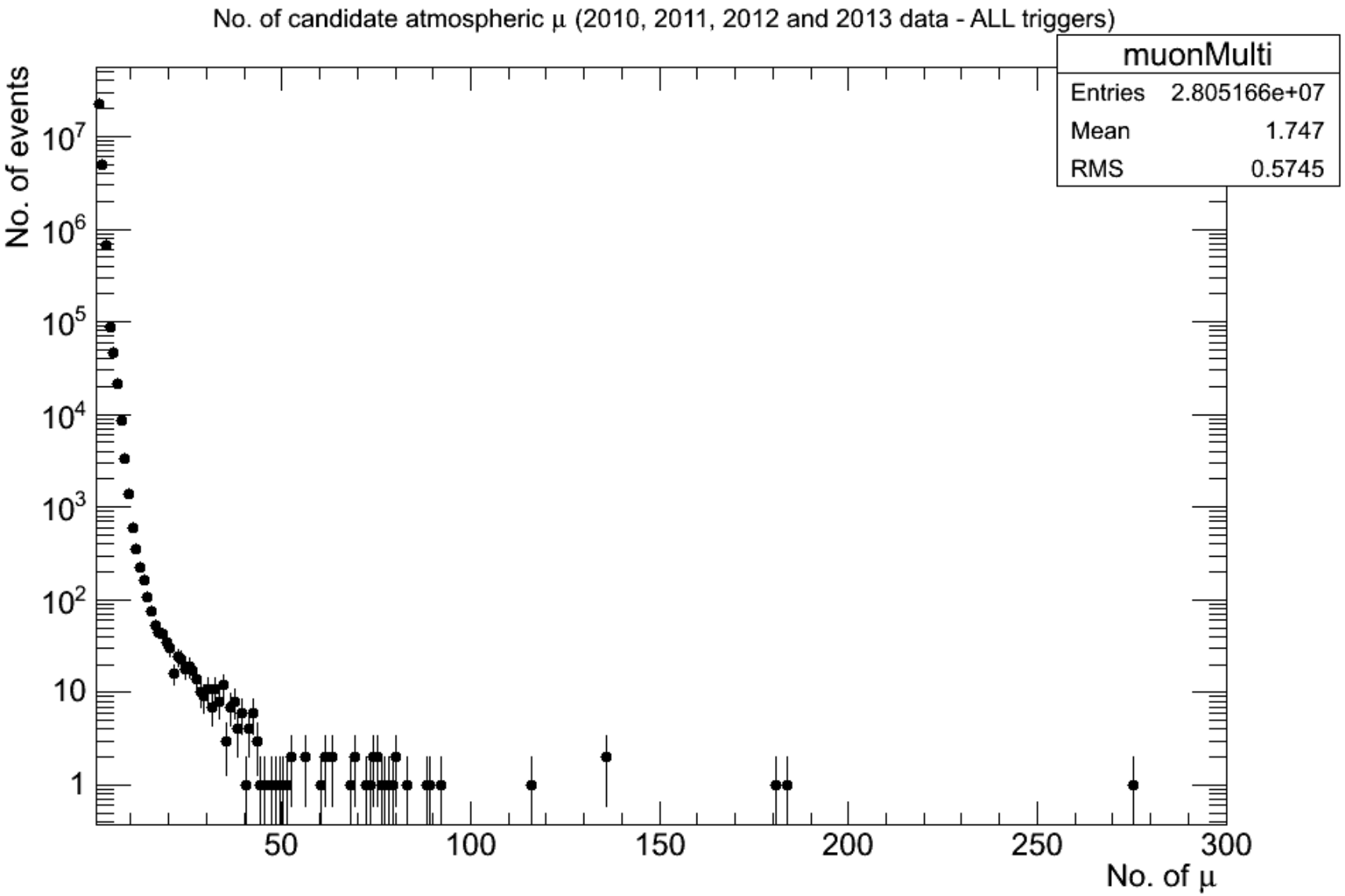
- 2010: LHC10a & LHC10d
- 2011: LHC11a, LHC11b, LHC11c, LHC11d, LHC11e & LHC11f
- 2012: LHC12a, LHC12b, LHC12c, LHC12d, LHC12f & LHC12h
- 2013: LHC13a

⌘ Cosmic runs: summary of statistics for 2010-2013 data (NO BEAM RUNS)

YEAR	PERIOD	# RUNS	DURATION (DAYS)	# OF EVENTS	# OF ANALYZED EVENTS	Live time analyzed (days)
2010	LHC10a	29	4	3,416,525	3,388,976	3.96
	LHC10d	2	0.46	3,602,651	3,582,384	0.45
2011	LHC11a	41	5.41	39,646,338	38,853,411	5.30
	LHC11b	21	1.24	6,188,454	4,612,176	0.92
	LHC11c	32	2.12	9,545,193	8,246,834	1.83
	LHC11d	70	4.82	9,350,408	9,168,457	4.72
	LHC11e	26	1.78	4,617,867	4,580,220	1.76
	LHC11f	5	0.28	667,697	667,697	0.28
2012	LHC12a	33	5.96	56,124,968	53,879,969	5.72
	LHC12b	8	0.68	3,469,389	3,330,613	0.65
	LHC12c	19	2.5	6,186,207	5,938,758	2.40
	LHC12d	9	0.65	1,169,663	1,146,269	0.63
	LHC12f	12	0.59	18,241,686	17,512,018	0.57
	LHC12h	9	1.02	1,906,222	1,868,097	1.00
2013	LHC13a	18	2.69	24,167,009	22,944,802	2.55
TOTAL		334	34.2	188,300,277	179,720,681	32.74

95.44% of the data analyzed

- Cosmic runs: 2010, 2011, 2012 and 2013



- MC vs DATA

As a first step, we compared the new MC with respect to the 2011 data (14.81 days of data taking). The previous result was compared only for 10 days of data taking.

Contribution of each energy range in the number of muons per event

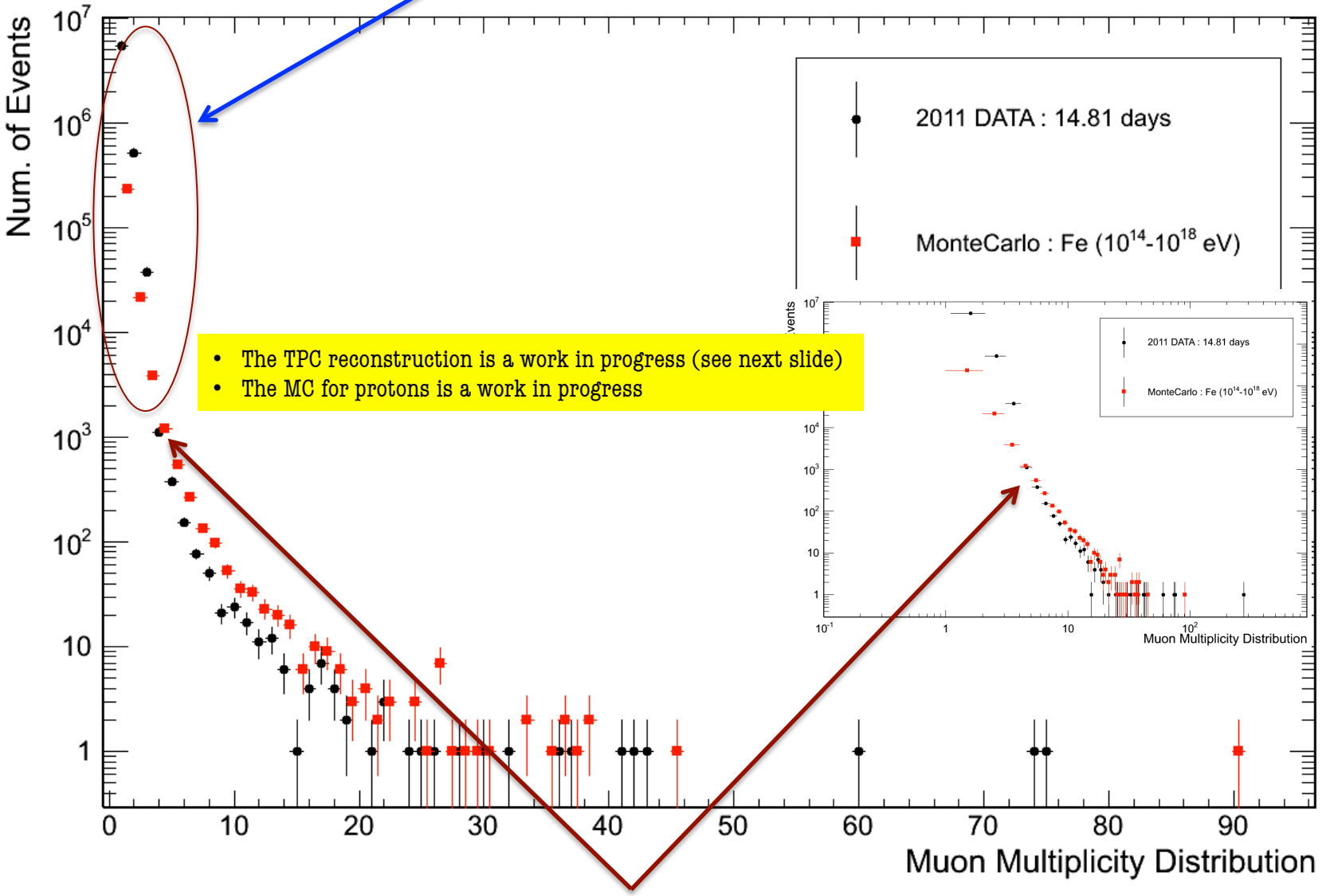
Prim. Ener. in eV	10^{13} 10^{14}	10^{14} 10^{15}	10^{15} $3\ 10^{15}$	$3\ 10^{15}$ 10^{16}	10^{16} $3\ 10^{16}$	$3\ 10^{16}$ 10^{17}	10^{17} $3\ 10^{17}$	$3\ 10^{17}$ 10^{18}
14.81 days	256,575,430	5,119,358	88,122	12,453	1094	124	10	1
p	1-4	1-10	1-20	1-47				
Fe	1-4	1-10	1-20	1-60				

It is expected to have more than 60 muons for Fe and more than 47 muons for proton in this range of energy.

The first range of energy does not have events with Nmu>4
The high mult. events (Nmu>100) have always E>10^{16} eV

- MC vs DATA

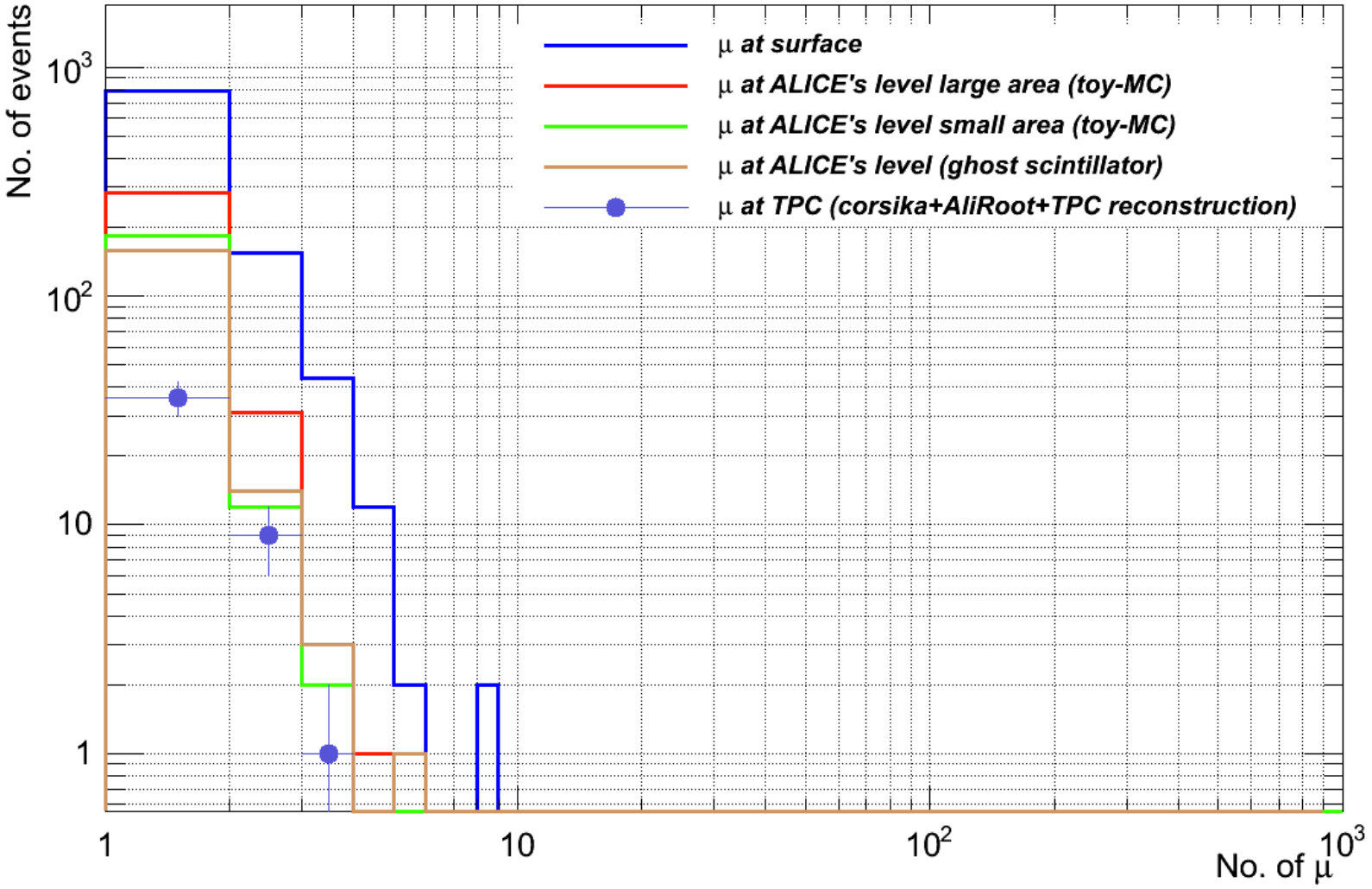
We are not simulating events with energies between 10^{13} - 10^{14} eV



The normalization is absolute and it is valid starting for #muons=4.

- MC vs DATA

# of events: 1000
Energy range of primary cosmic ray: 10^{14} – 10^{15} eV



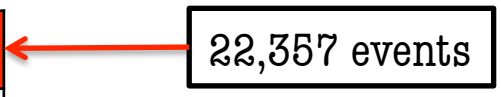
- Beam runs: 2012

BEAM RUNS (COSMIC TRIGGER DURING pp RUNS)

Period	Long (days)	#runs	# events (AMU triggers)	# events analyzed
LHC12c	2.07	53	5023	3255
LHC12d	6.67	168	29237	14384
LHC12e	0.79	21	4449	3911
LHC12f	5.26	101	27383	23181
LHC12g	0.84	15	4286	3887
TOTAL	15.63	359	70378	48618

Only 15.3% of vpass1 is reconstructed

LHC12h	178 runs	6.54 days
LHC12i	19 runs	0.72 days
TOTAL	197 runs	7.26 days



- Beam runs: 2012

BEAM RUNS (COSMIC TRIGGER DURING pp RUNS)

AMU trigger	LHC12c	LHC12d	LHC12e	LHC12f	LHC12g	LHC12h
mean L2a/L0b	0.78	0.56	0.78	0.68	0.64	0.47

Mean of L2a/L0b (AMU) for 2012 p-p runs: 0.65

Period	L2a/L0b (AMU)	Long (days)	Long (real days)	Days analyzed
LHC12c	0.78	2.07	1.61	1.05
LHC12d	0.56	6.67	3.74	1.84
LHC12e	0.78	0.79	0.62	0.54
LHC12f	0.68	5.26	3.58	3.03
LHC12g	0.64	0.84	0.54	0.49
TOTAL		15.63	10.08	6.94

Long (real days) = Long(days) x L2a/L0b

In 15.63 days (6.94 real days) we found one event with 68 atm. muons

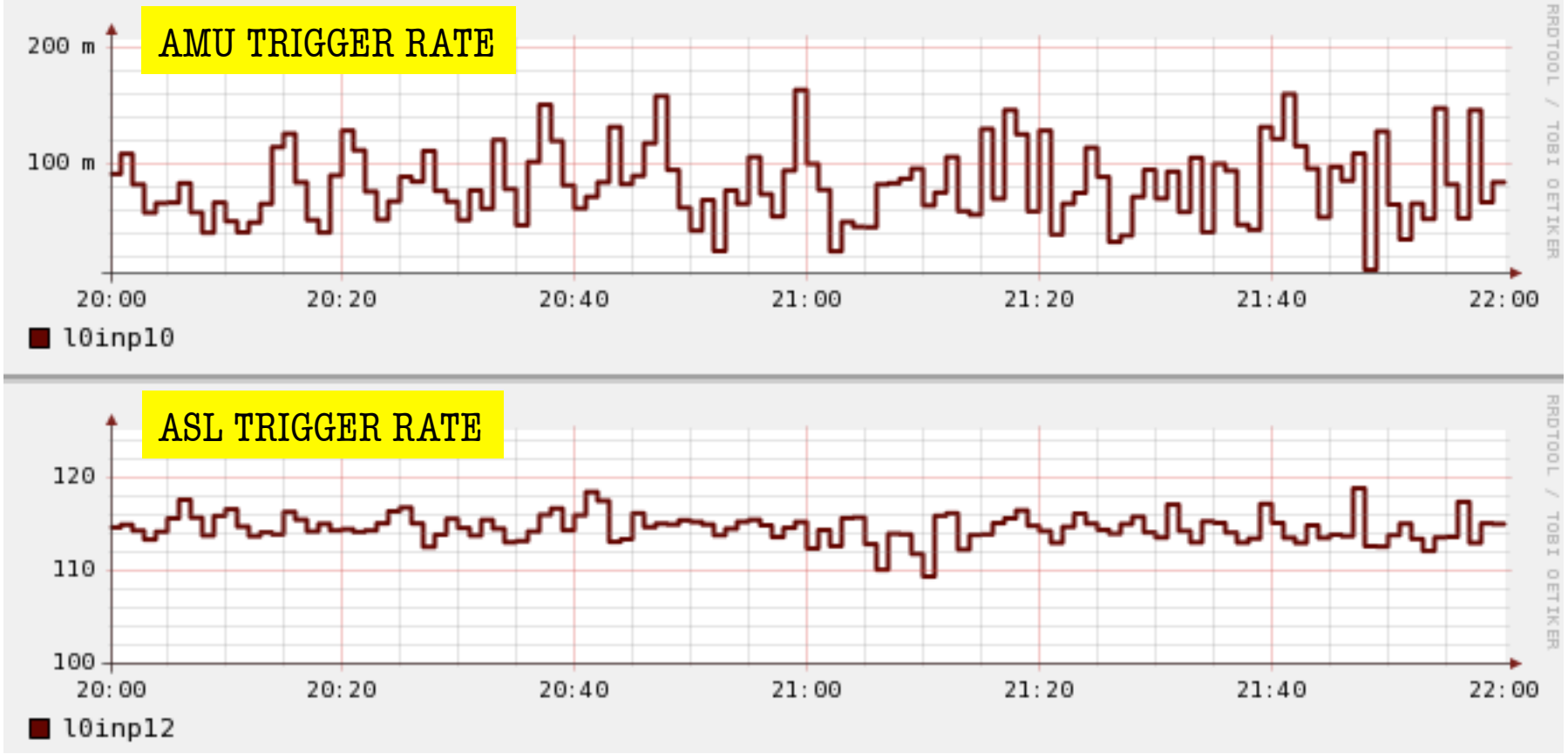
- Beam runs: 2012

SOME DEFINITIONS

- AMU : multi coincidence trigger of ACORDE
- SLO : single muon trigger of ACORDE
- BPA: beam presence side A
- BPC: beam presence side C

- Beam runs: 2012

ACORDE RATE DURING NO BEAM RUNS



- Beam runs: 2012

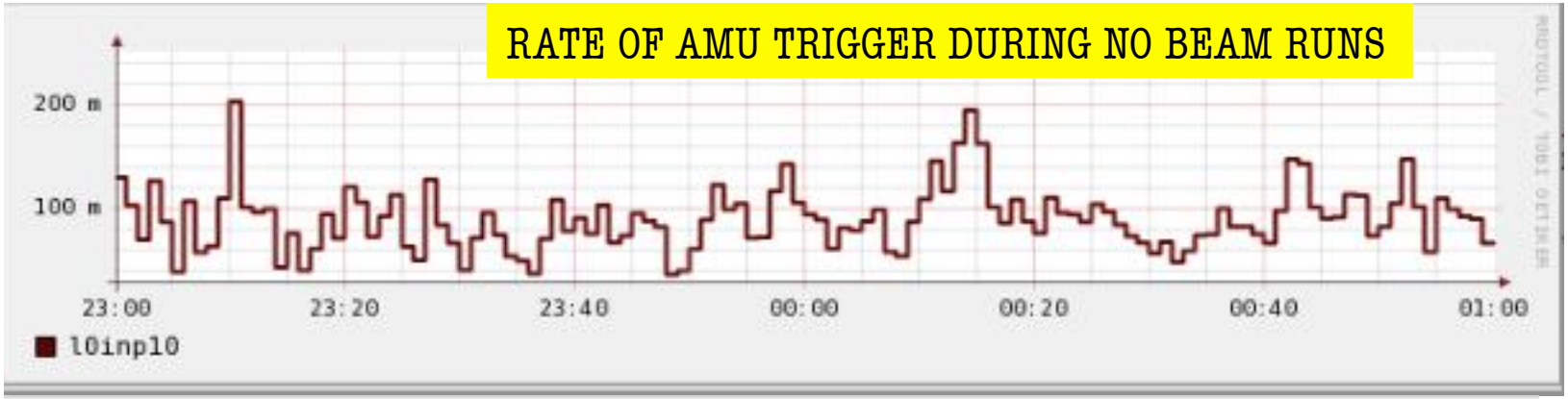
OVERVIEW ASL_BPA_BPC

- Beam runs: 2012

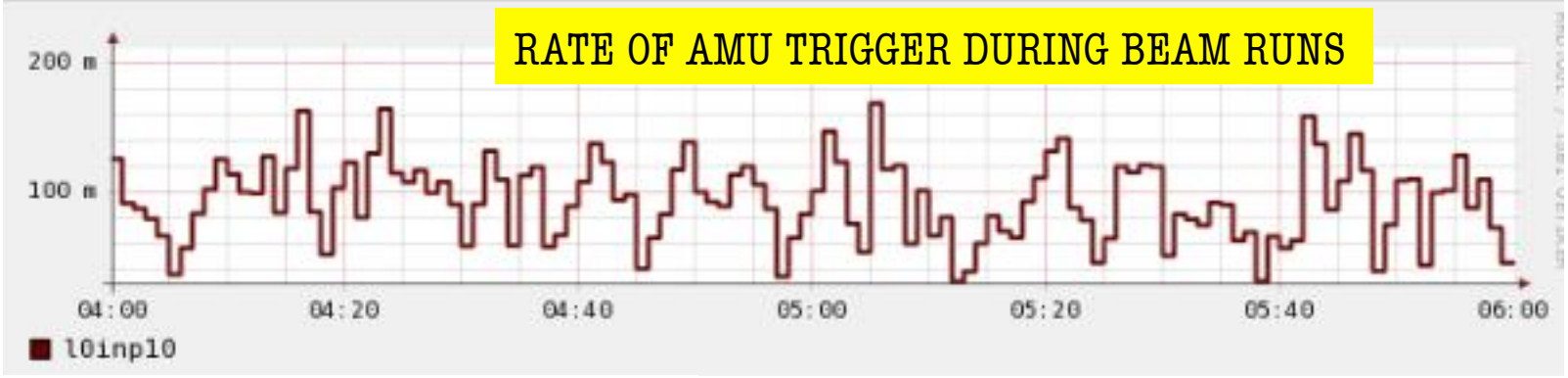
OVERVIEW OAMU

- Beam runs: 2012

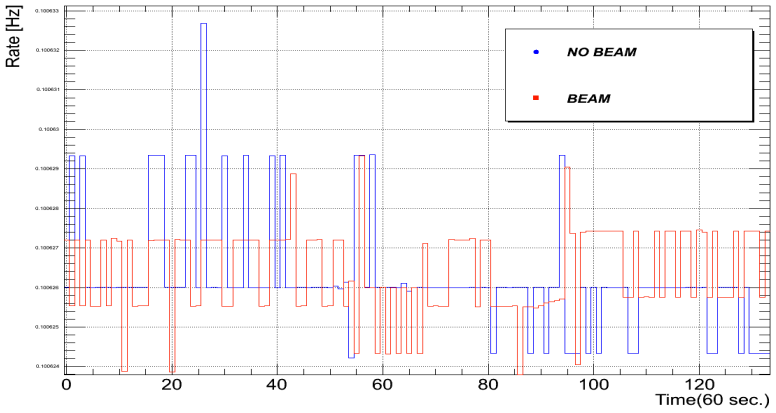
RATE OF AMU TRIGGER DURING NO BEAM RUNS



RATE OF AMU TRIGGER DURING BEAM RUNS

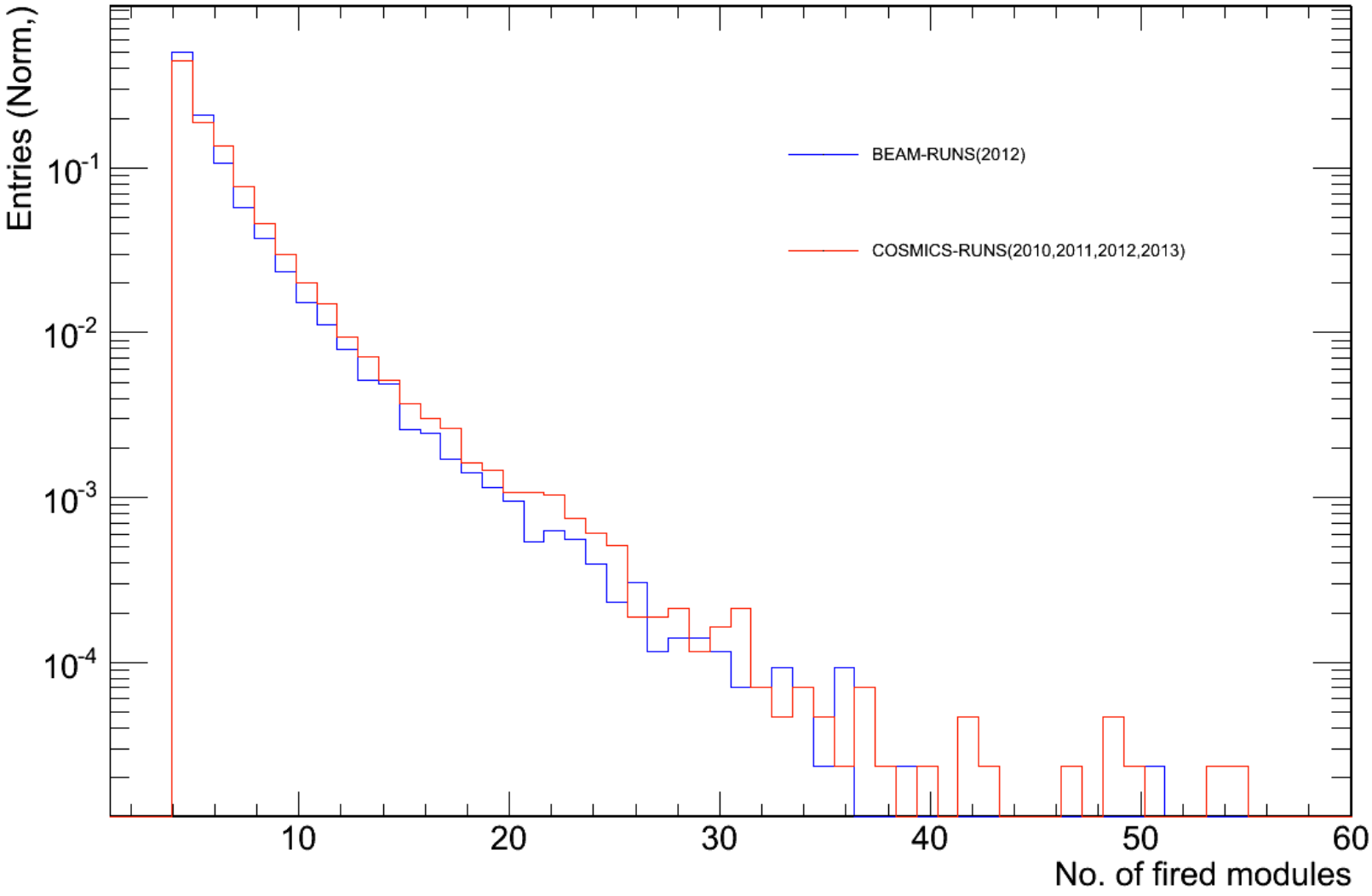


Rate of ACORDE



THE CONTAMINATION FROM THE BEAM IS NEGLICTIBLE FOR AMU TRIGGER

- Beam runs: 2012



- FINAL COMMENTS

NO BEAM RUNS (dedicated cosmic runs)

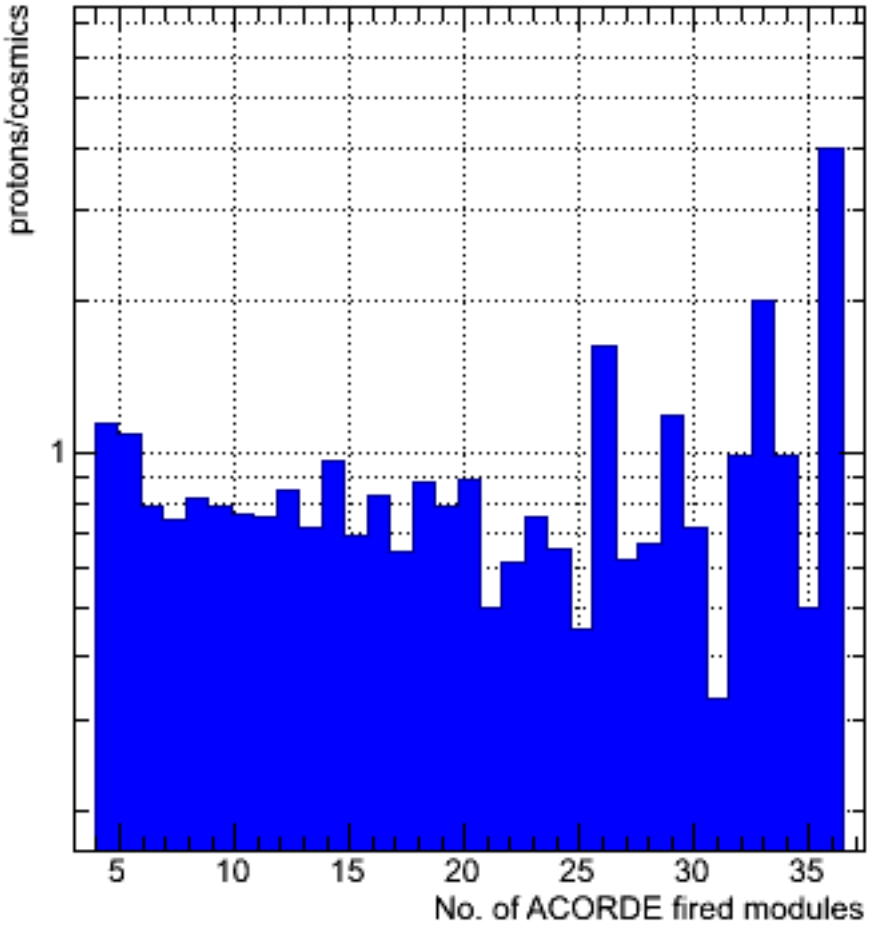
- The new MC production for Fe it is consistent with the new data sample analyzed for 2011 data.
- The TPC reconstruction is running → more news next week.
- The analysis of MC for protons is a work in progress.
- A detailed study on the events with more than 100 atmospheric muons is a work in progress.

BEAM RUNS (cosmic trigger during p-p collisions)

- The real effective live time analyzed is of 6.94 days.
- We can say more at the end of the analysis for this sample.

- Beam runs: 2012

imodule: 4 protones/cosmicos: 1.13949
imodule: 5 protones/cosmicos: 1.09281
imodule: 6 protones/cosmicos: 0.783728
imodule: 7 protones/cosmicos: 0.737501
imodule: 8 protones/cosmicos: 0.82065
imodule: 9 protones/cosmicos: 0.785147
imodule: 10 protones/cosmicos: 0.759689
imodule: 11 protones/cosmicos: 0.748001
imodule: 12 protones/cosmicos: 0.846036
imodule: 13 protones/cosmicos: 0.719172
imodule: 14 protones/cosmicos: 0.963802
imodule: 15 protones/cosmicos: 0.688902
imodule: 16 protones/cosmicos: 0.824628
imodule: 17 protones/cosmicos: 0.643289
imodule: 18 protones/cosmicos: 0.880324
imodule: 19 protones/cosmicos: 0.786985
imodule: 20 protones/cosmicos: 0.88754
imodule: 21 protones/cosmicos: 0.497888
imodule: 22 protones/cosmicos: 0.611045
imodule: 23 protones/cosmicos: 0.746833
imodule: 24 protones/cosmicos: 0.651085
imodule: 25 protones/cosmicos: 0.452626
imodule: 26 protones/cosmicos: 1.61814
imodule: 27 protones/cosmicos: 0.622361
imodule: 28 protones/cosmicos: 0.663851
imodule: 29 protones/cosmicos: 1.19493
imodule: 30 protones/cosmicos: 0.711269
imodule: 31 protones/cosmicos: 0.331926
imodule: 32 protones/cosmicos: 0.995777
imodule: 33 protones/cosmicos: 1.99155
imodule: 34 protones/cosmicos: 0.995777
imodule: 35 protones/cosmicos: 0.497888
imodule: 36 protones/cosmicos: 3.98311



- MC - sample

There are two sets of Monte Carlo data sample that can be used to compare against the data: Fe and proton as primary.

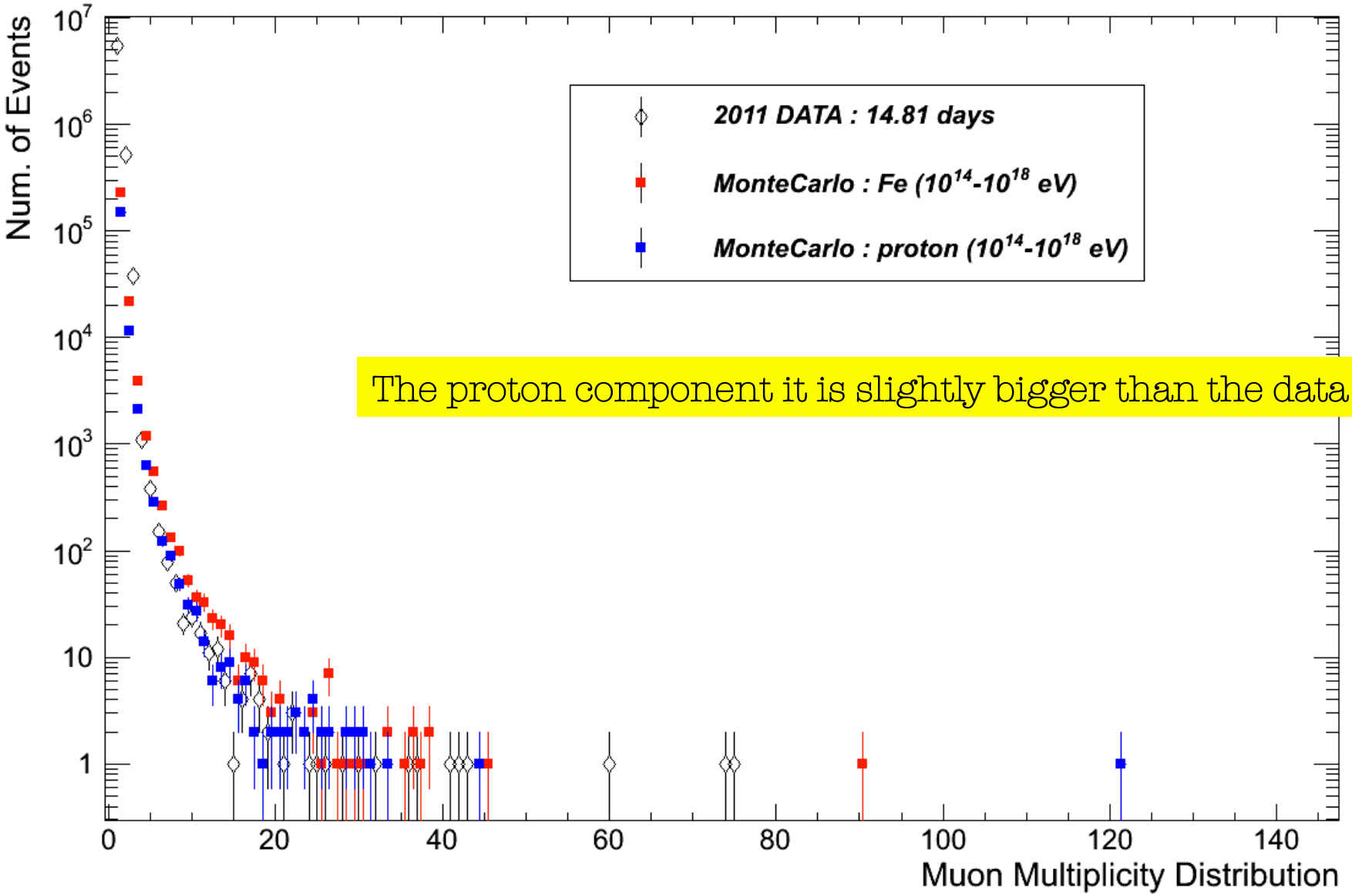
Chunk	#events (Fe)	#events (proton)
Fe/p_tree_1014_1015_wrall_1.root	1,410,000	1,460,691
Fe/p_tree_1014_1015_wrall_2.root	1,410,000	1,460,691
Fe/p_tree_1014_1015_wrall_3.root	1,410,000	1,460,691
Fe/p_tree_1014_1015_wrall_4.root	889,358	737,285
Fe/p_tree_1015_31015_wrall_1.root	88,122	88,122
Fe/p_tree_31015_1016_wrall_1.root	12,453	12,453
Fe/p_tree_1016_31016_wrall_1.root	1,094	1,094
Fe/p_tree_31016_1017_wrall_1.root	124	124
Fe/p_tree_1017_31017_wrall_1.root	10	10
Fe/p_tree_31017_1018_wrall_1.root	1	1

⌘ Cosmic runs: summary of statistics for 2011 data (NO BEAM RUNS)

We are going to compare the MC vs 2011 data (14.81 days)

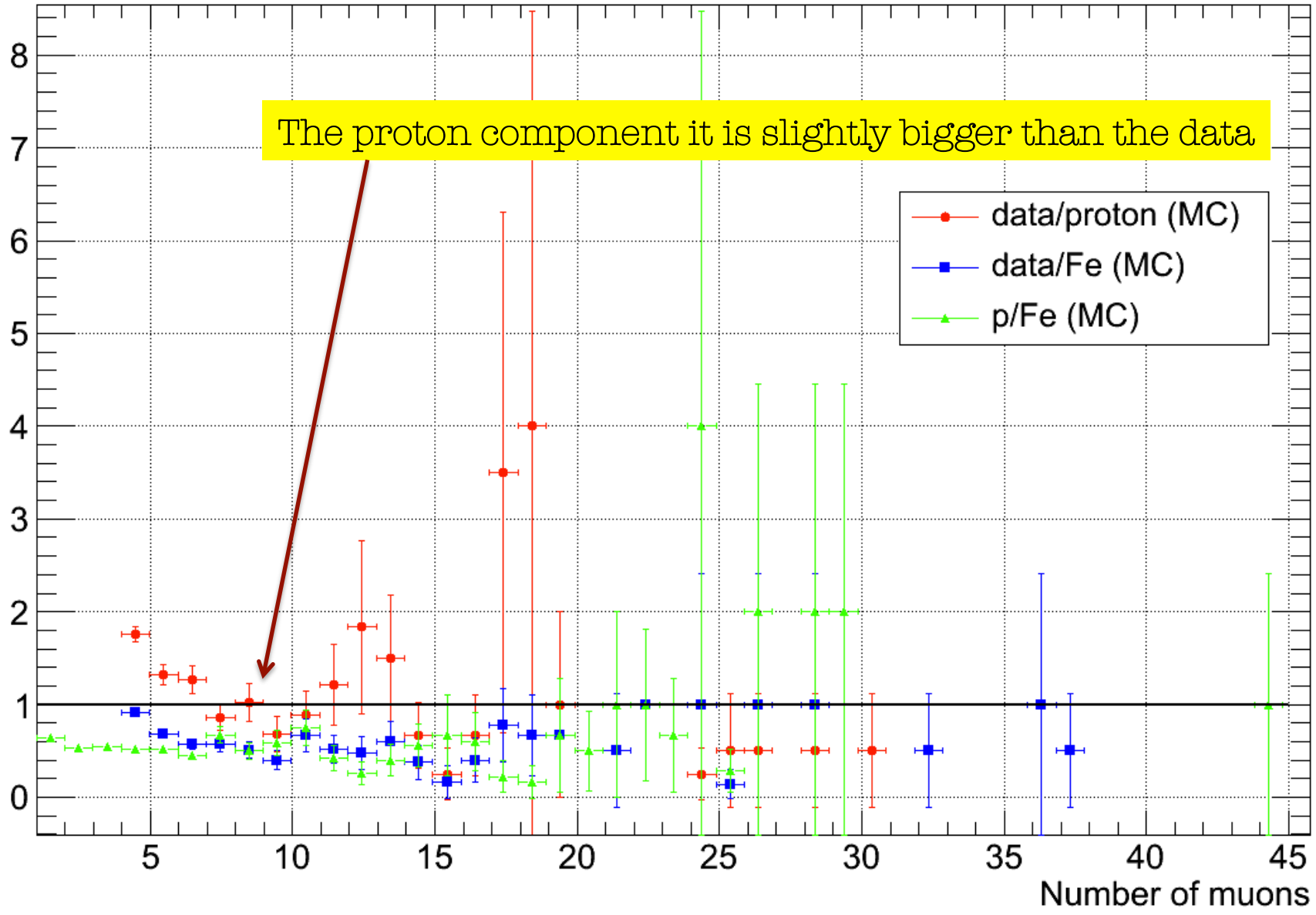
YEAR	PERIOD	# RUNS	DURATION (DAYS)	# OF EVENTS	# OF ANALYZED EVENTS	Live time analyzed (days)
2011	LHC11a	41	5.41	39,646,338	38,853,411	5.30
	LHC11b	21	1.24	6,188,454	4,612,176	0.92
	LHC11c	32	2.12	9,545,193	8,246,834	1.83
	LHC11d	70	4.82	9,350,408	9,168,457	4.72
	LHC11e	26	1.78	4,617,867	4,580,220	1.76
	LHC11f	5	0.28	667,697	667,697	0.28
TOTAL		195	15.65	70,015,957	66,128,795	14.81

- MC/Data sample

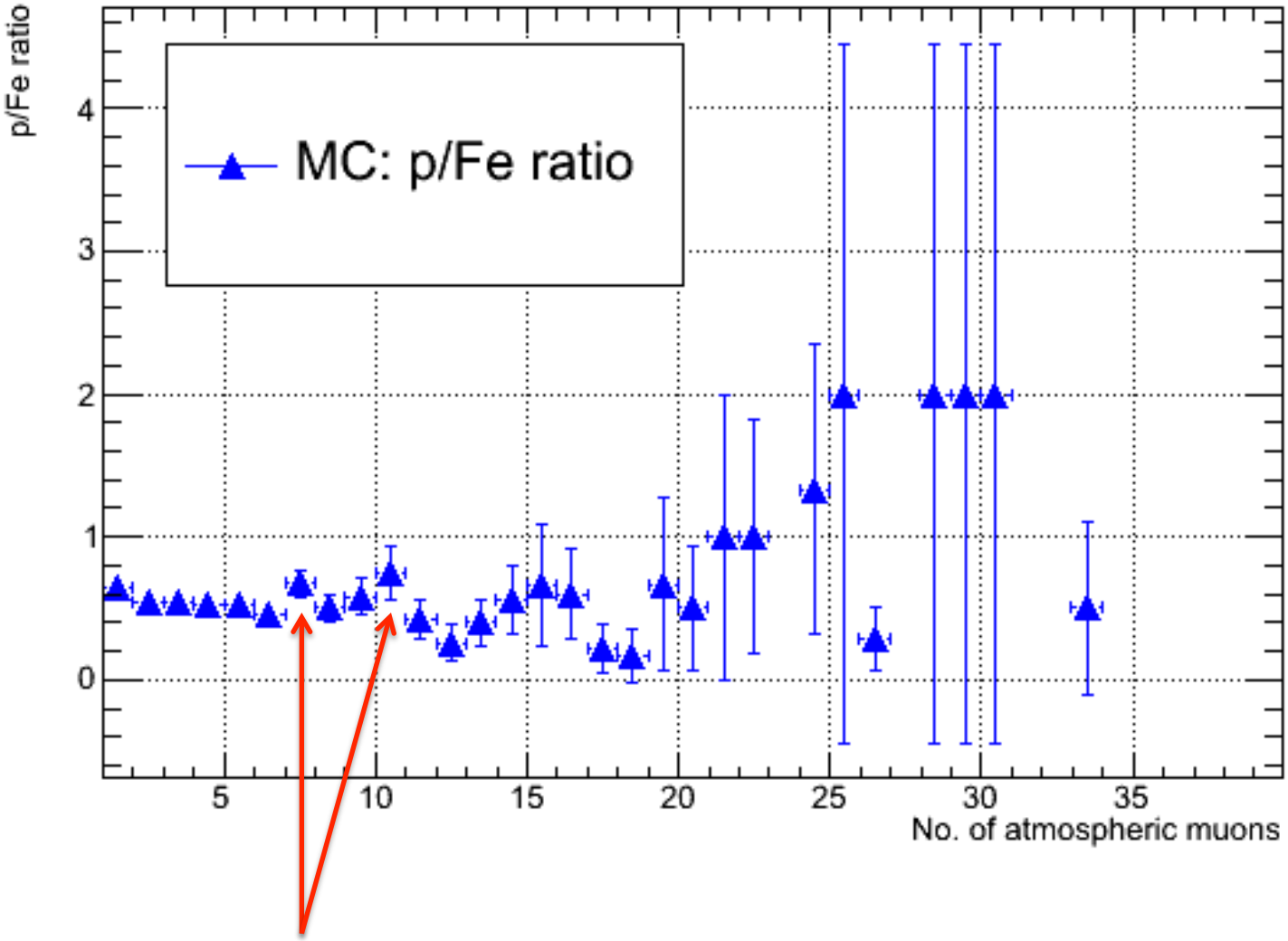


The proton component it is slightly bigger than the data

- MC/Data sample

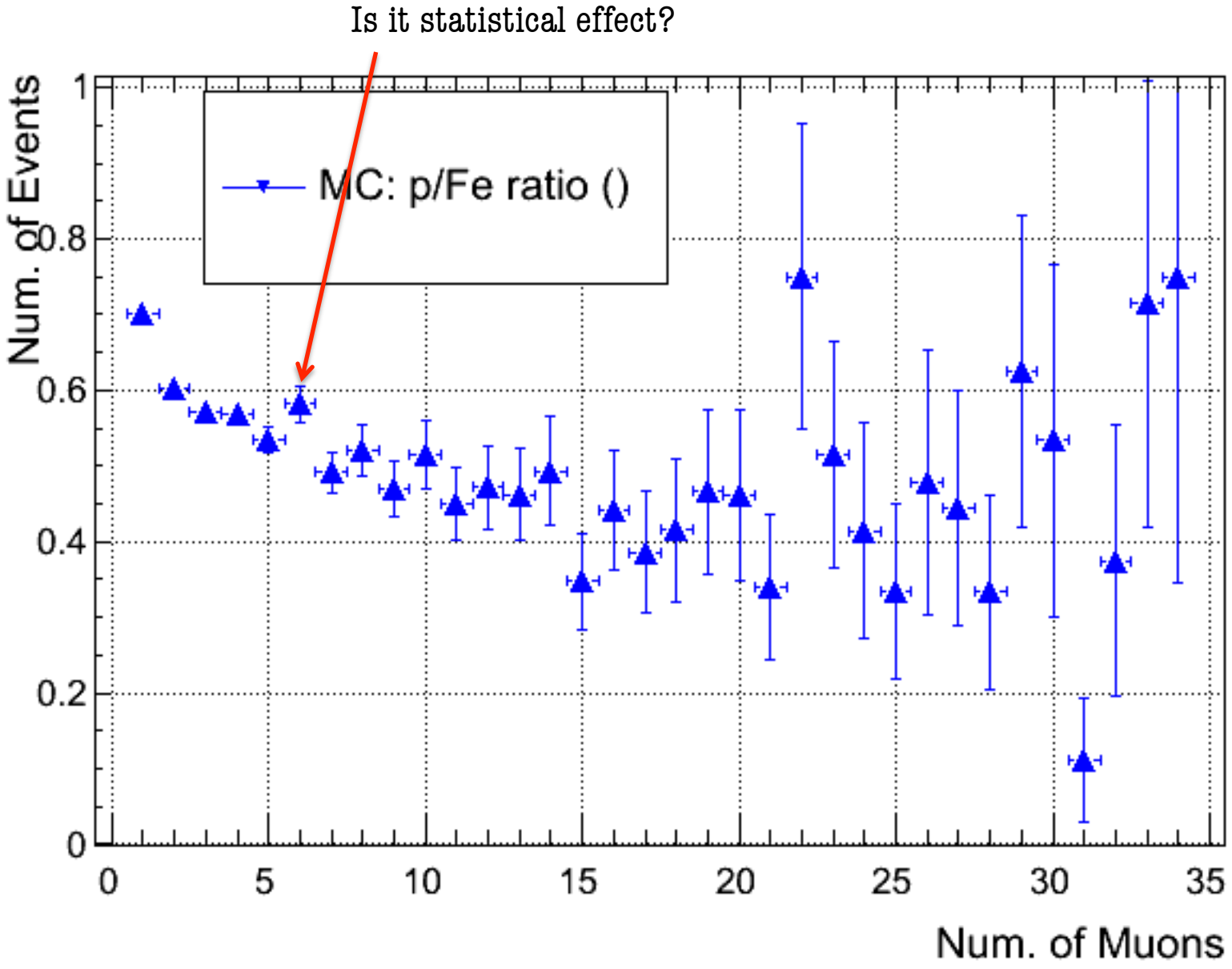


- MC/Data sample



Strange behavior? → Let's see with more statistics

- MC/Data sample



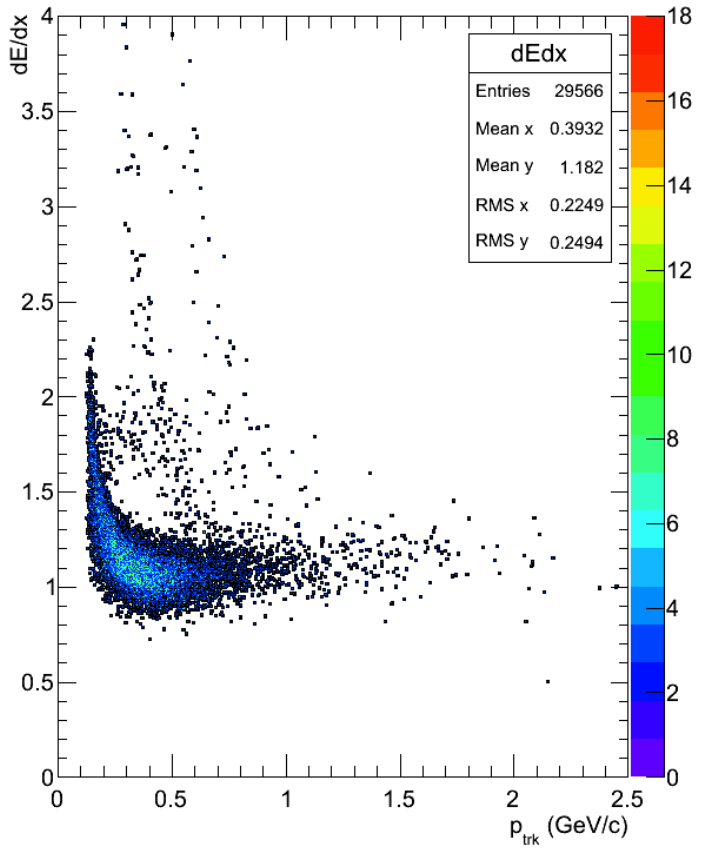
A first look to p-Pb data:

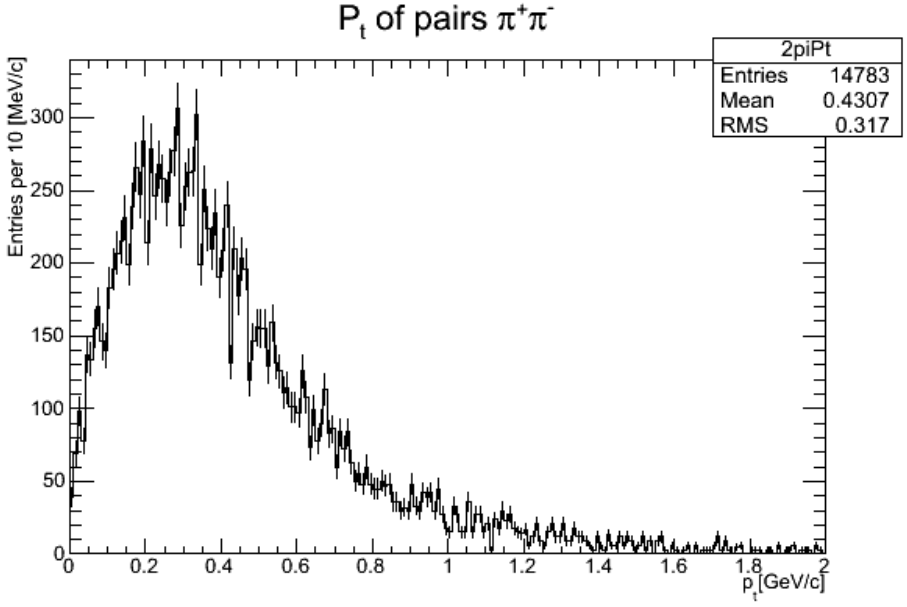
Minimum bias trigger: CINT1-B

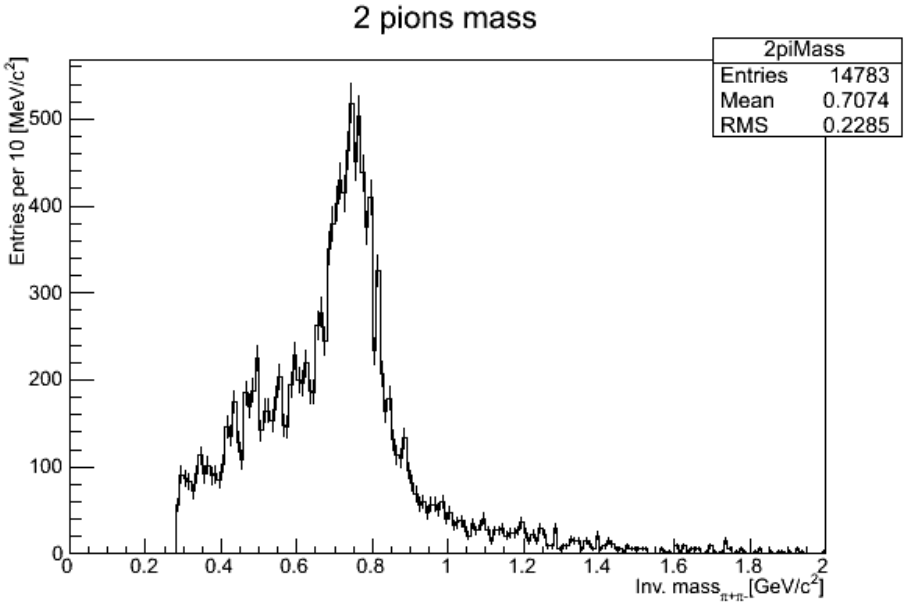
List of runs
195344
195346
195351
195389
195390
195391

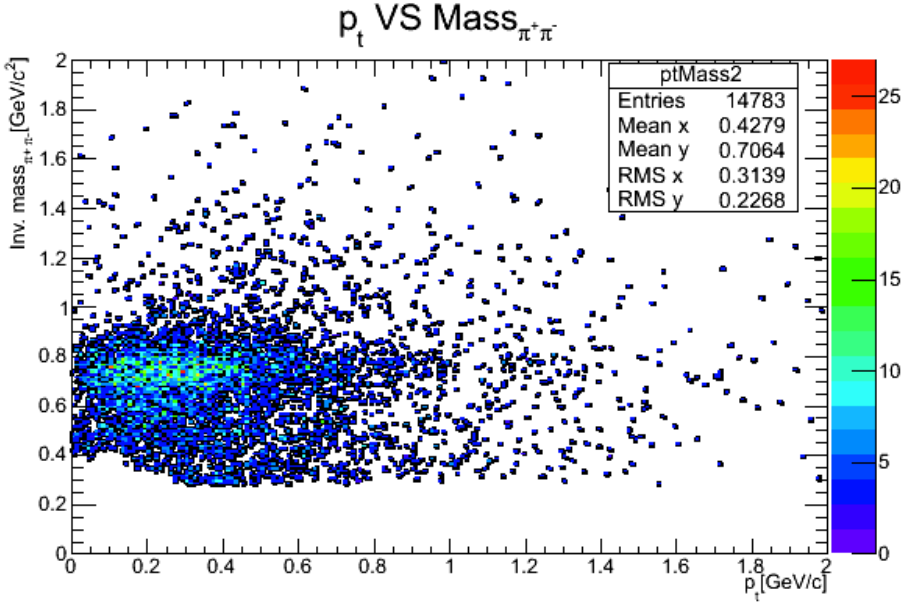
Trigger: CINT1-B && (!V0A && !V0C)

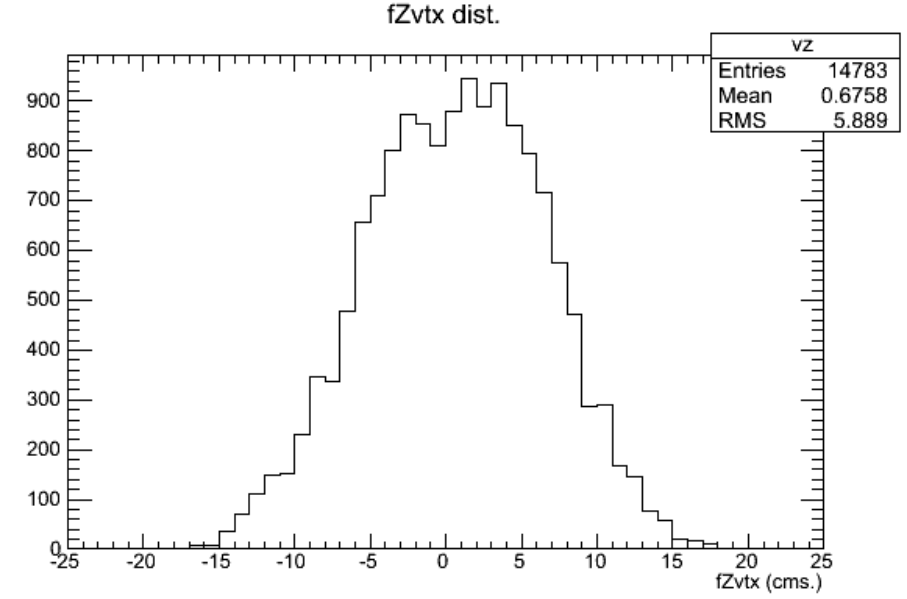
Cuts applied for 2 pions system
-- two accepted tracks: 15511
-- CutStandardTPC_ITS: 14783




P_t of pairs $\pi^+\pi^-$
2piPt
Entries 14783
Mean 0.4307
RMS 0.317
Entries per 10 [MeV/c]
p_t[GeV/c]


2 pions mass
2piMass
Entries 14783
Mean 0.7074
RMS 0.2285
Entries per 10 [MeV/c^2]
Inv. mass$_{\pi^+\pi^-}$[GeV/c^2]

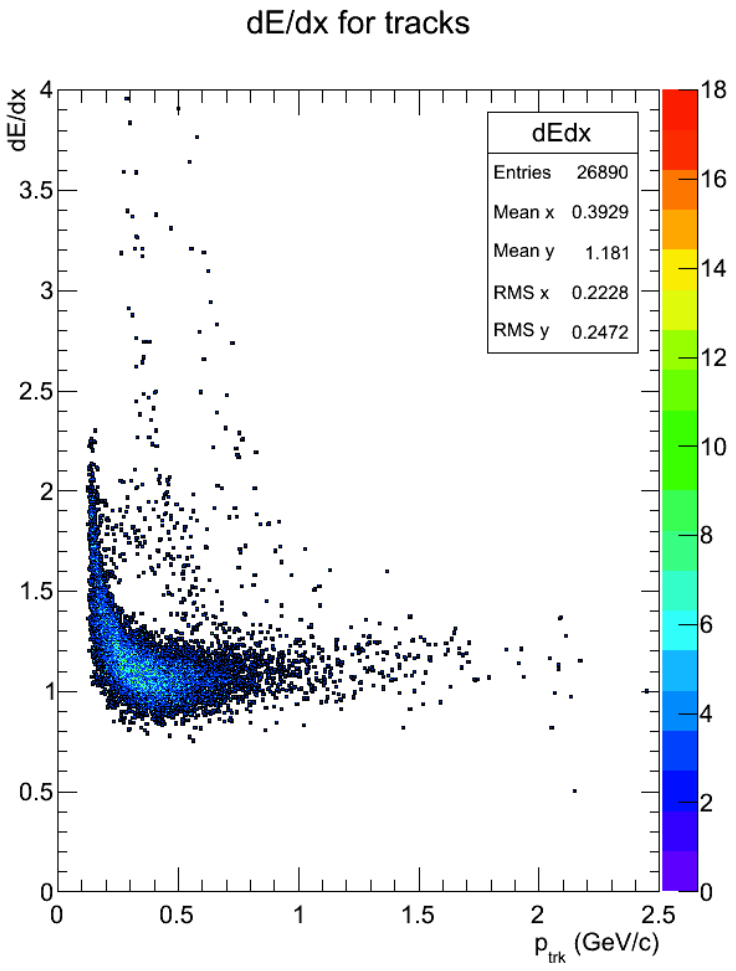

p_t VS Mass$_{\pi^+\pi^-}$
ptMass2
Entries 14783
Mean x 0.4279
Mean y 0.7064
RMS x 0.3139
RMS y 0.2268
Inv. mass$_{\pi^+\pi^-}$[GeV/c^2]
p_t[GeV/c]

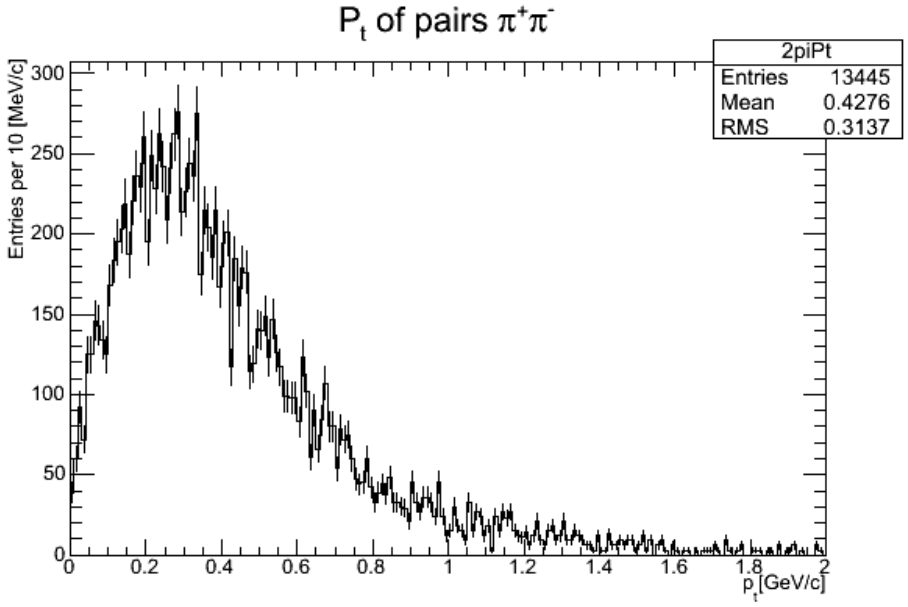

fZvtx dist.
vz
Entries 14783
Mean 0.6758
RMS 5.889
fZvtx (cms.)

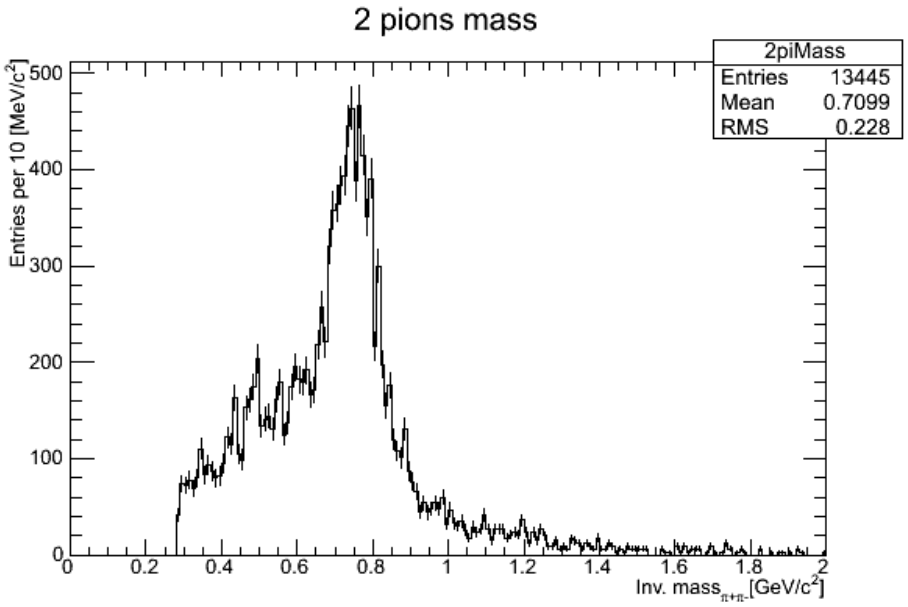
List of runs
195344
195346
195351
195389
195390
195391

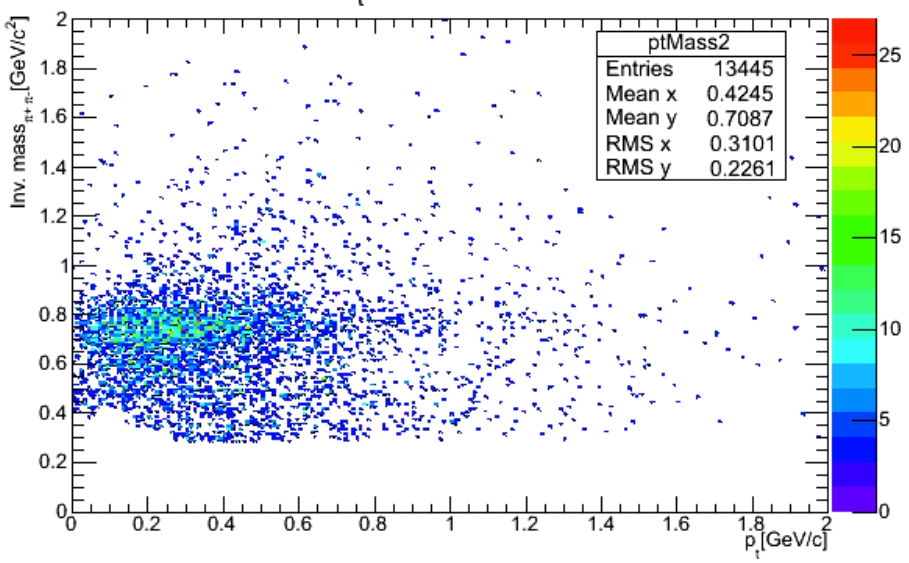
Trigger: CINT1-B && (!V0A && !V0C)

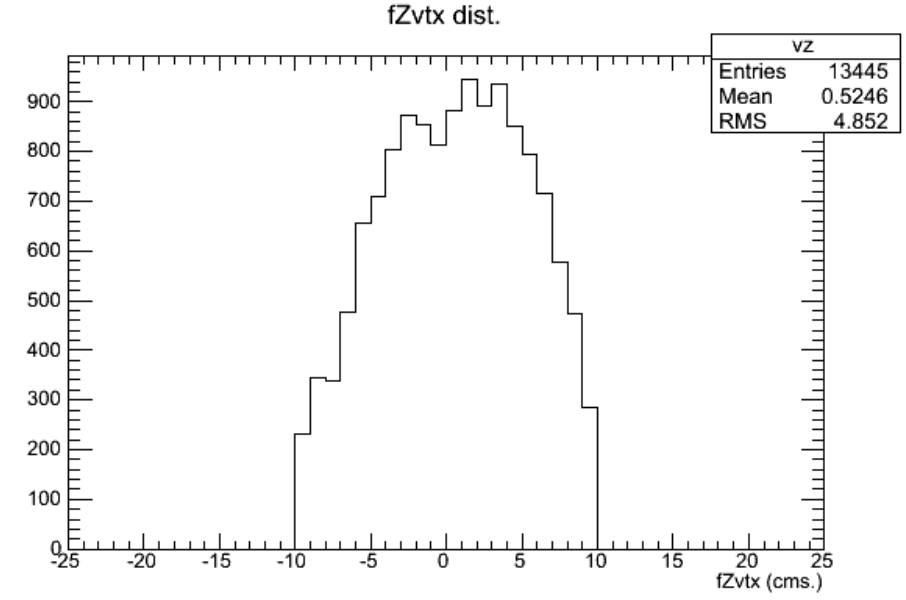
Cuts applied for 2 pions system
-- two accepted tracks: 15511
-- CutStandardTPC_ITS: 14783
-- |Vz|<10: 13445




P_t of pairs $\pi^+\pi^-$
2piPt
Entries 13445
Mean 0.4276
RMS 0.3137
Entries per 10 [MeV/c]
p_t[GeV/c]


2 pions mass
2piMass
Entries 13445
Mean 0.7099
RMS 0.228
Entries per 10 [MeV/c^2]
Inv. mass$_{\pi^+\pi^-}$[GeV/c^2]


p_t VS Mass$_{\pi^+\pi^-}$
ptMass2
Entries 13445
Mean x 0.4245
Mean y 0.7087
RMS x 0.3101
RMS y 0.2261
Inv. mass$_{\pi^+\pi^-}$[GeV/c^2]
p_t[GeV/c]

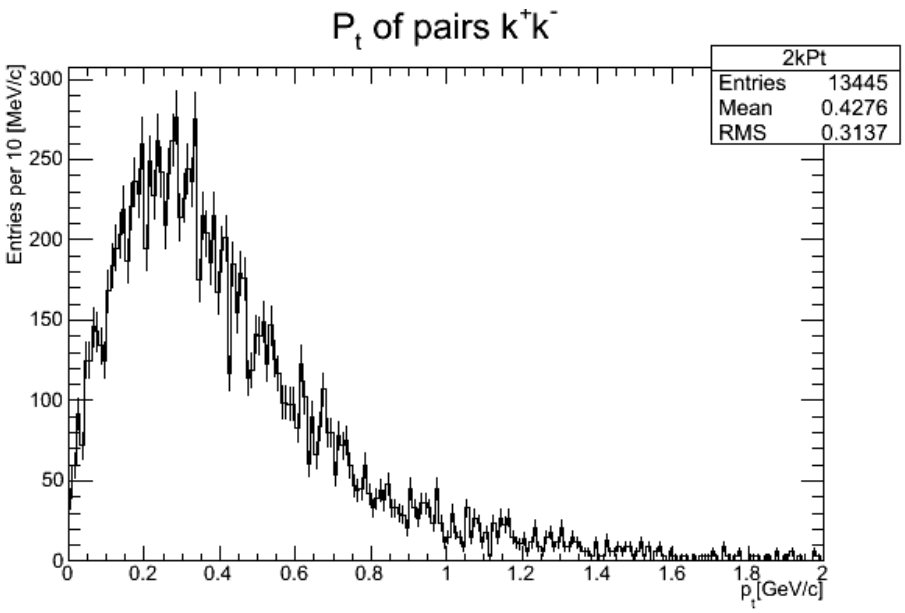

fZvtx dist.
vz
Entries 13445
Mean 0.5246
RMS 4.852
fZvtx (cms.)

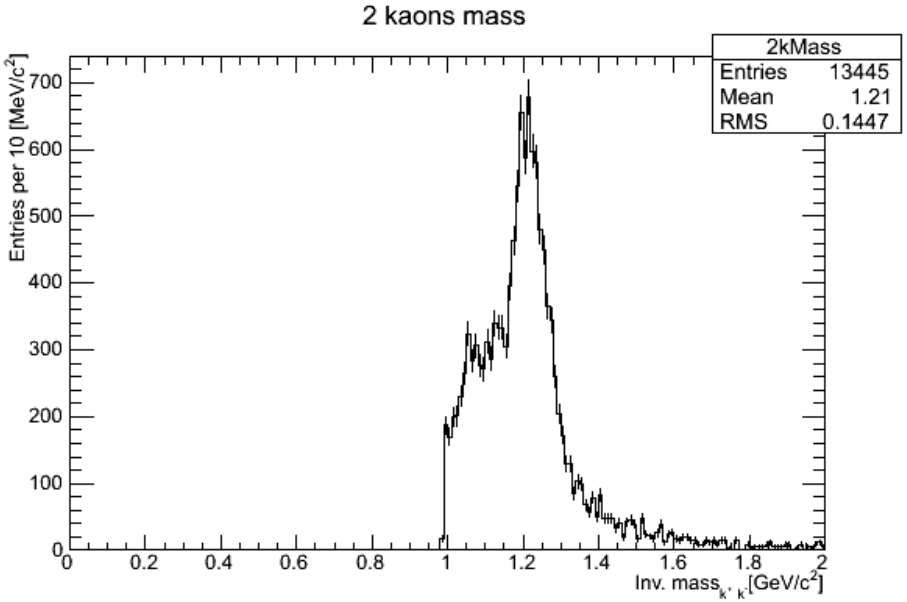
List of runs
195344
195346
195351
195389
195390
195391

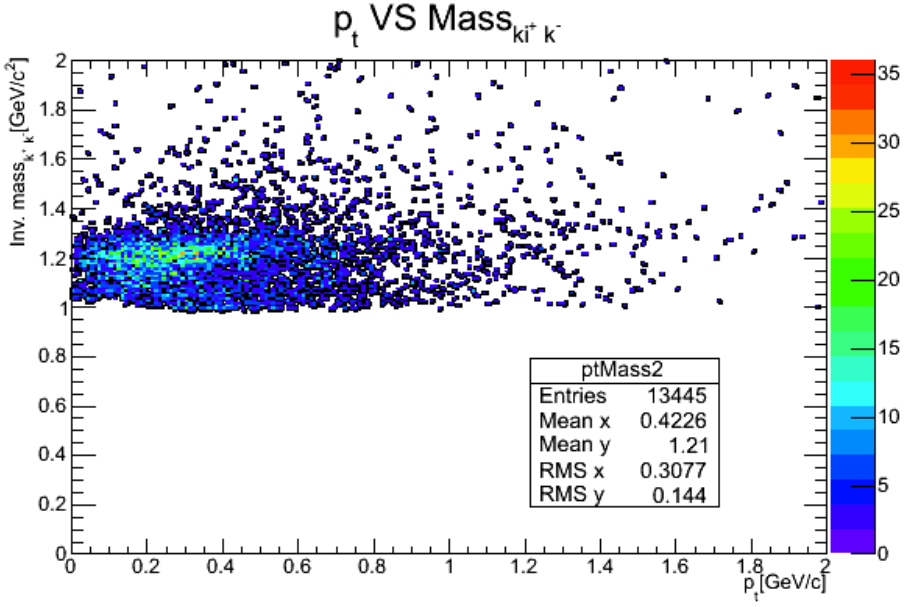
Trigger: CINT1-B && (!V0A && !V0C)

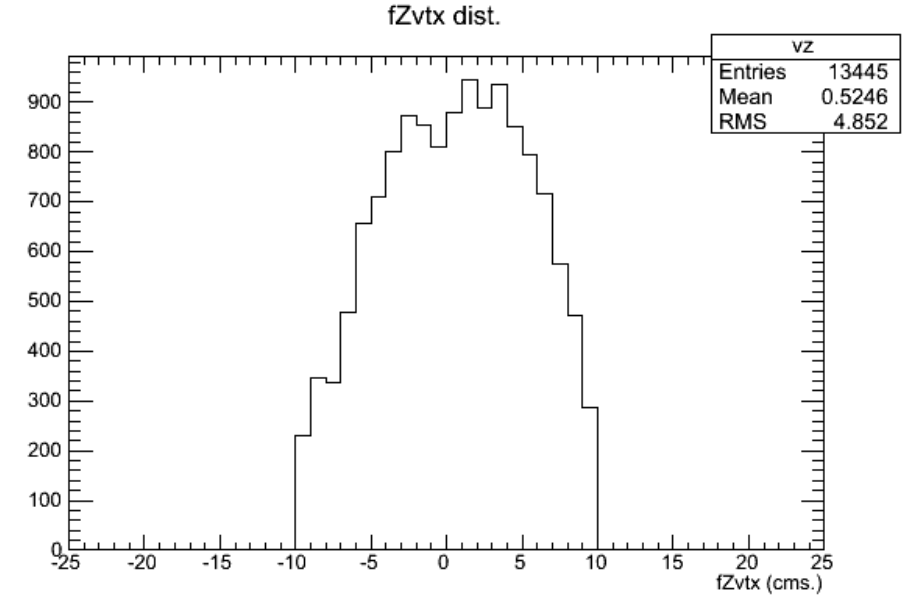
The momentum vector of each track is built assigning the kaon mass mass to the positive/negative tracks.

Cuts applied for 2 kaons system
-- two accepted tracks: 15511
-- CutStandardTPC_ITS: 14783
-- |Vz|<10: 13445


P_t of pairs k^+k^-
2kPt
Entries 13445
Mean 0.4276
RMS 0.3137
Entries per 10 [MeV/c]
p_t[GeV/c]


2 kaons mass
2kMass
Entries 13445
Mean 1.21
RMS 0.1447
Entries per 10 [MeV/c^2]
Inv. mass$_{k^+,k^-}$[GeV/c^2]

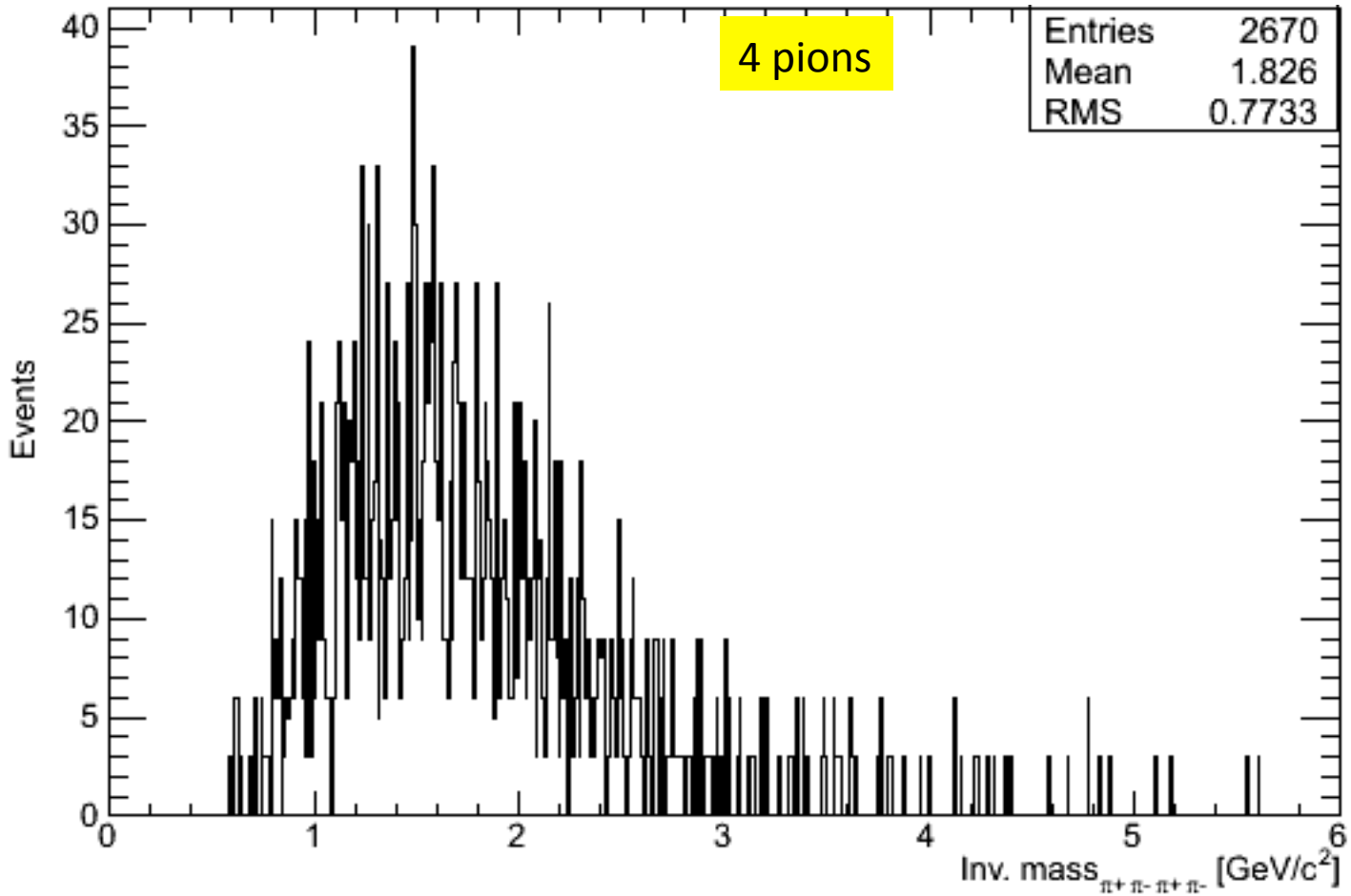

p_t VS Mass$_{ki^+ k^-}$
ptMass2
Entries 13445
Mean x 0.4226
Mean y 1.21
RMS x 0.3077
RMS y 0.144
Inv. mass$_{k^+,k^-}$[GeV/c^2]
p_t[GeV/c]

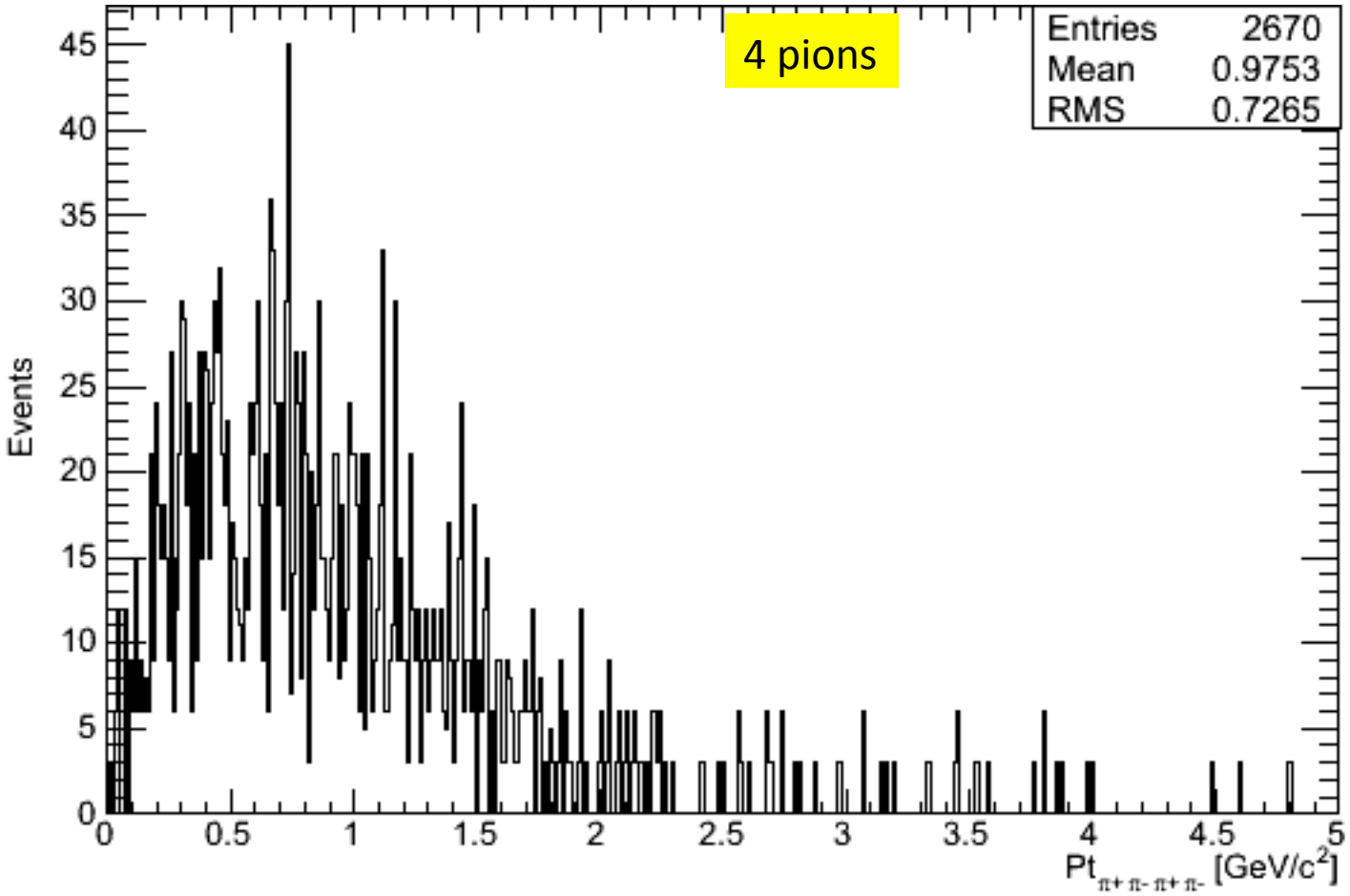

fZvtx dist.
vz
Entries 13445
Mean 0.5246
RMS 4.852
fZvtx (cms.)

List of runs
195344
195346
195351
195389
195390
195391

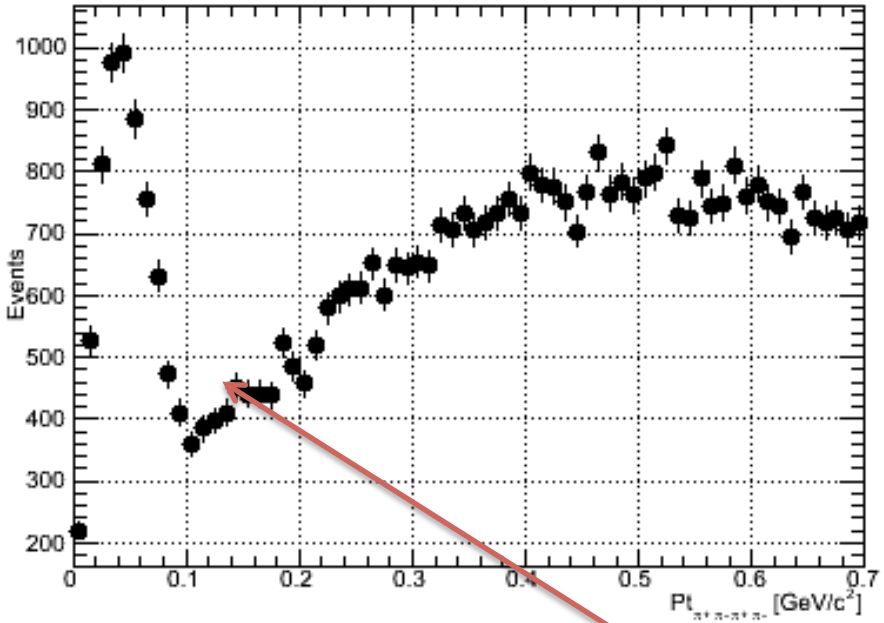
Trigger: CINT1-B && (!V0A && !V0C)

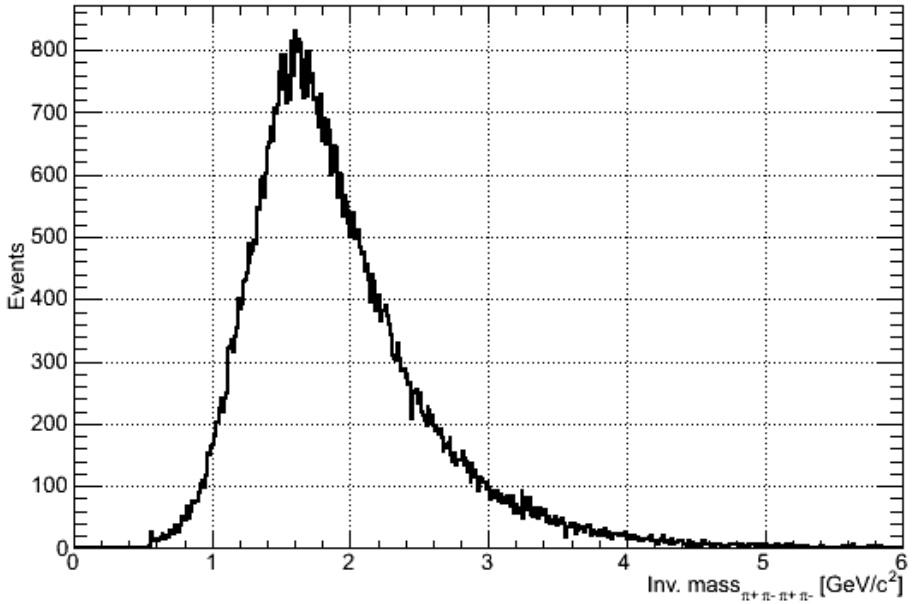
Cuts applied for 4 pions system
-- four accepted tracks: 2670

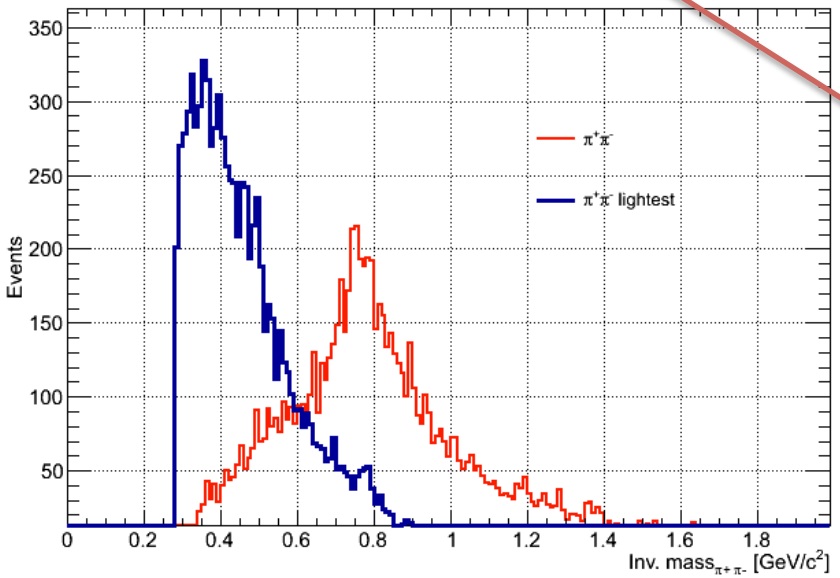

4 pions
Entries 2670
Mean 1.826
RMS 0.7733
Events
Inv. mass$_{\pi^+\pi^-\pi^+\pi^-}$ [GeV/c^2]
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6


4 pions
Entries 2670
Mean 0.9753
RMS 0.7265
Events
0
5
10
15
20
25
30
35
40
45
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Pt π+ π- π+ π- [GeV/c²]

4-pi analysis: Pb-Pb data 2011







Pt of four π < 0.15 GeV/c (coherent events): 8683

A. Szczurek

1) in the plot with minv(2pi,light) and minv(2pi,heavy) there is a peak in minv(2pi,light) around the rho^0 mass: this is due to double rho^0 production
2) it would be very interesting to make a 2D plot with minv(2pi) vs. minv(2pi) for (4pi-)coherent events. You may use all combinations. In such a plot one could maybe see different contributions, like 2rho^0, rho'->rho^0+sigma and maybe more...

- FINAL COMMENTS

The analysis of 2011 is running again → to ensure that we are comparing the correct statistic with the MC sample.

The MC production with the TPC reconstruction is running @ tlapoa → only events with more than 4 muons (in large area) are going to be passed with AliRoot.

Next steps for rho analysis:

- To think how to estimate the efficiency of the trigger (plus acceptance) for CCUP4-B trigger
- To do the same analysis with p-Pb data.
- To look for the plots

TARGET: TO HAVE PRELIMINAR RESULTS (for cosmics and upc) APPROVED DURING THE APRIL APROVALS IN ALICE.