Pion production from 30 GeV p+C at NA61/SHINE. First results

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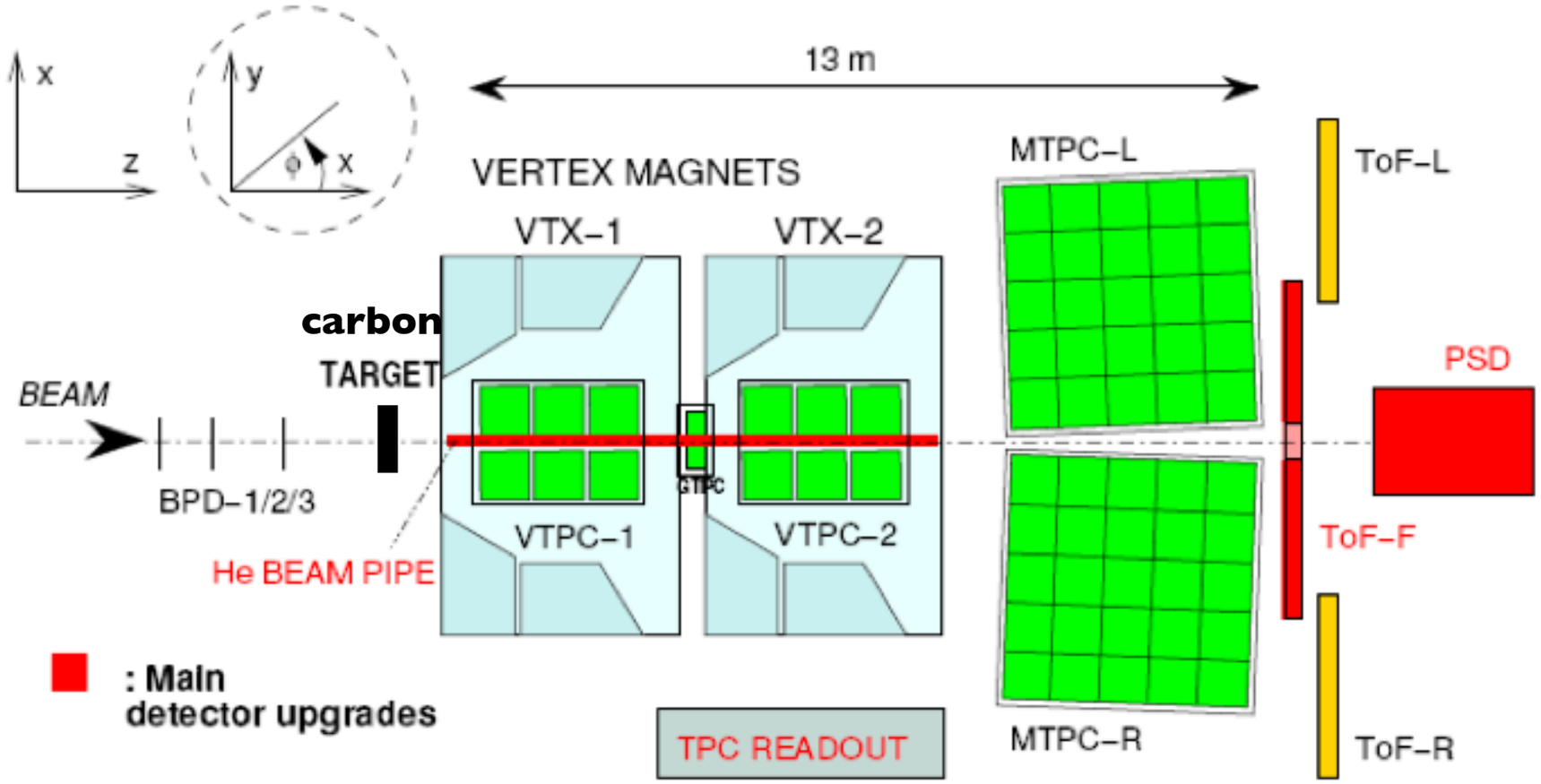
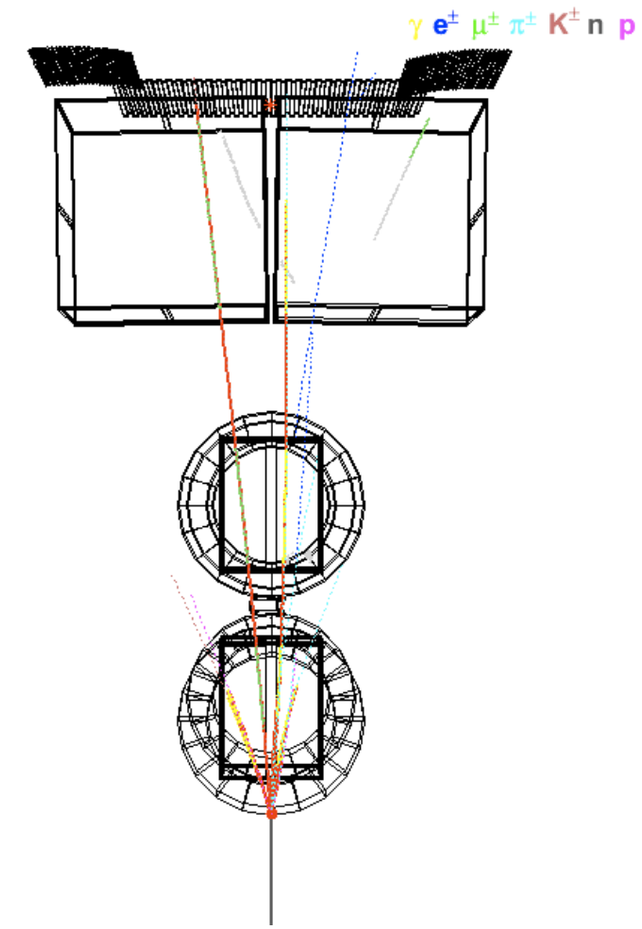
For the NA61/SHINE collaboration

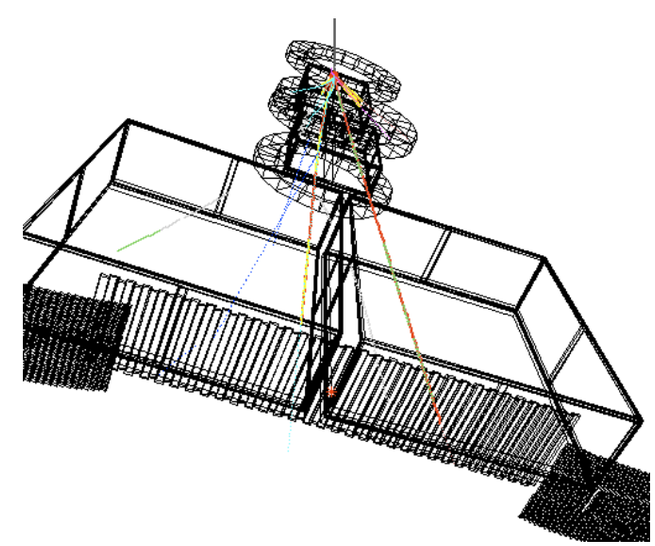
One of the Goals of the NA61/SHINE (SHINE SPS Heavy Ion and Neutrino Experiment) experiment is to provide hadron production reference measurements for the T2K neutrino oscillation experiment. Shown here are results of pion cross sections from pilot data collected in October 2007.

http://na61.web.cern.ch

NA61 detector







thin target: 2.5x2.5x2 cm^3 int. length ~ 0.04 ~600 k triggers in 2007

long target: 90 cm ∅ = 2.6 cm int. length ~ 1.9 ~250 k triggers in 2007

3 BPDs (Beam position detectors)

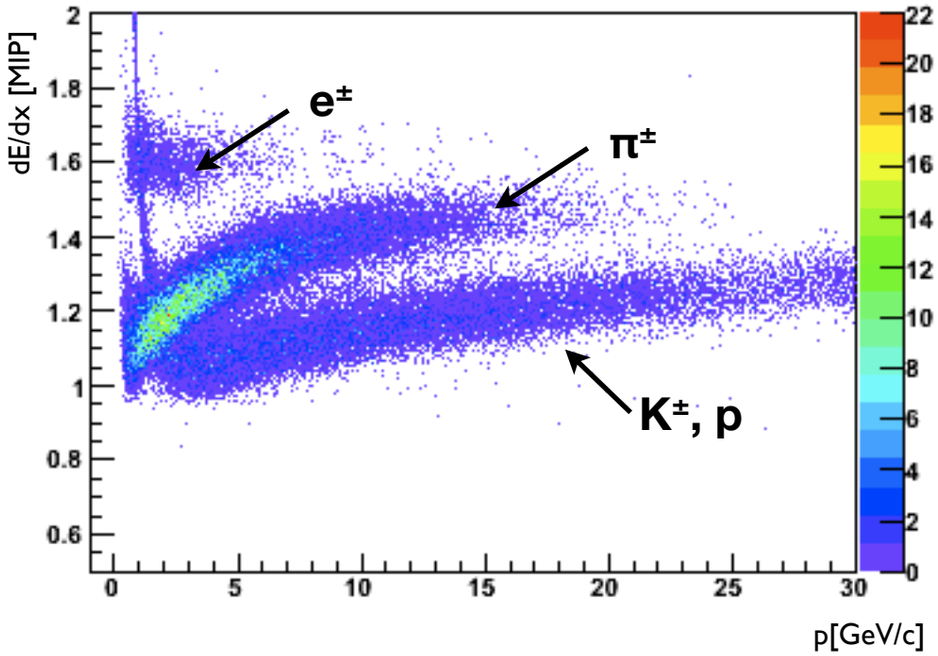
5 TPCs $\sigma(p)/p^2 \sim 10^{-4}$

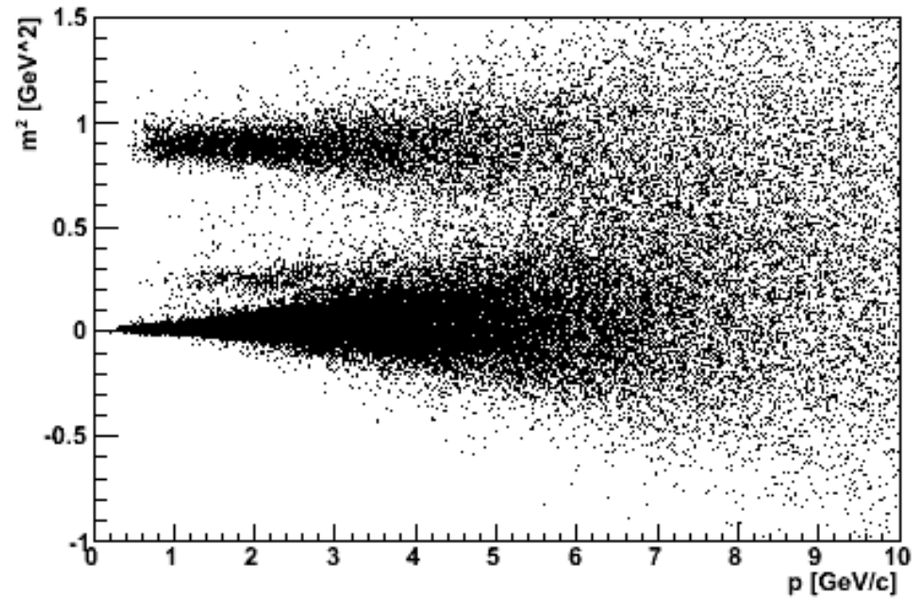
3 Time of flight: FTOF resolution ~120ps <=Added in 2007

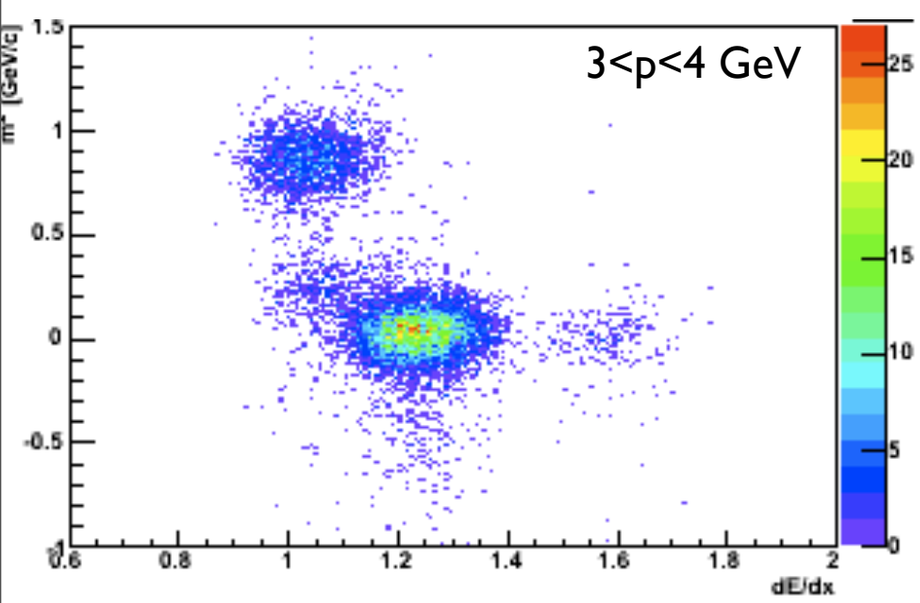
TOF,L,R resolution ~70 ps

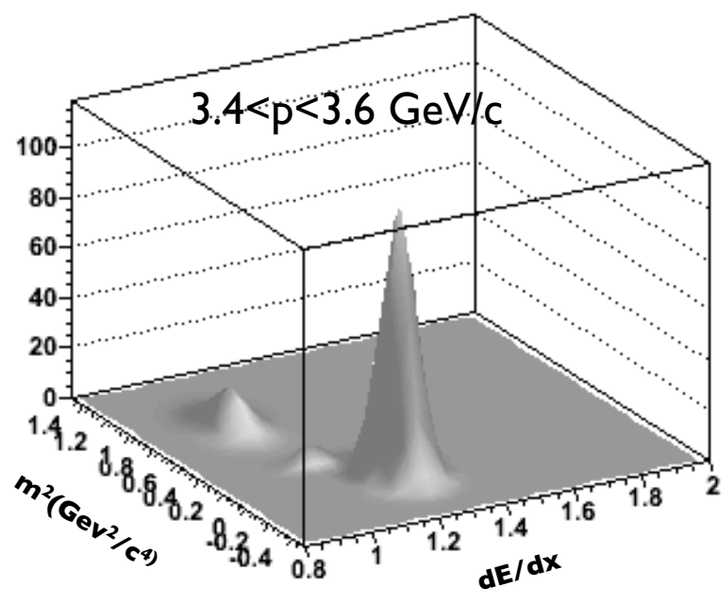
Combined ToF and dE/dx PID

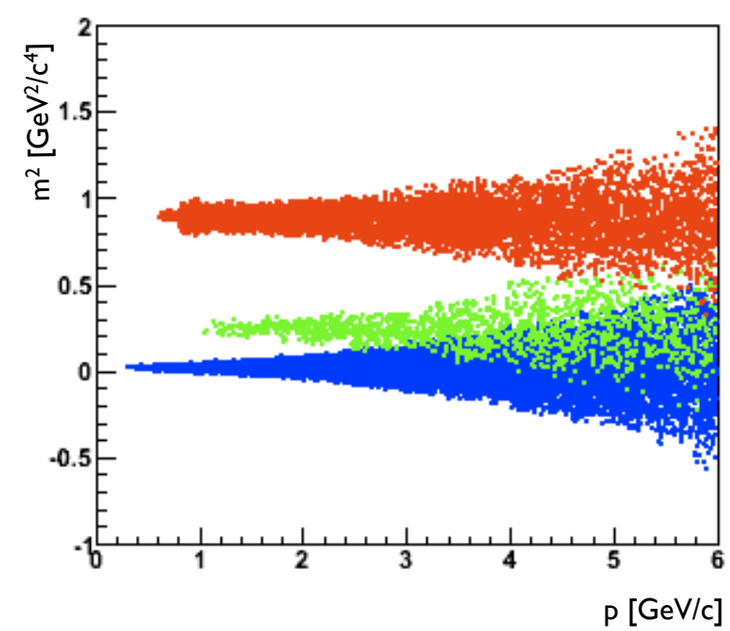
a high purity PID is performed by combining ToF and dE/dx measurements:
Typically below 4 GeV/c momenta, PID is mainly performed by ToF
4<p<10 GeV/c pi/p separation is still ToF but dE/dX is needed for pi/K discrimination
dE/dX is needed to identify electrons







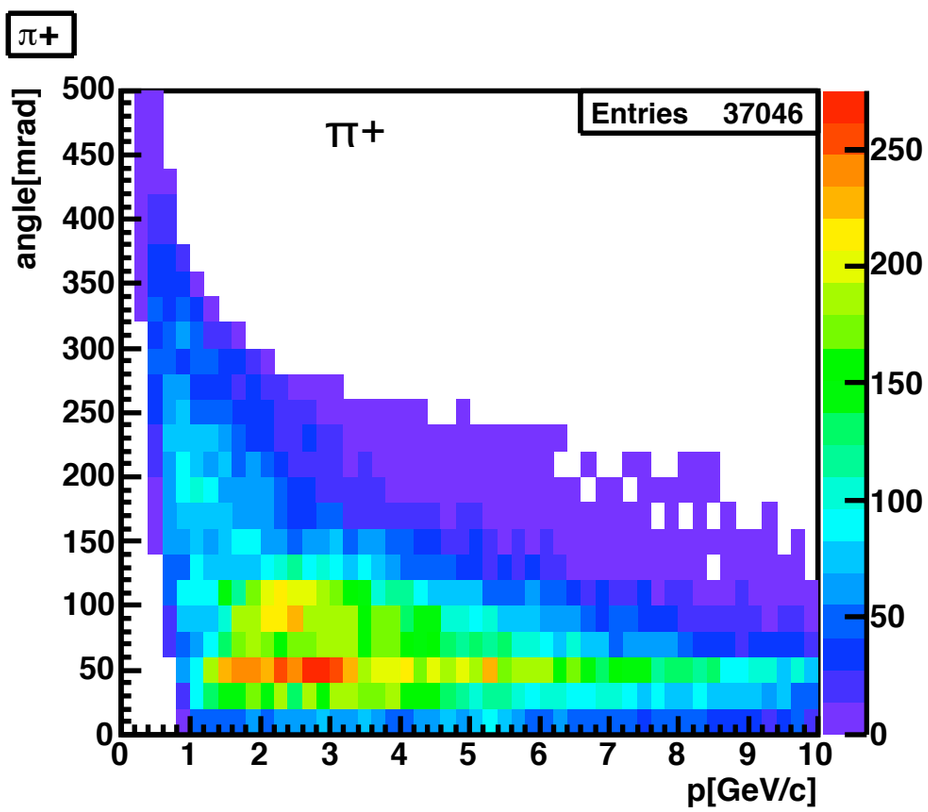


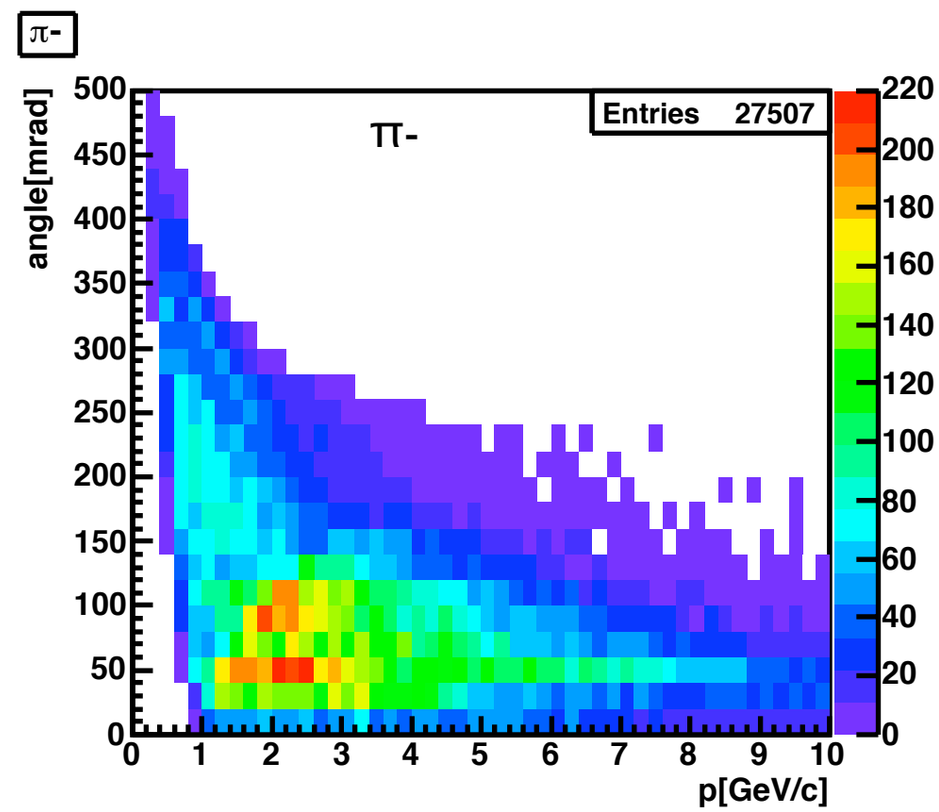


Raw spectras

37046 π+ in ToF below 10 GeV/c
27507 π- in ToF below 10 GeV/c

Raw π+ and π- spectra:





Corrections applied

Instead of making a global MC correction the corrections are factorized.

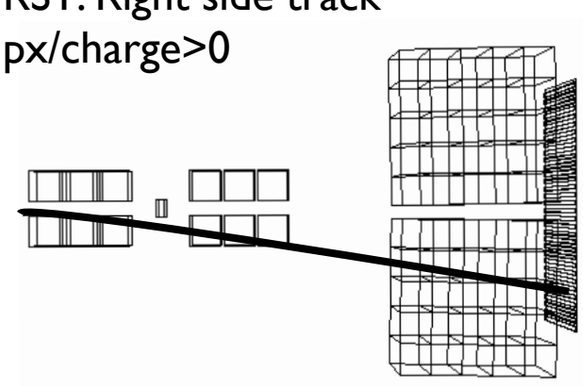
The following effects are accounted for:

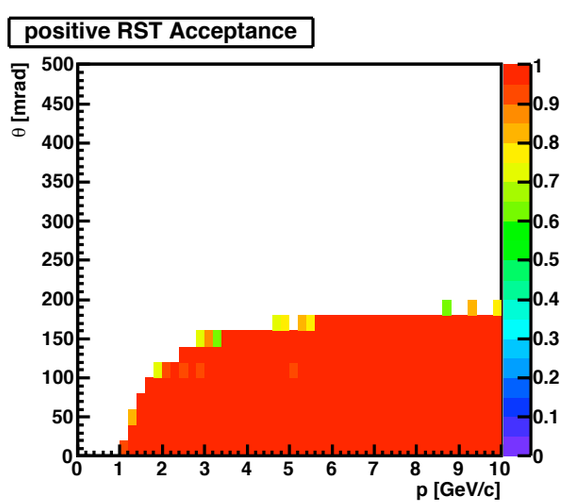
- geometrical acceptance of the detector.
- reconstruction efficiency.
- ToF efficiency.
- pions decaying before reaching the ToF.
- pions from weak decays reconstructed as a primary track (important correction for π- from lambda decay).

Example of correction: geometrical acceptance

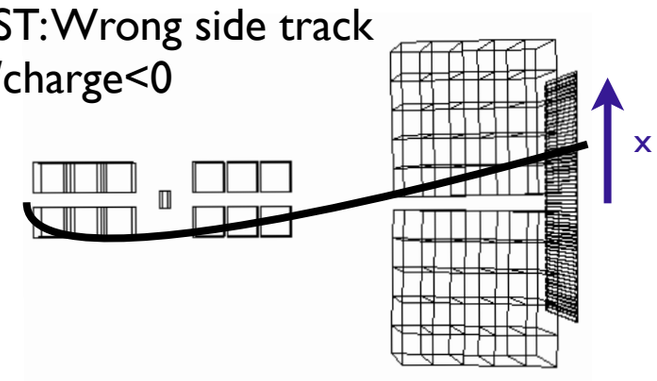
Two track topologies called Right Side Tracks (RST) and Wrong Side Tracks (WST) populate different areas of the detector phase space. Bins with a lower than 40% acceptance are not considered to avoid sharp fluctuations on the detector side.

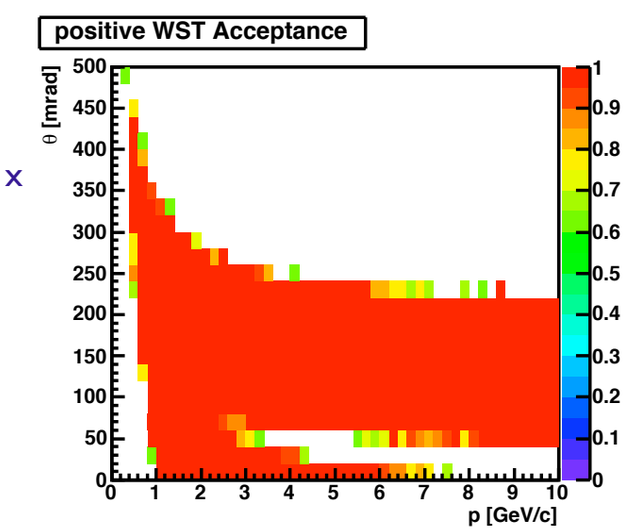
RST: Right side track
px/charge>0





WST: Wrong side track
px/charge<0

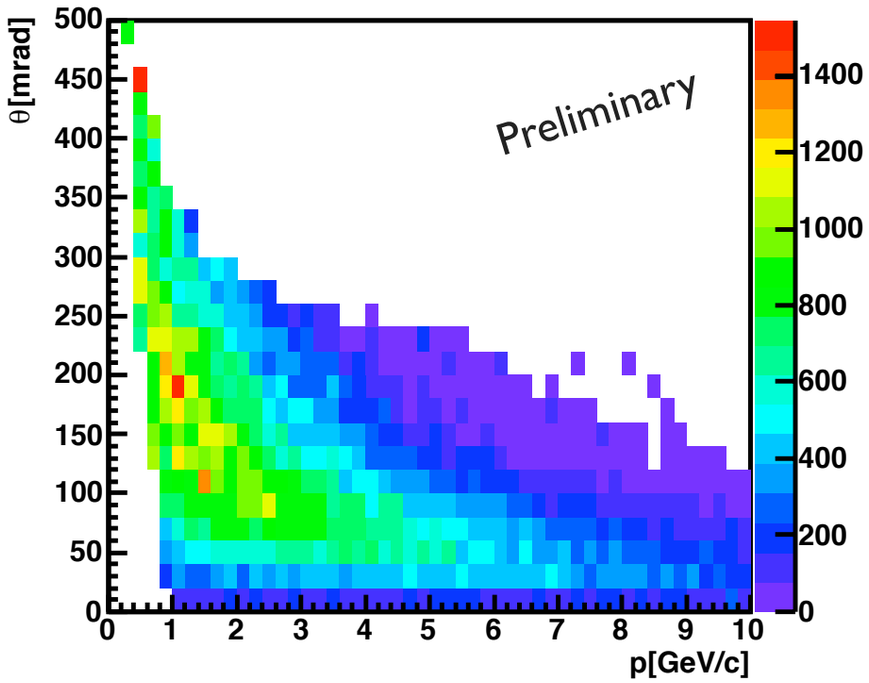


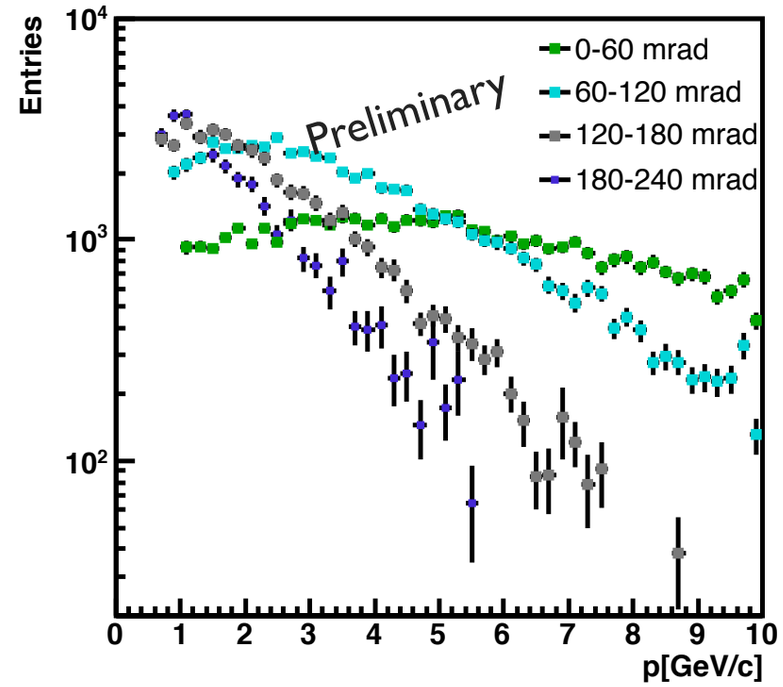


Results: corrected π+ and π- spectra

π+

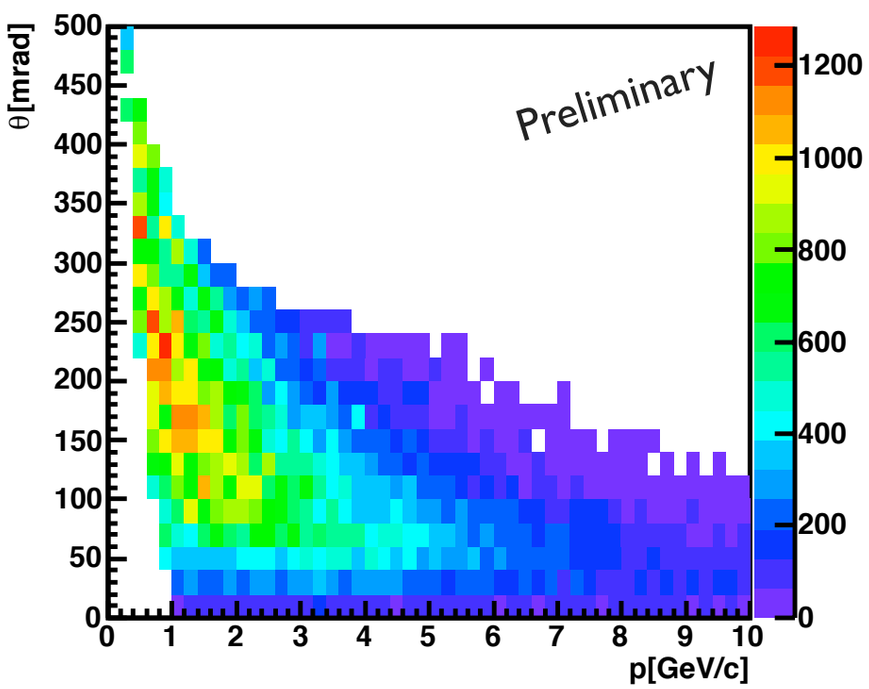
systematic error <20%

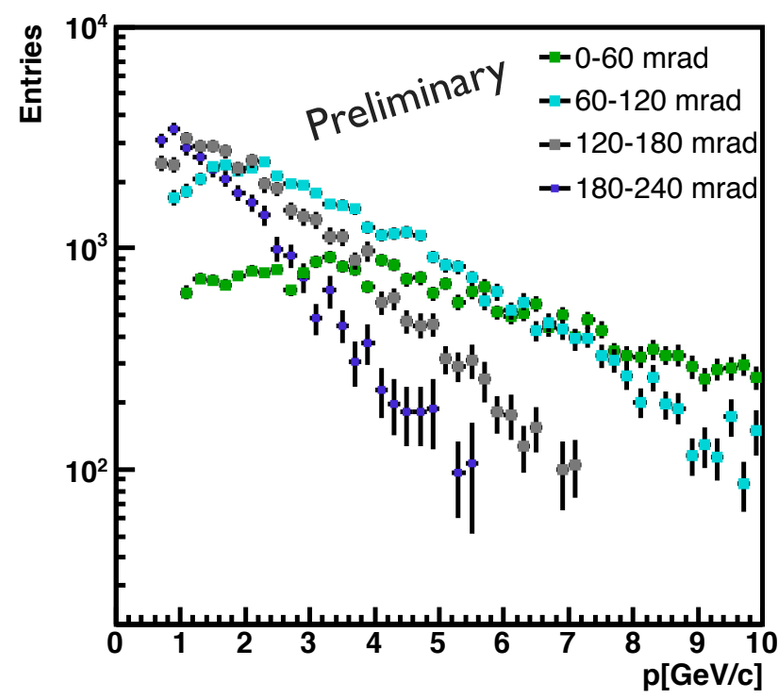




π-

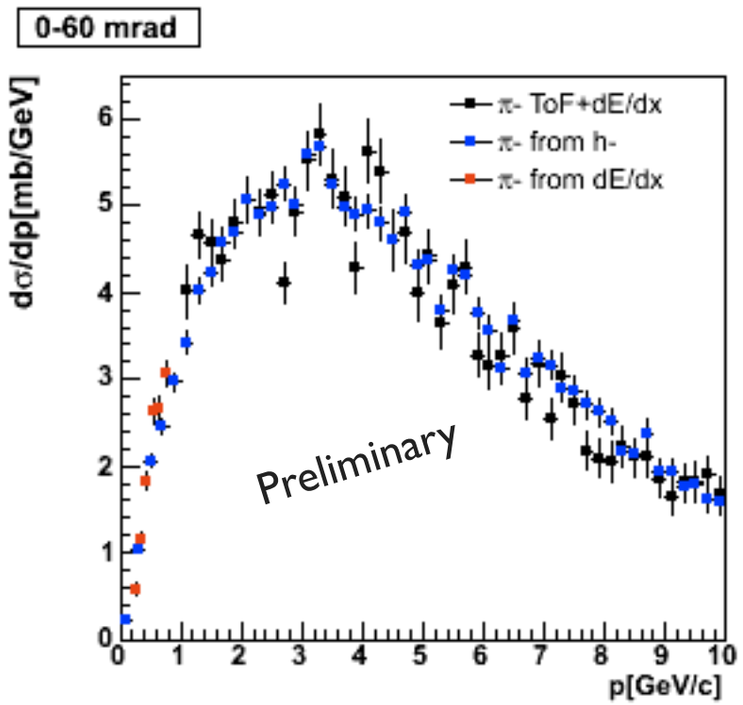
systematic error <20%

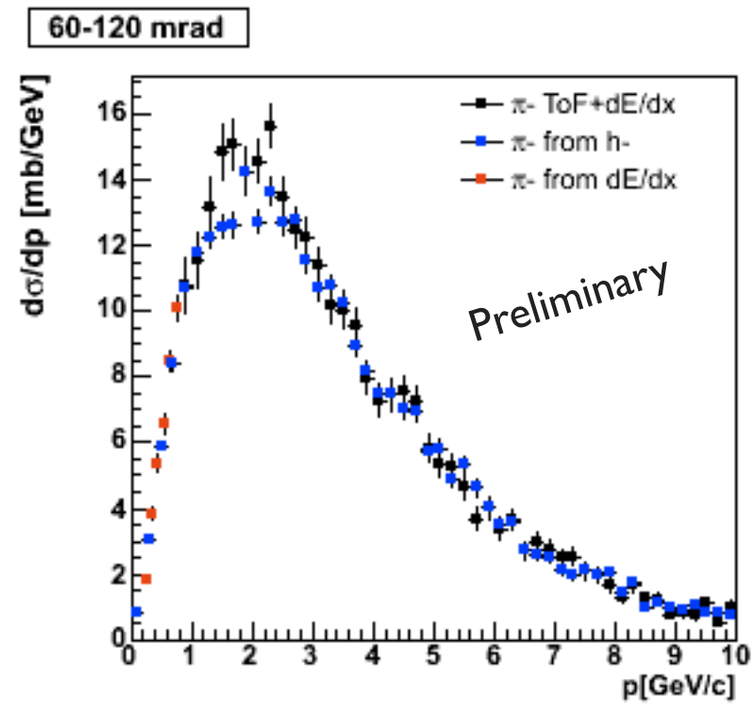




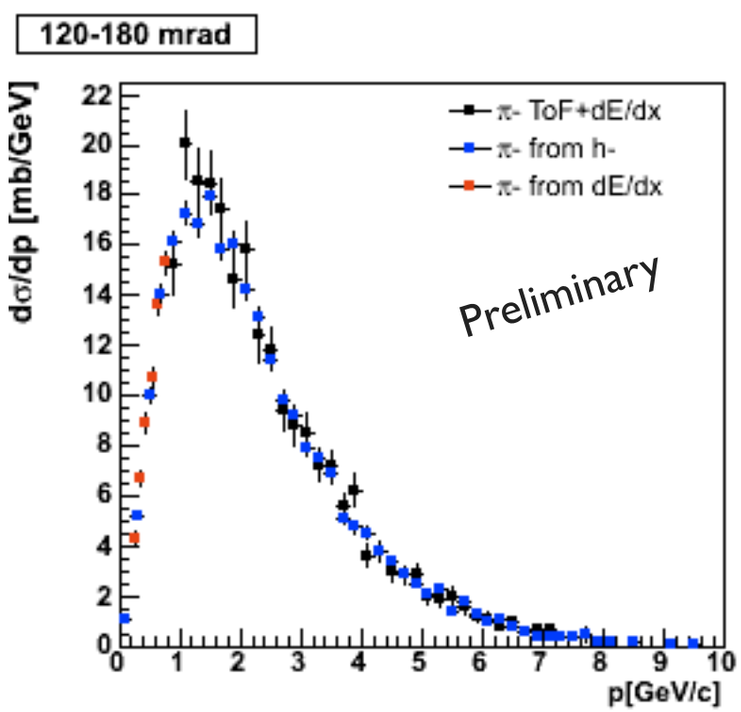
comparison between all results π-

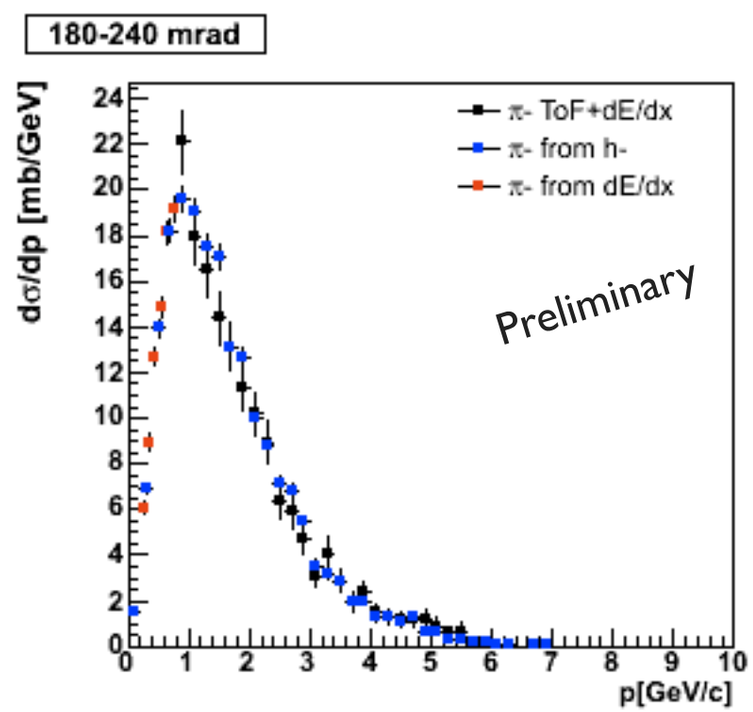
Results have been checked for consistency with two other analysis:
- hminus: No pid - consider all negative tracks remove electrons and k- with MC.
- dE/dx below 800 Mev/c: Pid with only dE/dx performed below 800 MeV/c of momentum.





systematic error <20%





systematic error <20%

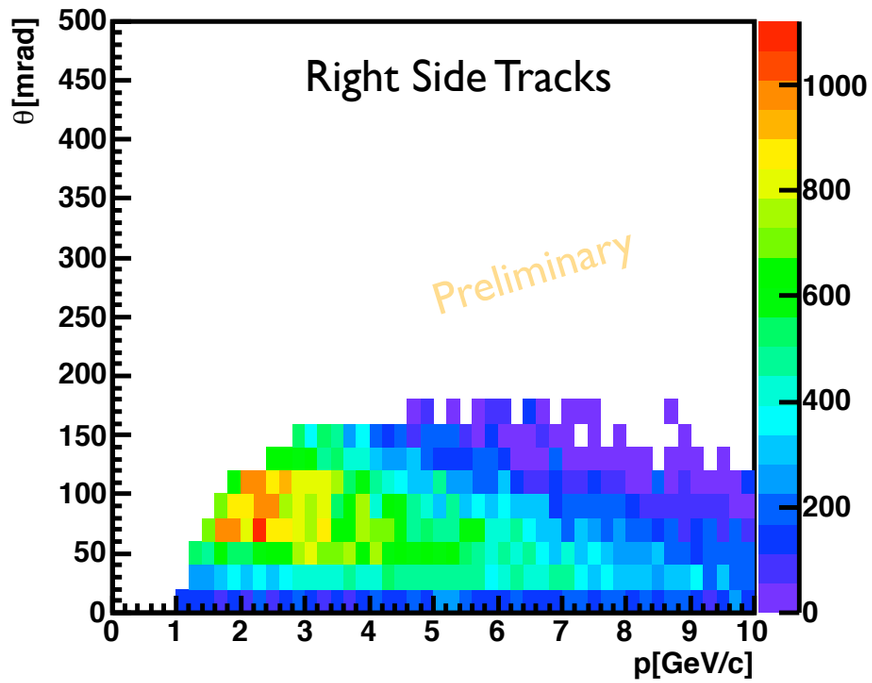
summary

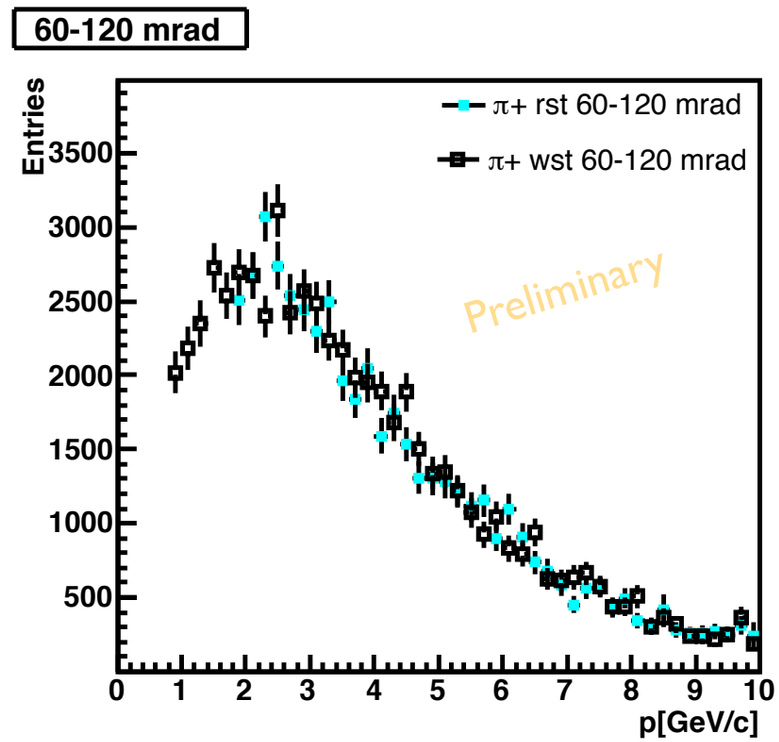
- **First results on pi+ spectra in p+C interactions at 31 GeV/c in momentum range 1-10 GeV/c have been obtained using the ToF-dE/dx pion identification**
- **Provides input for the T2K beam simulation.**
- **Goal is now to reduce systematics (NA49 managed ~ 4%)**
- **~10 times larger set of data in 2009 which has yet to be analysed.**
- **all the results are publicly available on na61 twiki page: https://twiki.cern.ch/twiki/bin/view/NA61/OfficialPlots**

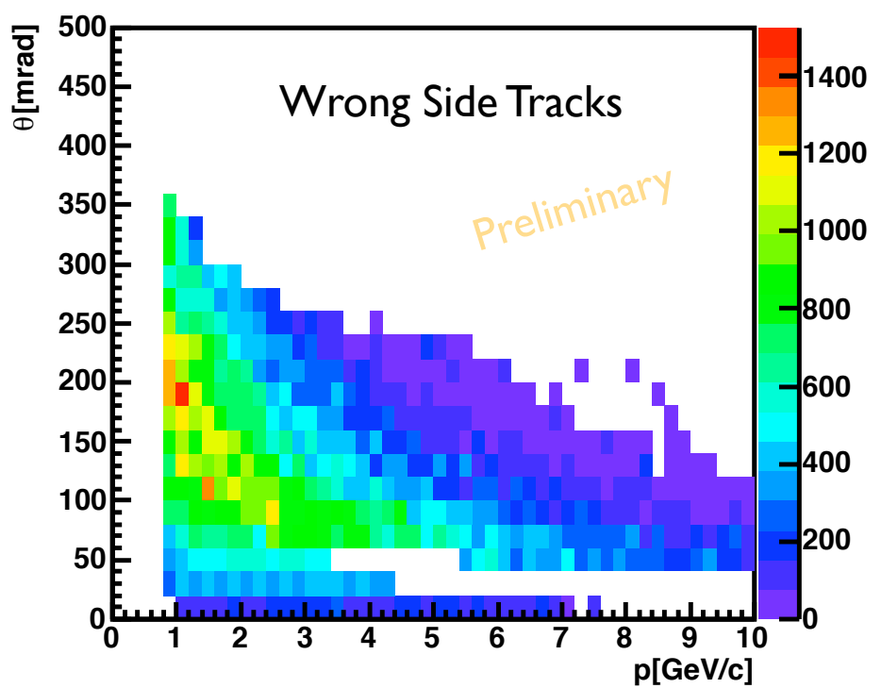
Thank you !

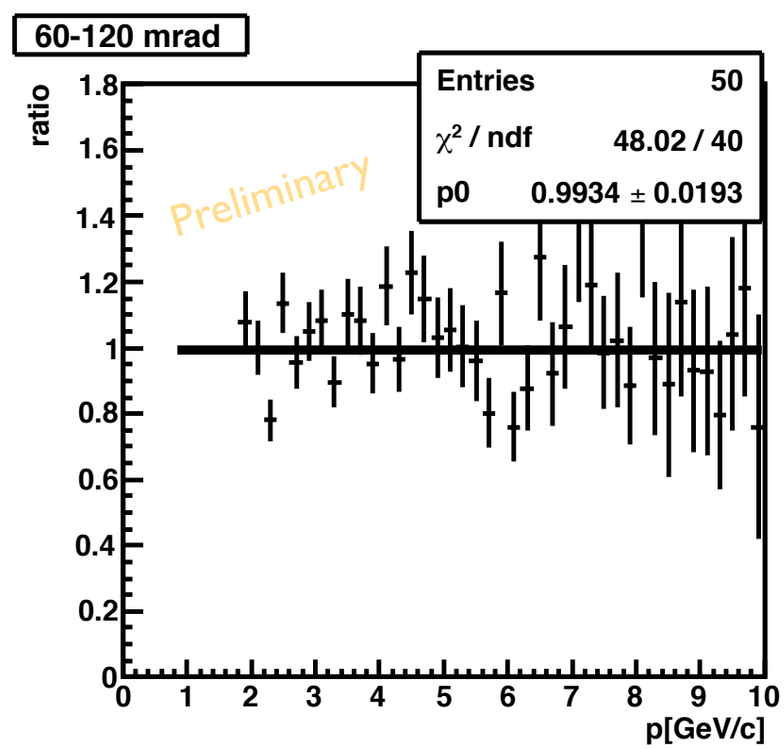
extra slides

π+ WST/RST


Right Side Tracks
Preliminary
θ[mrad]
p[GeV/c]


60-120 mrad
π+ rst 60-120 mrad
π+ wst 60-120 mrad
Preliminary
Entries
p[GeV/c]


Wrong Side Tracks
Preliminary
θ[mrad]
p[GeV/c]

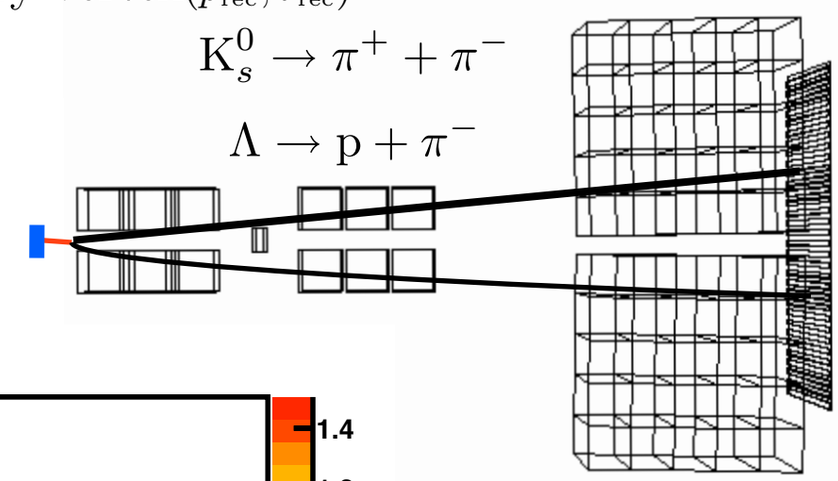

60-120 mrad
Entries 50
χ² / ndf 48.02 / 40
p0 0.9934 ± 0.0193
Preliminary
ratio
p[GeV/c]

Example of correction: Feed down

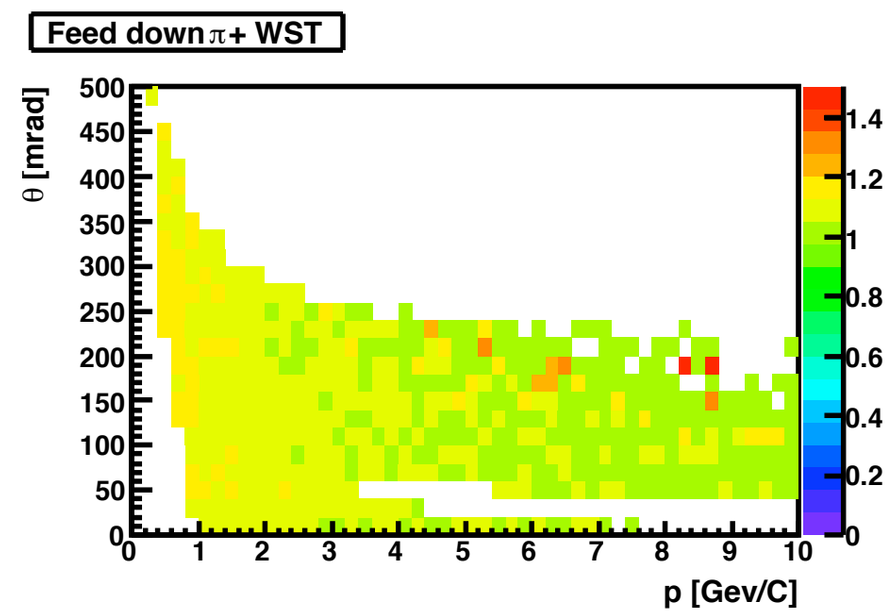
$$C_{\text{Feed-down}}(p,\theta) = \frac{\text{reconstructed MC pion tracks in MC ToF}(p_{\text{rec}},\theta_{\text{rec}})}{\text{reconstructed MC pion tracks in MC ToF from primary vertex}(p_{\text{rec}},\theta_{\text{rec}})}$$

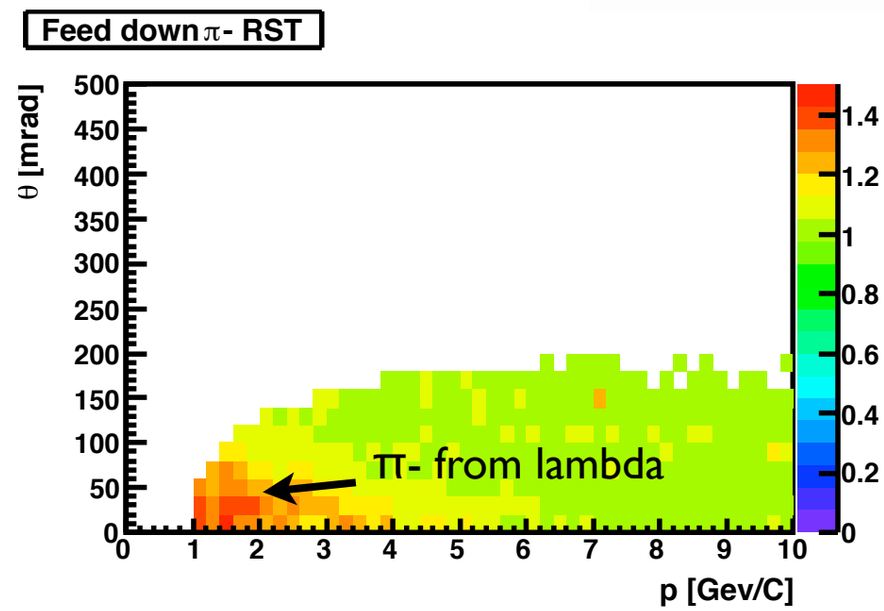
$$\mathrm{K}^0_s \rightarrow \pi^+ + \pi^-$$

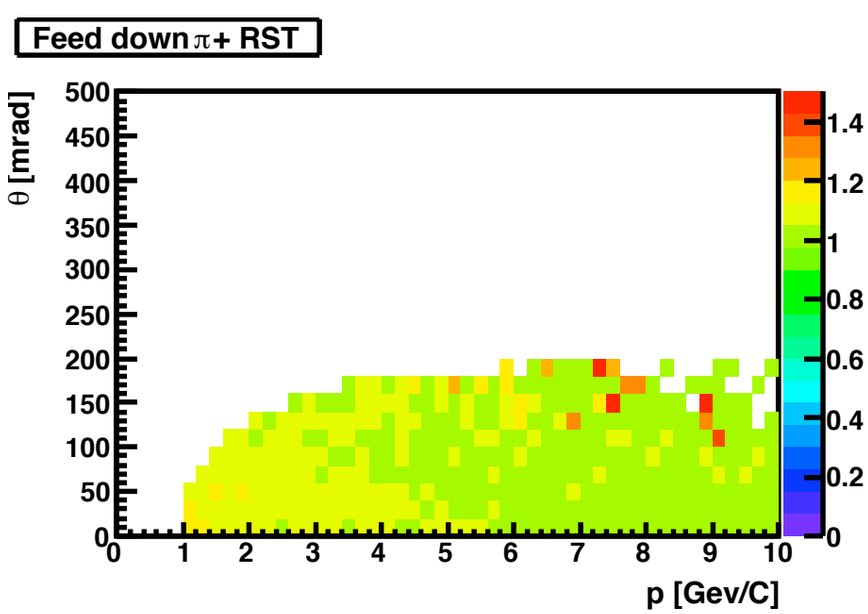
$$\Lambda \rightarrow \mathrm{p} + \pi^-$$

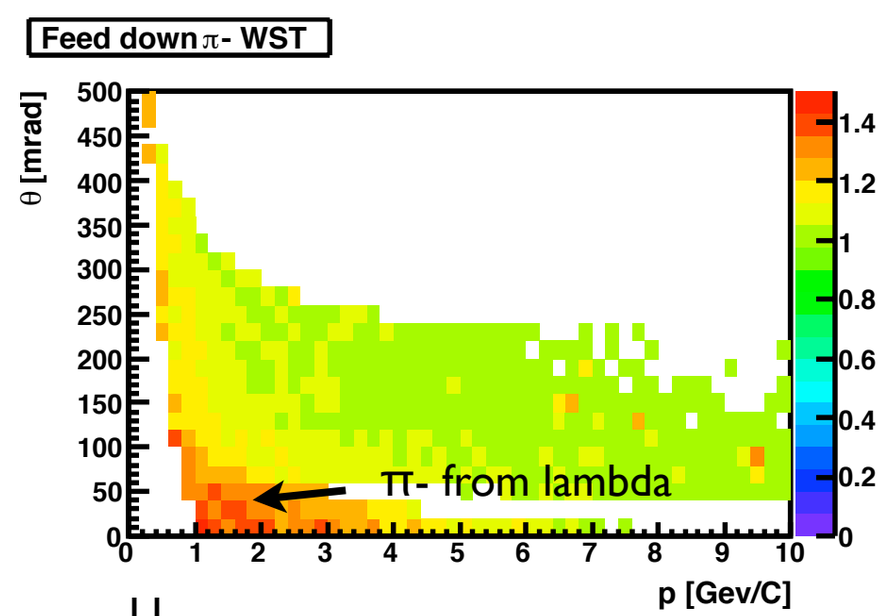


Pions not coming from primary vertex (weak decays)
Biggest correction in the list and 100% MC model dependent..



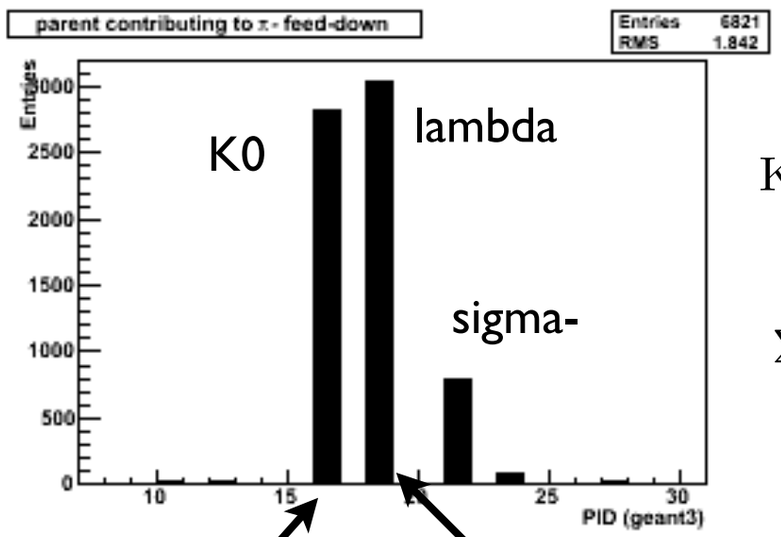






particles leading to π- and π+ feed down

particles leading to π- feed down

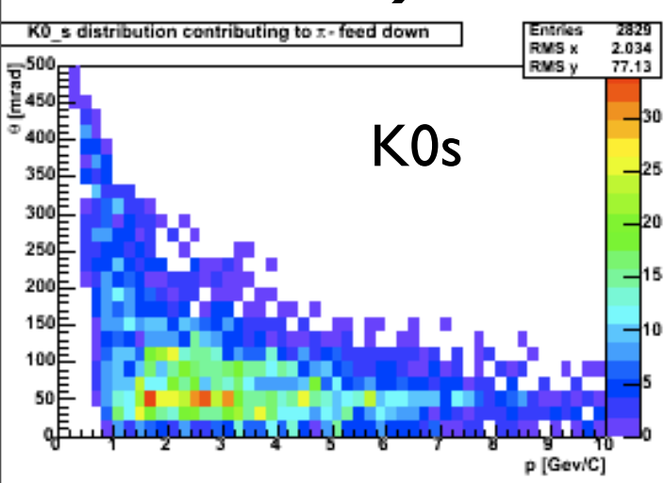


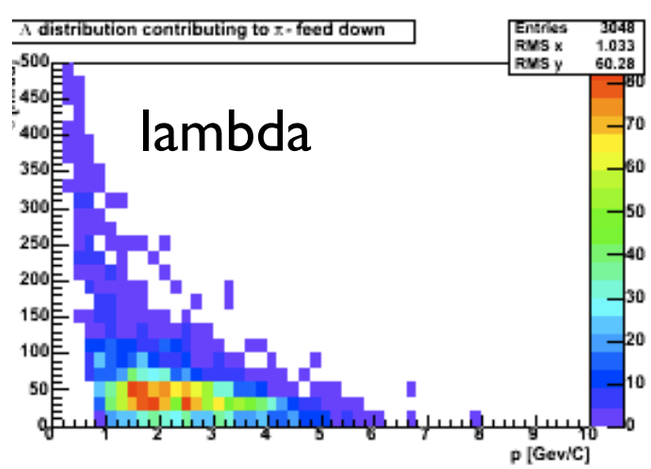
main source:

$$K_s^0 \rightarrow \pi^+ + \pi^-$$

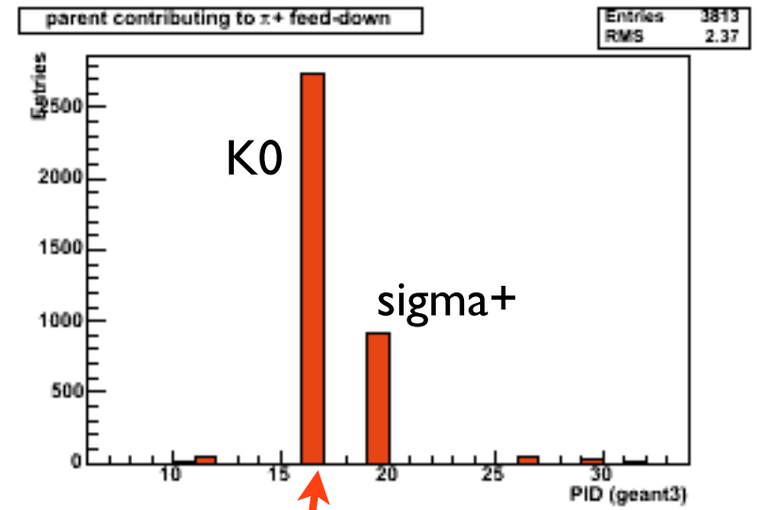
$$\Lambda \rightarrow p + \pi^-$$

$$\Sigma^- \rightarrow n + \pi^-$$





particles leading to π+ feed down



main source:

$$K_s^0 \rightarrow \pi^+ + \pi^-$$

$$\Sigma^+ \rightarrow n + \pi^+$$