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

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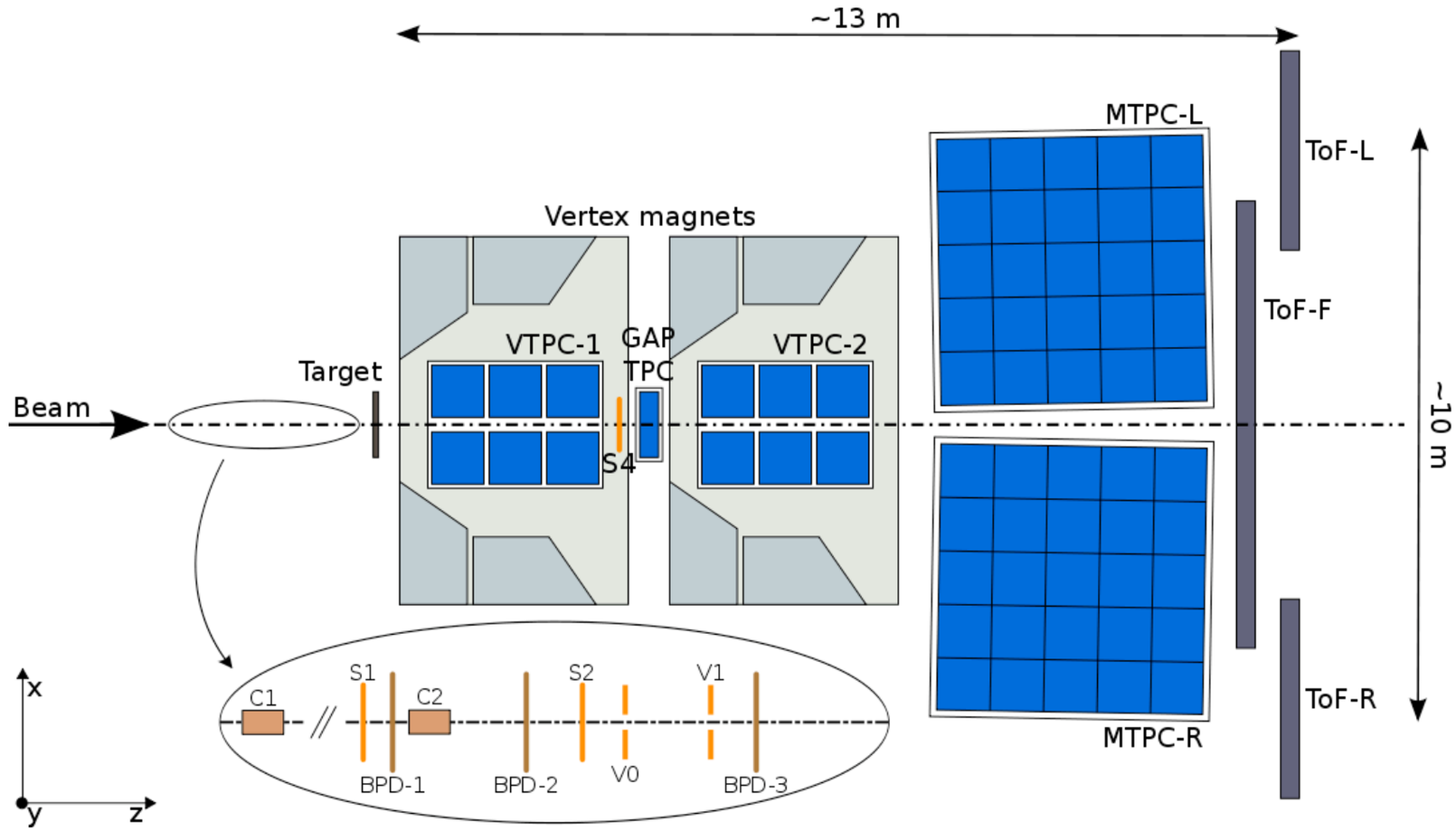
One of the Goals of the NA61/SHINE (SHINE SPS Heavy Ion and Neutrino Experiment) experiment is to provide hadron production reference measurements for the T2K neutrino oscillation experiment[1]. Shown here are results of pion cross sections from pilot data collected in October 2007.

http://na61.web.cern.ch

[1] See Mark Hartz Talk on T2K Saturday

The NA61/SHINE detector at CERN SPS



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

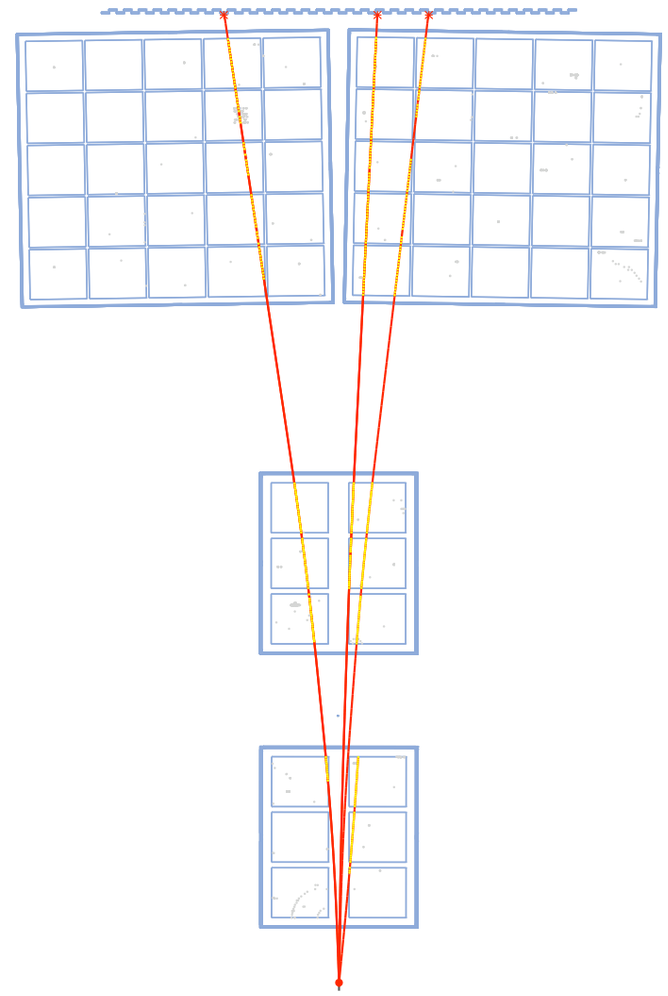
long target (T2K replica): 90 cm ∅ = 2.6 cm int. length ~ 1.9

3 BPDs (Beam position detectors)

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

3 Time of flight: FTOF resolution ~120ps
TOF,L,R resolution ~70 ps

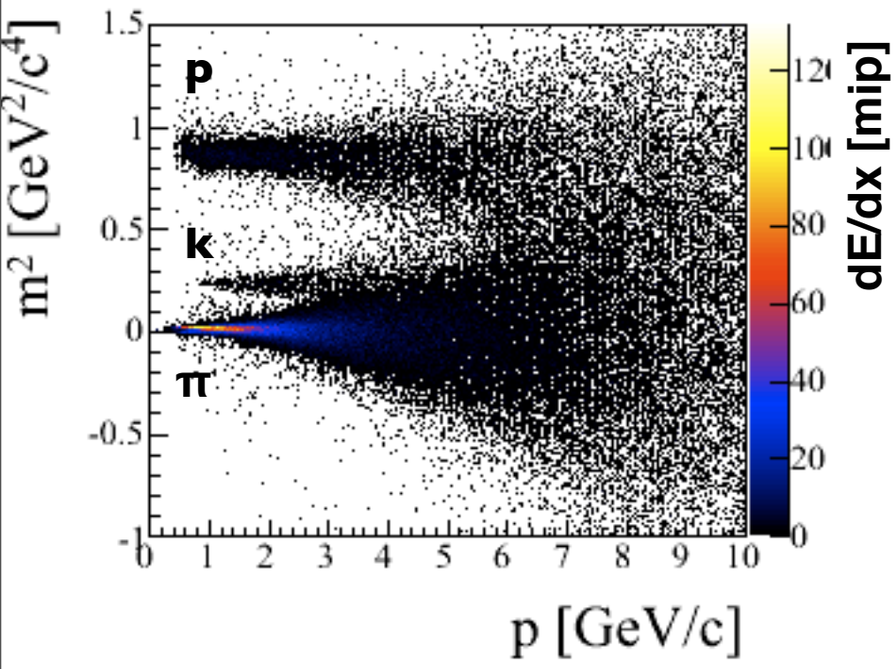
<=Added in 2007 for T2K measurements and extended in 2009

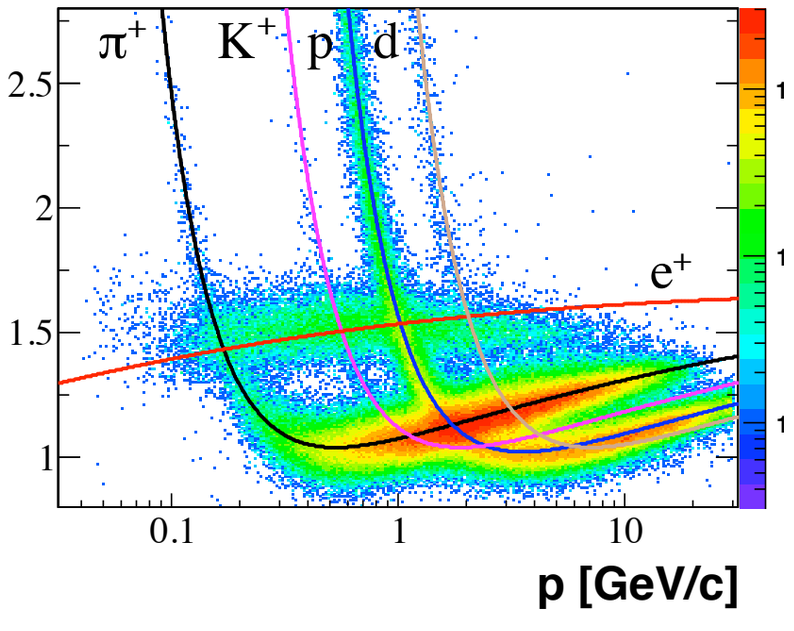


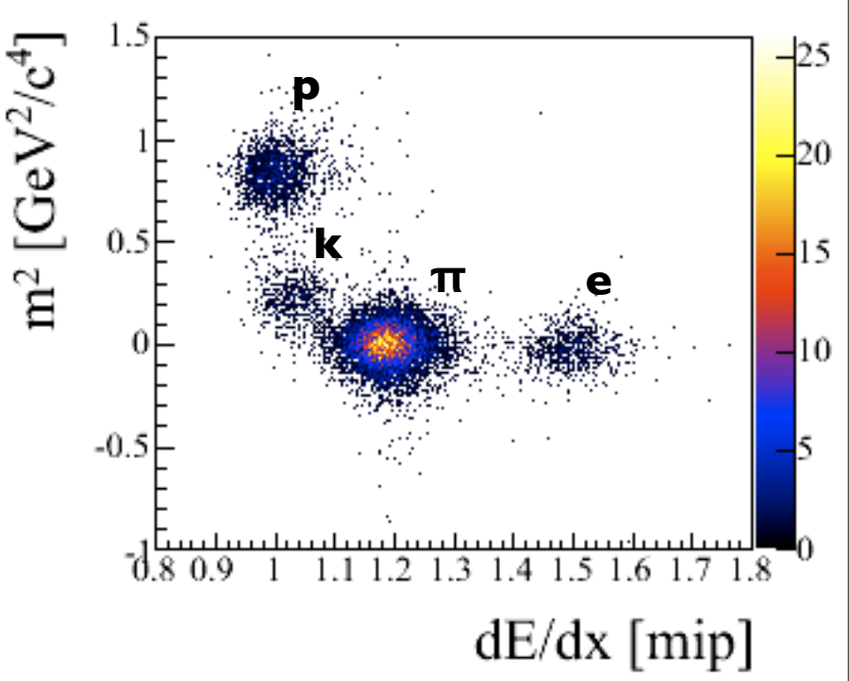
example of a p+C interaction at 30 GeV

Particle identification

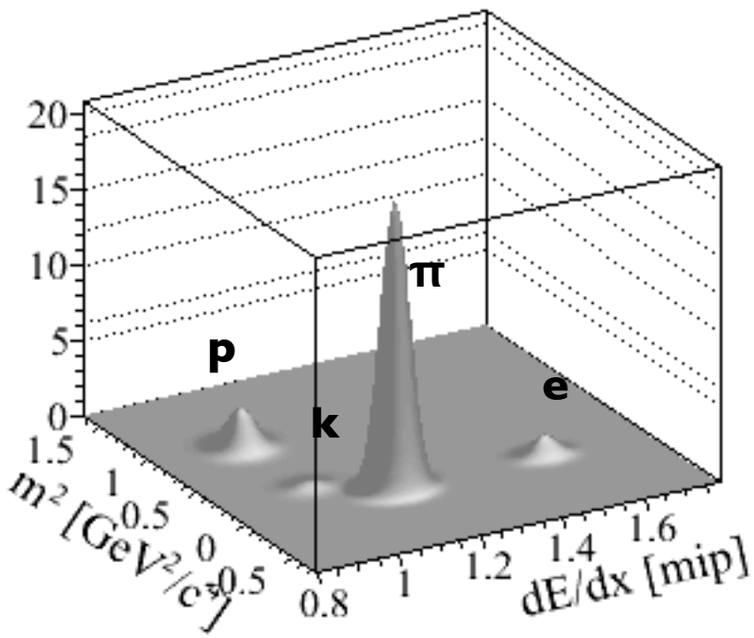
- Combined ToF-dE/dx PID over the whole momentum range:
  - very high purity pion yields
  - Bi-dimensional max-likelihood fits to extract the yields



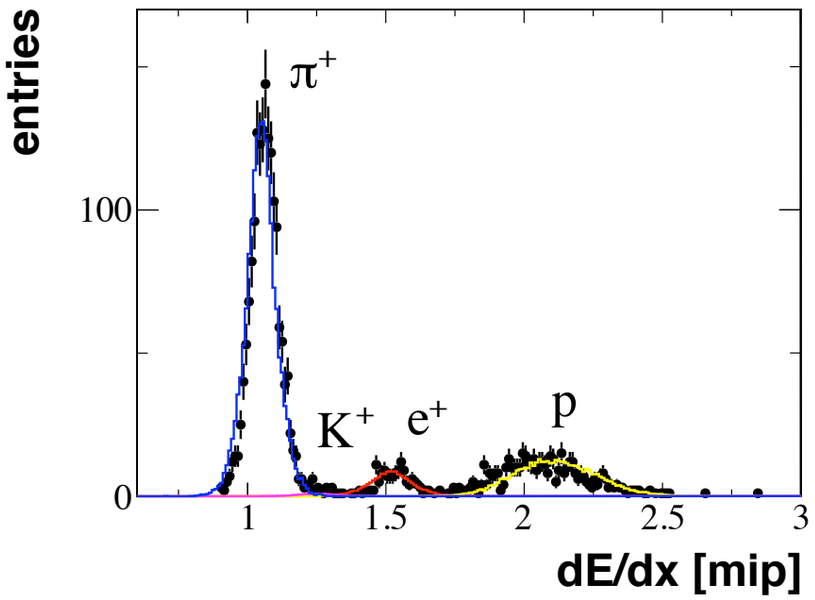




Max. Likelihood fit to the combined ToF-dE/dx distribution between 3<p<3.2 GeV/c and 40<Θ<60 mrad



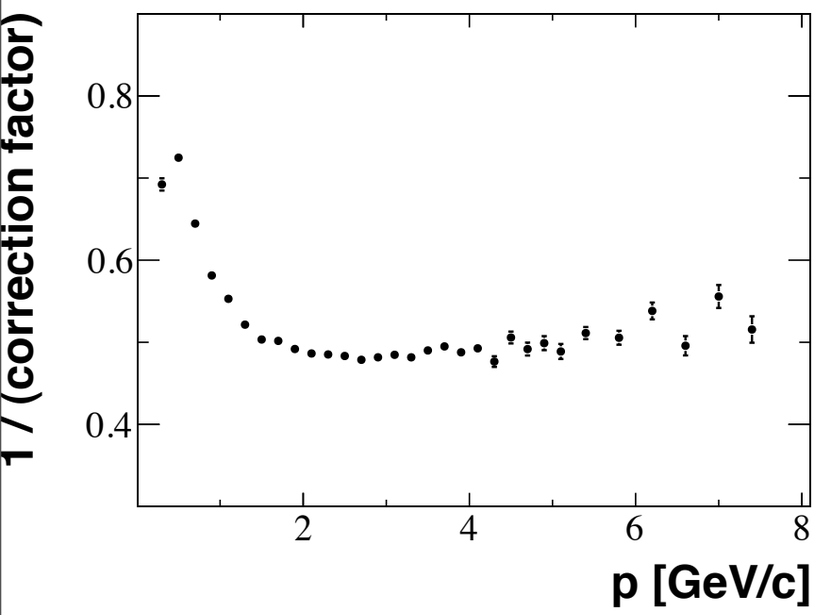
Example of a fit to the dE/dx distribution between 0.7<p<0.8 GeV/c and 140<Θ<180 mrad



Analysis methods

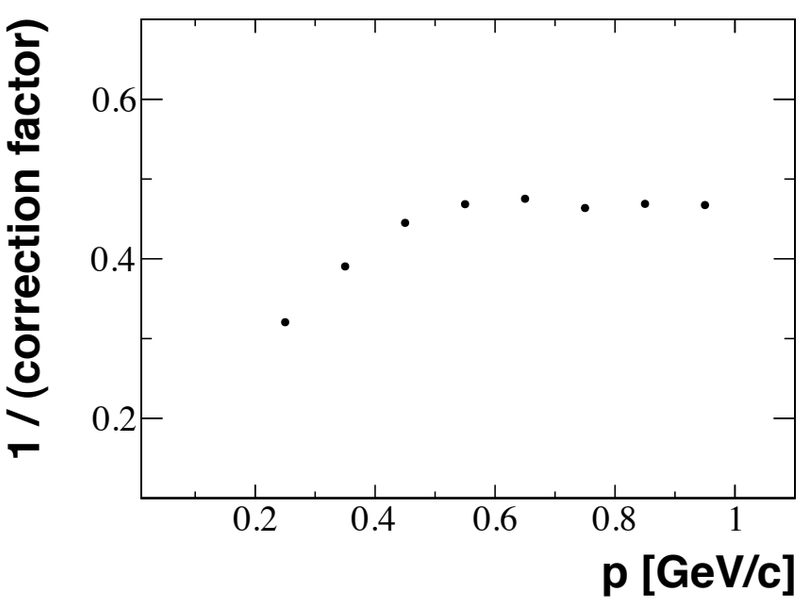
3 independent analysis methods have been implemented

- **h minus analysis**:
  - only for π-. >90% of negative hadrons are π-.
  - pure tracking with no pid- large acceptance.
  - consider all negative tracks and remove electrons and k- with a global Monte Carlo correction.



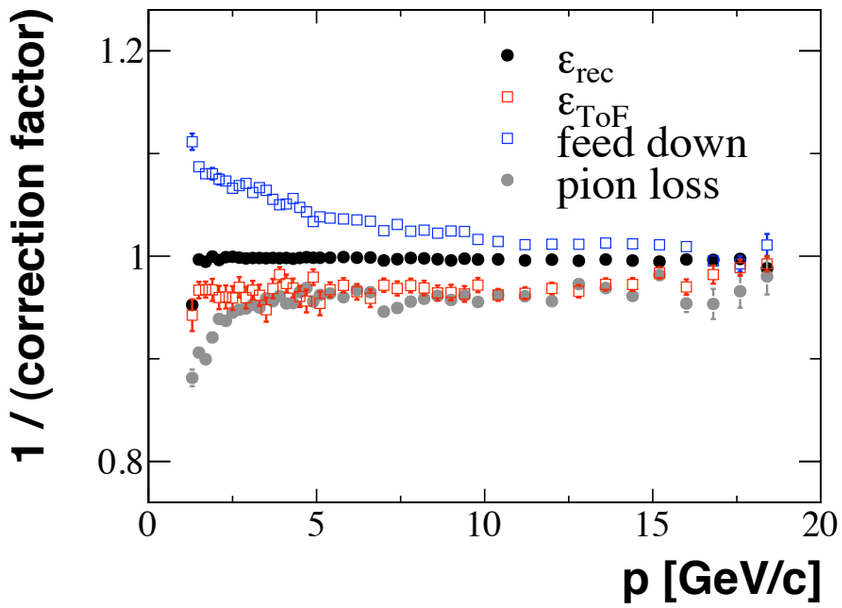
MC correction factor
π- 140<Θ<180 mrad bin

- **Dedicated dE/dx below 1 GeV/c**:
  - Fast change of energy loss with momentum.
  - π+ and π- large acceptance
  - PID based only on dE/dx.
  - Global MC correction.



MC correction factor
π+ 140<Θ<180 mrad bin

- **Analysis based on combined ToF+dE/dx PID:**
  - π+ and π-
  - Request particles in ToF ->High purity PID over whole momentum range, but reduced acceptance.
  - Select maximum acceptance regions to minimize MC corrections
  - Step by step MC correction

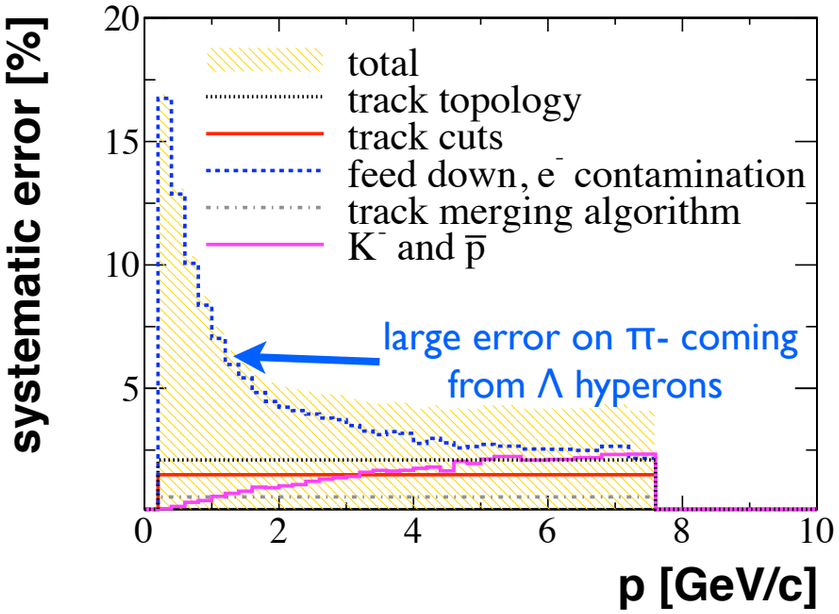


MC correction factor
π+ 40<Θ<60 mrad bin

Systematical errors

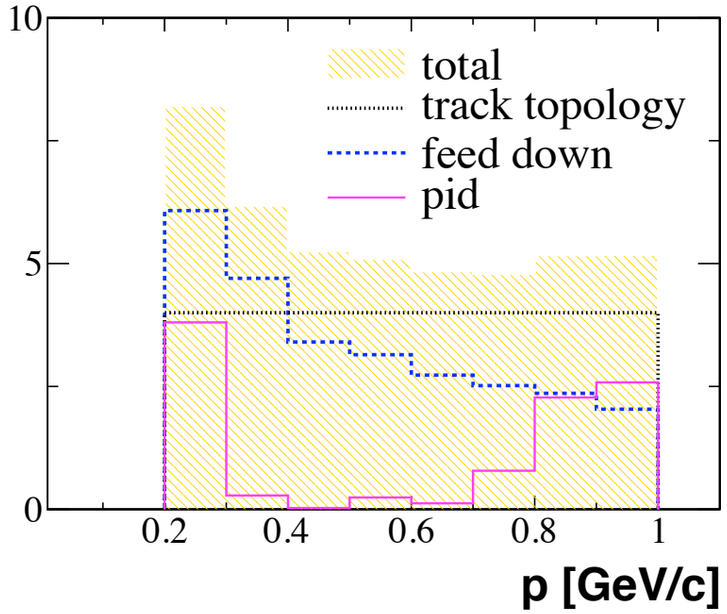
h minus

example for 140<Θ<180 mrad bin



dE/dx below 1 GeV/c

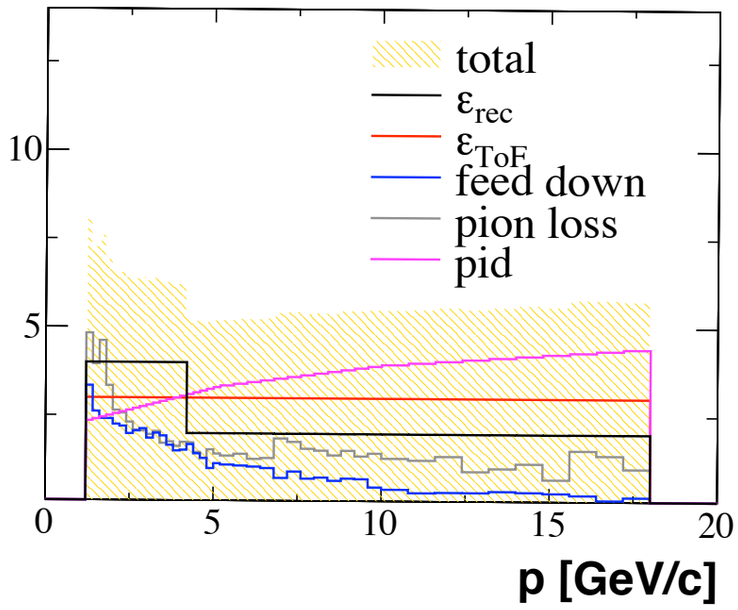
example for 140<Θ<180 mrad bin



Typical value around 6%

ToF+dE/dx

example for 40<Θ<60 mrad bin

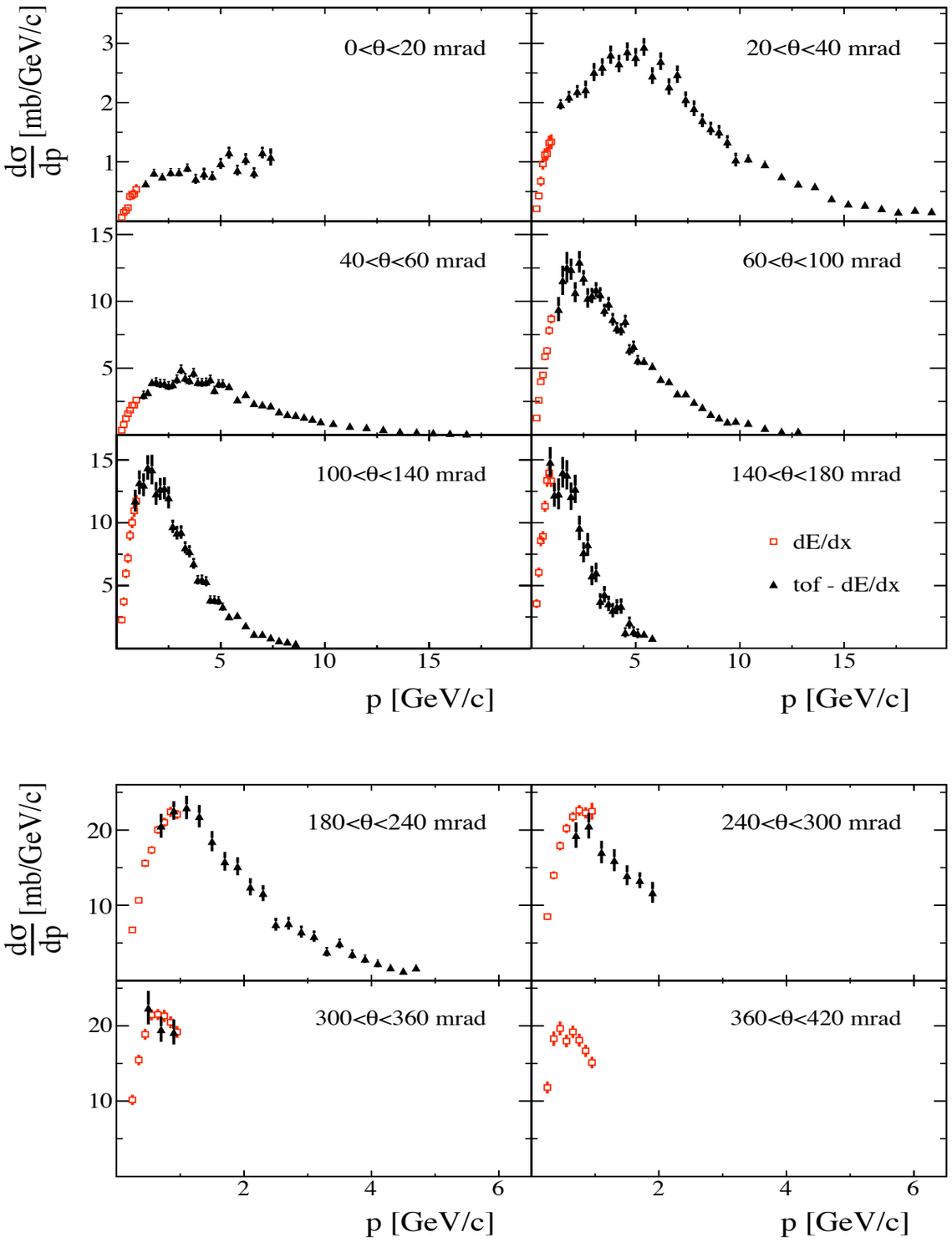


Results

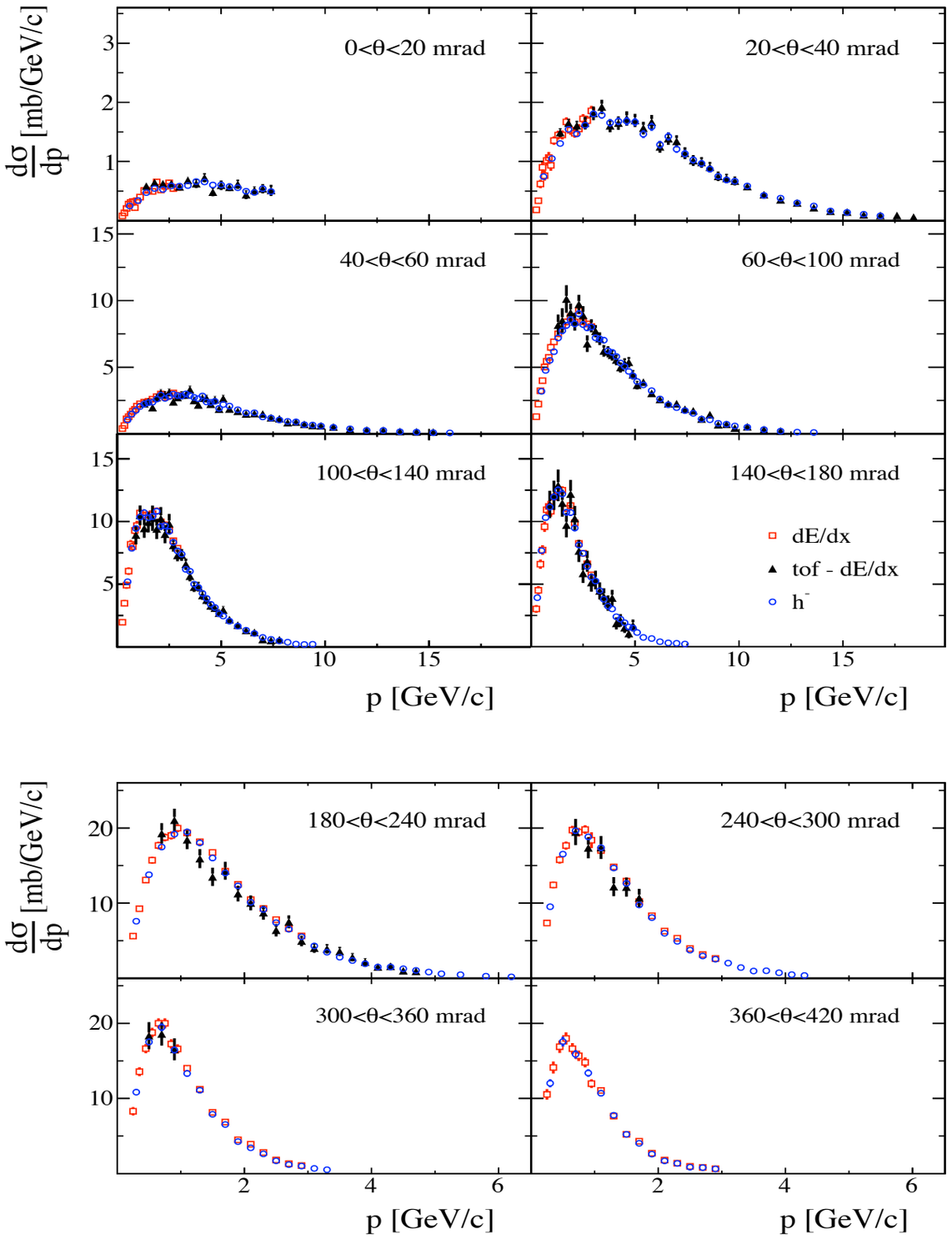
Differential cross-sections for pion meson production in p+C interactions at 31GeV/c as a function of laboratory momentum (p) and polar angle (Θ) - only statistical errors are shown.

arXiv:1102.0983 [hep-ex] , submitted to PRC

π+



π-



Summary

•First results on pi+ spectra in p+C interactions at 31 GeV/c have been obtained: preprint arXiv:1102.0983 [hep-ex], submitted to Phys. Rev. C

•Those results are currently used and provide useful input for the T2K beam simulation.

• 10 times larger set of data in 2009. Calibration almost complete, analysis will start soon.

•2007 data from long target is currently been analyzed ->crucial because an important part of the neutrino flux in T2K comes from target re-interactions. PID capabilities are similar to short target.

• 10M long target triggers in 2010 run to be calibrated and analyzed.

•Ongoing work and fast progress in extracting kaon cross sections from 2007 data.

•Knowledge of kaon x-section is important since kaons contribute to about 33% of the ν_e contamination of the T2K beam.

THANK YOU!