The physics experiment E31 to search for the Λ(1405) via the d(K-, πΣ) reaction at J-PARC K1.8BR.

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   - Identification of the particles;
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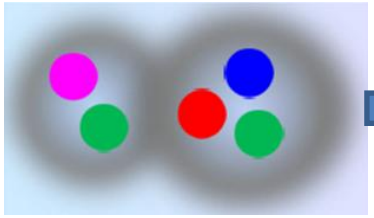
Motivations:

1. How are hadrons formed from quarks?
2. Are there hadrons made of more than 3 quarks?



???

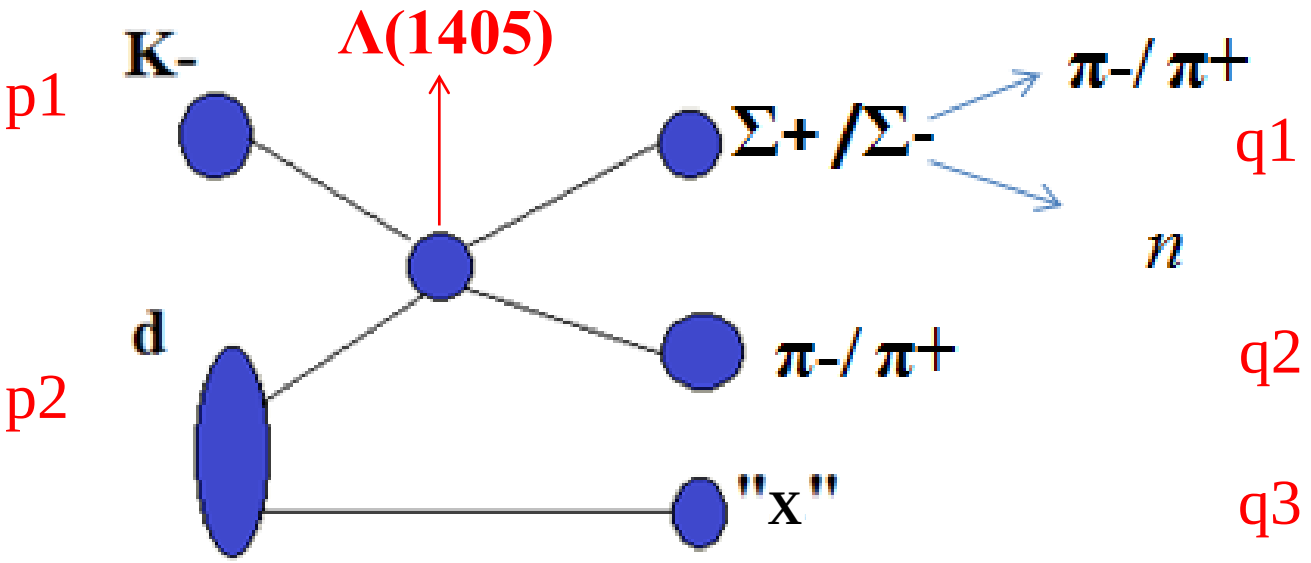
Λ(1405)

(an exotic state)

Contains 5 quarks

Exotic state may give hints to solve the questions: how are hadrons formed from quarks and further understanding of the strong interaction

Direct process (one step reaction): $K^- d \longrightarrow \Sigma^+\pi^-/\Sigma^-\pi^+$ "X"



Λ(1405) can be formed in the collision of K with proton in the deuteron. Formation is observed by detecting its decay products Σ and π

How to measure mass:

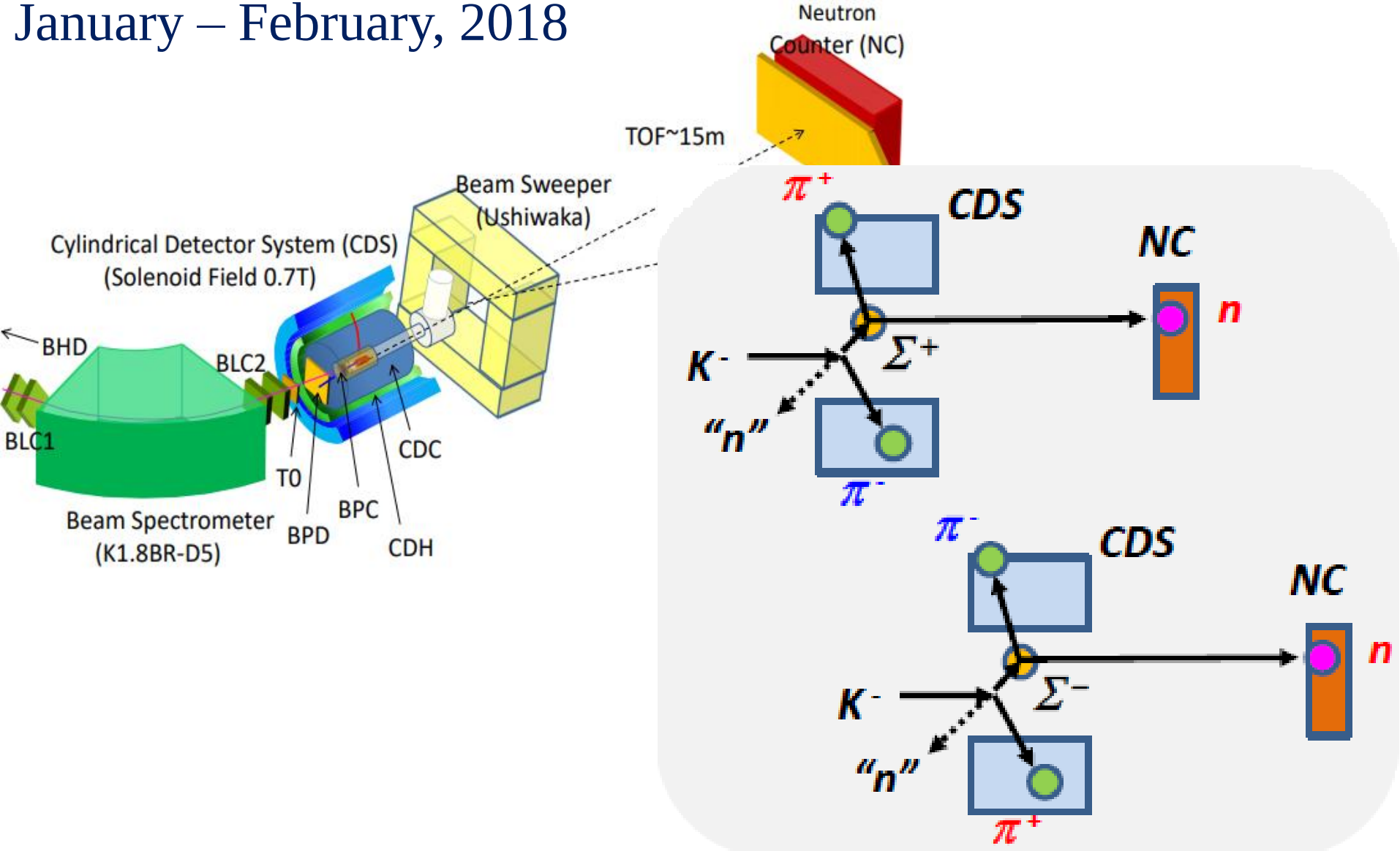
Missing mass

Invariant mass

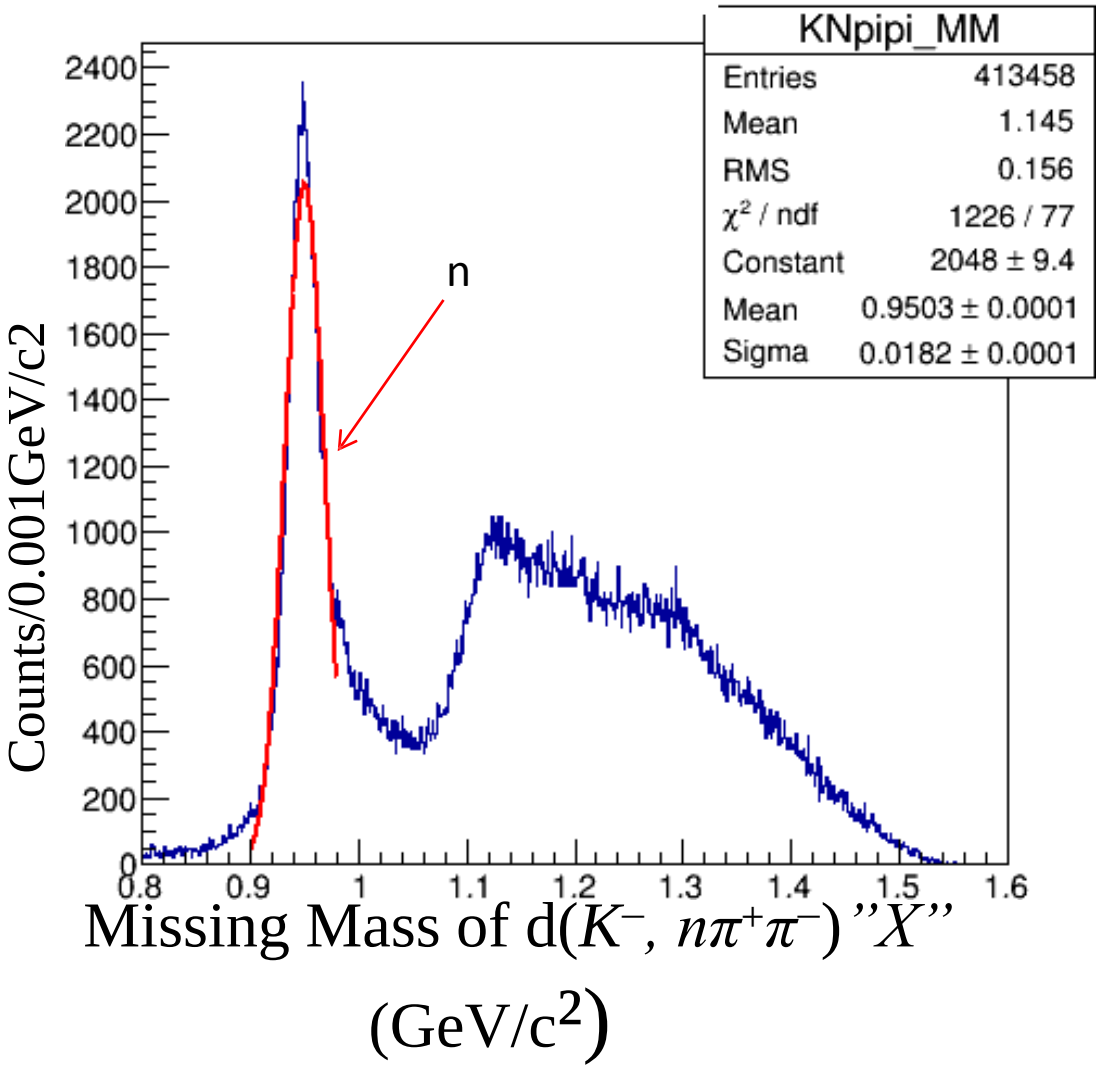
$$(p_1 + p_2 - q_3)^2 \equiv (q_1 + q_2)^2$$

Experimental setup

January – February, 2018



Missing neutron identification in d(K^-, $n\pi^+\pi^-$)"X"

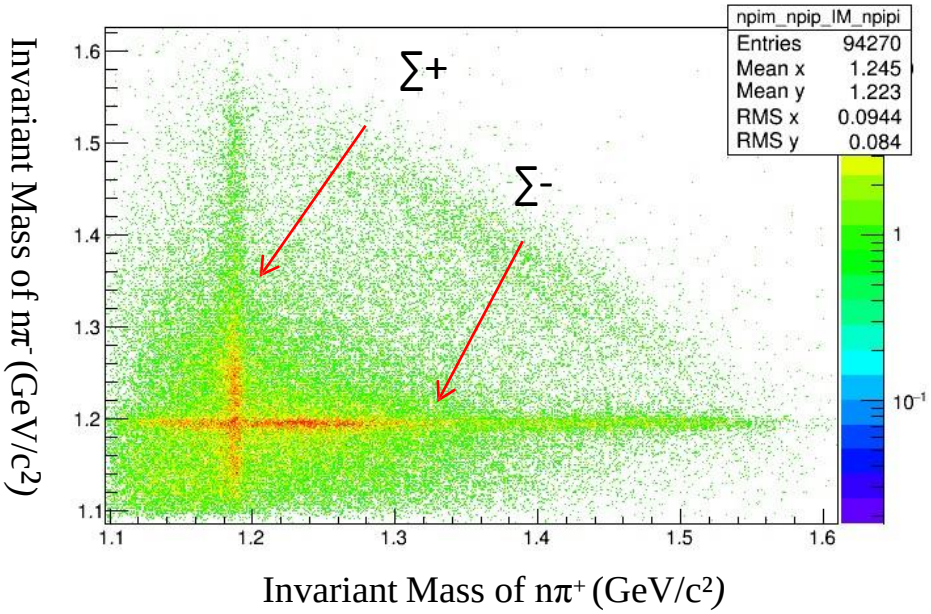


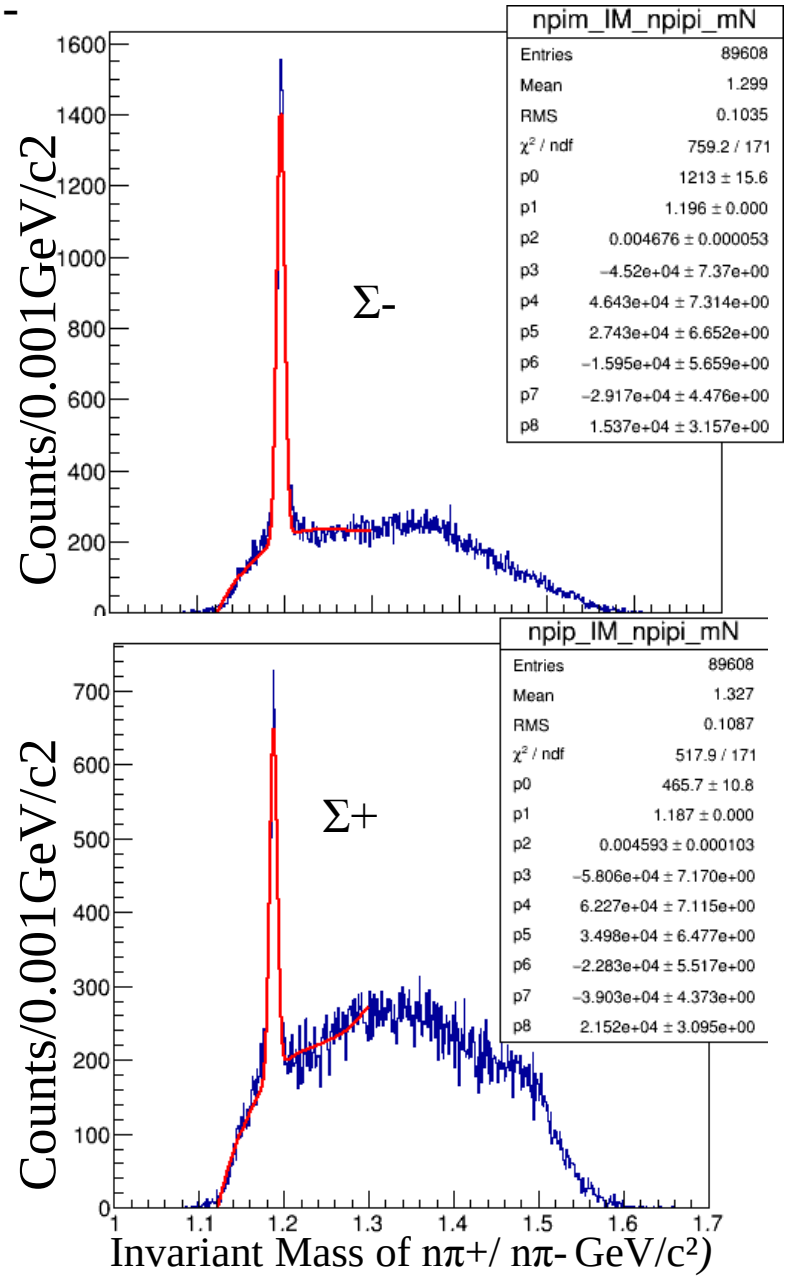
0.9< mass_neutron<0.98

Selected as a neutron mass

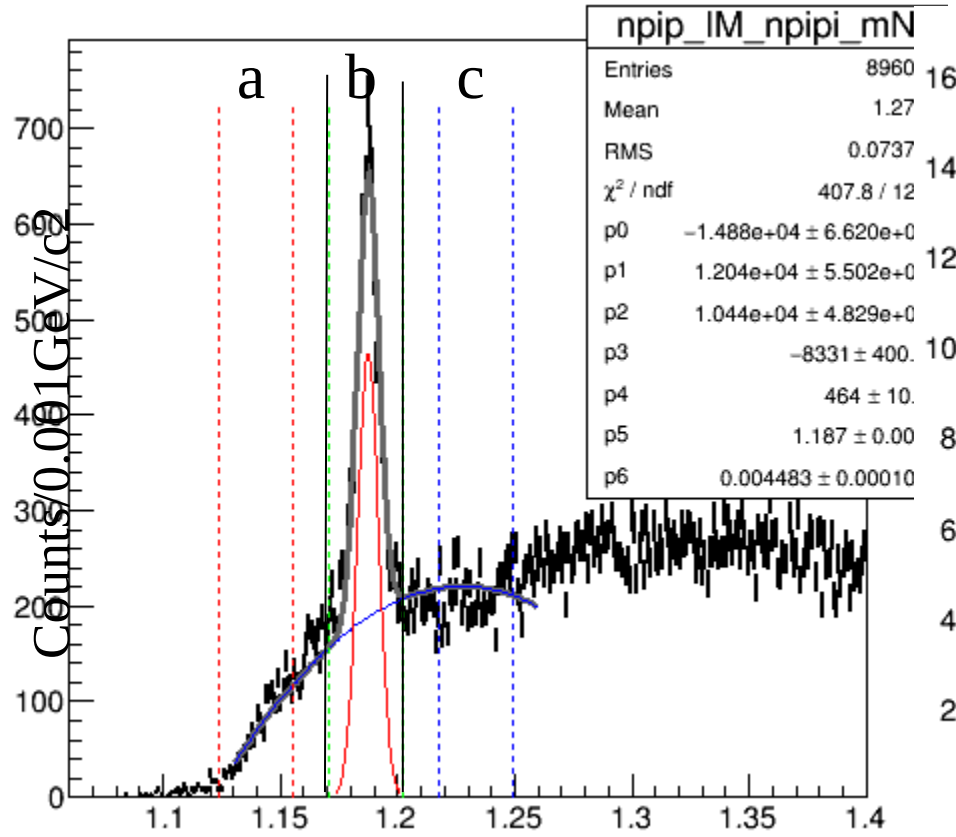
Invariant Mass of $n\pi^+$ and $n\pi^-$

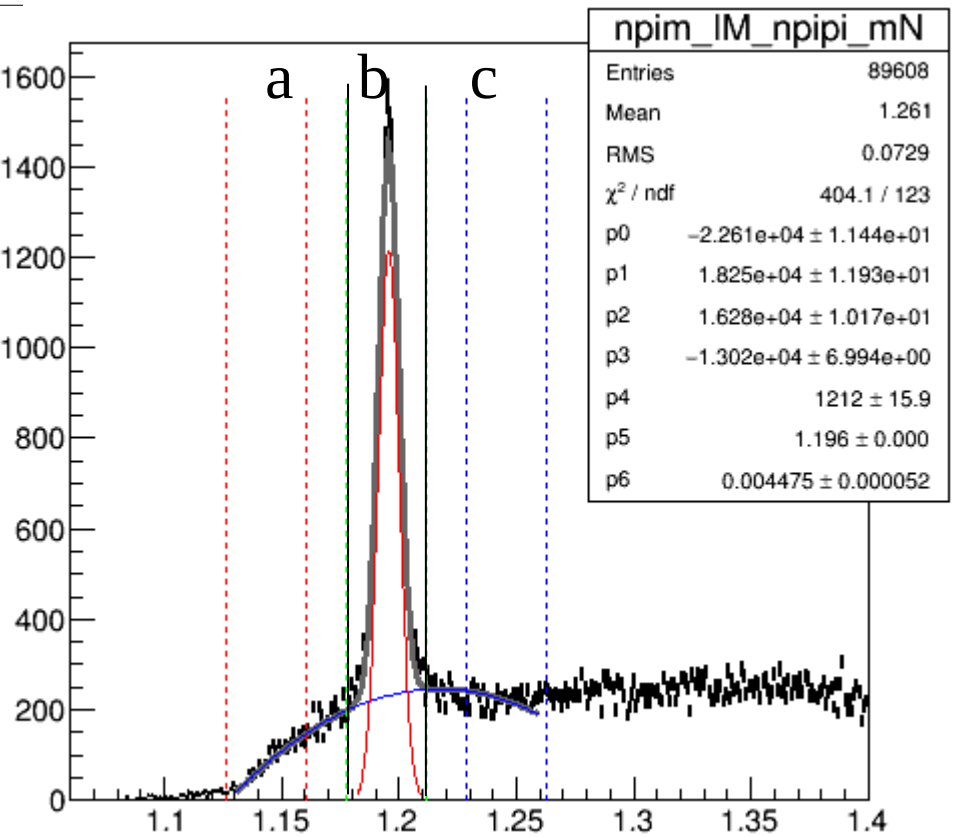
The strong focusing cross-image corresponds to Σ-decay event.





Invariant mass of nπ+and nπ-

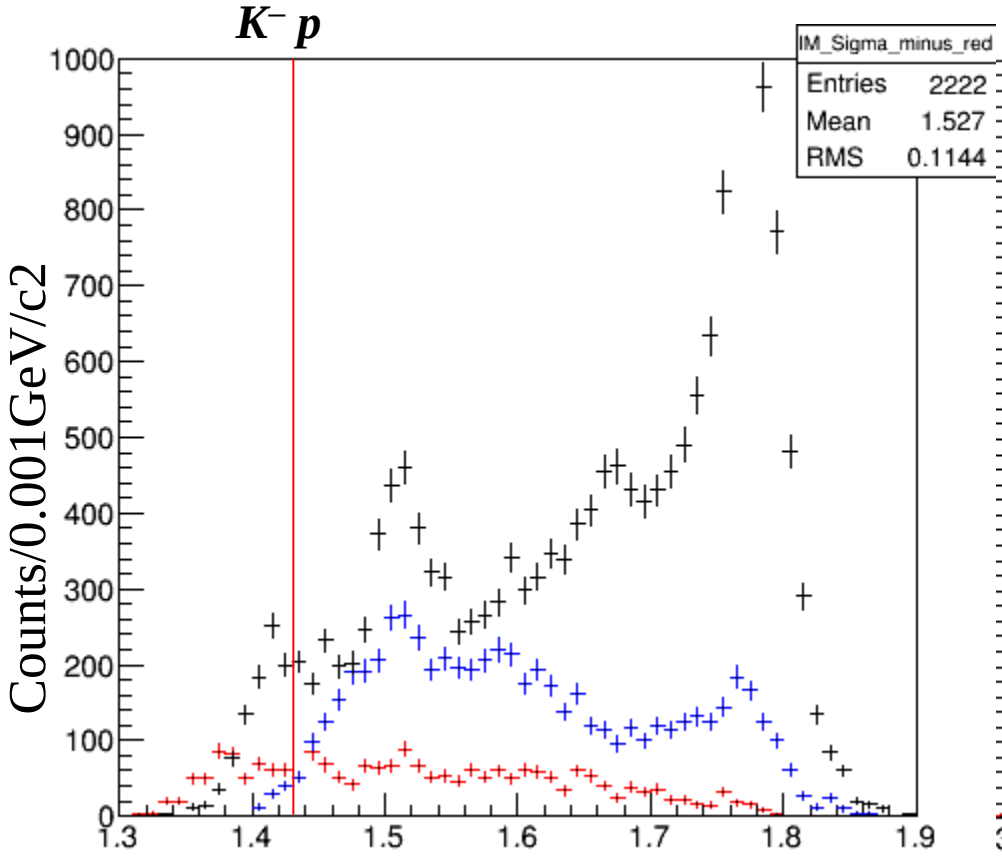




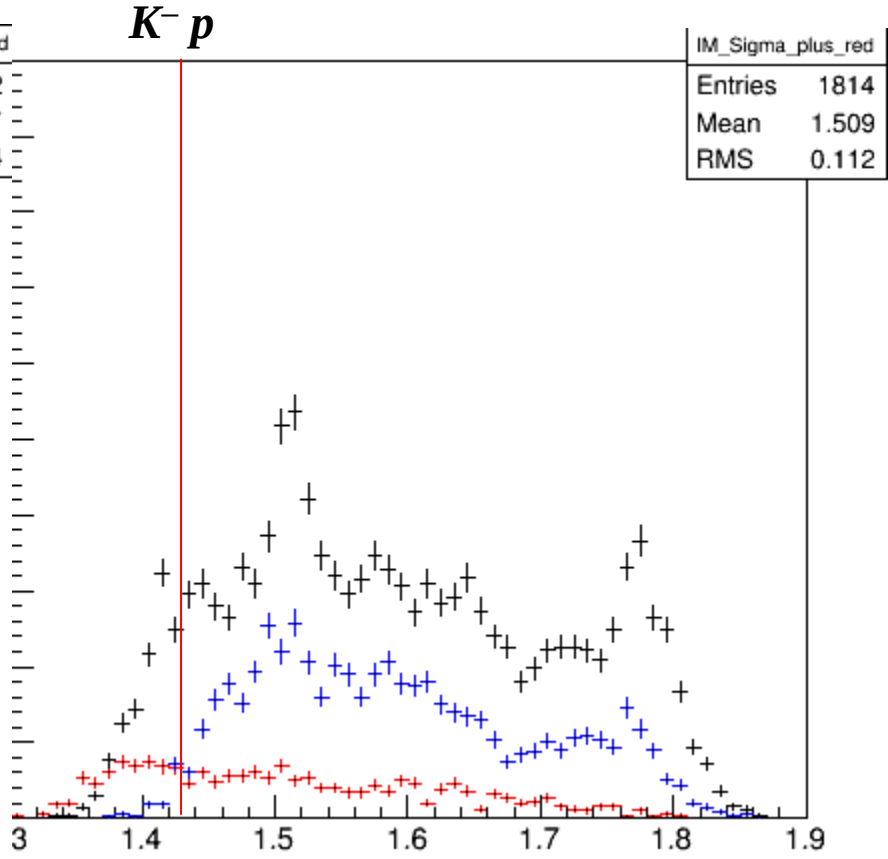
Entries_a = 1440
Entries_b = 4080
Entries_c = 4800
Sigma = 0.00428133
Mean = 1.18726

Entries_a = 1920
Entries_b = 5160
Entries_c = 6000
Sigma = 0.00450004
Mean = 1.19556

Invariant mass of **Σ-π+** and **Σ+π-** with sideband (a=red, b=black, c=blue) events



Invariant Mass of **Σ-π** $^{+}$(GeV/c^2)

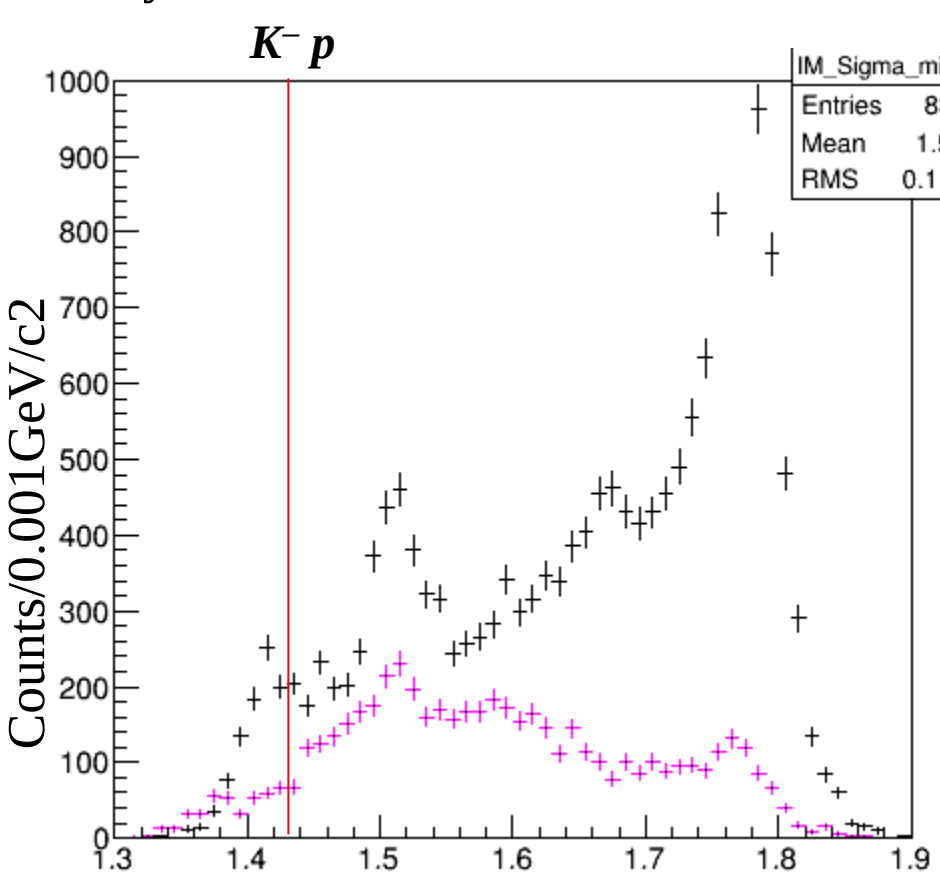


Invariant Mass of **Σ+π-**(GeV/c^2)

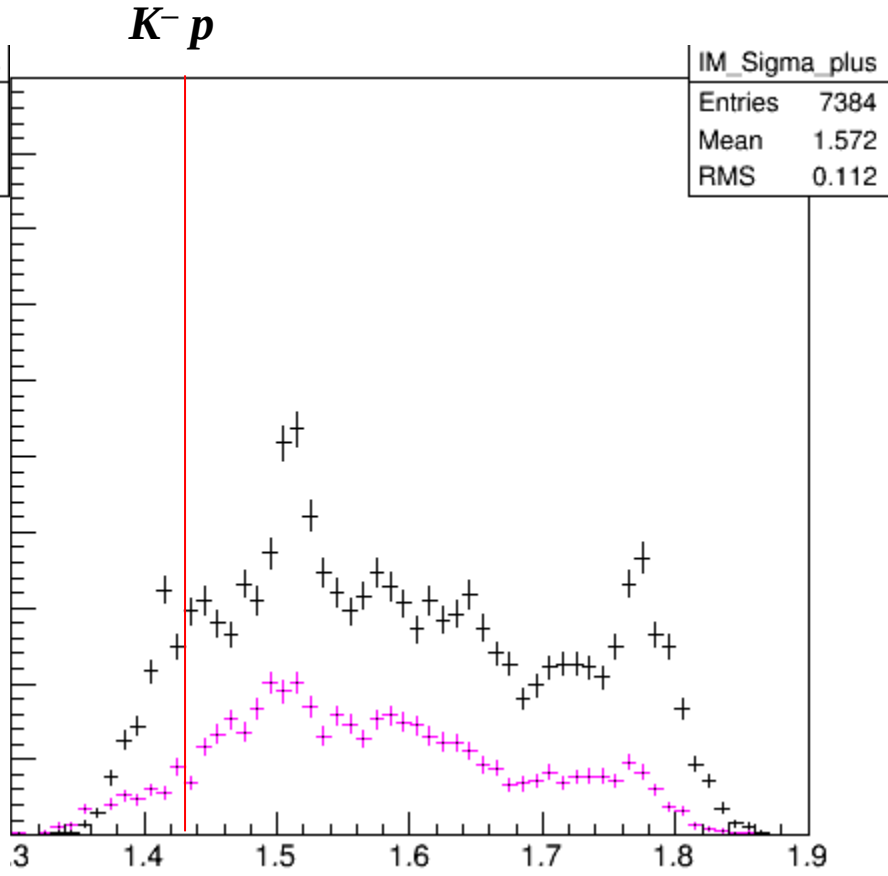
Invariant mass of Σ-π+ and Σ+π- with normalization of the side band

"average" = b/(a+c)

scaled by this formula



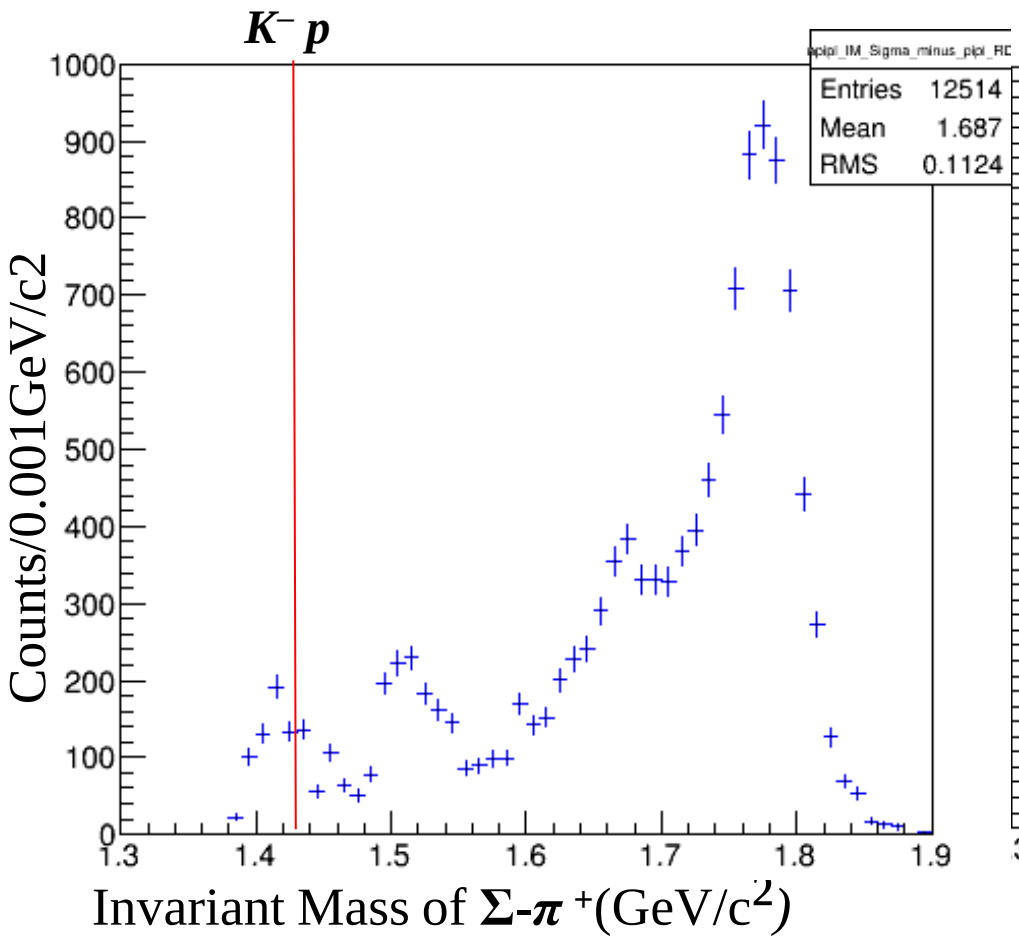
Invariant Mass of Σ-π+(GeV/c^2)

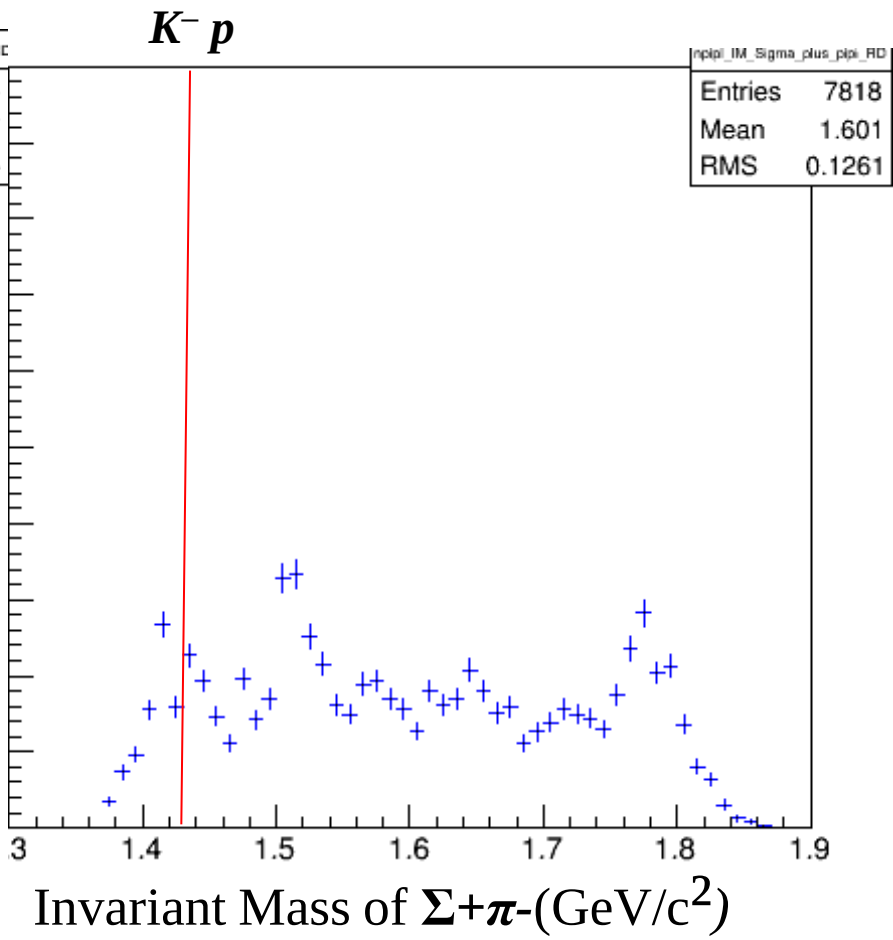


Invariant Mass of Σ+π-(GeV/c^2)

Invariant Mass of the $\Sigma^-\pi^+$ and $\Sigma^+\pi^-$ in the $d(K^-, \Sigma\pi)$"n" reaction (acceptance is uncorrected)

back ground subtracted spectrums





Summary:::

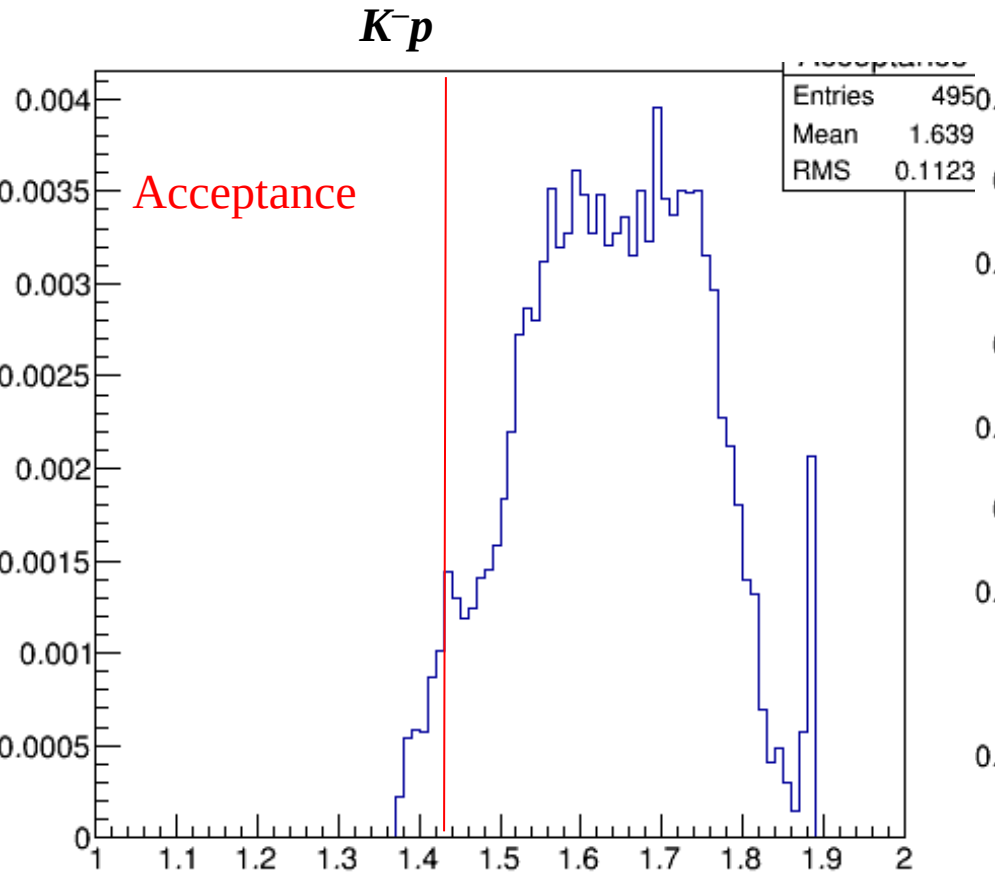
1. We have performed the physics experiment E31-2 run and obtained d(K-, Σπ)”n” spectrum shape;
2. All the related behaviors of the d(K-, Σπ)”n” reaction are explained by one step process;
3. By using background estimation we have obtained the clear Λ(1405) peak position.

To Do:::

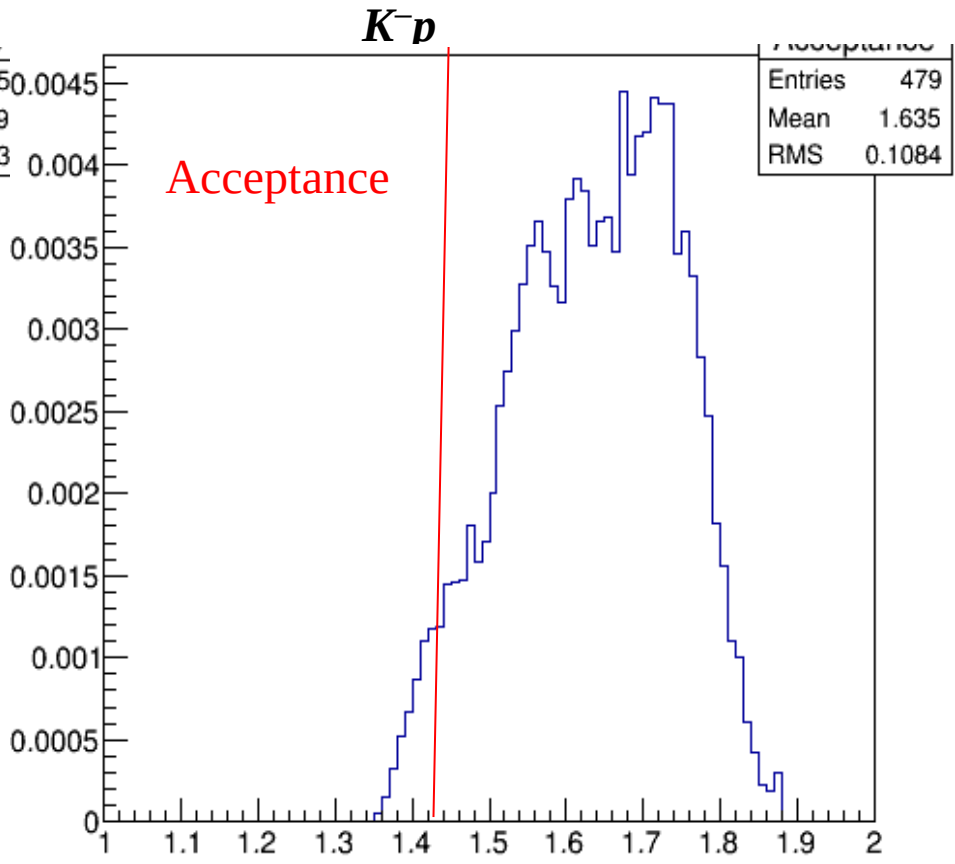
Monte Carlo simulation;

- acceptance correction (current status);
- detection efficiencies for the relevant particles, including analysis efficiency;
- cross section

BACKUP

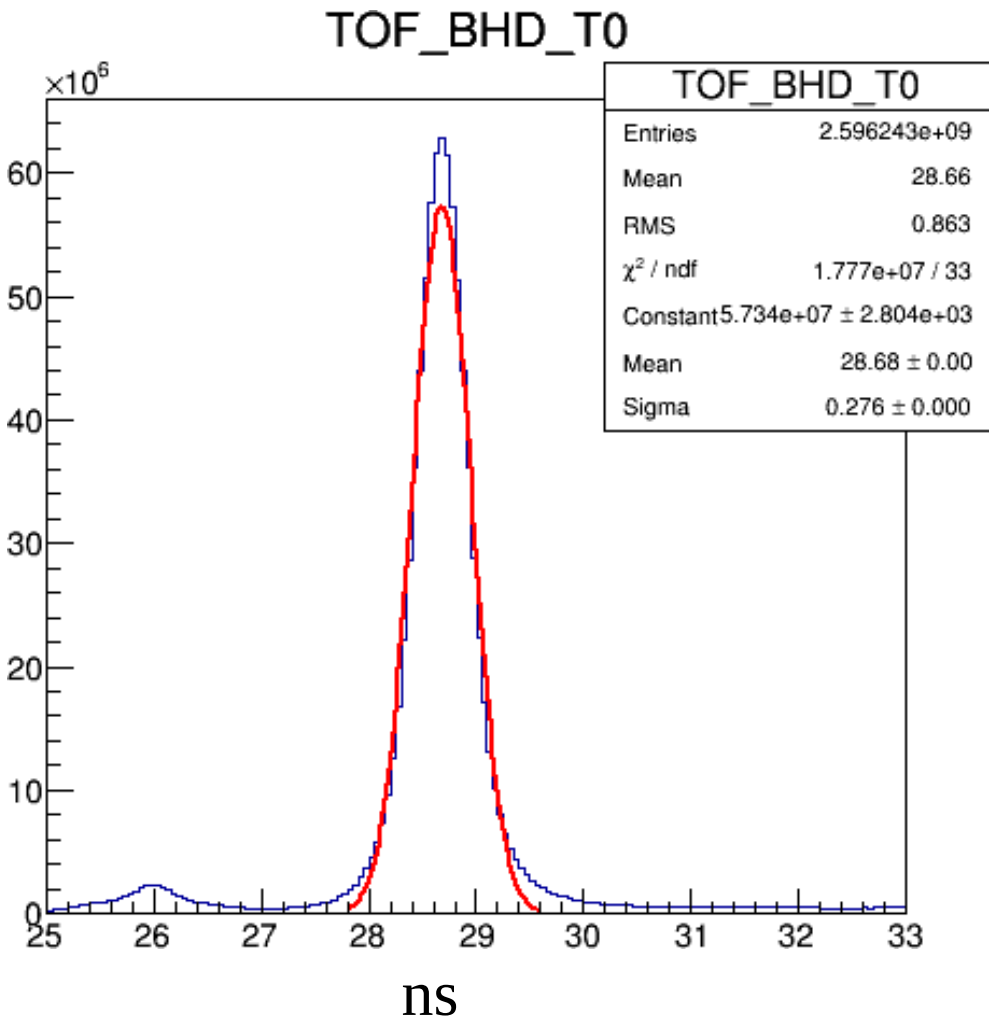


Invariant Mass of **Σ-π+**(GeV/ c^2)

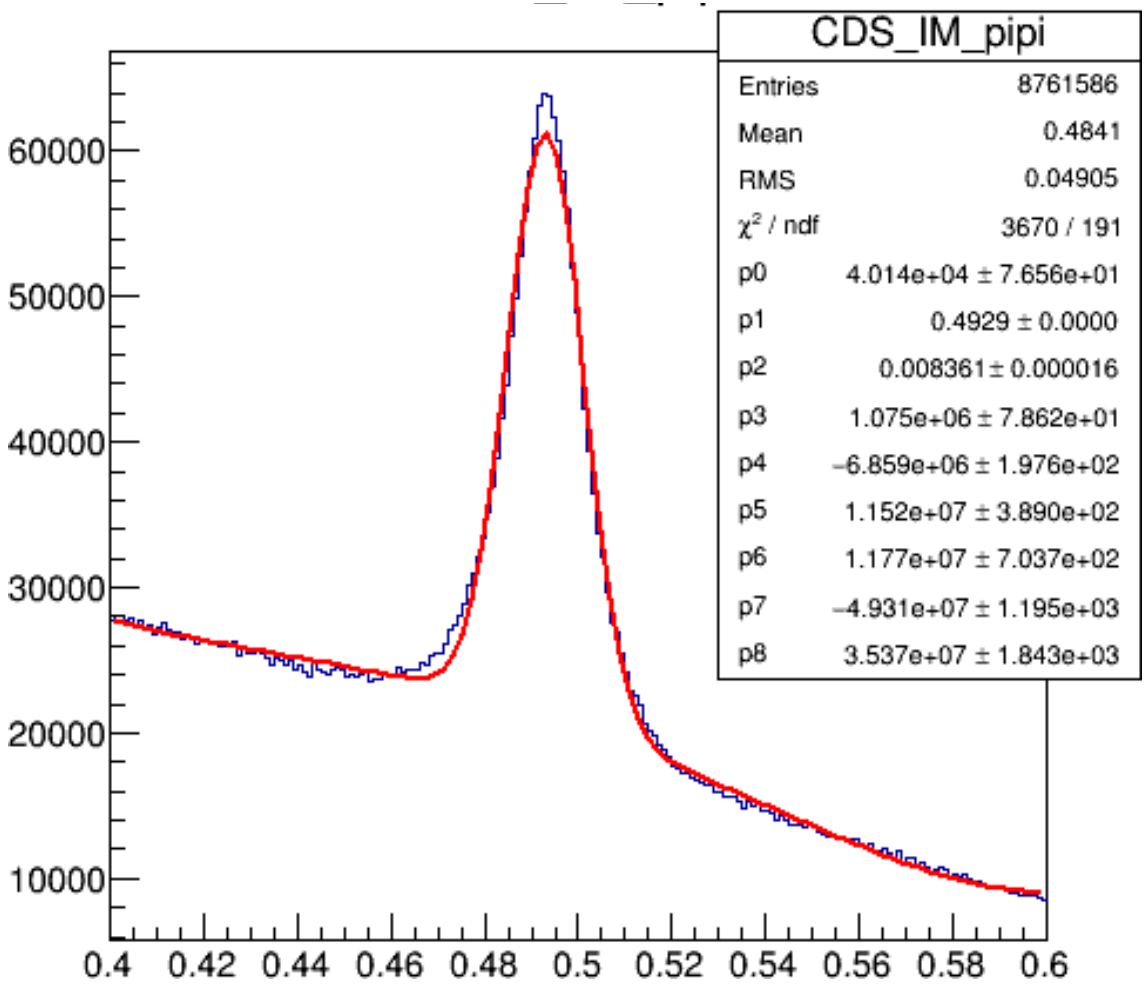


Invariant Mass of **Σ-π+**(GeV/ c^2)

K and π peaks have seen clearly.
Trig:KCDH2
Condition: T01hit, BHD mul



K⁰bar mass reconstruction



Trig:KCDH2
Condition: cds 2 track

Momentum and mass distribution