

Run78

$d(K^-, n) \rightarrow \Sigma^0 \pi^0$ spectrum

analysis status

2020/09/09

BG SIM estimation

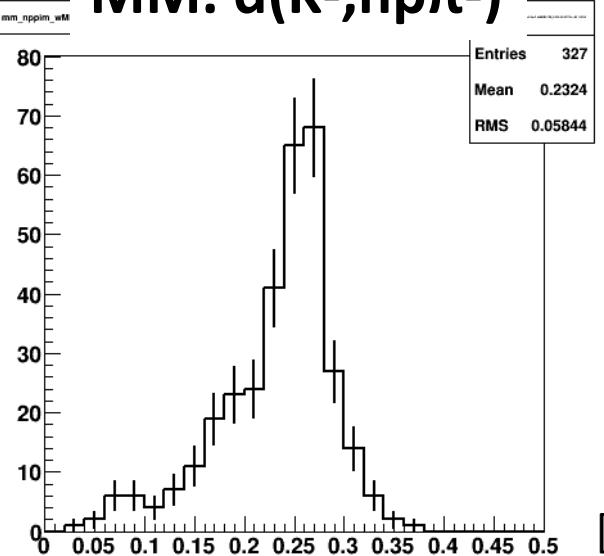
- 2 successive reaction (**Stopped K**)
 - K- “n” \rightarrow K- n ; “n” is bound in a deuteron
 - K- “p(n)” \rightarrow Y π ; “p(n)” is in different deuteron
(K- momentum = 0)
 - w/o Eloss correction for 1st scattered K-
 - Vertex distribution
 - 1st reaction : uniformly in z axis \rightarrow in proportion to the depth from edge of the target in z axis to fit all generated event in the target length
 - 2nd reaction : uniformly along recoiled K- direction from 1st reaction point

Reaction mode of 2nd reaction

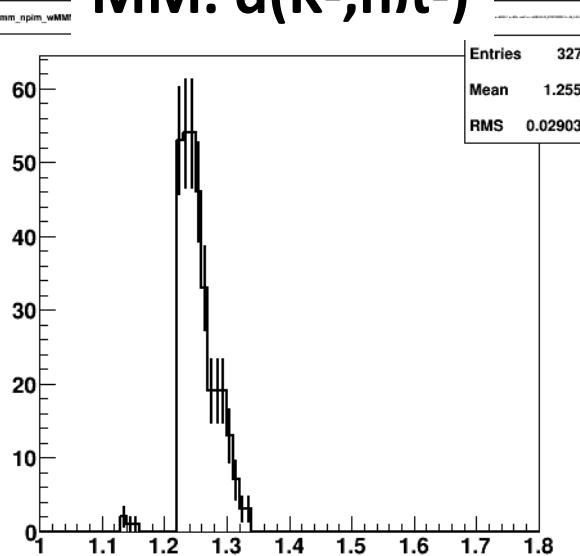
- K-p **Stopped K- ratio**
 - $\Sigma^0\pi^0$ 0.162
 - $\Sigma^+\pi^-$ 0.276
 - $\Sigma^-\pi^+$ 0.098 -no backward proton
 - $\pi^0\Lambda$ 0.069
- K-n
 - $\Sigma^0\pi^-$ 0.050
 - $\Sigma^-\pi^0$ 0.050 -no backward proton
 - $\Lambda\pi^-$ 0.138

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K, n\pi^-)$
- $d(K, n) 1.43 \sim 1.50$ select

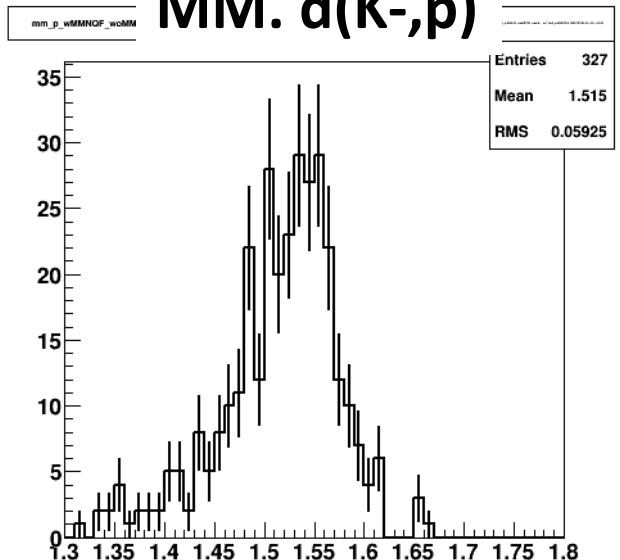
MM. $d(K, n\pi^-)$



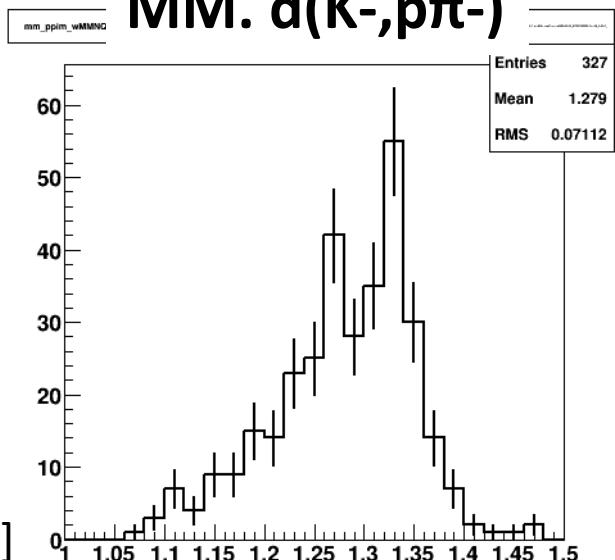
MM. $d(K, n\pi^-)$



MM. $d(K, p)$

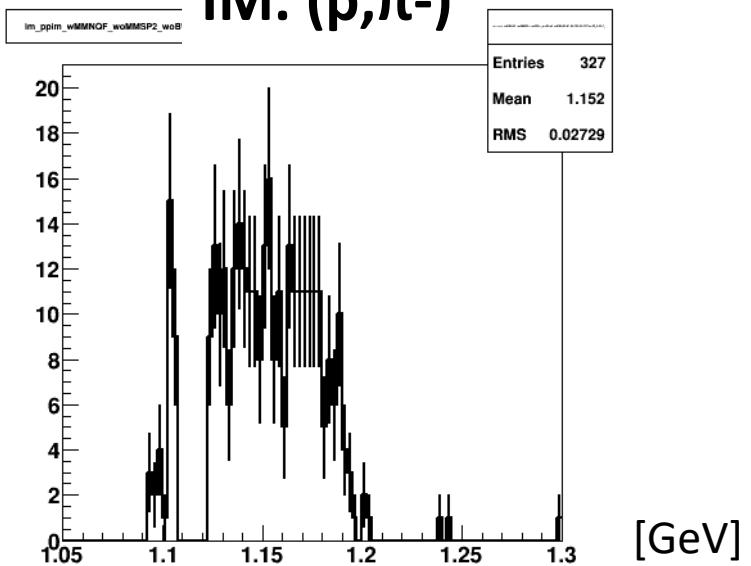


MM. $d(K, p\pi^-)$

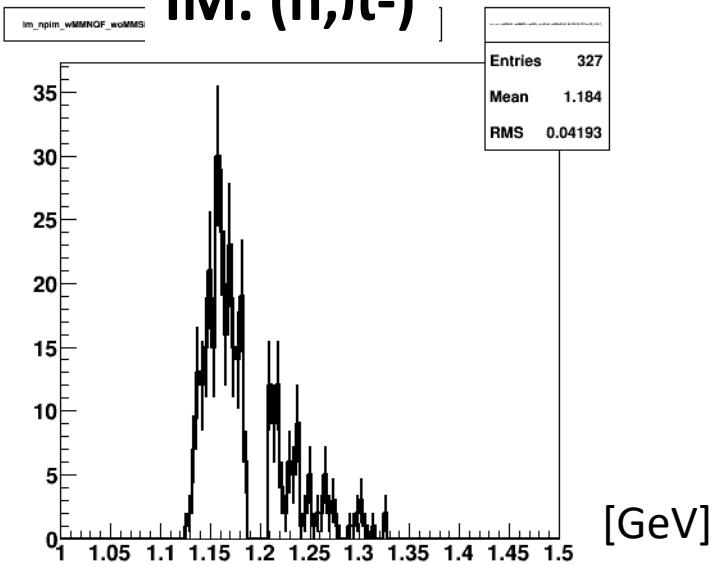


- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K, np\pi^-)$
- $d(K, n) 1.43 \sim 1.50$ select

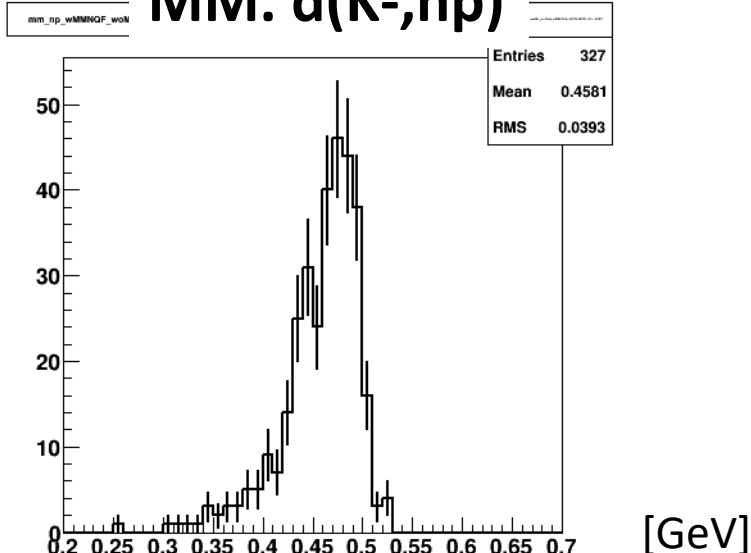
IM. (p, π^-)



IM. (n, π^-)

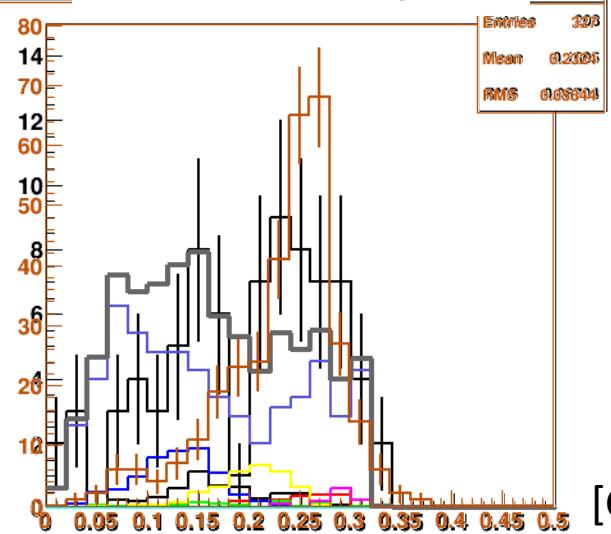


MM. $d(K^-, np)$

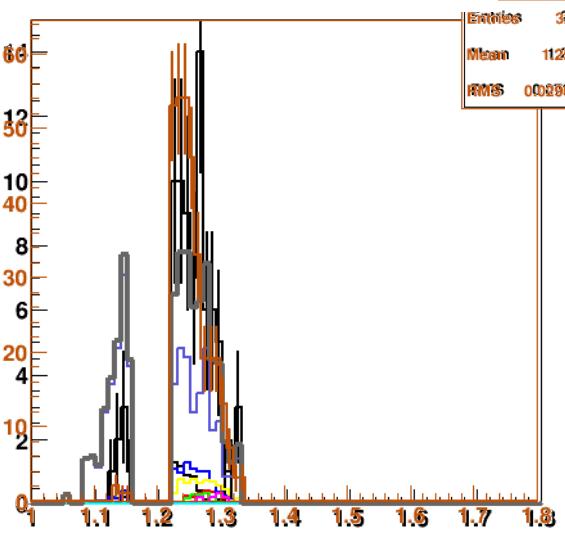


- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K, n\pi^-)$
- $d(K, n) 1.43 \sim 1.50$ select

MM. $d(K, n\pi^-)$

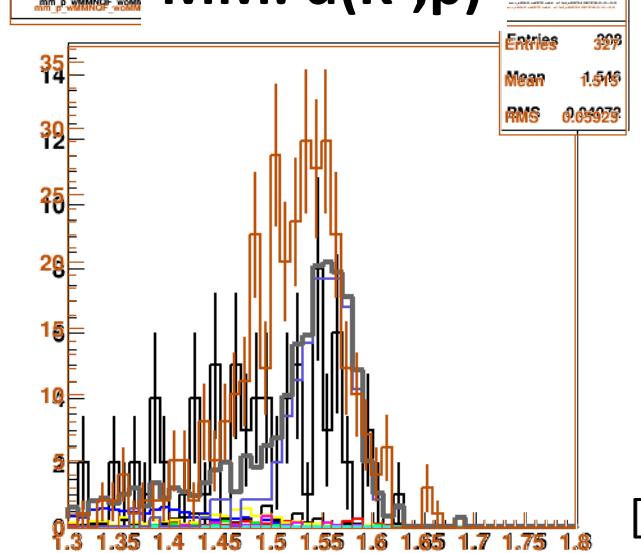


MM. $d(K, n\pi^-)$

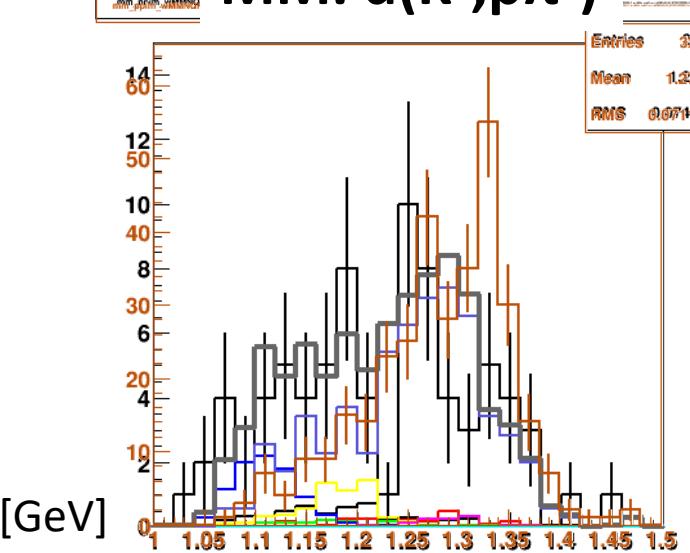


[GeV]

MM. $d(K, p)$



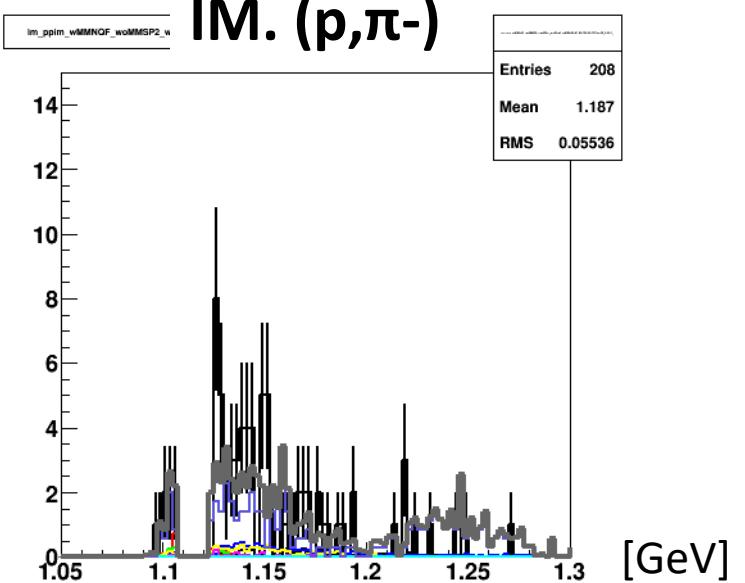
MM. $d(K, p\pi^-)$



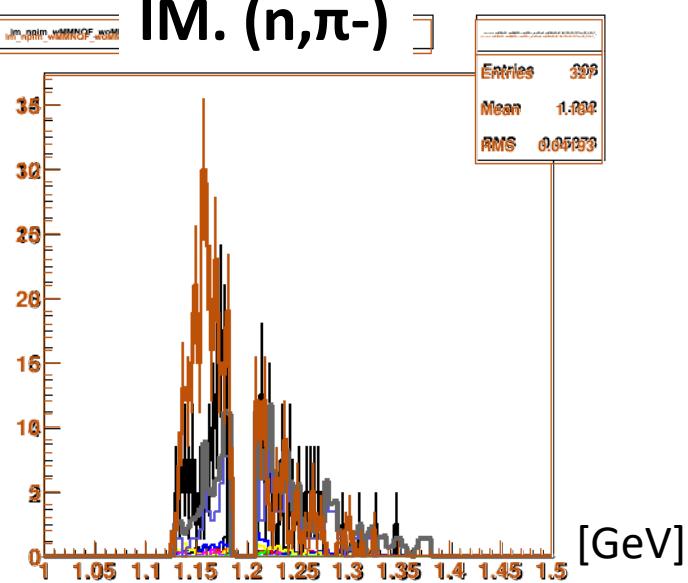
[GeV]

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K, np\pi^-)$
- $d(K, n) 1.43 \sim 1.50$ select

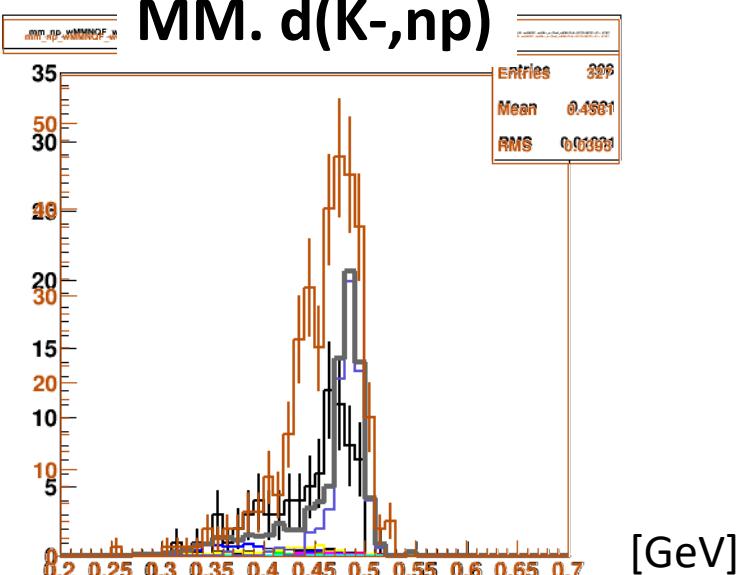
IM. (p, π^-)



IM. (n, π^-)

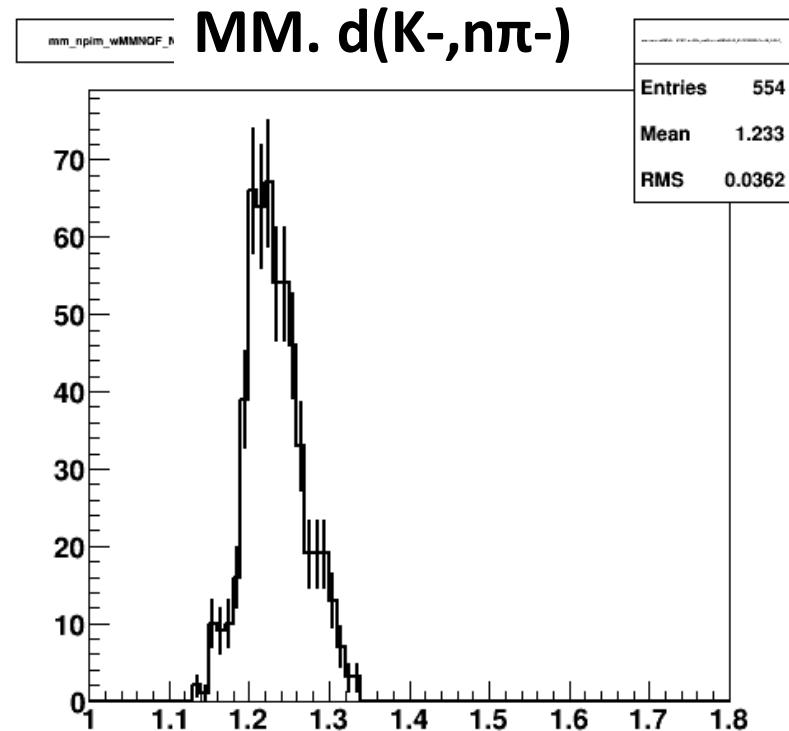
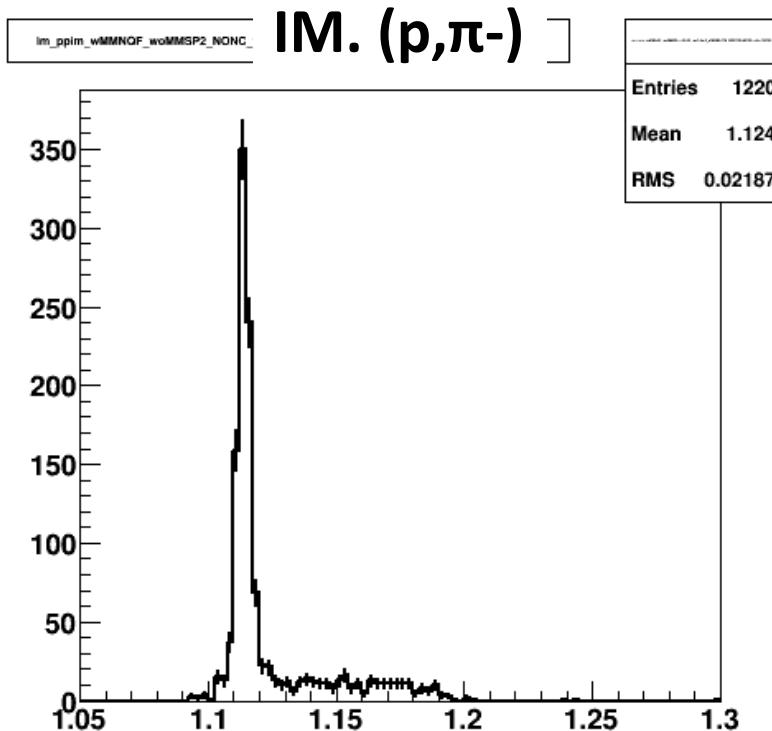


MM. $d(K, np)$



- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^+)$ is rejected
- ~~• Λ from IM. (p, π^-) is rejected~~
- $0 < d(K^-, n\pi\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select

- Σ^- from IM. (n, π^-) is rejected
- ~~• Σ^+ from MM. $d(K^-, n\pi^+)$ is rejected~~
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select

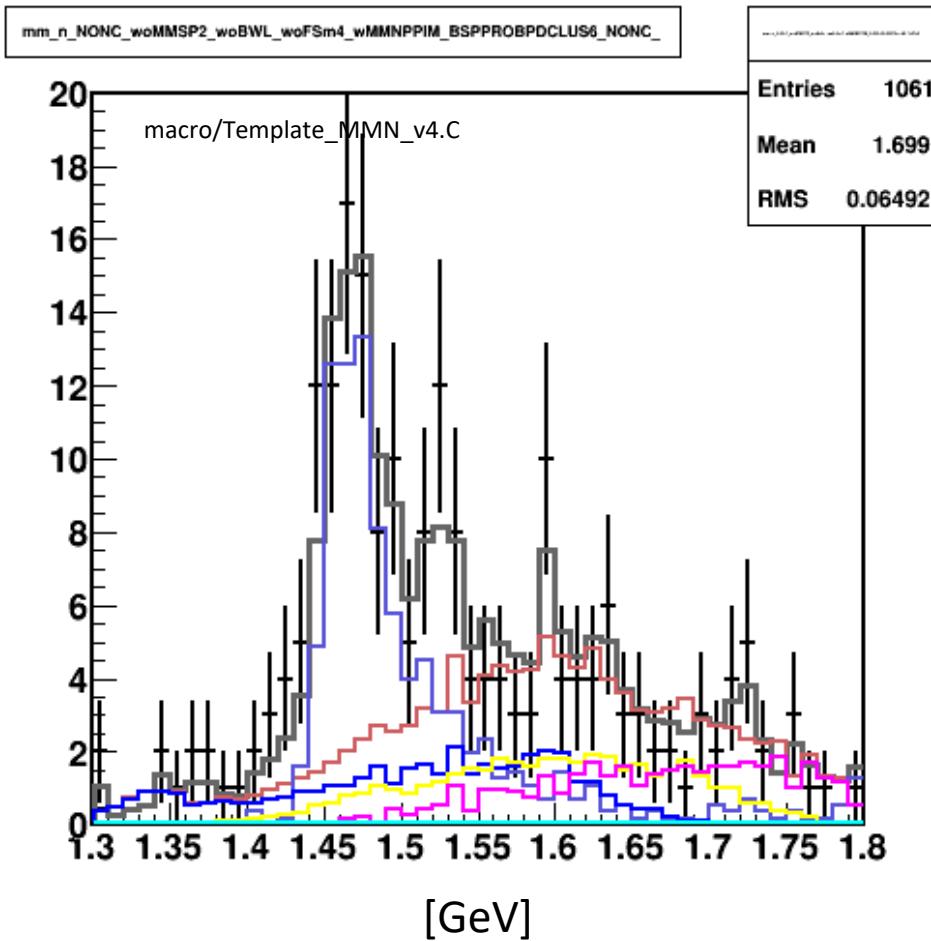


BG SIM estimation

- $K^- d \rightarrow p Y \pi$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - data shape of MM. $d(K^-, p)$
- 2 successive reaction (**Stopped K**)
 - $K^- "n" \rightarrow K^- n$; "n" is bound in a deuteron
 - $K^- "p(n)" \rightarrow Y \pi$; "p(n)" is in different deuteron (**K- momentum = 0**)
 - w/o Eloss correction for 1st scattered K^-
 - Vertex distribution
 - 1st reaction : uniformly in z axis \rightarrow in proportion to the depth from edge of the target in z axis to fit all generated event in the target length
 - 2nd reaction : uniformly along recoiled K^- direction from 1st reaction point

Fitting of MM. $d(K_-, n)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K_-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K_-, n\pi\pi^-)$



† Data

- $K-d \rightarrow p \Sigma \pi$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$

- Stopped K
- Fit Result

- The relative ratio of 4 components in $K-d \rightarrow p \Sigma \pi$ is fixed by fitting of MM. $d(K_-, p\pi^-)$ P.807
- Scaling factors of SIM ($K-d \rightarrow p \Sigma \pi$, $K-d \rightarrow n K-p$) are free

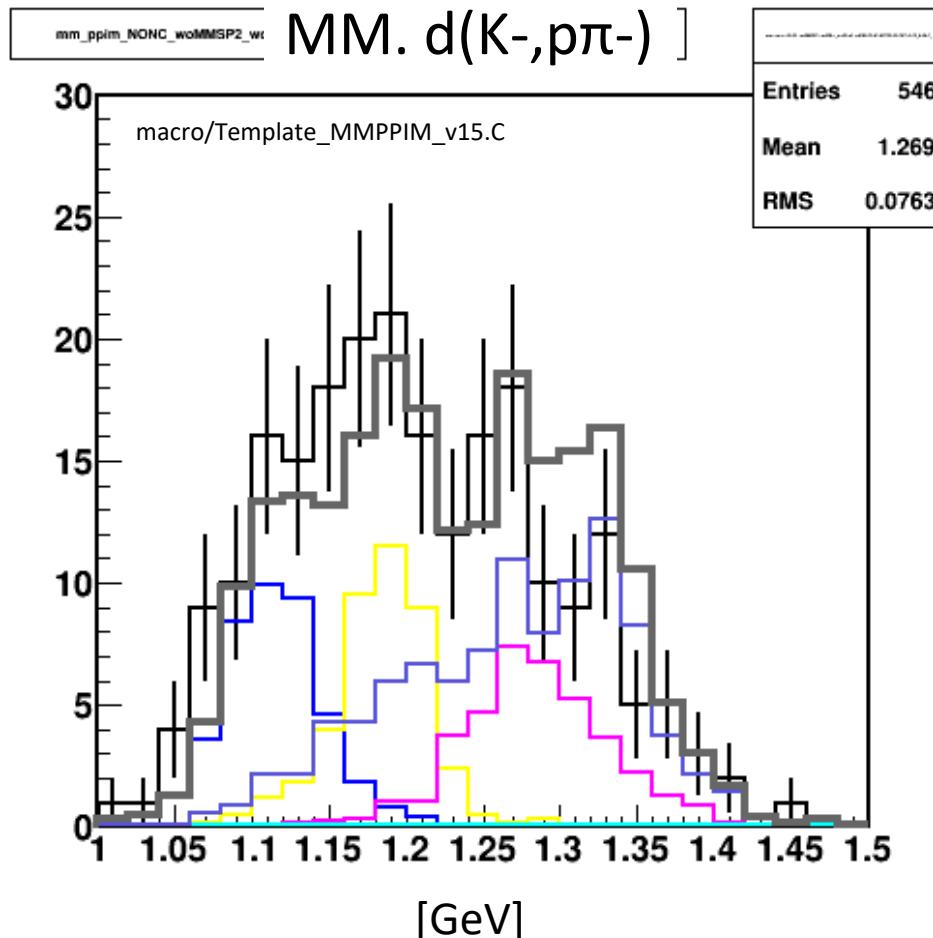
Fit Range
1.30 ~ 1.80 GeV

Chi2/ndf = 36.7/50

sca sca_err
0: 0.741445
1: 0.179945
chi2: 36.7119

Fitting result

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$

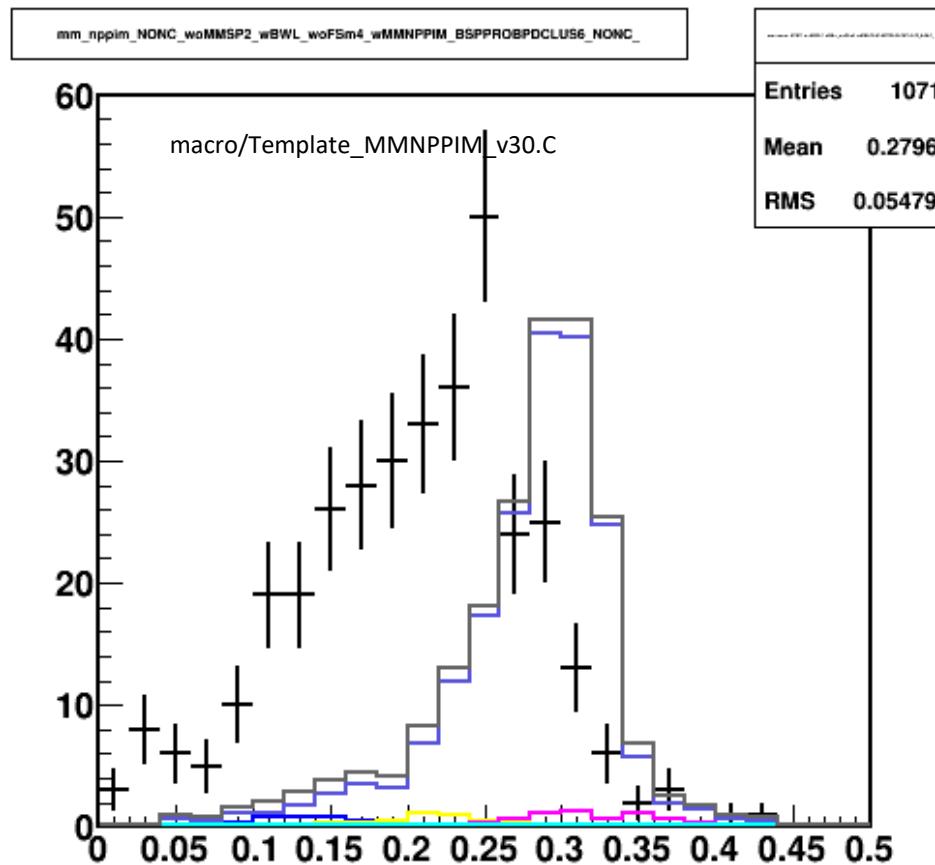


† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi-\pi^0$
- $K-d \rightarrow p \Sigma^0 \pi-\pi^0$
- $\text{Stopped } K$
- SUM

MM. $d(K^-, n\Lambda)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) selected
- $0 < d(K^-, n\pi^-)$



† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- Stopped K
- SUM

Fitting fails due to the Λ event from stopped K

Check another K- scatter reaction

- 1 step , stopped K- hyperon production
- 1 step , in-flight K- decay
 - backward proton has only fermi momentum ~ small acceptance
- 2 step , stopped K- hyperon production
- 2 step , in-flight K- decay
 - Already done, seems to explain BG

Hyperon production ($\Lambda\pi^0$, $\Sigma^0\pi^0$, $\Lambda\pi^-$) makes Λ peak in IM.(p,π^-) , which can be BG

To do

- Detection efficiency -> SIM
- ratio of stopped K- -> SIM
- Ratio of 1 step to 2 step -> data analysis

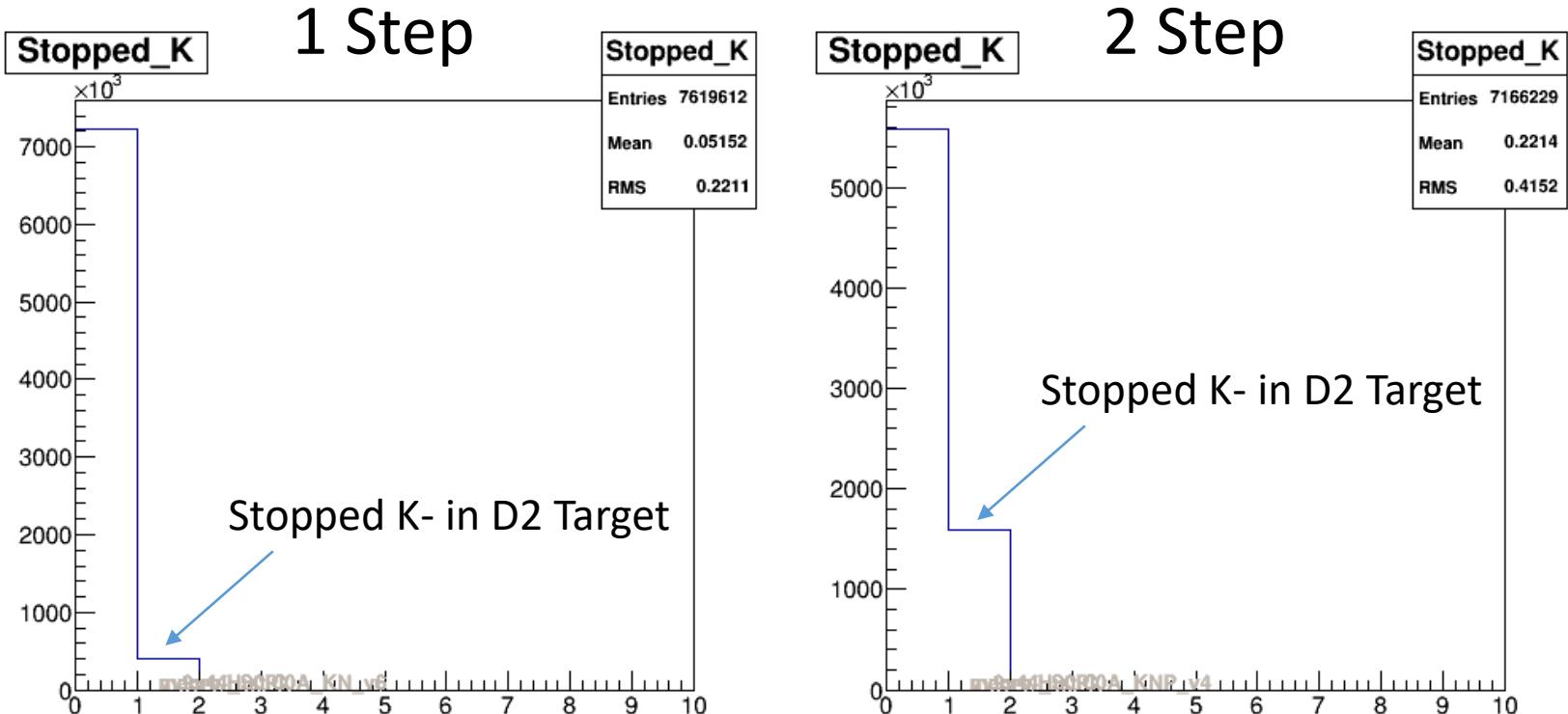
Analysis of SIM is on going

Analysis Correction

- Time of Flight & Flight length of Scattered K-
 - K- initial momentum (w/o Energy loss correction)
-> use fitting function from SIM data

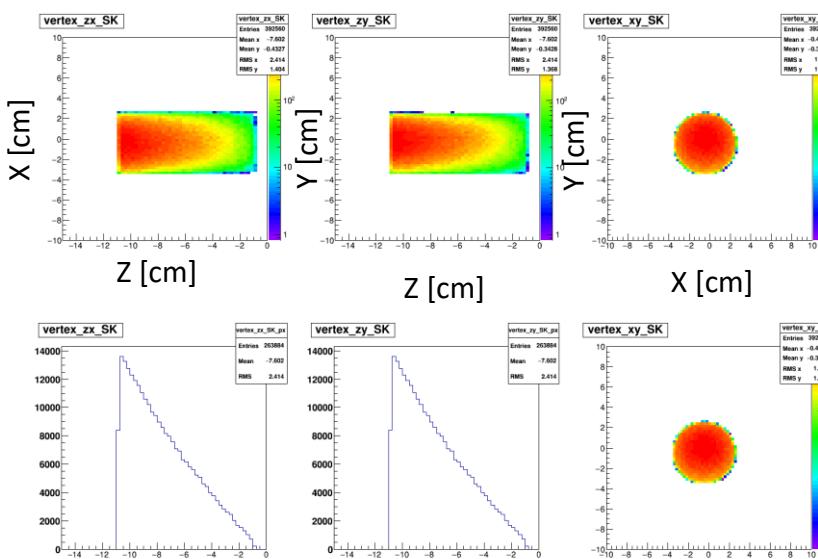
Ratio of Stopped K-

Generate event

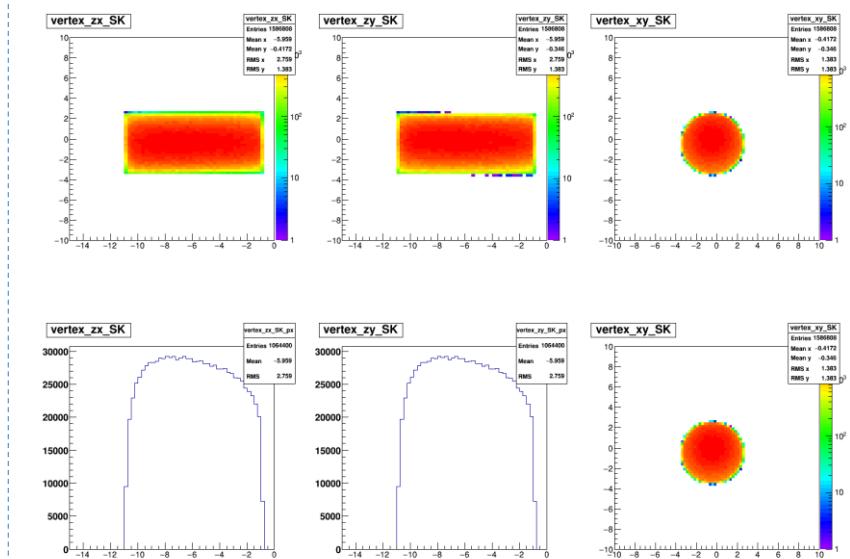


Position of K- Stopped

1 Step

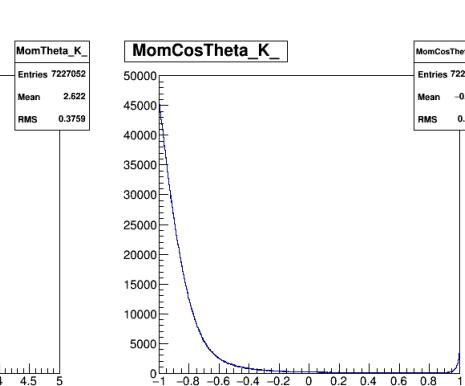
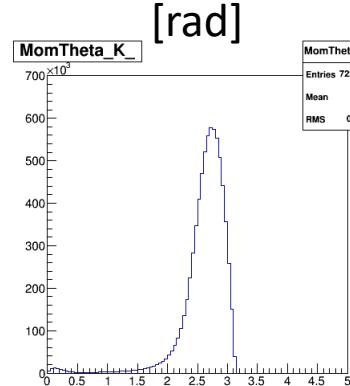
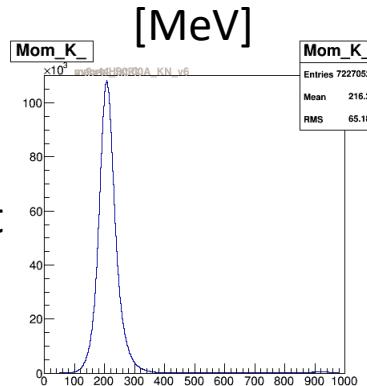
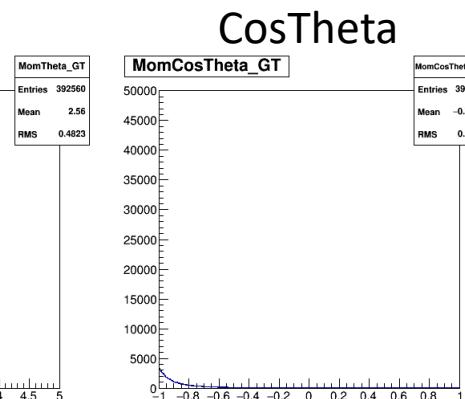
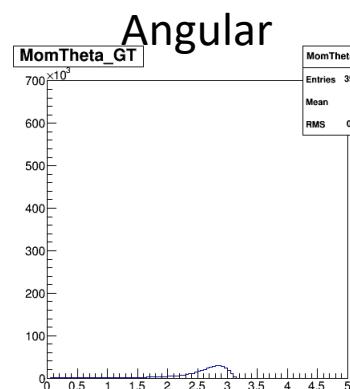
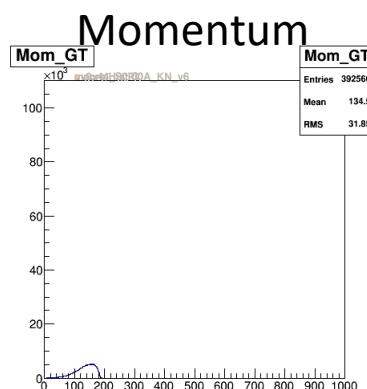


2 Step

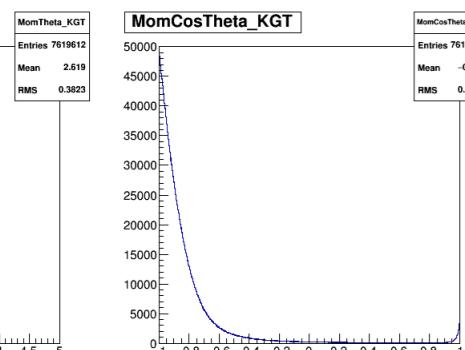
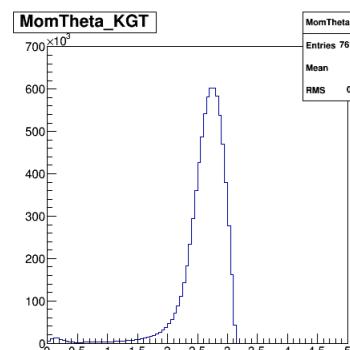
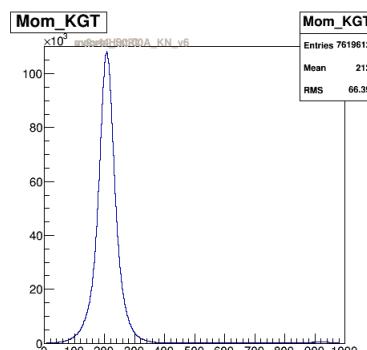


K- momentum

1 Step



Stopped K- event

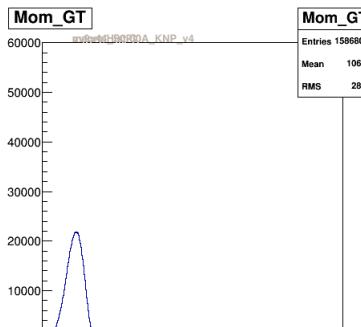


All event

K-momentum

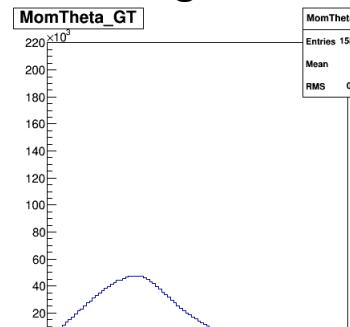
2 Step

Momentum



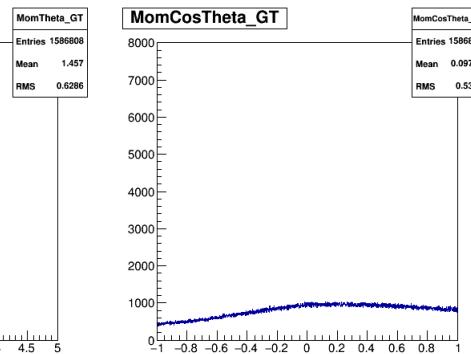
[MeV]

Angular

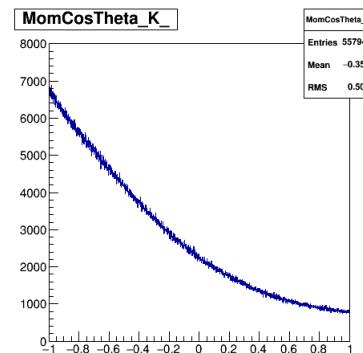
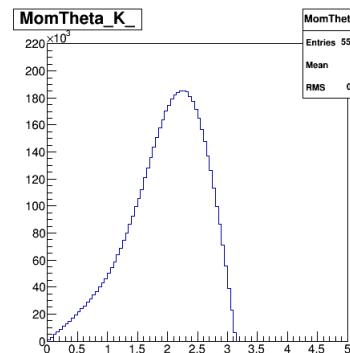
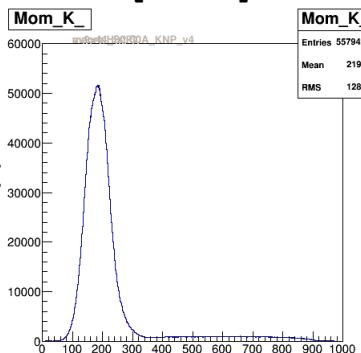


[rad]

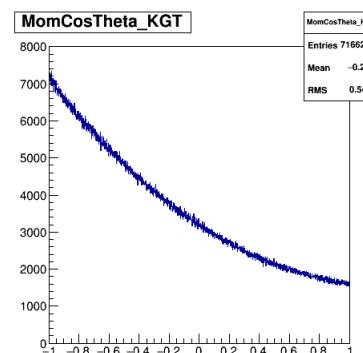
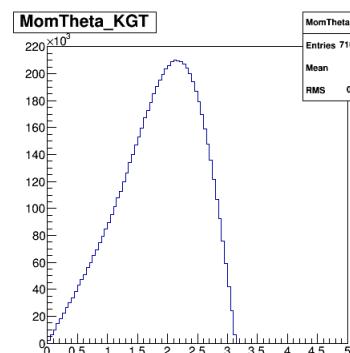
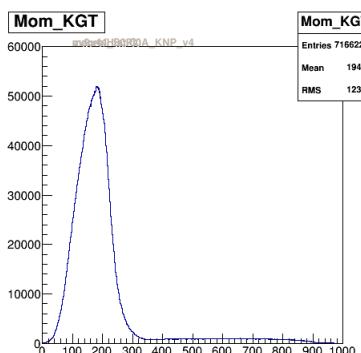
CosTheta



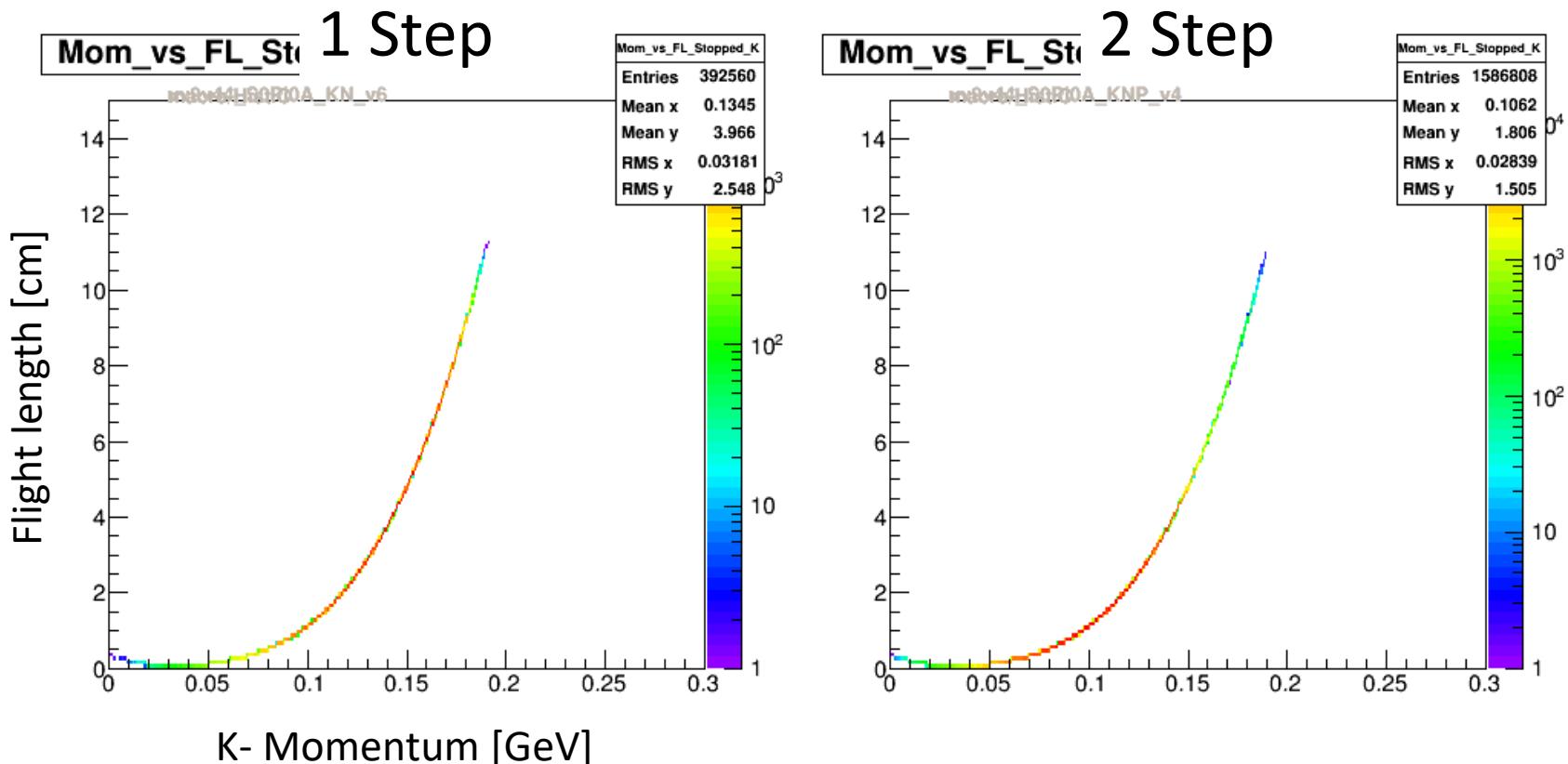
Stopped K-event



All event



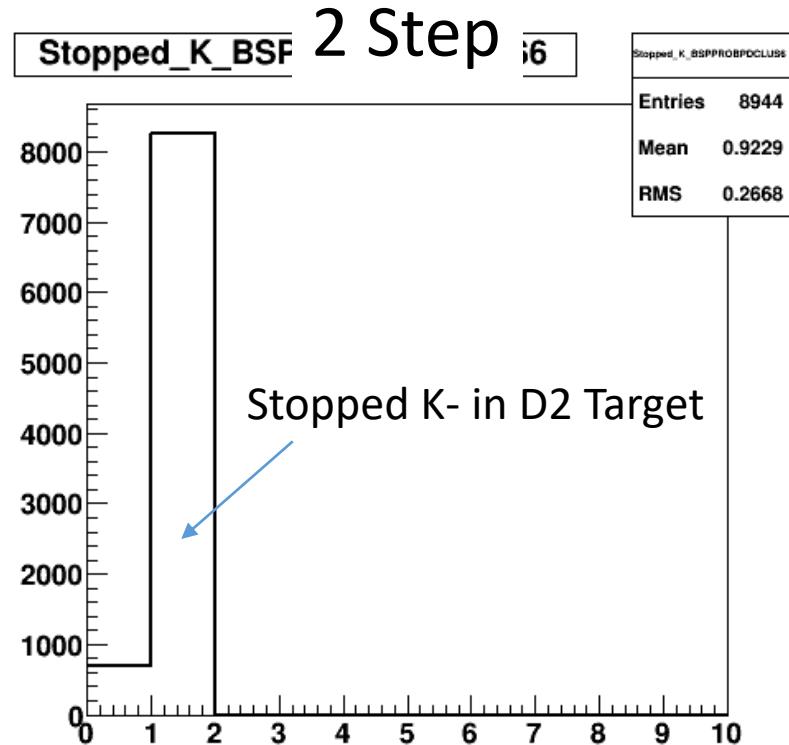
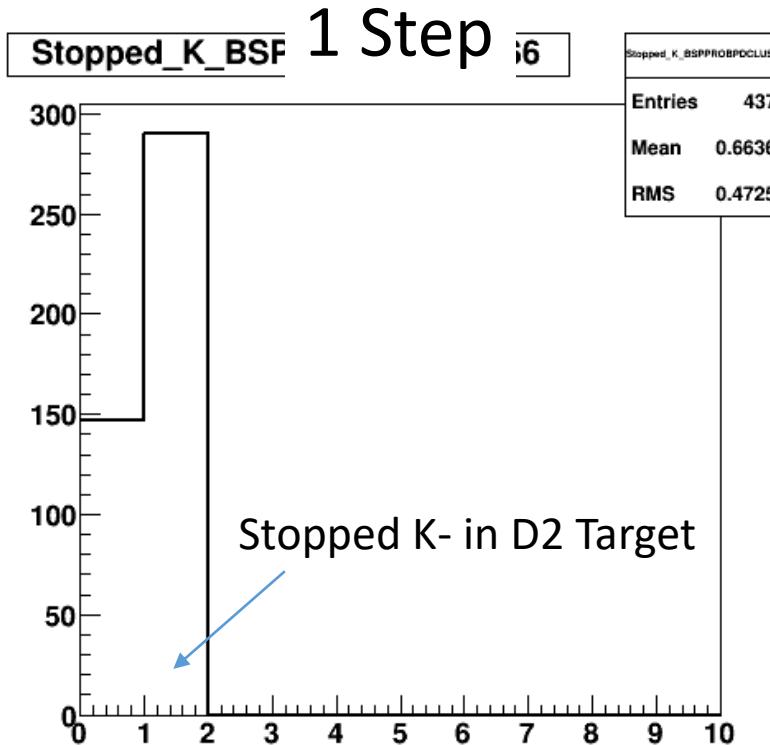
Check of Stopped K- Flight length



Reproduce the function

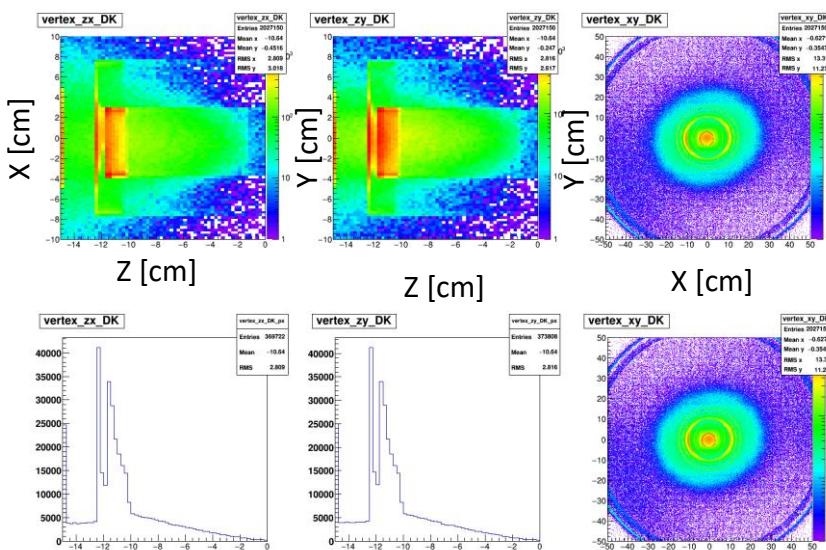
Ratio of Stopped K-

Detection event

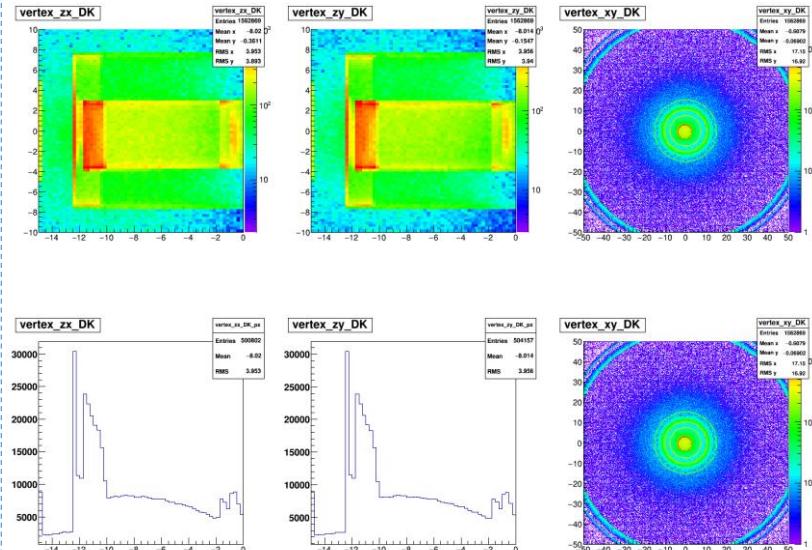


Position of K- in-flight decay

1 Step



2 Step



Check another K- scatter reaction

- 1 step , stopped K- hyperon production
- 1 step , in-flight K- decay
 - backward proton has only fermi momentum ~ small acceptance
- 2 step , stopped K- hyperon production
- 2 step , in-flight K- decay
 - Already done, seems to explain BG

Hyperon production ($\Lambda\pi^0$, $\Sigma^0\pi^0$, $\Lambda\pi^-$) makes Λ peak in IM.(p,π^-) , which can be BG

To do

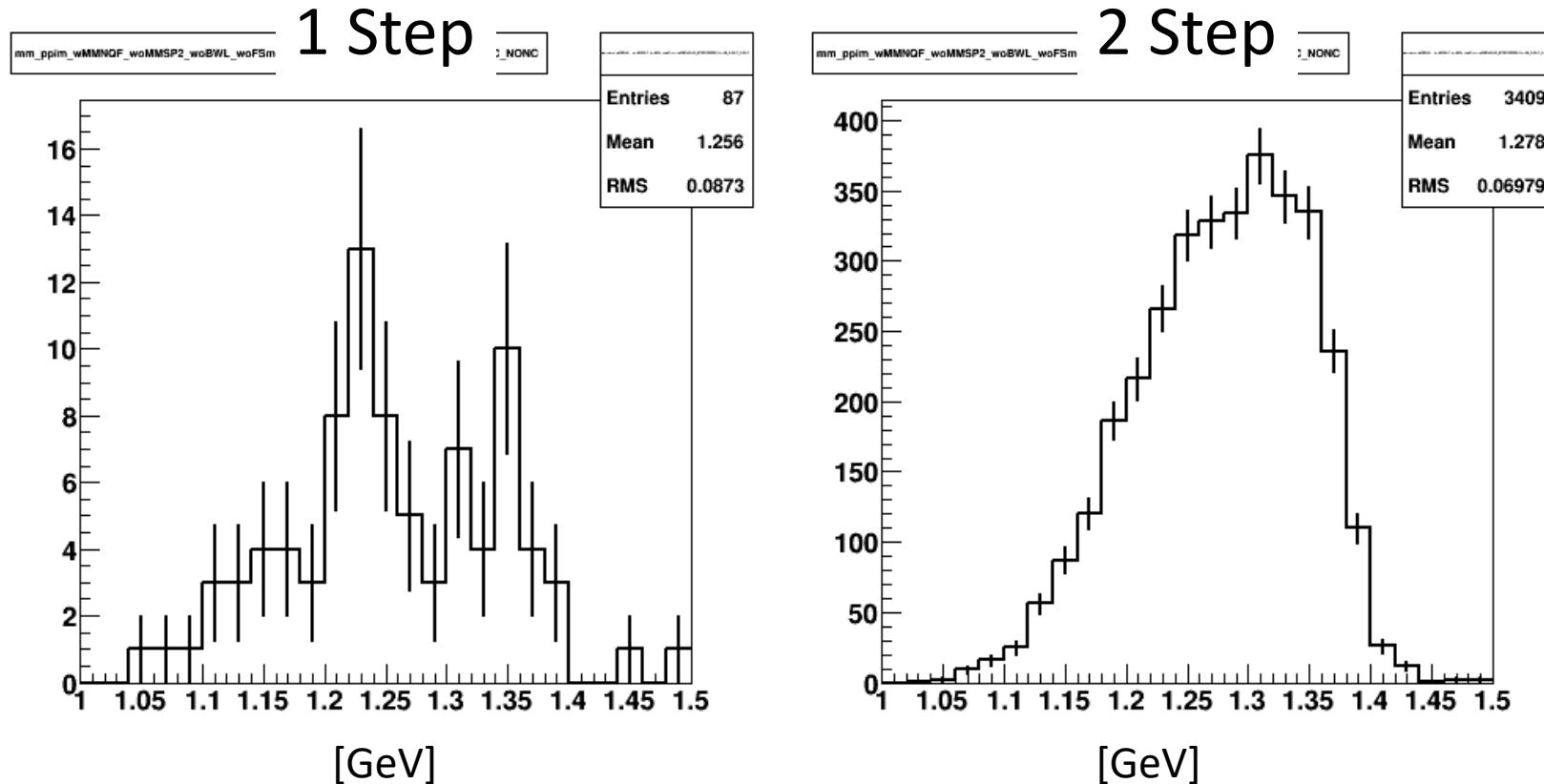
- Detection efficiency -> SIM
- ratio of stopped K- -> SIM
- Ratio of 1 step to 2 step -> data analysis

Analysis of SIM is on going

MM. $d(K^-, p\pi^-)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

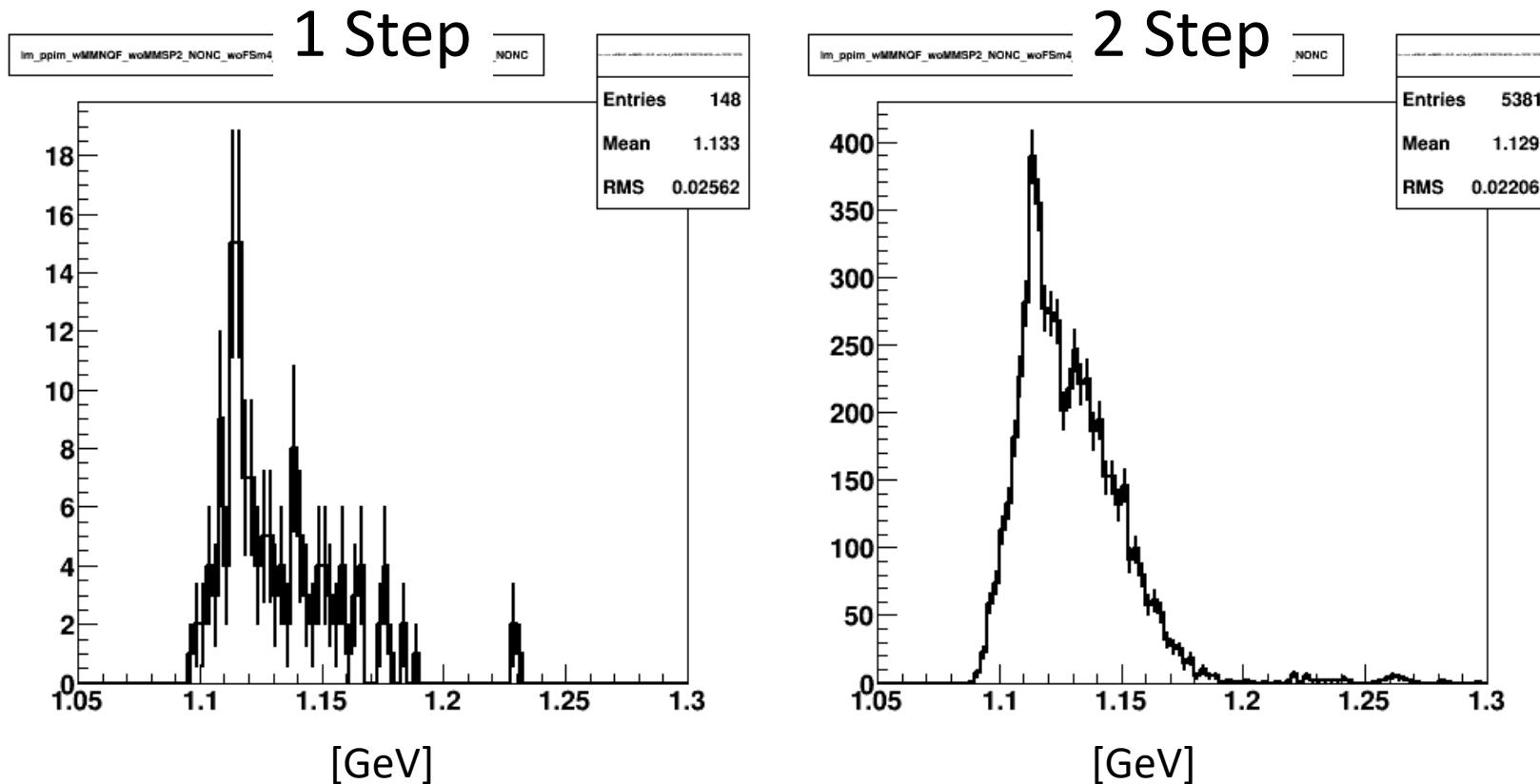
- Stopped K^-



IM.(p, π^-)

- Stopped K-

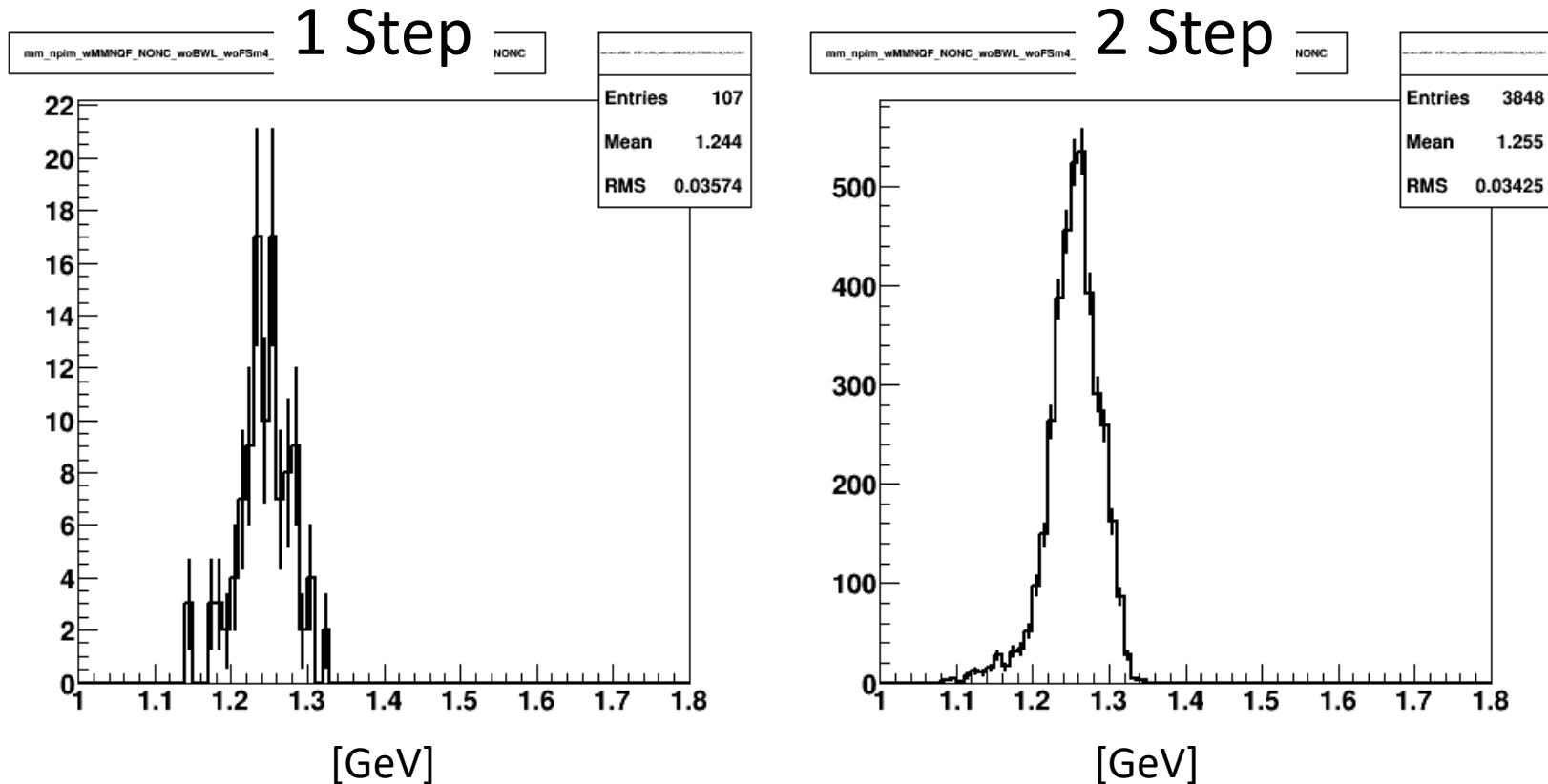
- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**



MM. $d(K^-, n\pi^-)$

- Stopped K^-

- Σ^- from IM. (n, π^-) rejected
- Λ^- from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

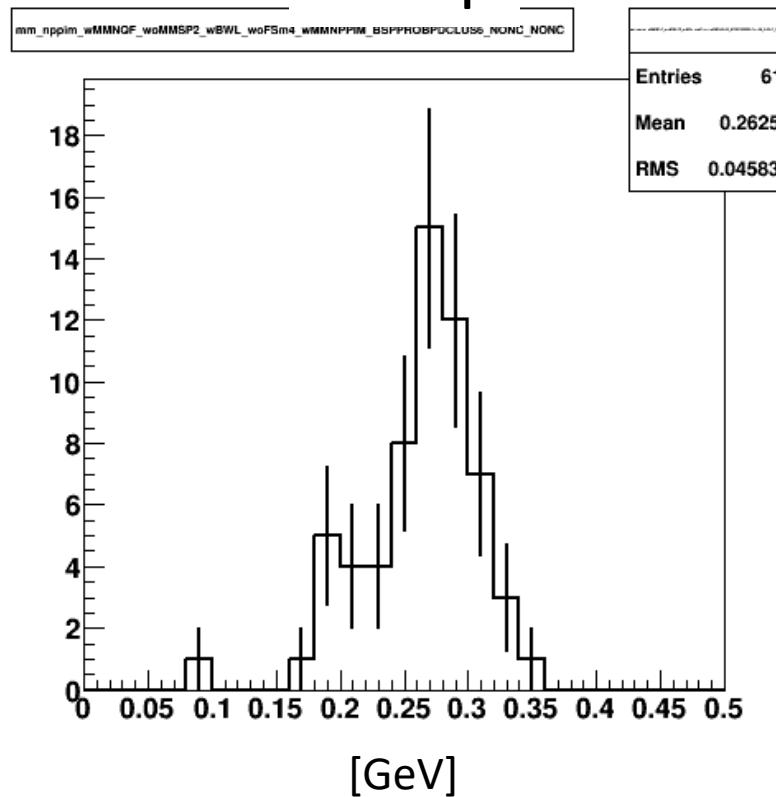


MM. $d(K^-, n\Lambda)$

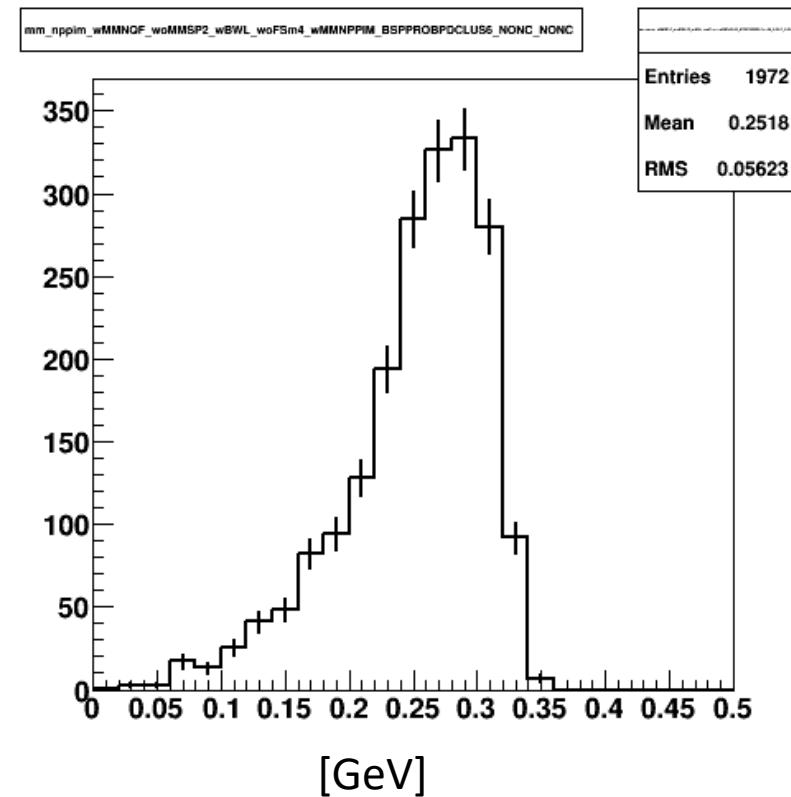
- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) selected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

- Stopped K^-

1 Step



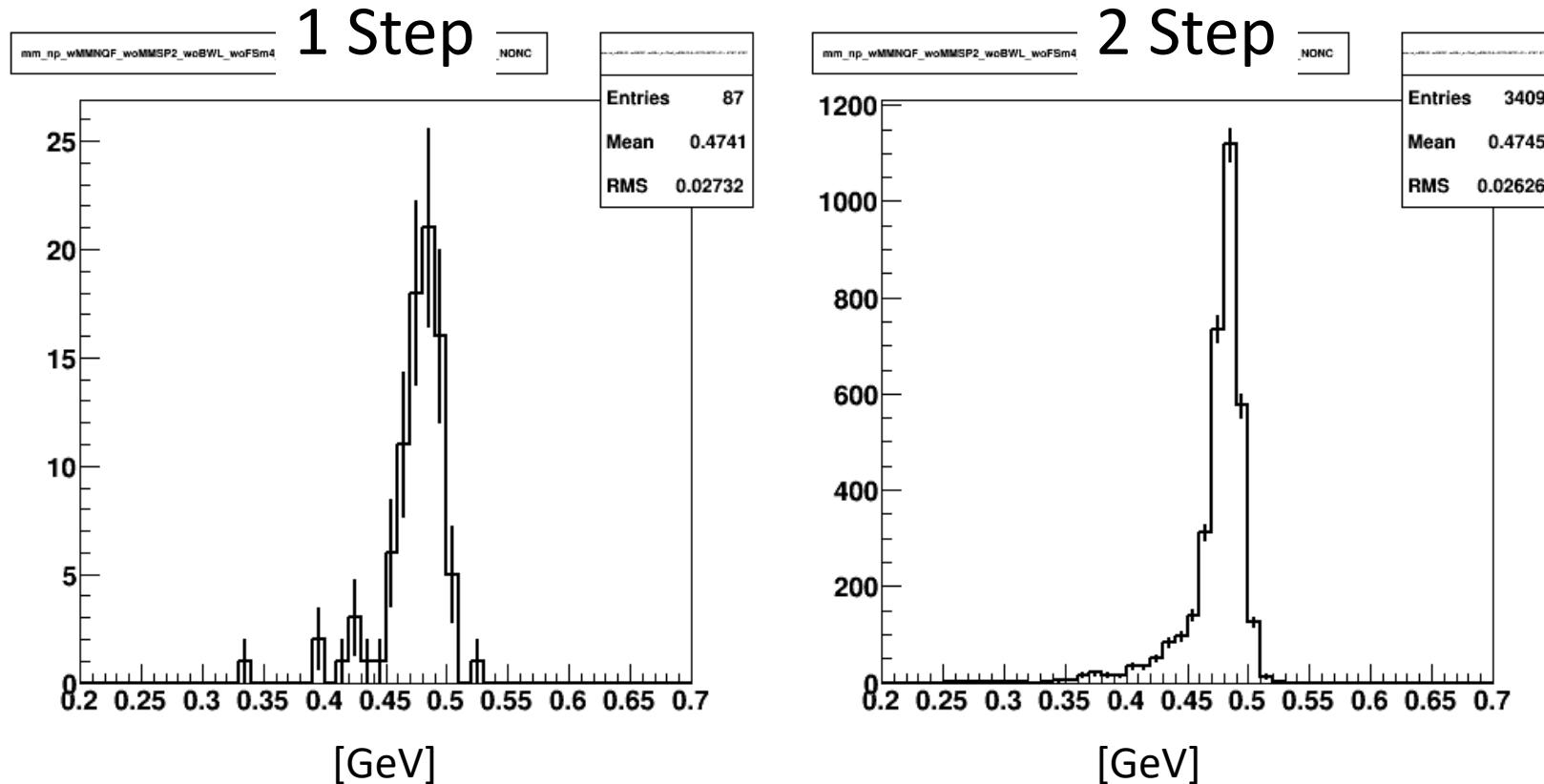
2 Step



MM. $d(K^-, np)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

- Stopped K^-

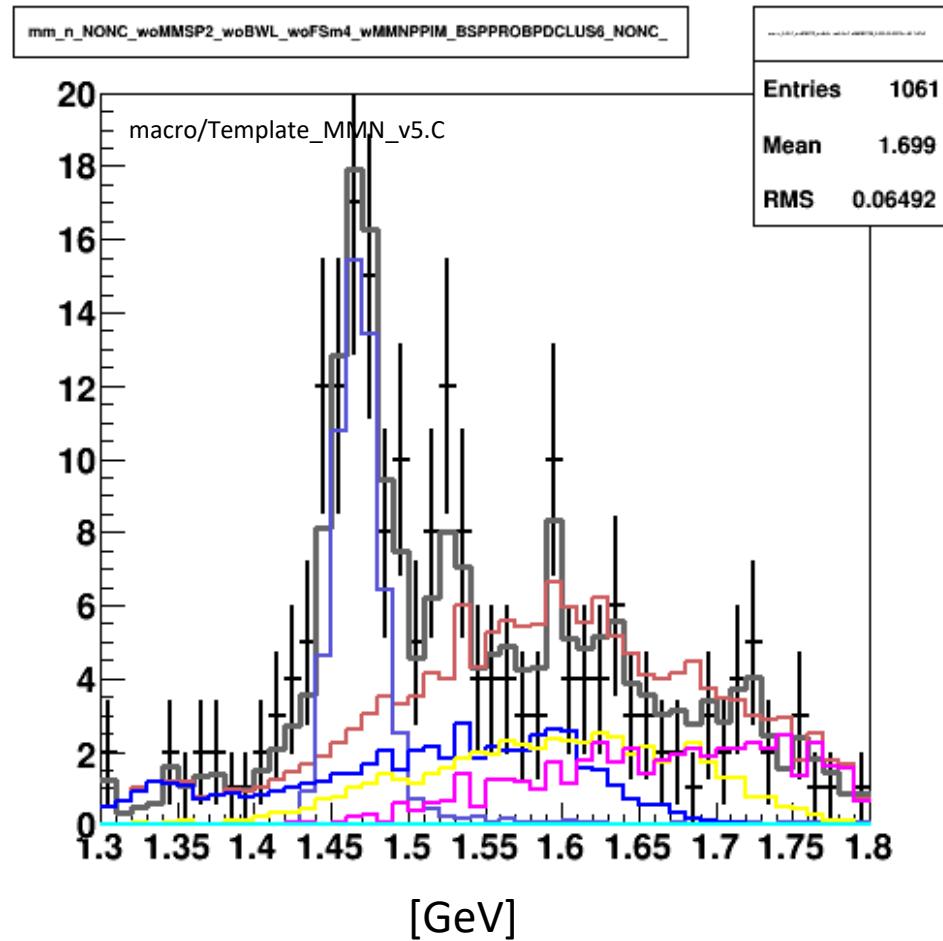


BG SIM estimation

- $K^- d \rightarrow p Y \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^-$
 - $K^- d \rightarrow p \Sigma^0 \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^- \pi^0$
 - $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - $Y\pi^-$ distribution use data shape from MM. $d(K^-, p)$
- 2step Stopped K^-

Fitting of MM. $d(K_-, n)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K_-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K_-, n\pi^-)$



† Data

- $K-d \rightarrow p \gamma \pi$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K
- Fit Result

- The relative ratio of 4 components in $K-d \rightarrow p \gamma \pi$ is fixed by fitting of MM. $d(K_-, p\pi^-)$
- Scaling factors of SIM ($K-d \rightarrow p \gamma \pi$, 2step Stopped K) are free

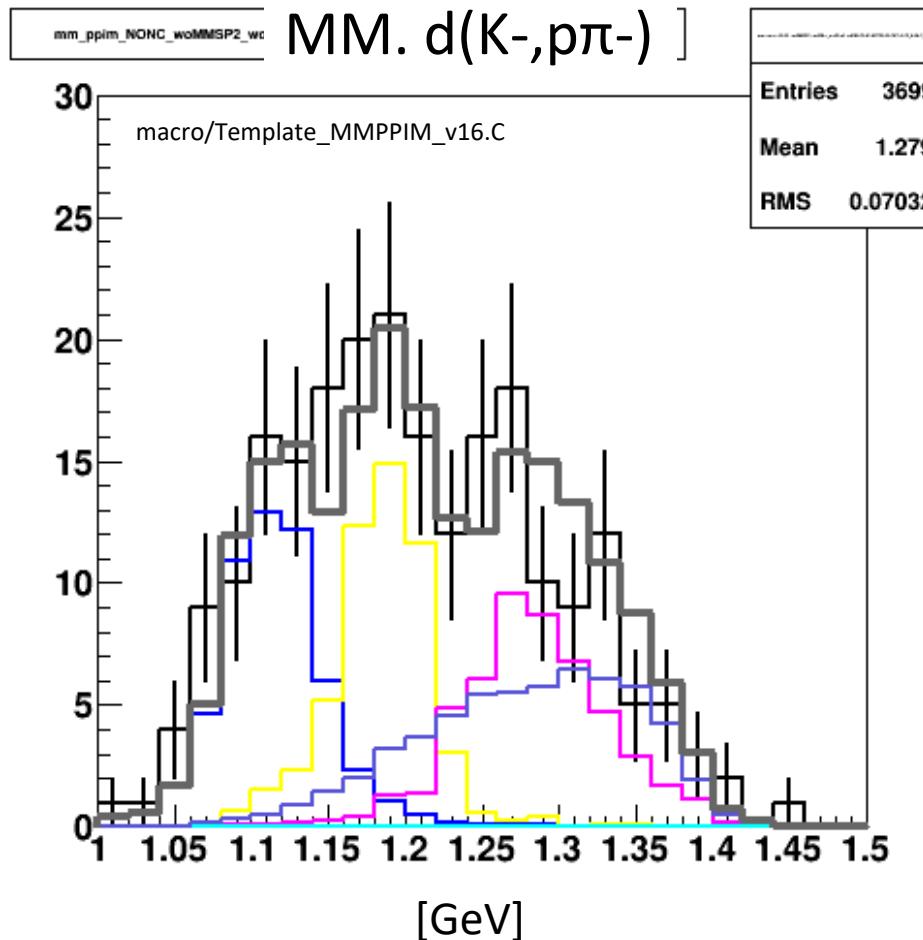
Fit Range
1.30 ~ 1.80 GeV

Chi2/ndf = 37.2/50

sca sca_e
0: 0.960288
1 :0.015872
chi2: 37.29

Fitting result

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$



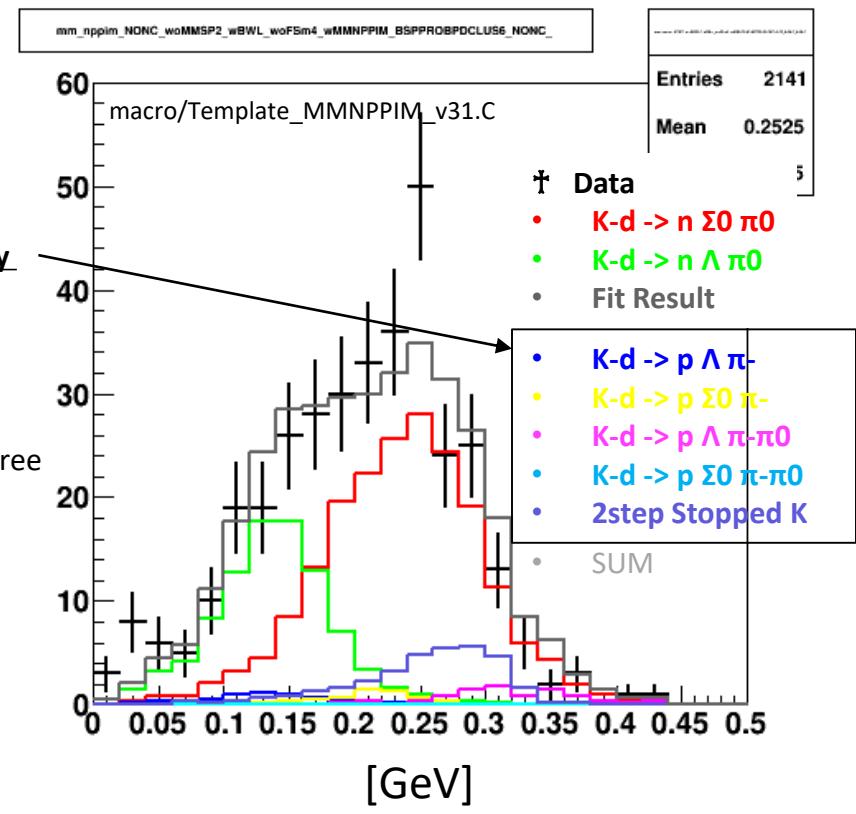
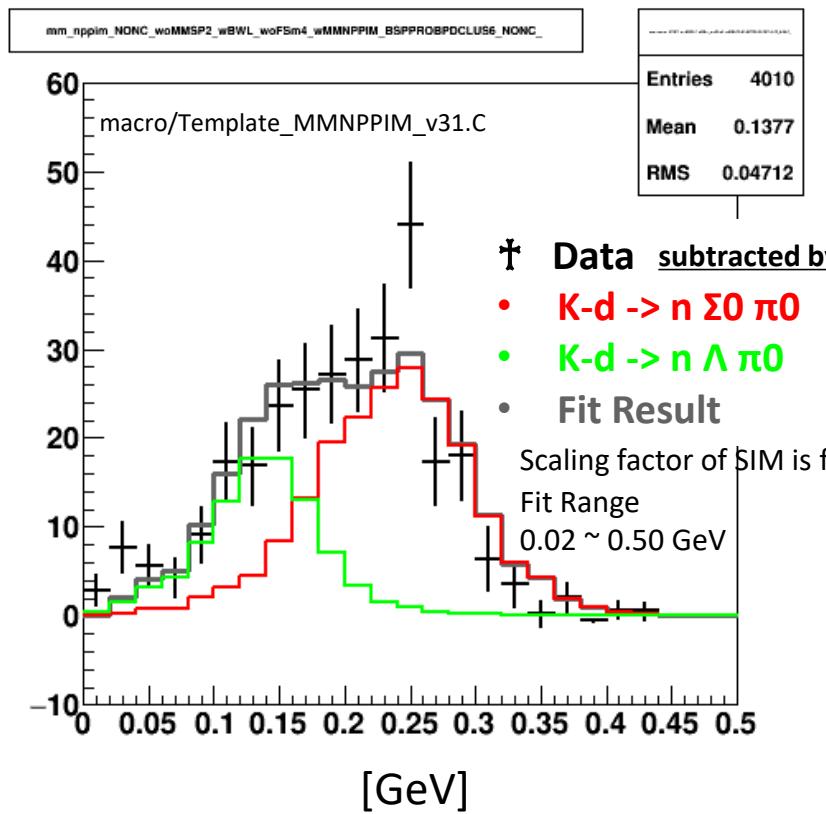
† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi-\pi^0$
- $K-d \rightarrow p \Sigma^0 \pi-\pi^0$
- **2step Stopped K**
- **SUM**

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is selected

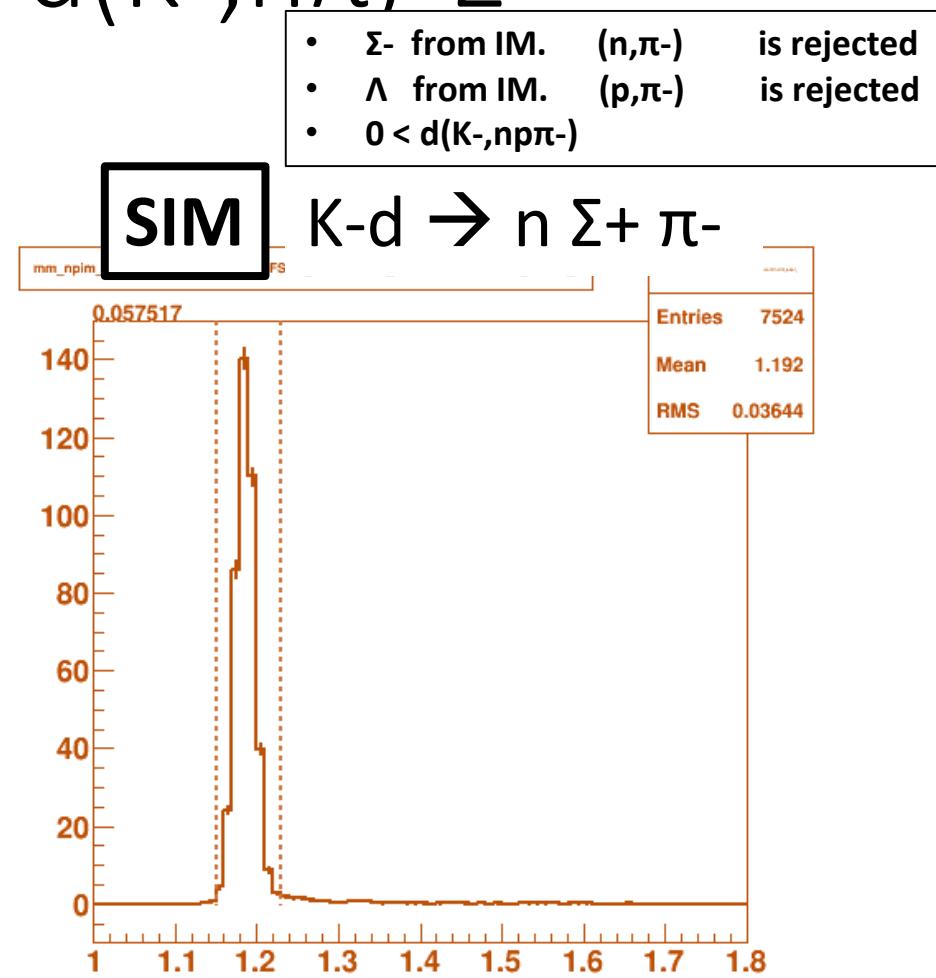
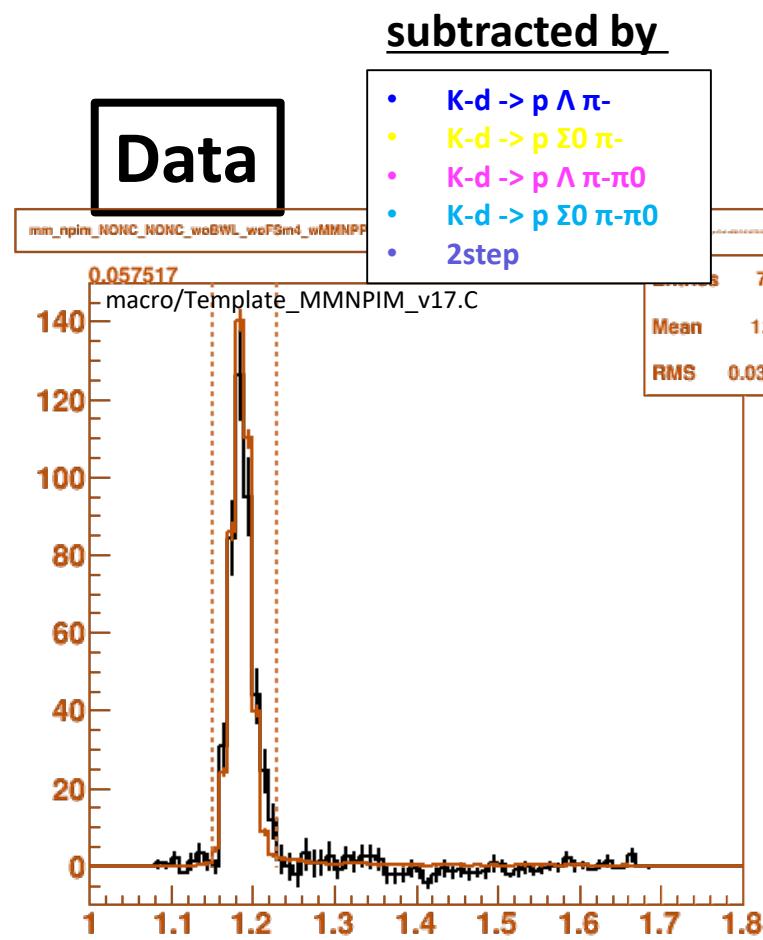
Fitting of MM. $d(K^-, n\pi^-)$

- Fitting w/ $K-d \rightarrow n \Sigma^0 \pi^0$, $K-d \rightarrow n \Lambda \pi^0$
- Data is subtracted by $K-d \rightarrow p \Lambda \pi^-$, $K-d \rightarrow p \Sigma^0 \pi^-$, $K-d \rightarrow p \Lambda \pi^- \pi^0$, $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$, 2step

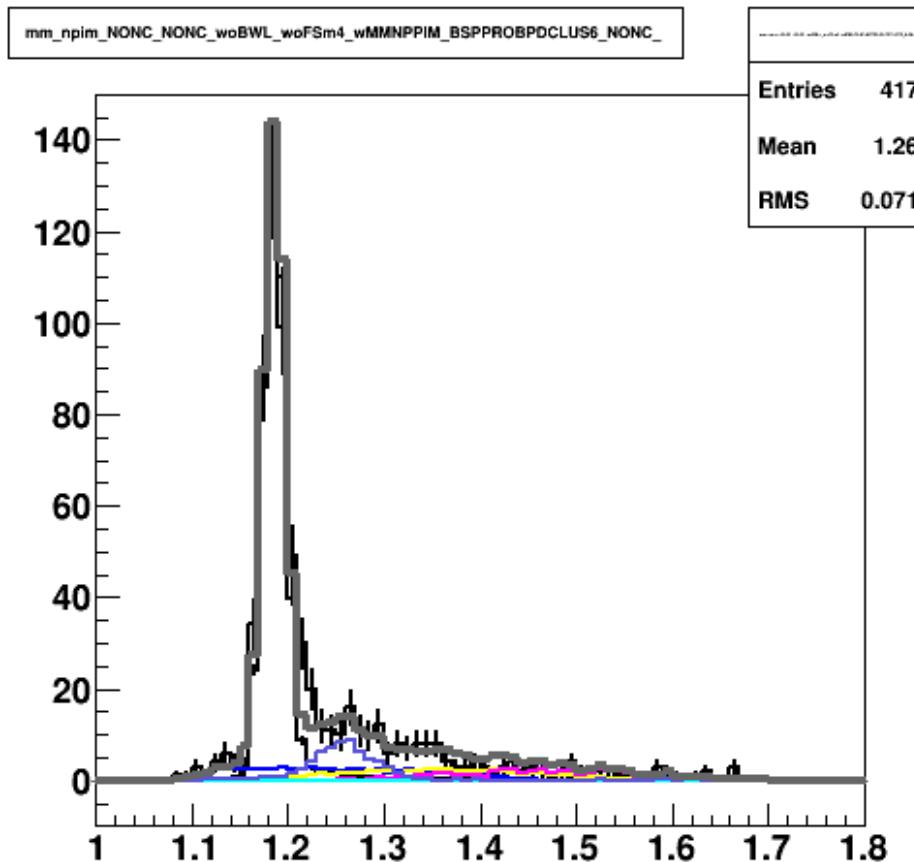


$K-d \rightarrow n \Sigma^+ \pi^-$;

Scaled by event # of $d(K-,n\pi)^{\prime\prime}\Sigma^{\prime\prime}$



MM. $d(K^-, n\pi^-)$ w/ BG components



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$

† Data

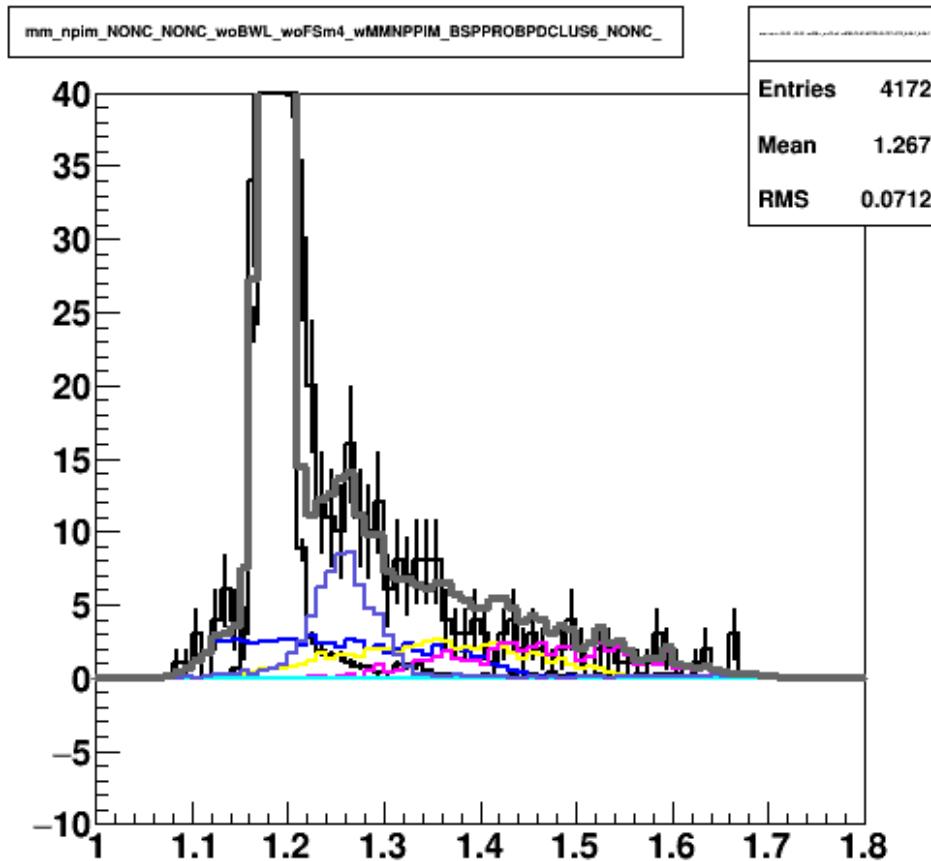
- $K-d \rightarrow n \Sigma^+ \pi^-$

BG

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K
- SUM

The tail of Σ^+ seems to be explained by these BGs

MM. $d(K^-, n\pi^-)$ w/ BG components



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$

† Data

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

BG

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K
- SUM

The tail of Σ^+ seems to be explained by these BGs

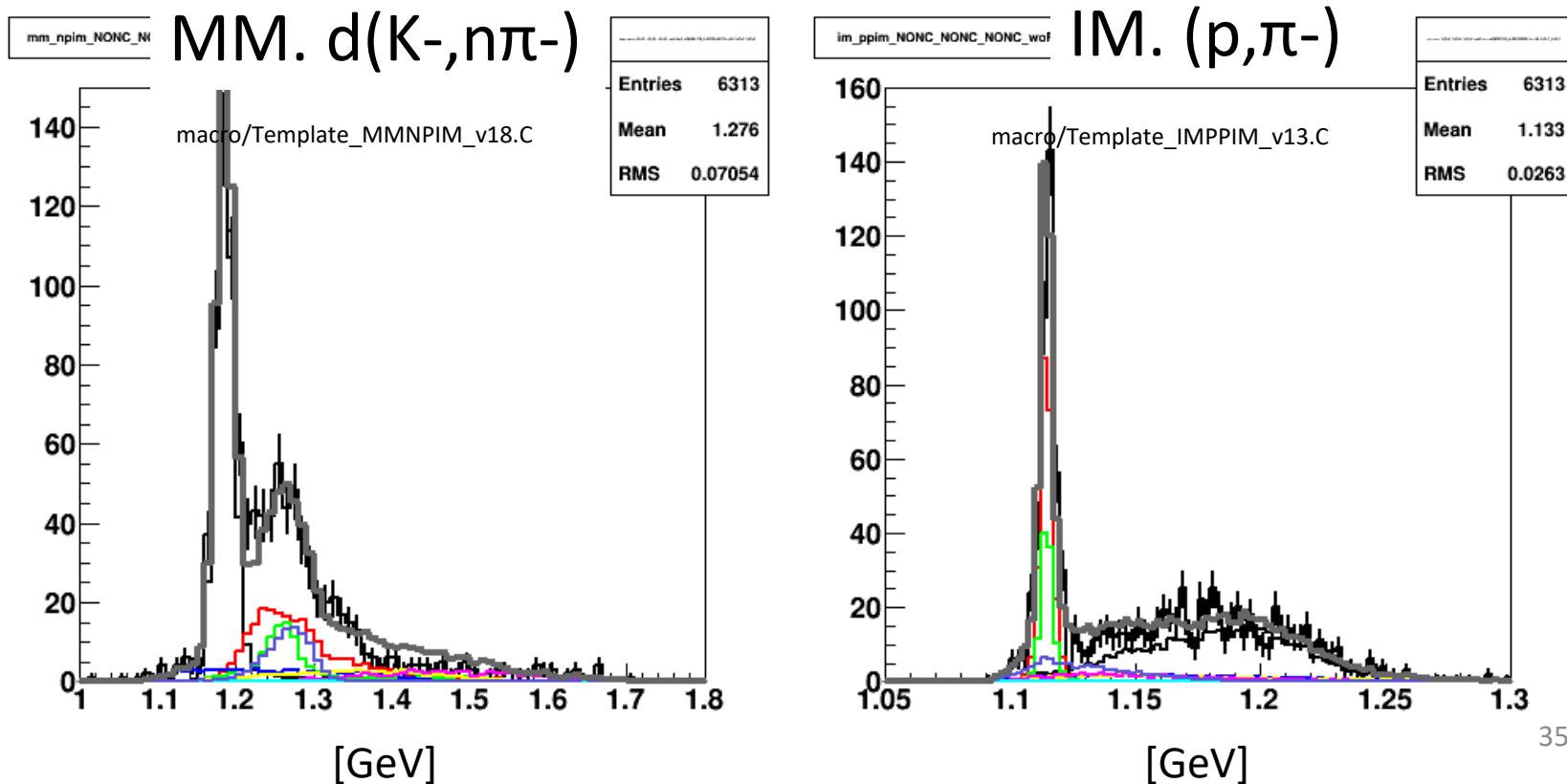
- Σ^- from IM. (n, π^-) is rejected
- $0 < d(K^-, n\pi\pi^-)$

Fitting Results

† Data

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

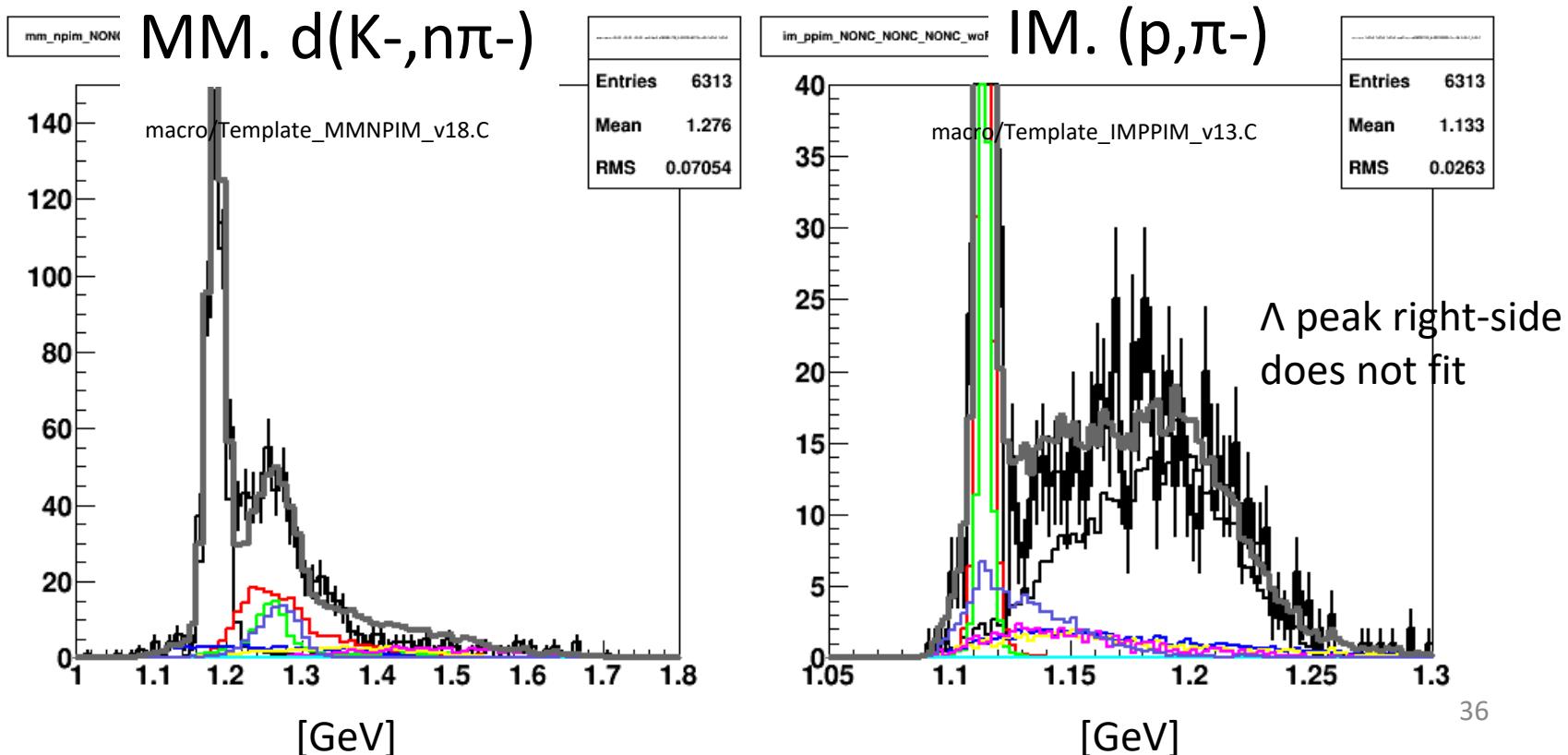
- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K



Fitting Results

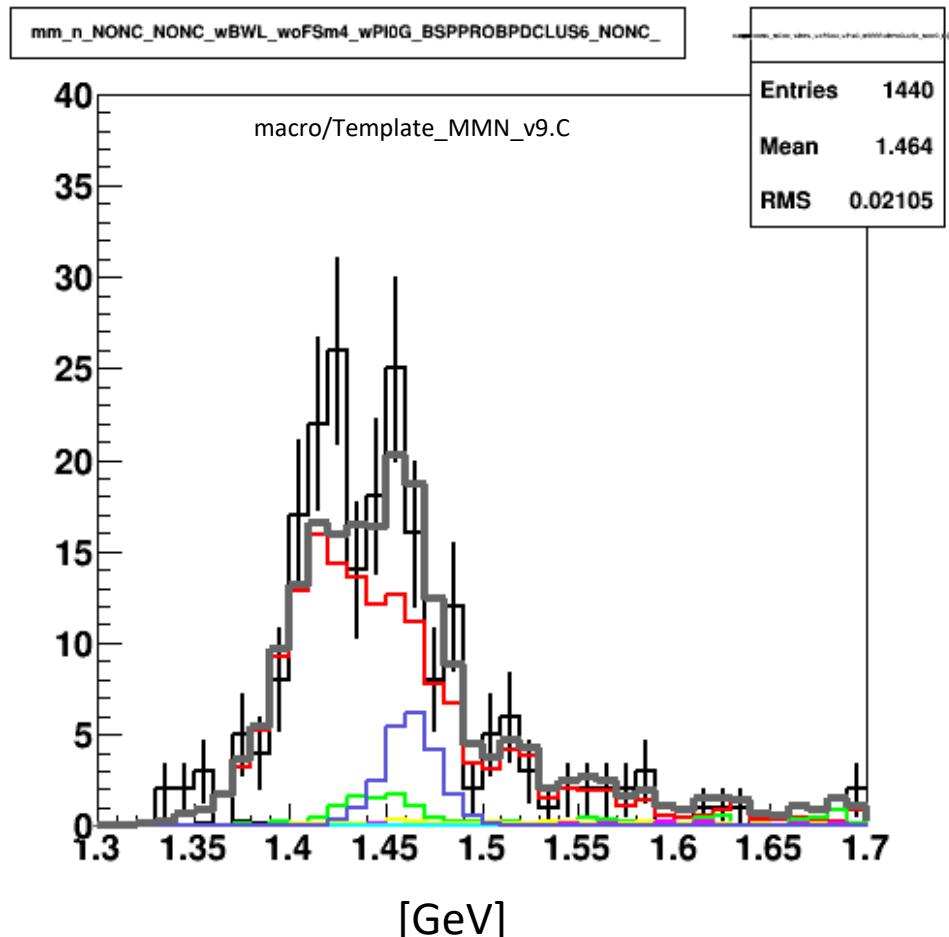
- Σ^- from IM. (n, π^-) is rejected
- $0 < d(K^-, n\pi\pi^-)$

- † Data
- $K-d \rightarrow n \Sigma + \pi^-$
 - $K-d \rightarrow n \Sigma^0 \pi^0$
 - $K-d \rightarrow n \Lambda \pi^0$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - 2step Stopped K



- Σ - from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$



† Data

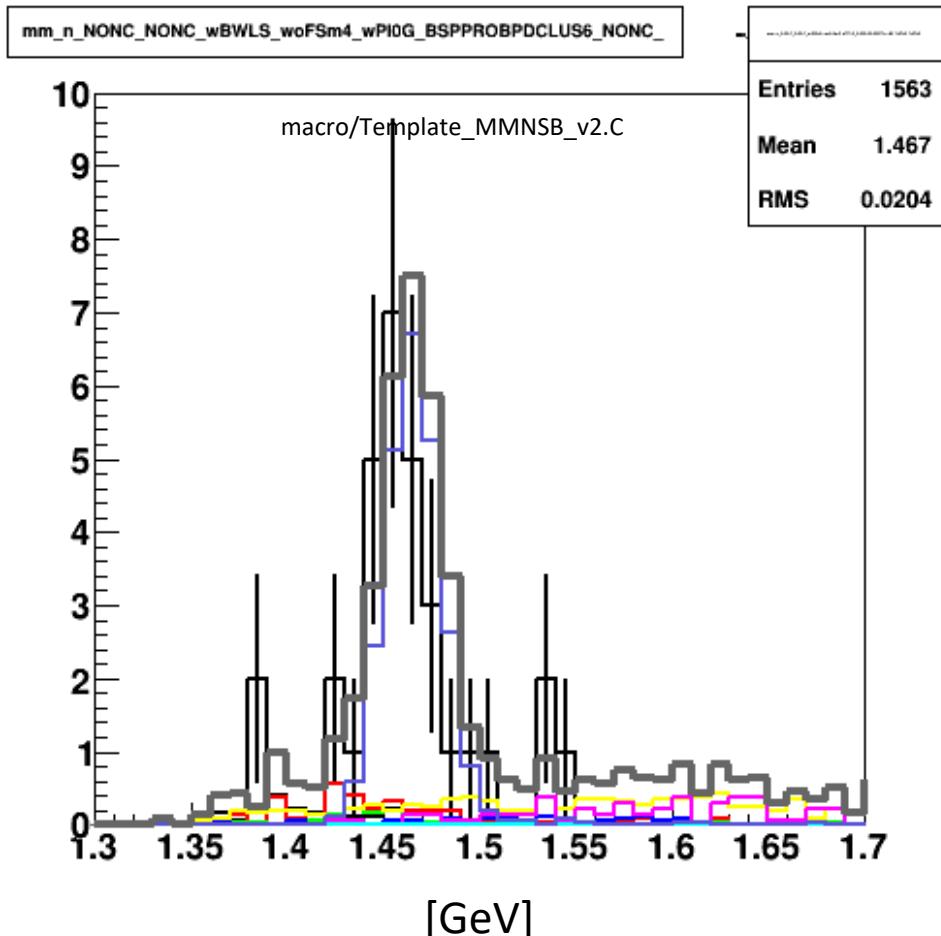
- $K-d \rightarrow n \Sigma^+ \pi^-$

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K

- Σ^- from IM. (n, π^-) is rejected
- Λ -Side from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$ (Λ side-band)



† Data

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

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

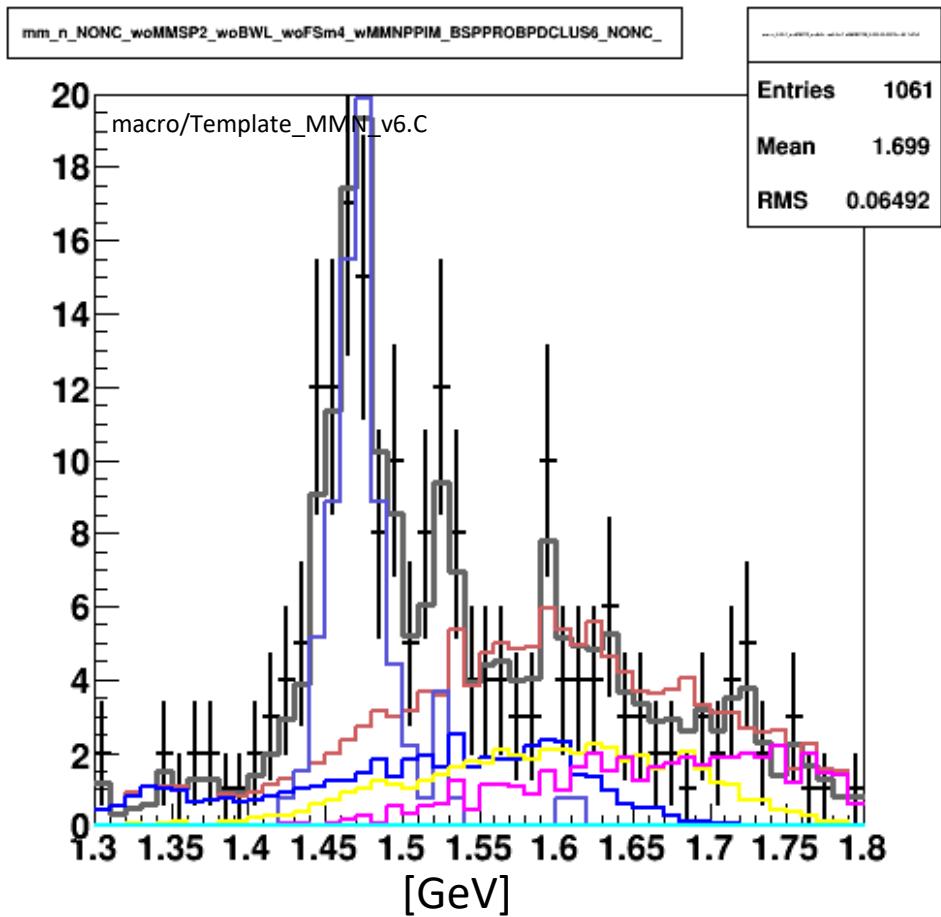
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K

BG SIM estimation

- $K^- d \rightarrow p Y \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^-$
 - $K^- d \rightarrow p \Sigma^0 \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^- \pi^0$
 - $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - $Y\pi^-$ distribution use data shape from MM. $d(K^-, p)$
- 1step Stopped K^-

Fitting of MM. $d(K_-, n)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K_-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K_-, n\pi\pi^-)$



† Data

- $K-d \rightarrow p \gamma \pi$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 1step Stopped K
- Fit Result

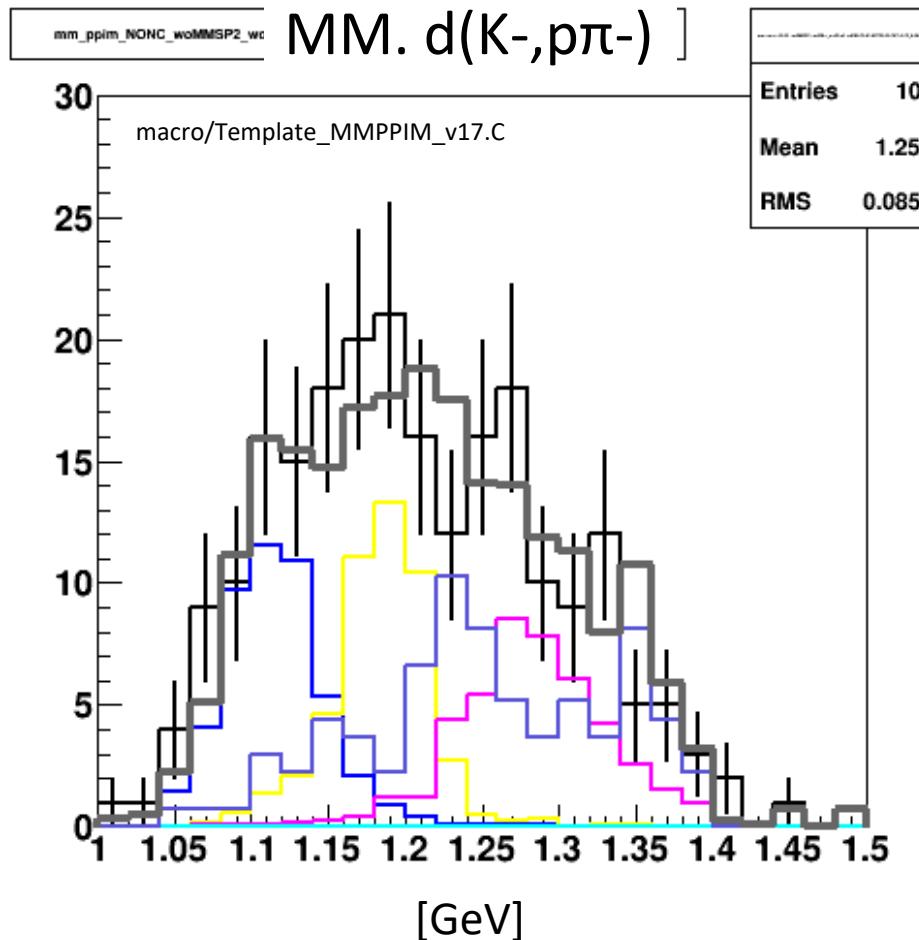
- The relative ratio of 4 components in $K-d \rightarrow p \gamma \pi$ is fixed by fitting of MM. $d(K_-, p\pi^-)$
- Scaling factors of SIM ($K-d \rightarrow p \gamma \pi$, 1step Stopped K) are free

Fit Range
1.30 ~ 1.80 GeV

Chi2/ndf = 37.2/50

Fitting result

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$



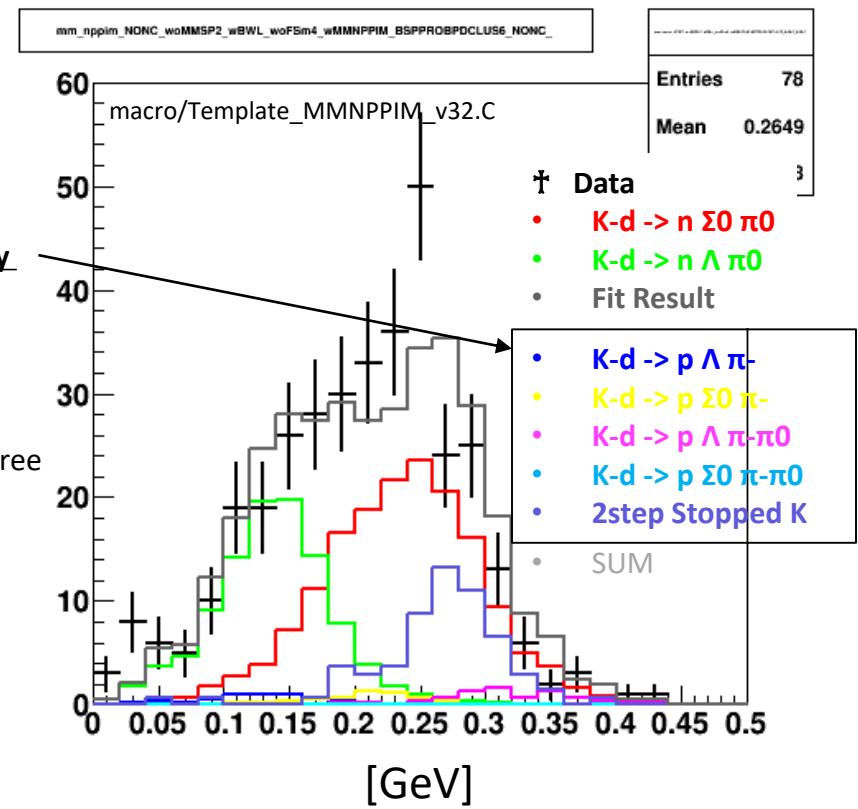
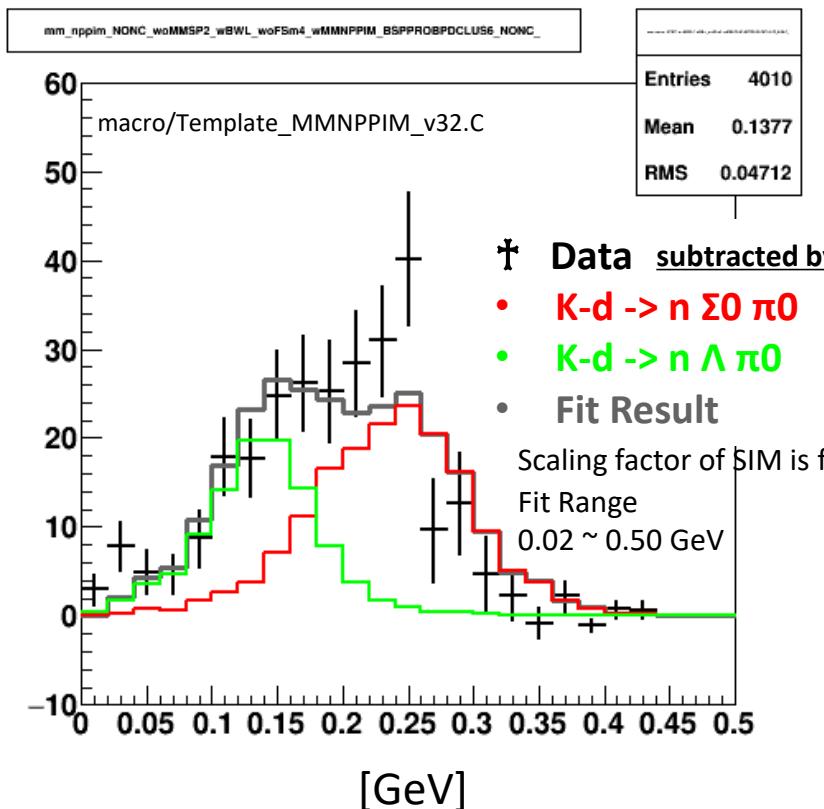
† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi-\pi^0$
- $K-d \rightarrow p \Sigma^0 \pi-\pi^0$
- 1step Stopped K
- SUM

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is selected

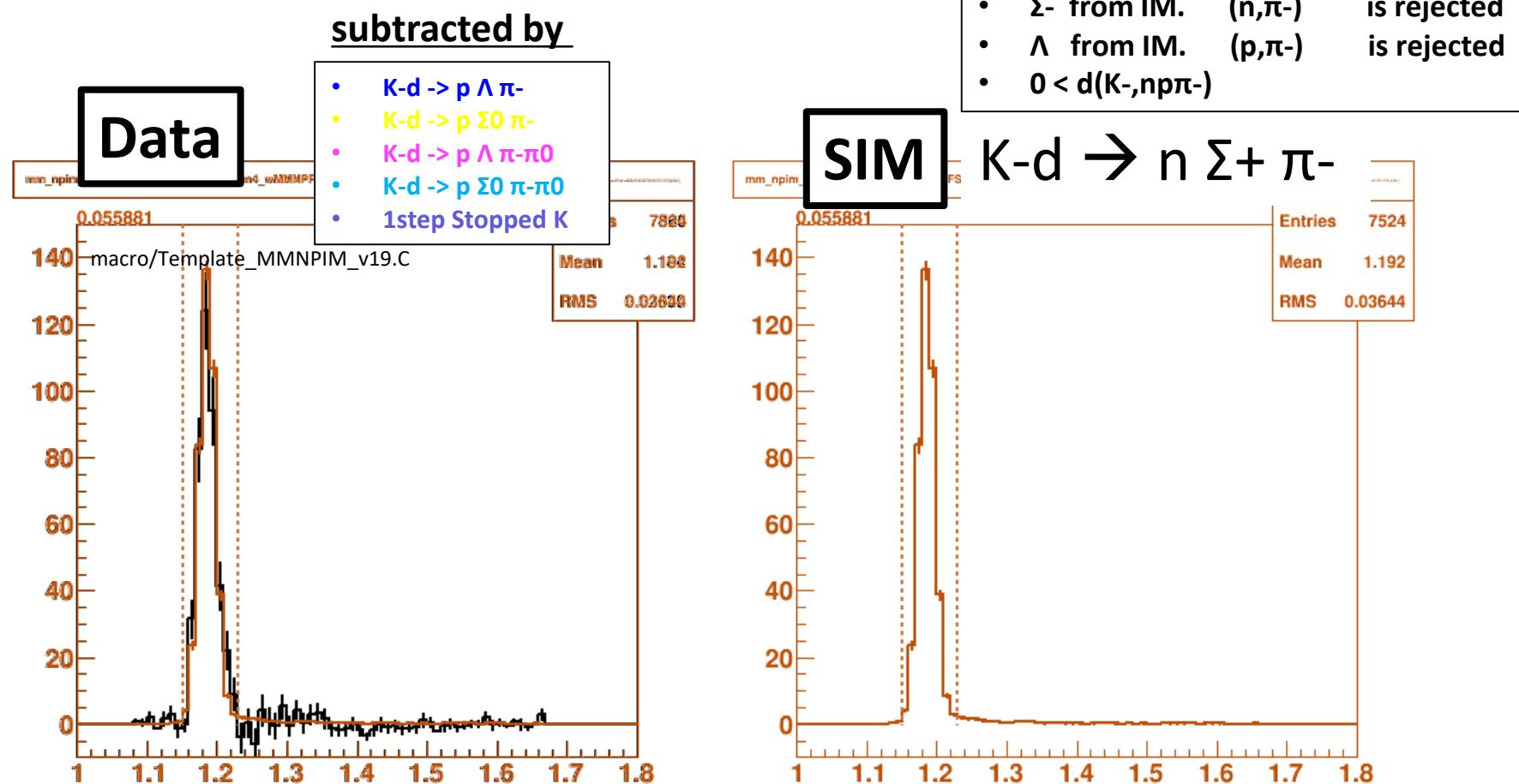
Fitting of MM. $d(K^-, n\pi^-)$

- Fitting w/ $K-d \rightarrow n \Sigma^0 \pi^0$, $K-d \rightarrow n \Lambda \pi^0$
- Data is subtracted by $K-d \rightarrow p \Lambda \pi^-$, $K-d \rightarrow p \Sigma^0 \pi^-$, $K-d \rightarrow p \Lambda \pi^- \pi^0$, $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$, 2step

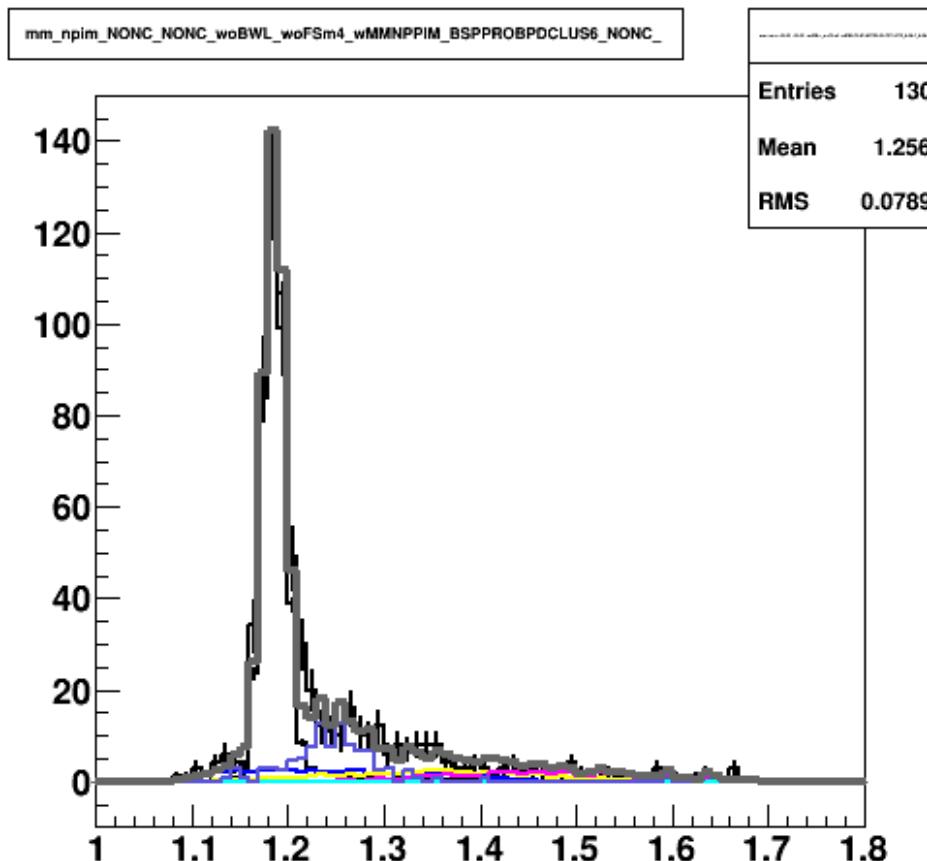


$K-d \rightarrow n \Sigma^+ \pi^-$;

Scaled by event # of $d(K-,n\pi)^{\prime\prime}\Sigma^+$ "



MM. $d(K^-, n\pi^-)$ w/ BG components



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$

† Data

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

BG

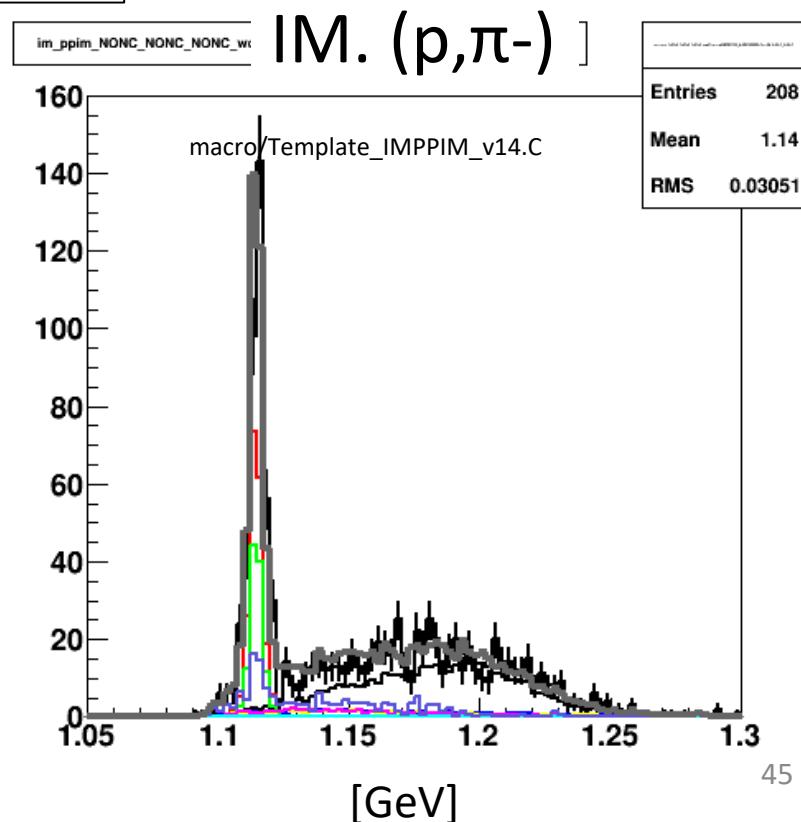
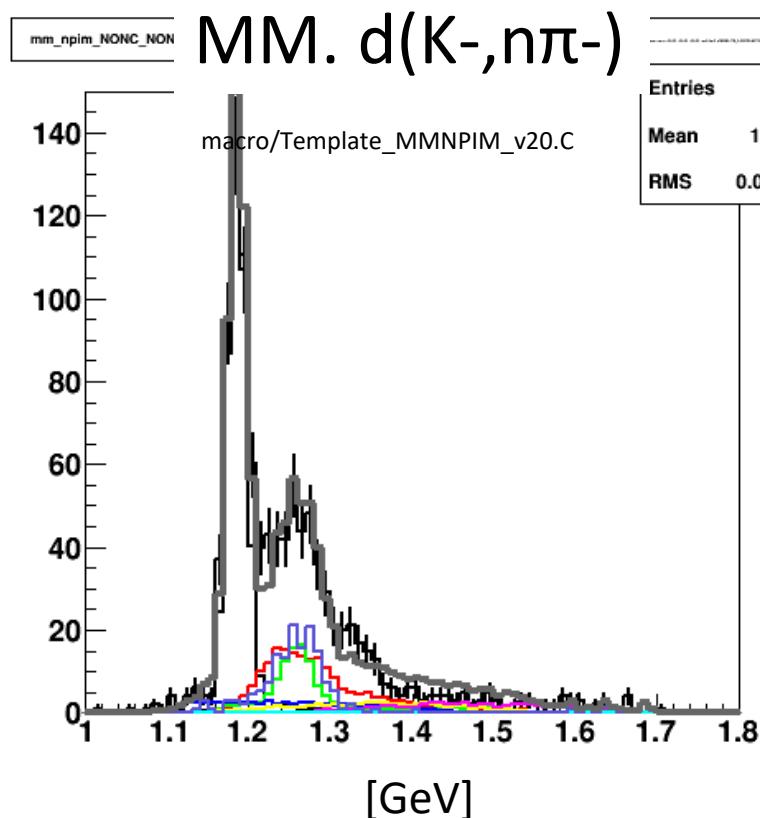
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 1step Stopped K
- SUM

The tail of Σ^+ seems to be explained by these BGs

- Σ^- from IM. (n, π^-) is rejected
- $0 < d(K^-, n\pi\pi^-)$

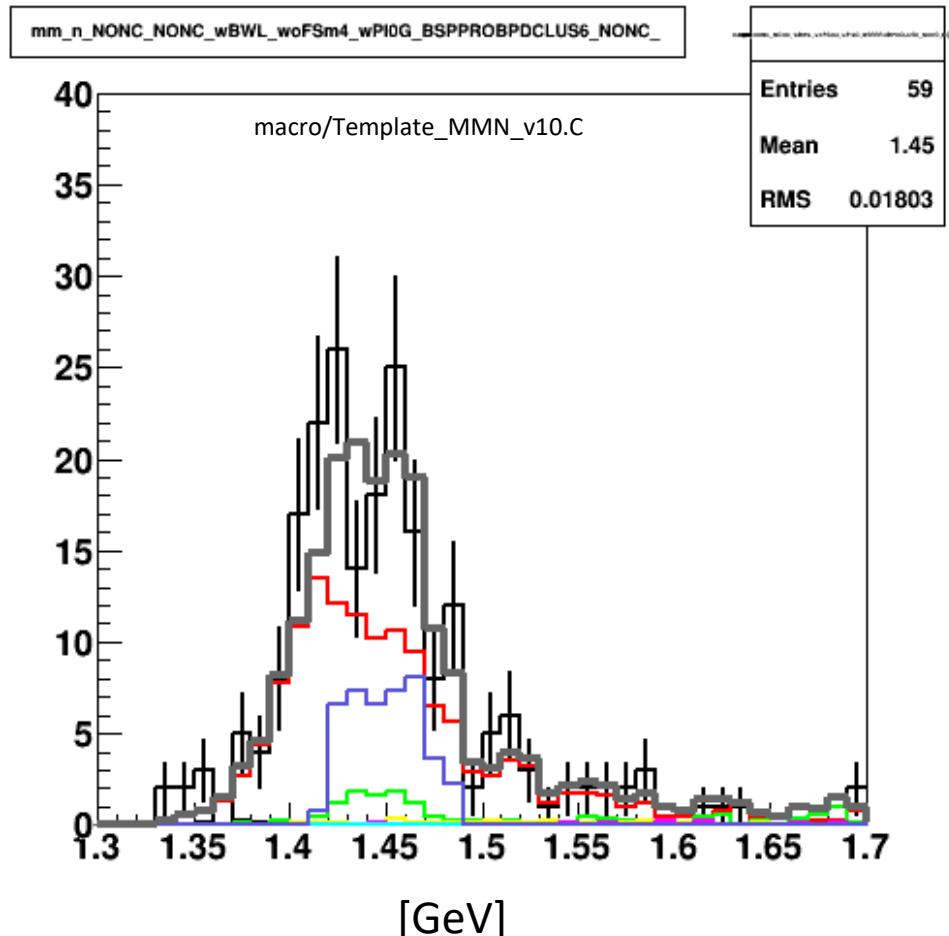
Fitting Results

- † Data
- $K-d \rightarrow n \Sigma + \pi^-$
 - $K-d \rightarrow n \Sigma^0 \pi^0$
 - $K-d \rightarrow n \Lambda \pi^0$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - 1step stopped K



- Σ - from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$



† Data

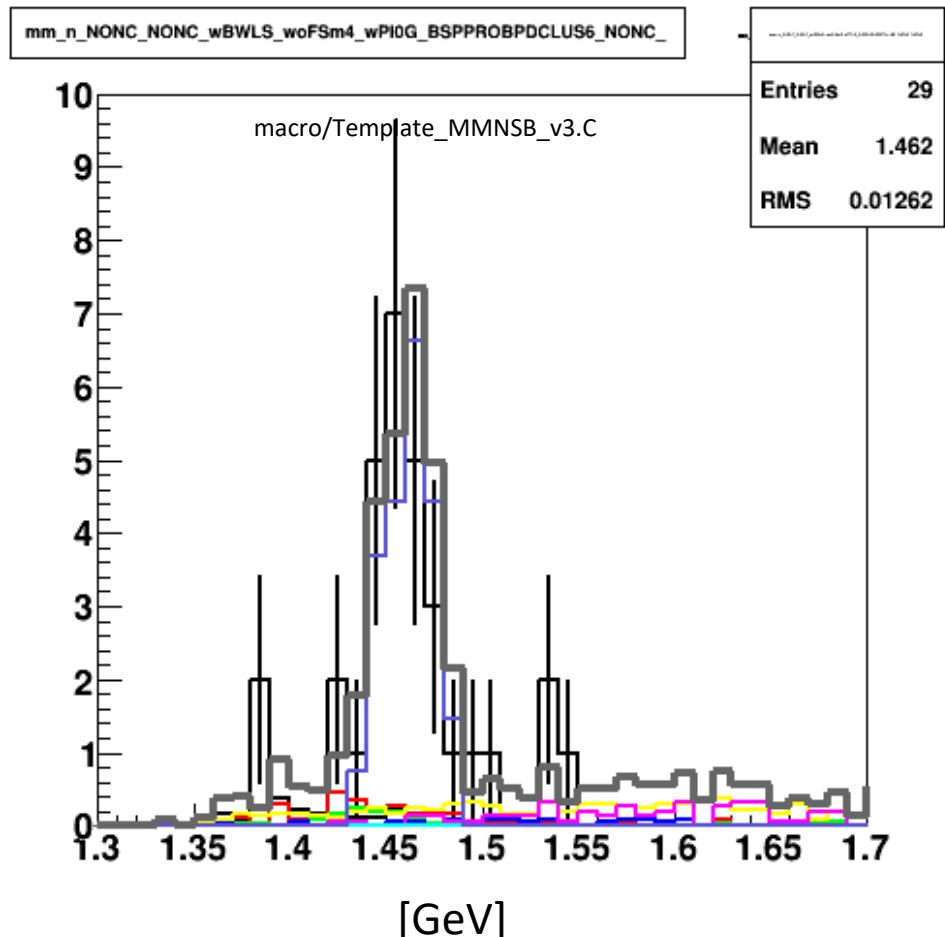
- $K-d \rightarrow n \Sigma^+ \pi^-$

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 1step stopped K

- Σ^- from IM. (n, π^-) is rejected
- Λ -Side from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$ (Λ side-band)



† Data

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

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 1step stopped K

Check another K- scatter reaction

- 1 step , stopped K- hyperon production
- 1 step , in-flight K- decay
 - backward proton has only fermi momentum ~ small acceptance
- 2 step , stopped K- hyperon production
- 2 step , in-flight K- decay
 - Already done, seems to explain BG

Hyperon production ($\Lambda\pi^0$, $\Sigma^0\pi^0$, $\Lambda\pi^-$) makes Λ peak in IM.(p,π^-) , which can be BG

To do

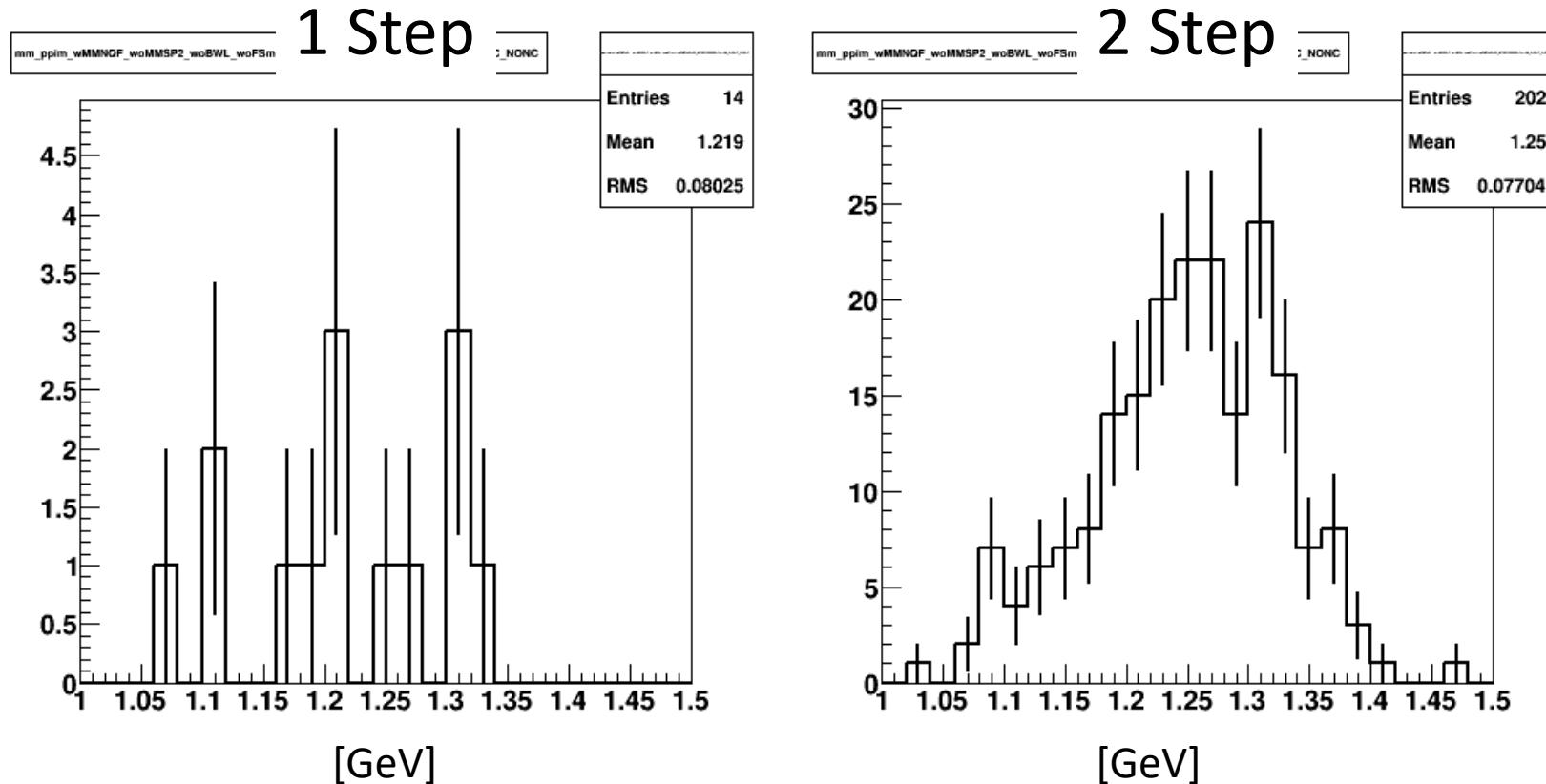
- Detection efficiency -> SIM
- ratio of stopped K- -> SIM
- Ratio of 1 step to 2 step -> data analysis

Analysis of SIM is on going

MM. $d(K^-, p\pi^-)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

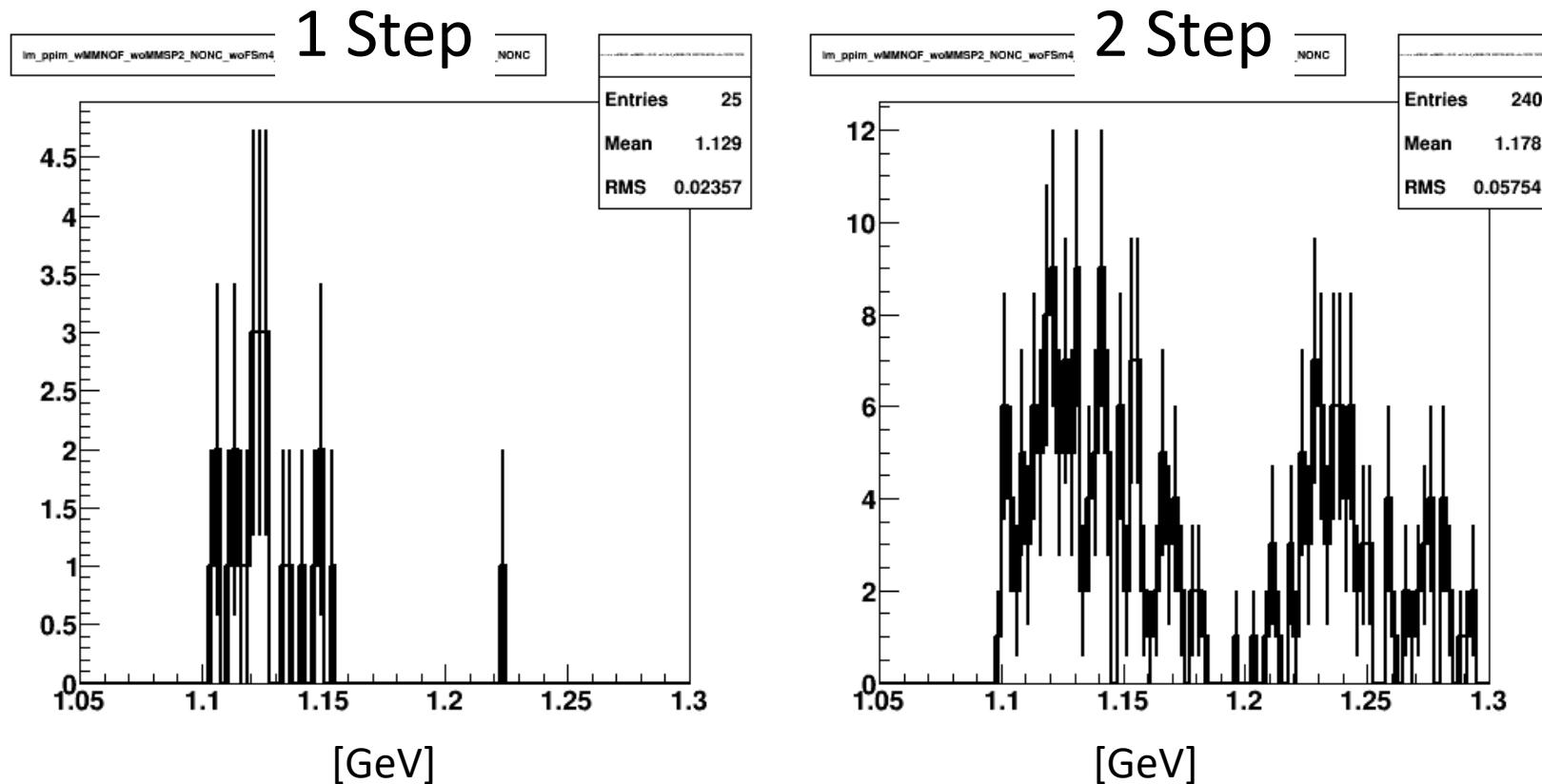
- K- in-flight decay



IM.(p, π^-)

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

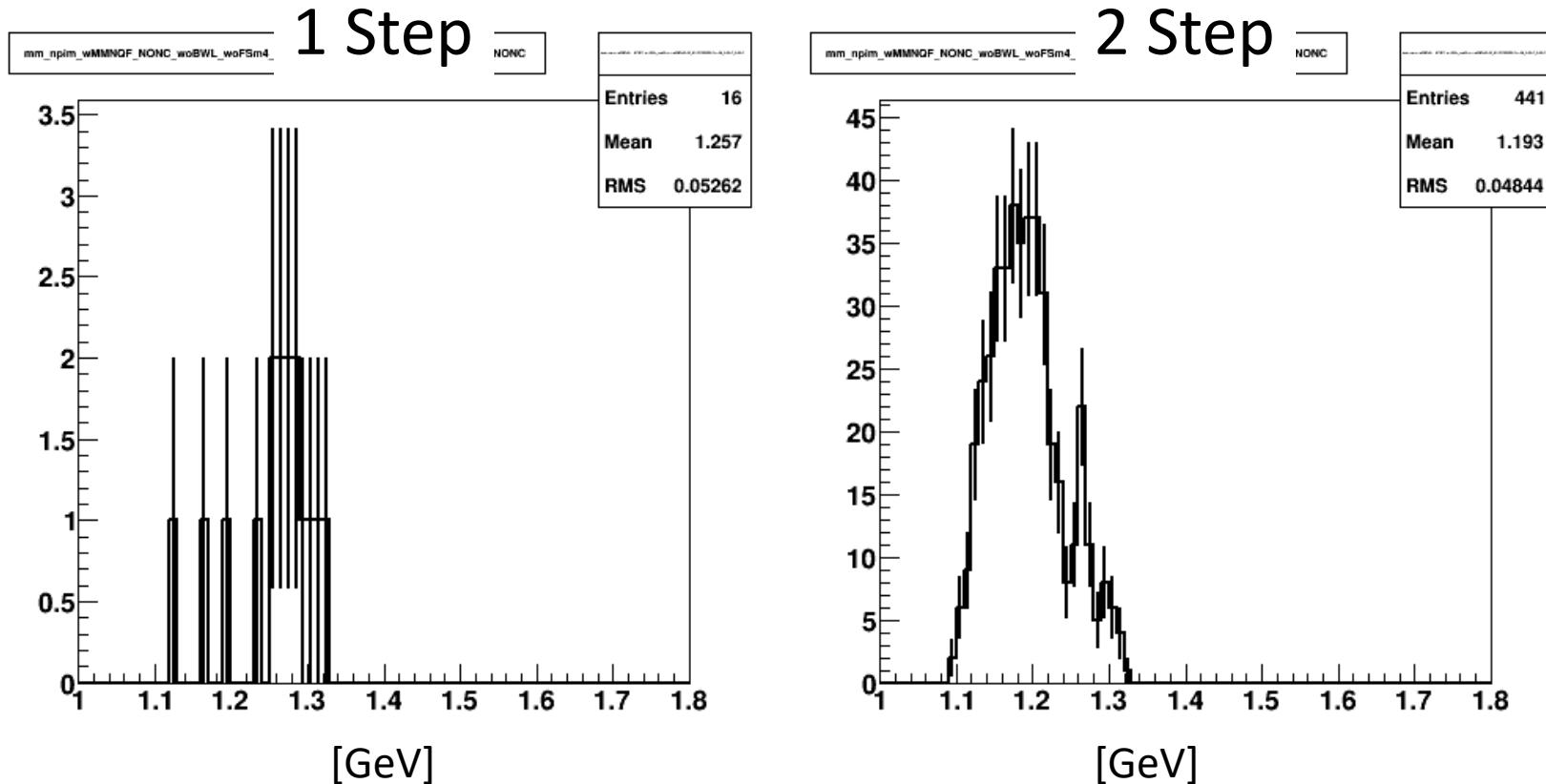
- K- in-flight decay



MM. $d(K^-, n\pi^-)$

- K- in-flight decay

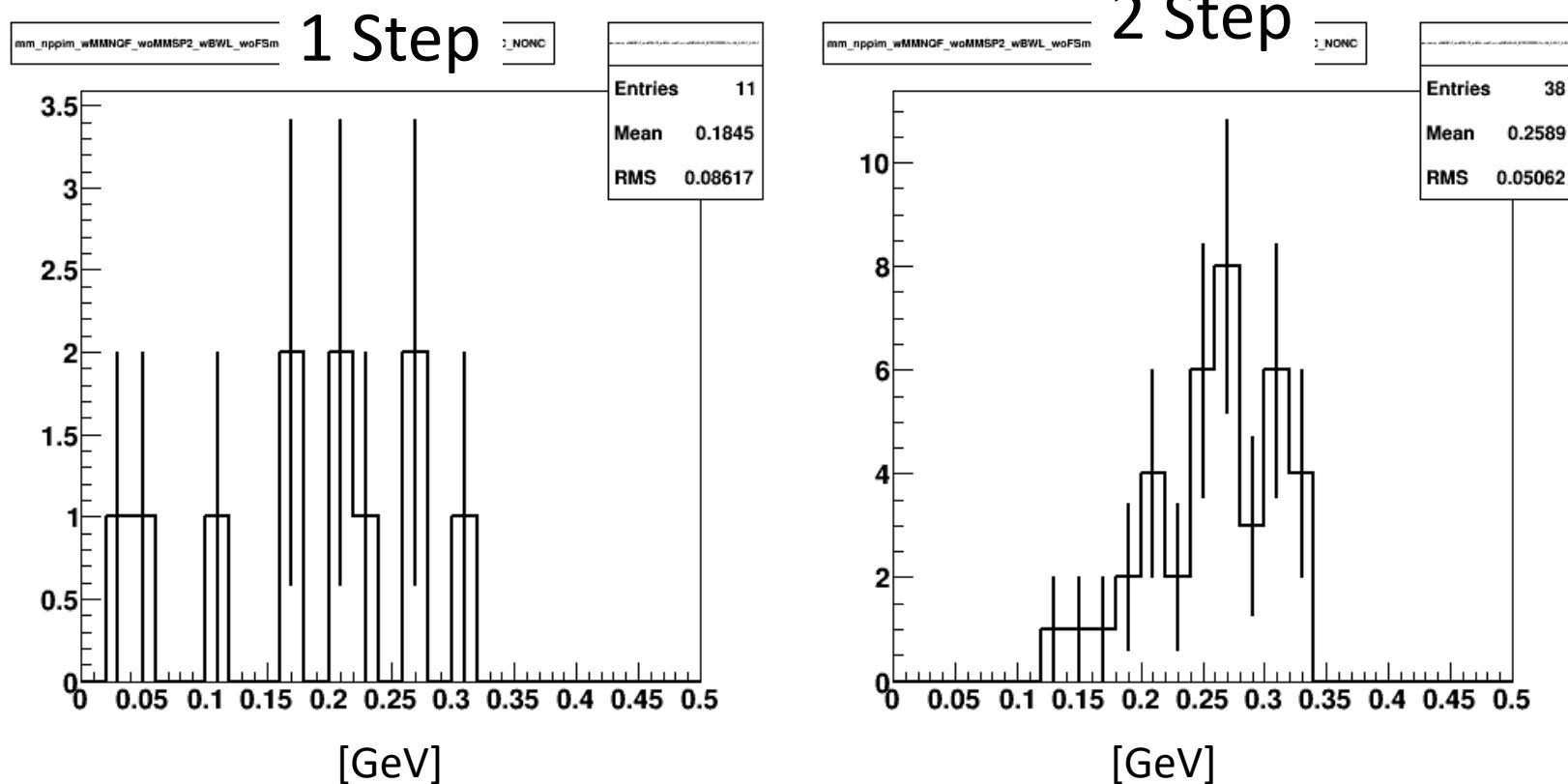
- Σ^- from IM. (n, π^-) rejected
- Λ^- from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**



MM. $d(K^-, n\Lambda)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) selected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

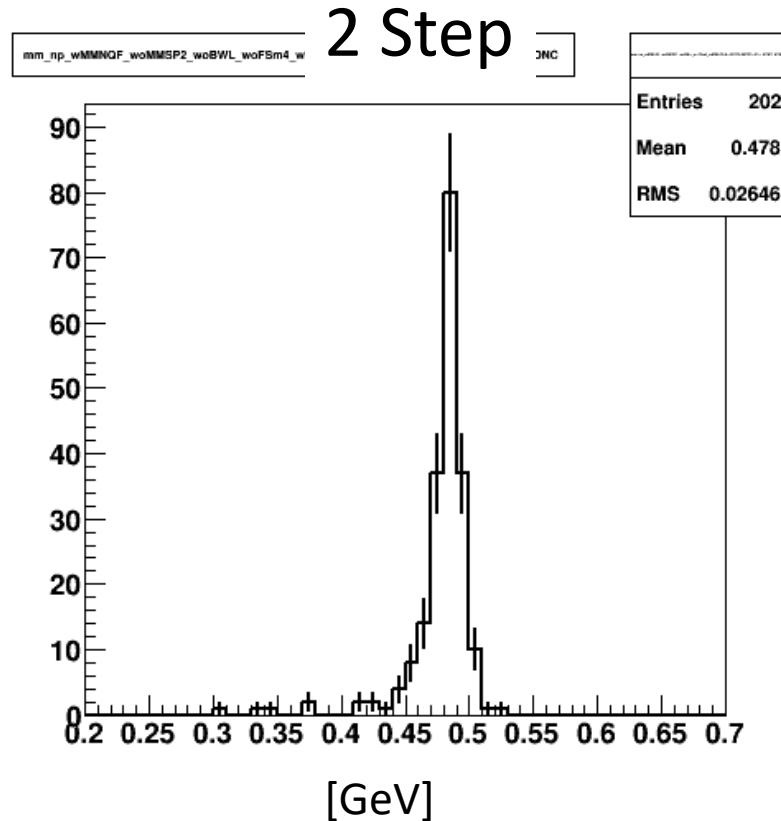
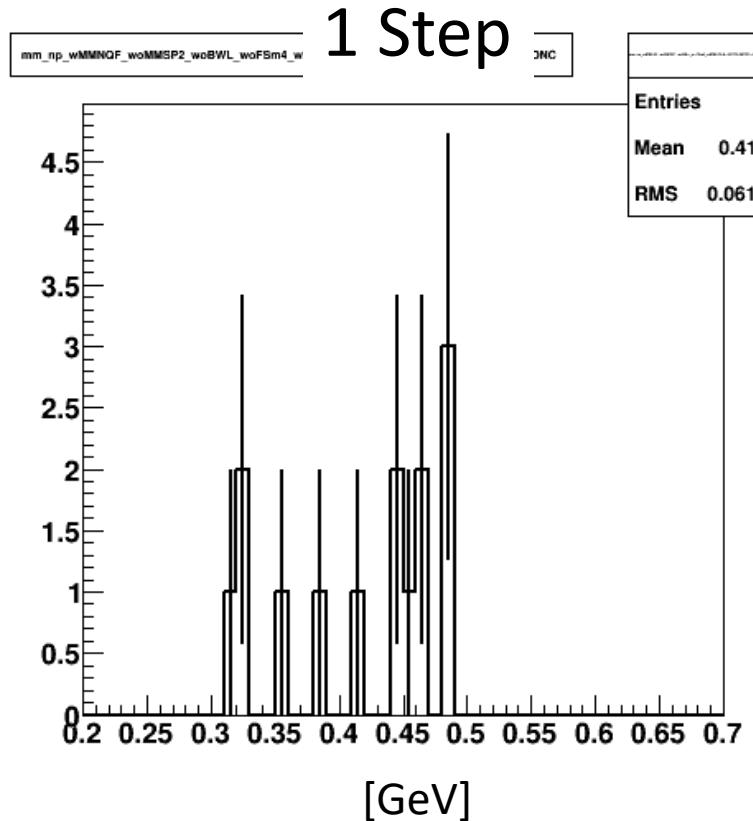
- K- in-flight decay



MM. $d(K^-, np)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

- K^- in-flight decay

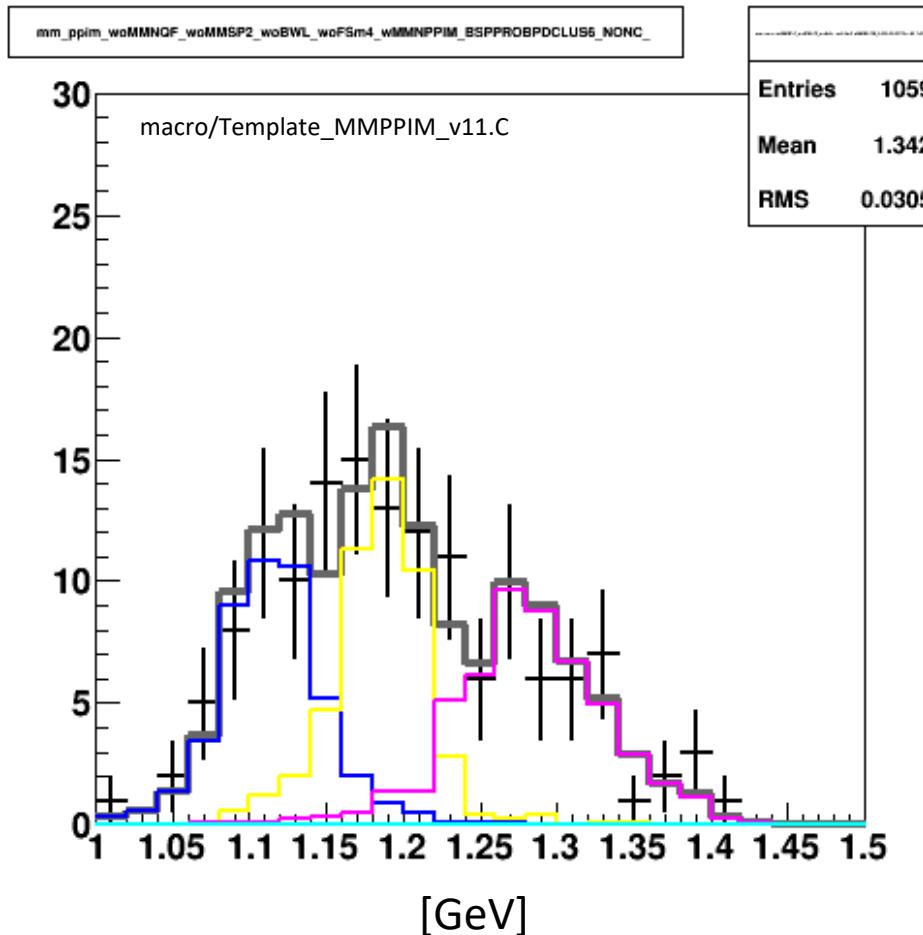


BG SIM estimation

- $K^- d \rightarrow p Y \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^-$
 - $K^- d \rightarrow p \Sigma^0 \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^- \pi^0$
 - $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - $Y\pi^-$ distribution use data shape from MM. $d(K^-, p)$
- 2step K^- decay

Fitting of MM. $d(K^-, p\pi^-)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 rejected**



† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- Fit Result

Scaling factor of SIM is free

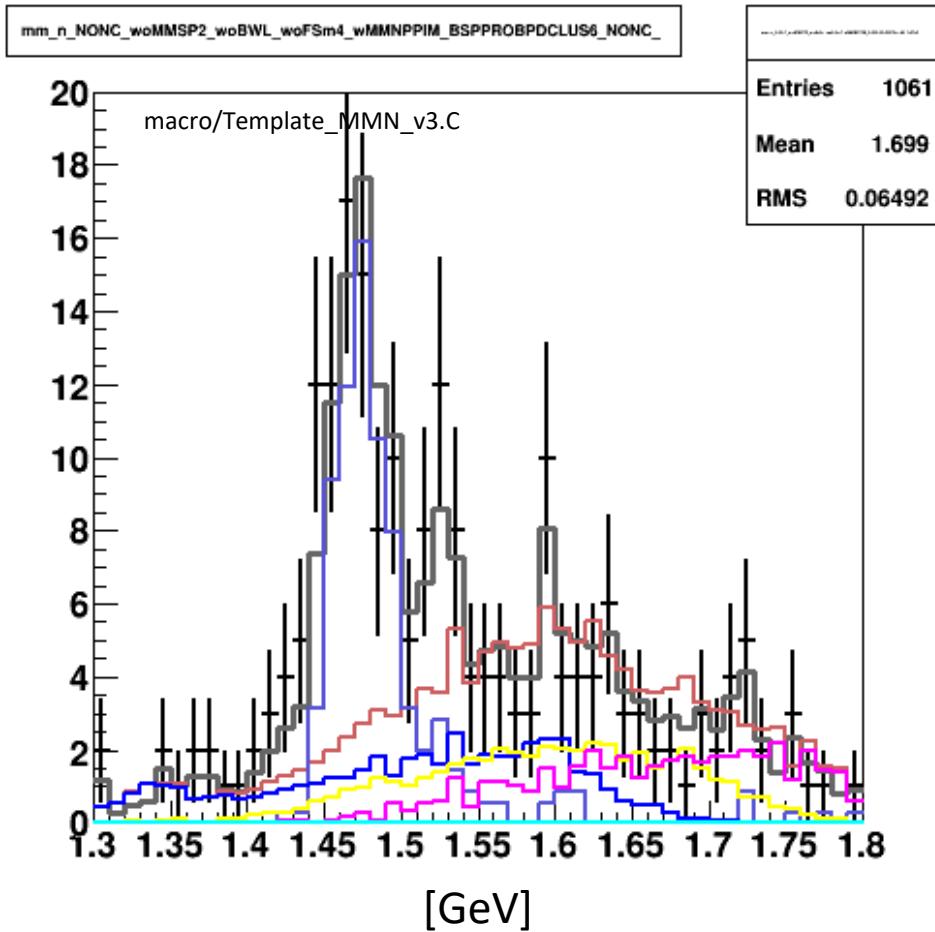
Fit Range

1.00 ~ 1.50 GeV

$\text{Chi}^2/\text{ndf} = 13.4/25$

Fitting of MM. $d(K_-, n)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K_-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K_-, n\pi\pi^-)$



† Data

- $K-d \rightarrow p \gamma \pi$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^- 0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^- 0$
- 2step K-decay
- Fit Result

- The relative ratio of 4 components in $K-d \rightarrow p \gamma \pi$ is fixed by fitting of MM. $d(K_-, p\pi^-)$ P.807
- Scaling factors of SIM ($K-d \rightarrow p \gamma \pi$, 2step K-decay) are free

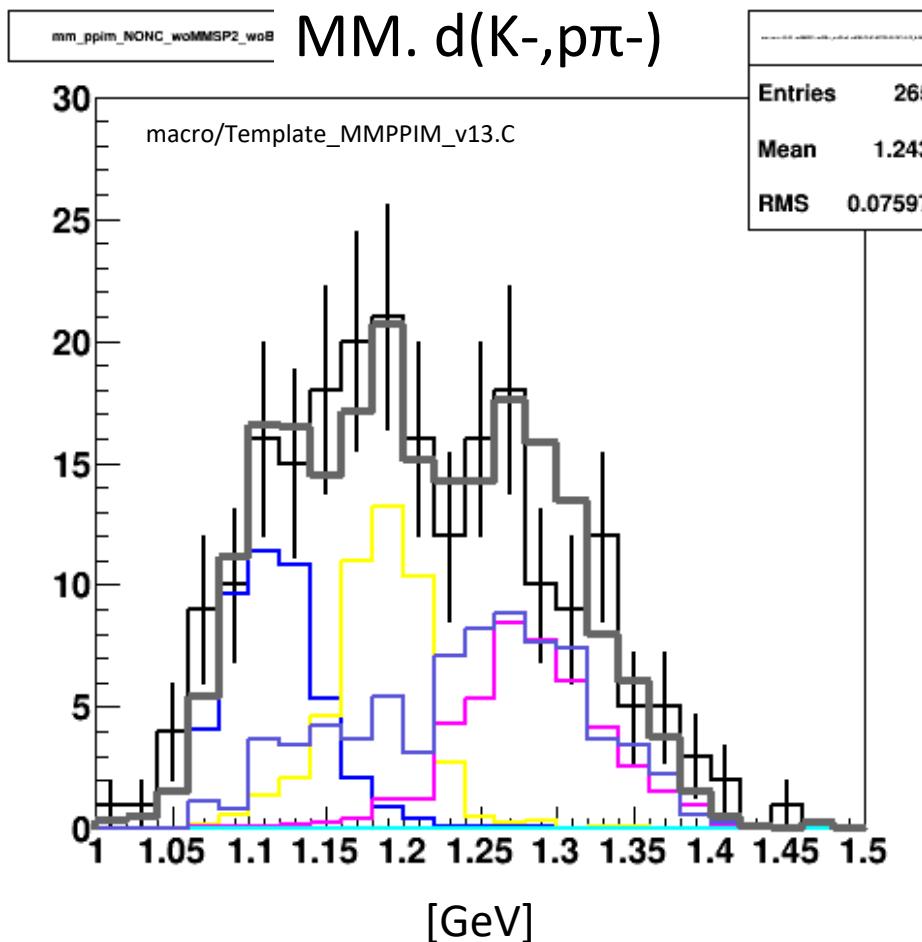
Fit Range
1.30 ~ 1.80 GeV

Chi2/ndf = 36.4/50

sca sca_err
0: 0.852567
1: 0.28411
chi2: 36.4193

Fitting result

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$



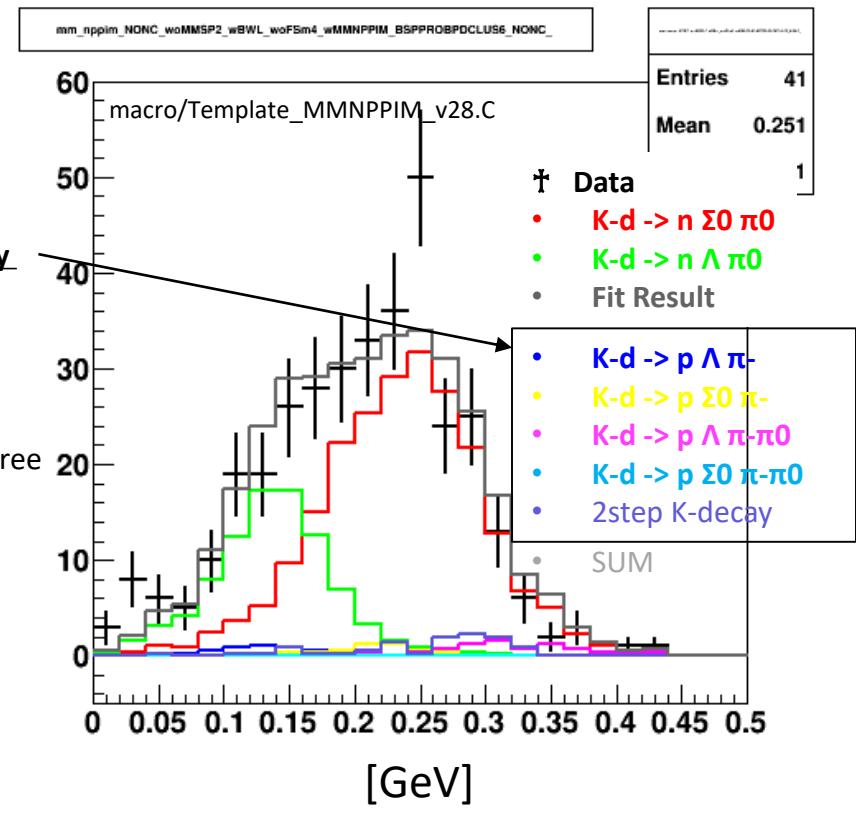
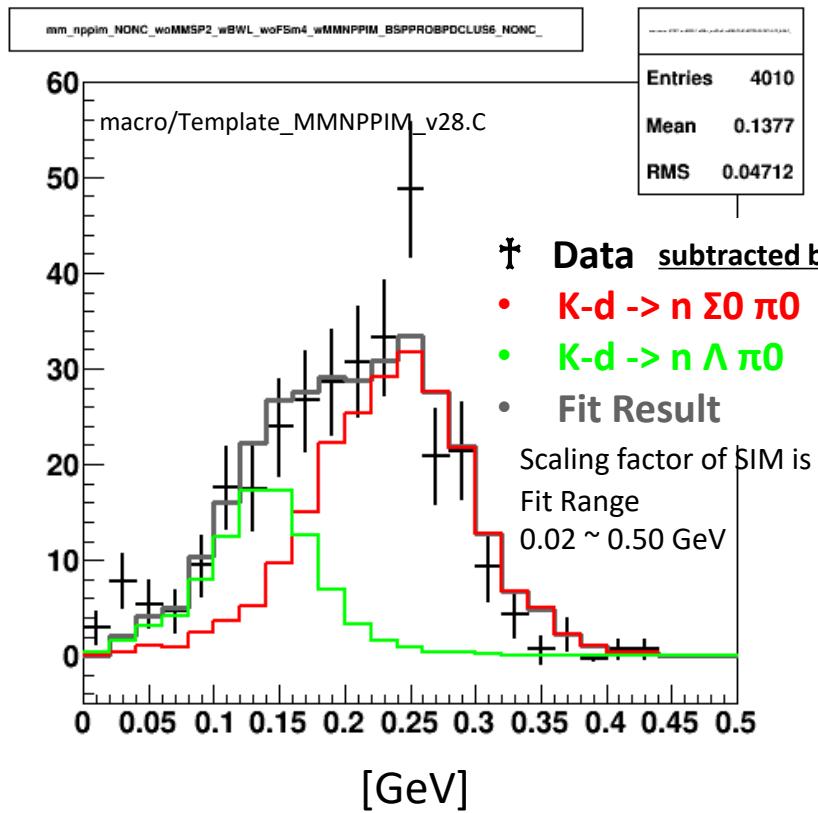
† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi-\pi^0$
- $K-d \rightarrow p \Sigma^0 \pi-\pi^0$
- 2step K-decay
- SUM

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is selected

Fitting of MM. $d(K^-, n\pi^-)$

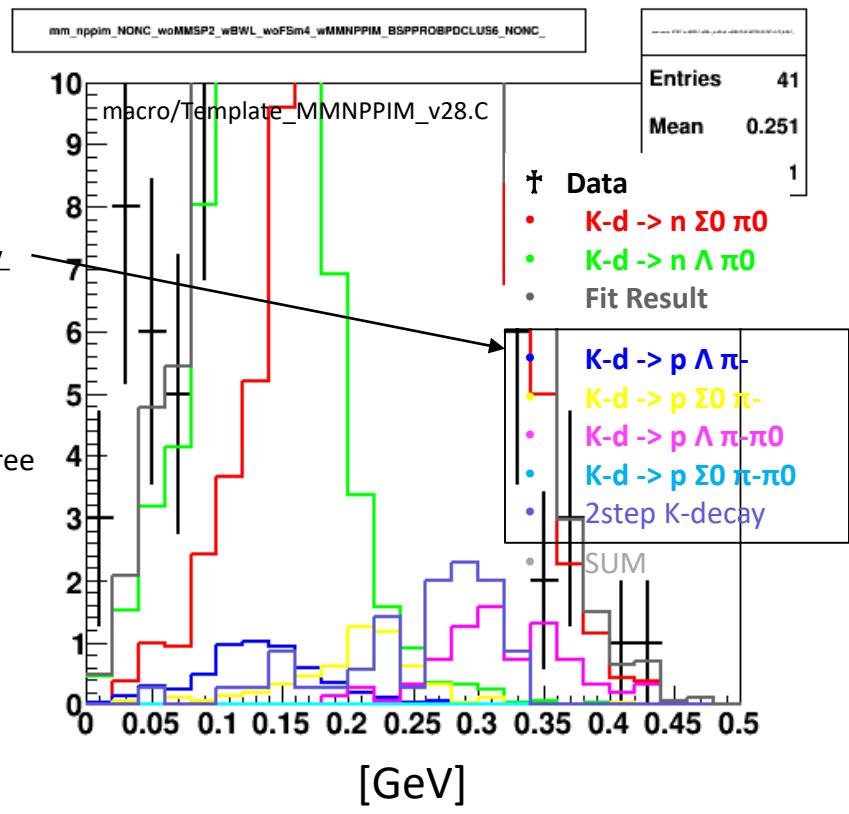
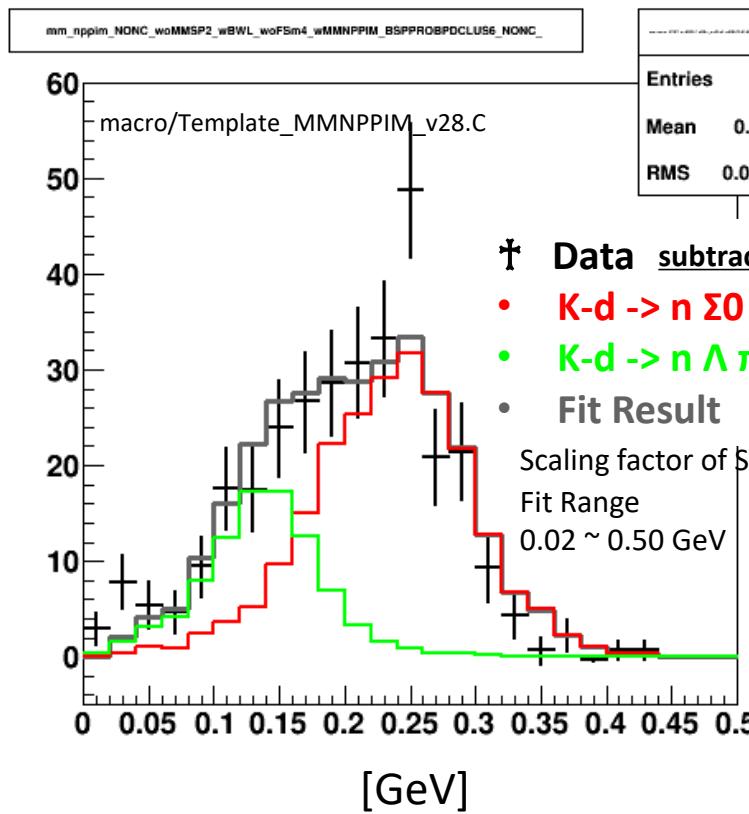
- Fitting w/ $K-d \rightarrow n \Sigma^0 \pi^0$, $K-d \rightarrow n \Lambda \pi^0$
- Data is subtracted by $K-d \rightarrow p \Lambda \pi^-$, $K-d \rightarrow p \Sigma^0 \pi^-$, $K-d \rightarrow p \Lambda \pi^- \pi^0$, $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$, 2step



- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is selected

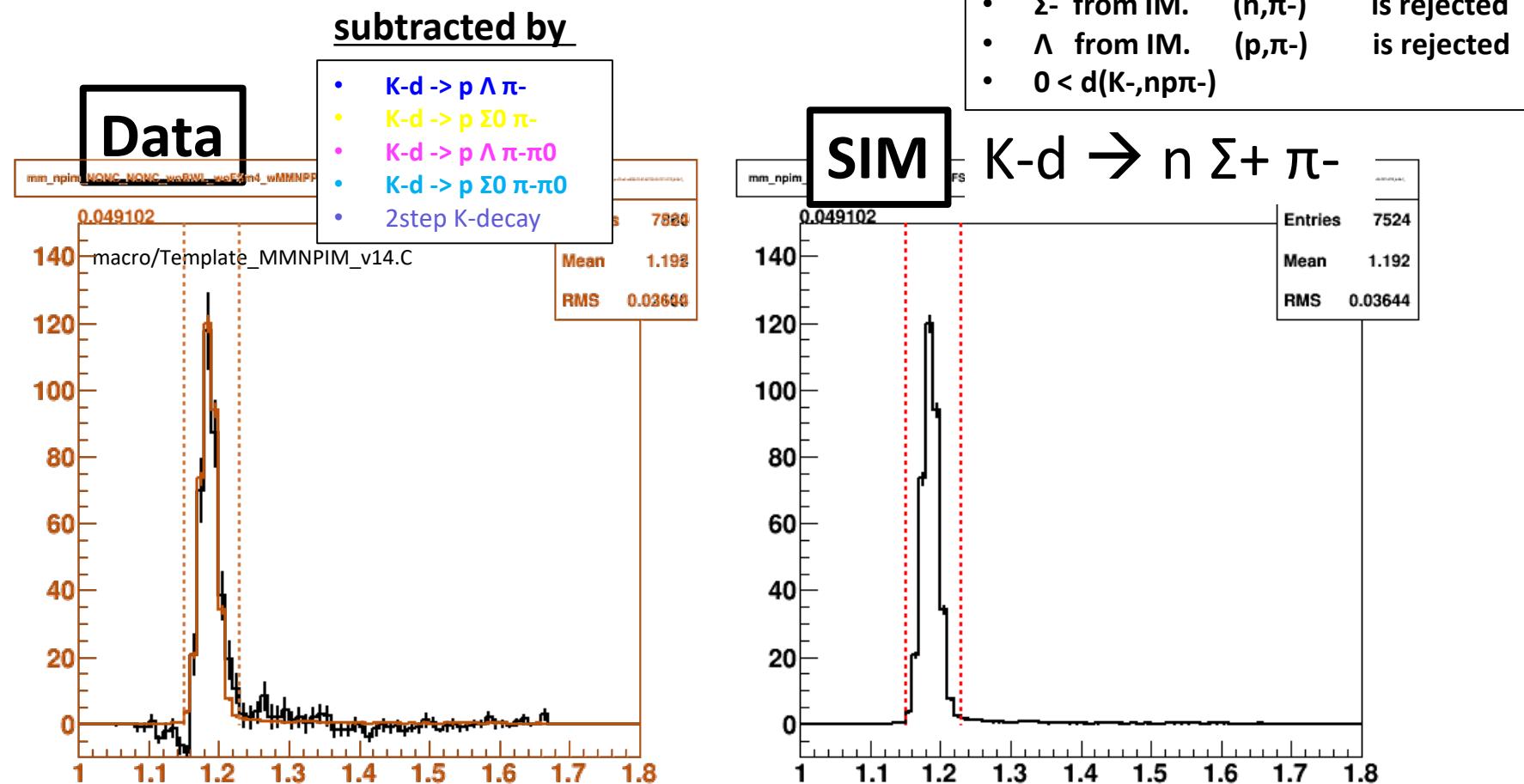
Fitting of MM. $d(K^-, n\pi^-)$

- Fitting w/ $K-d \rightarrow n \Sigma^0 \pi^0$, $K-d \rightarrow n \Lambda \pi^0$
- Data is subtracted by $K-d \rightarrow p \Lambda \pi^-$, $K-d \rightarrow p \Sigma^0 \pi^-$, $K-d \rightarrow p \Lambda \pi^- \pi^0$, $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$, 2step

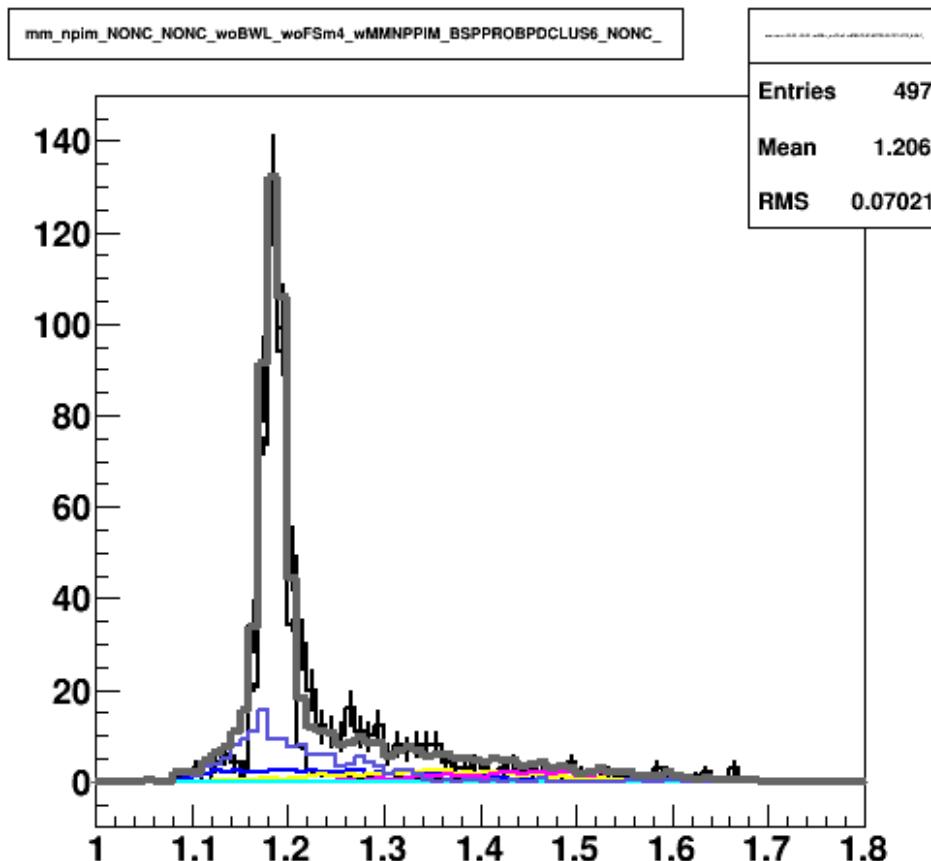


$K-d \rightarrow n \Sigma^+ \pi^-$;

Scaled by event # of $d(K-,n\pi)^{\prime\prime}\Sigma^+$ "



MM. $d(K^-, n\pi^-)$ w/ BG components



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$

† Data

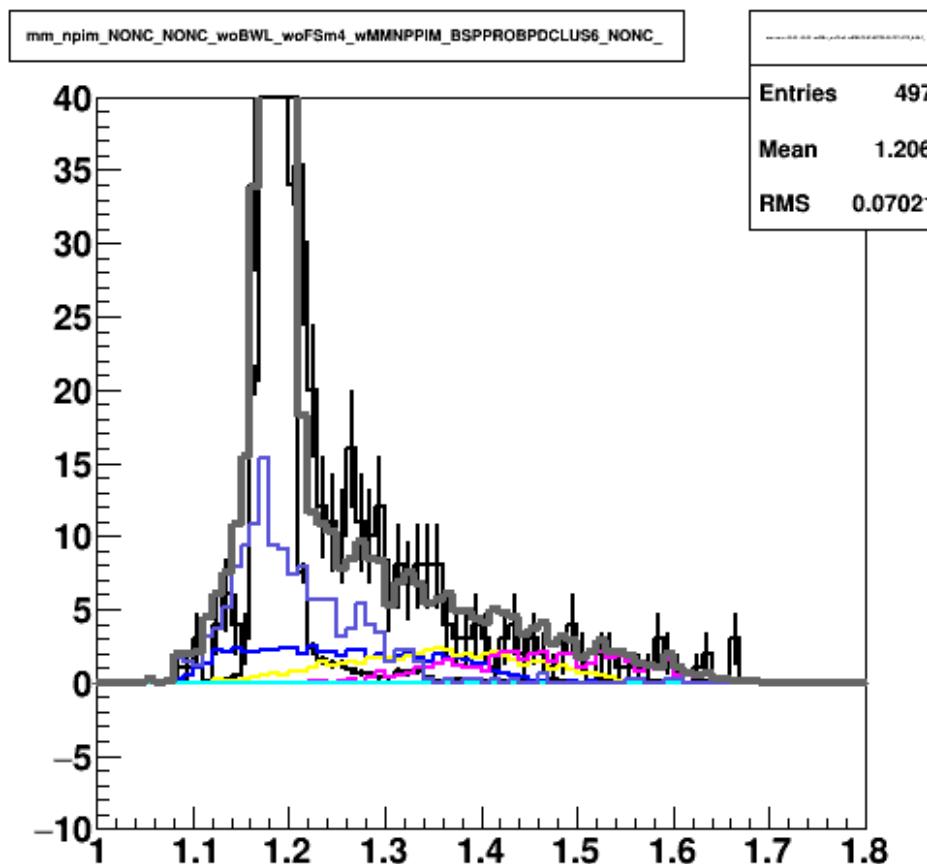
- $K-d \rightarrow n \Sigma^+ \pi^-$

BG

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step K-decay
- SUM

The tail of Σ^+ seems to be explained by these BGs

MM. $d(K^-, n\pi^-)$ w/ BG components



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$

† Data

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

BG

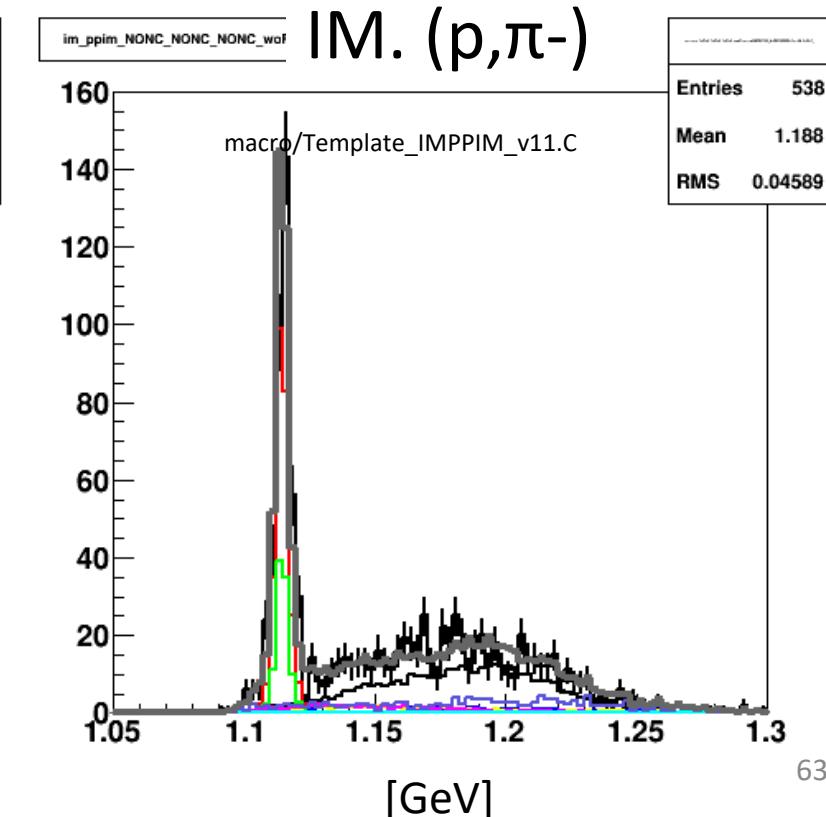
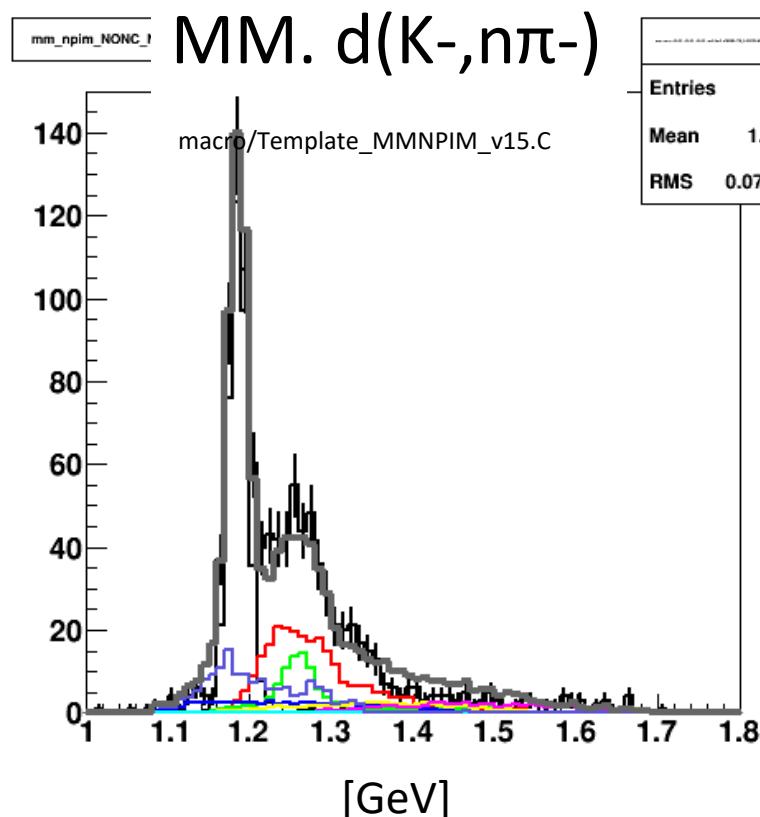
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^-\pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^-\pi^0$
- 2step K-decay
- SUM

The tail of Σ^+ seems to be explained by these BGs

- Σ^- from IM. (n, π^-) is rejected
- $0 < d(K^-, n\pi\pi^-)$

Fitting Results

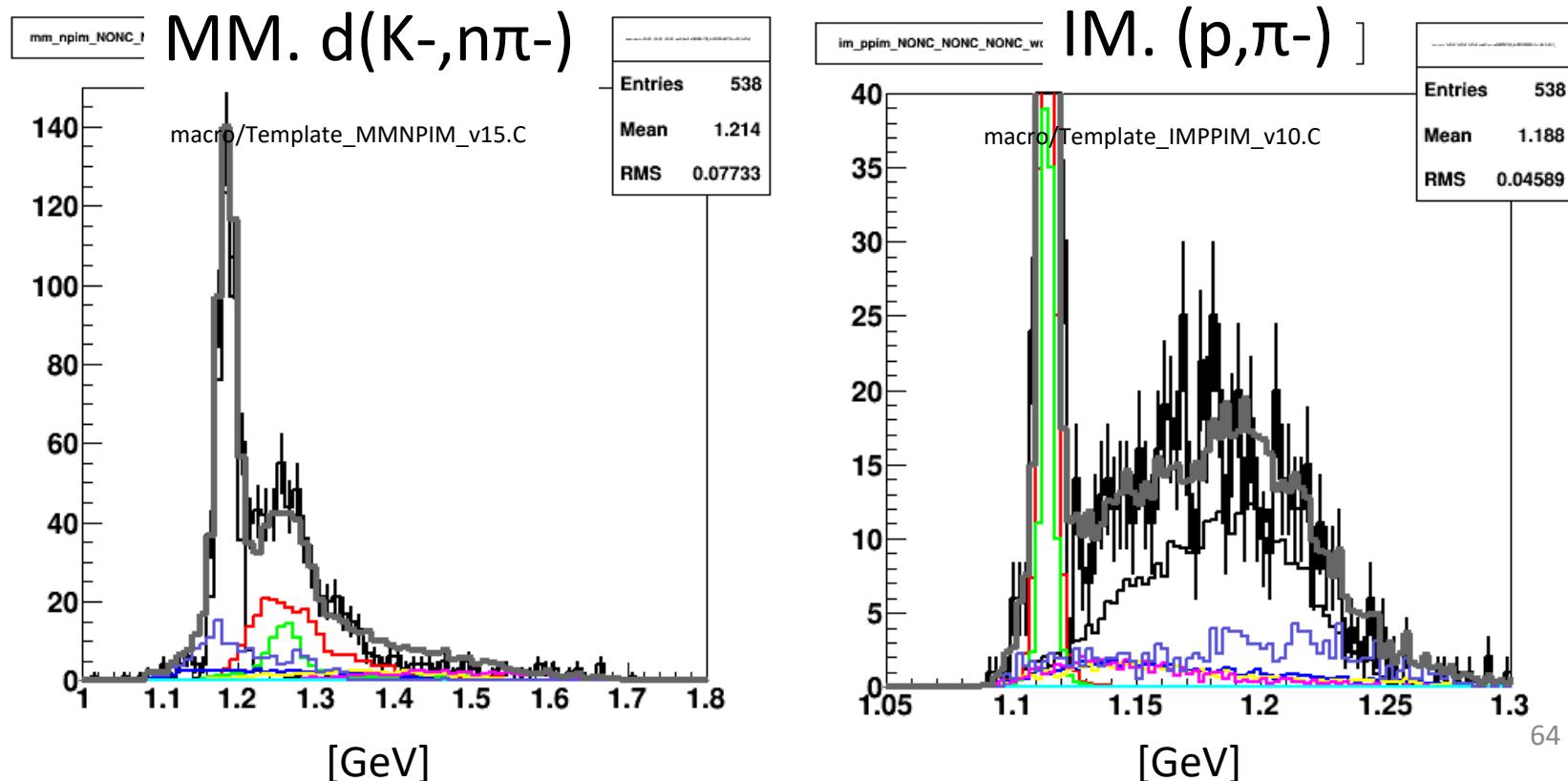
- † Data
- $K-d \rightarrow n \Sigma + \pi^-$
 - $K-d \rightarrow n \Sigma^0 \pi^0$
 - $K-d \rightarrow n \Lambda \pi^0$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - 2step K-decay



Fitting Results

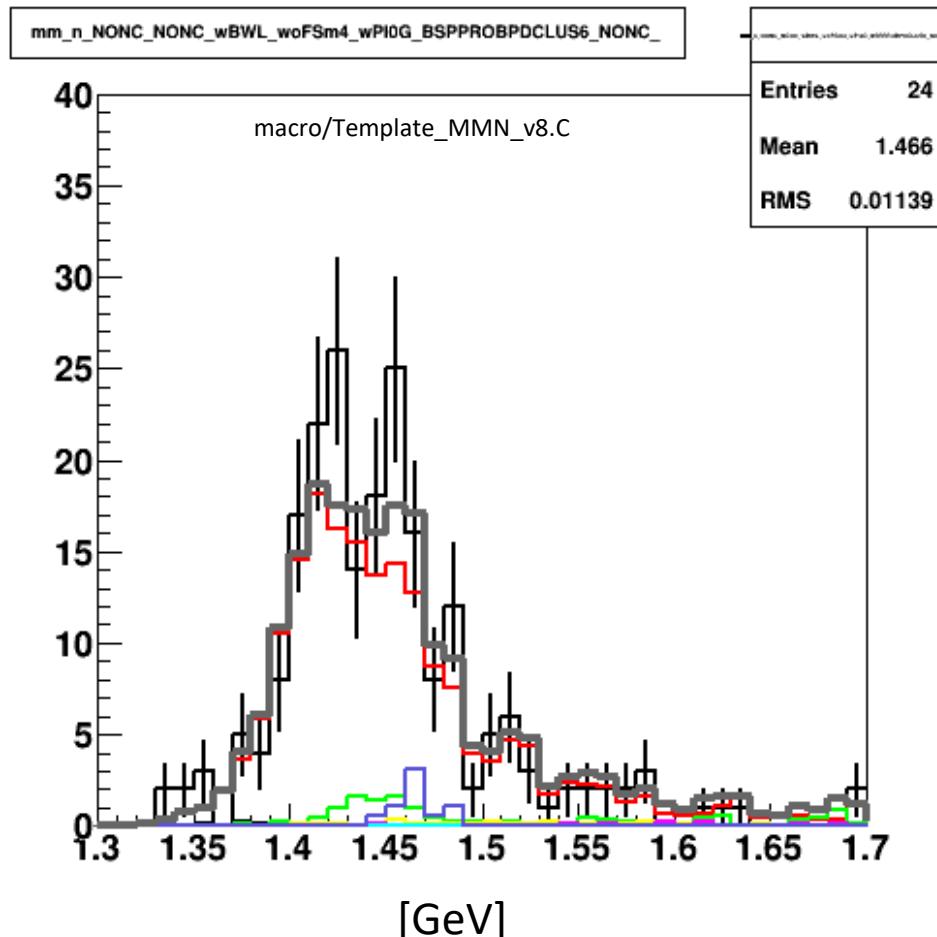
- Σ^- from IM. (n, π^-) is rejected
- $0 < d(K^-, n\pi\pi^-)$

- † Data
- $K-d \rightarrow n \Sigma + \pi^-$
 - $K-d \rightarrow n \Sigma^0 \pi^0$
 - $K-d \rightarrow n \Lambda \pi^0$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - 2step K-decay



- Σ - from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$



† Data

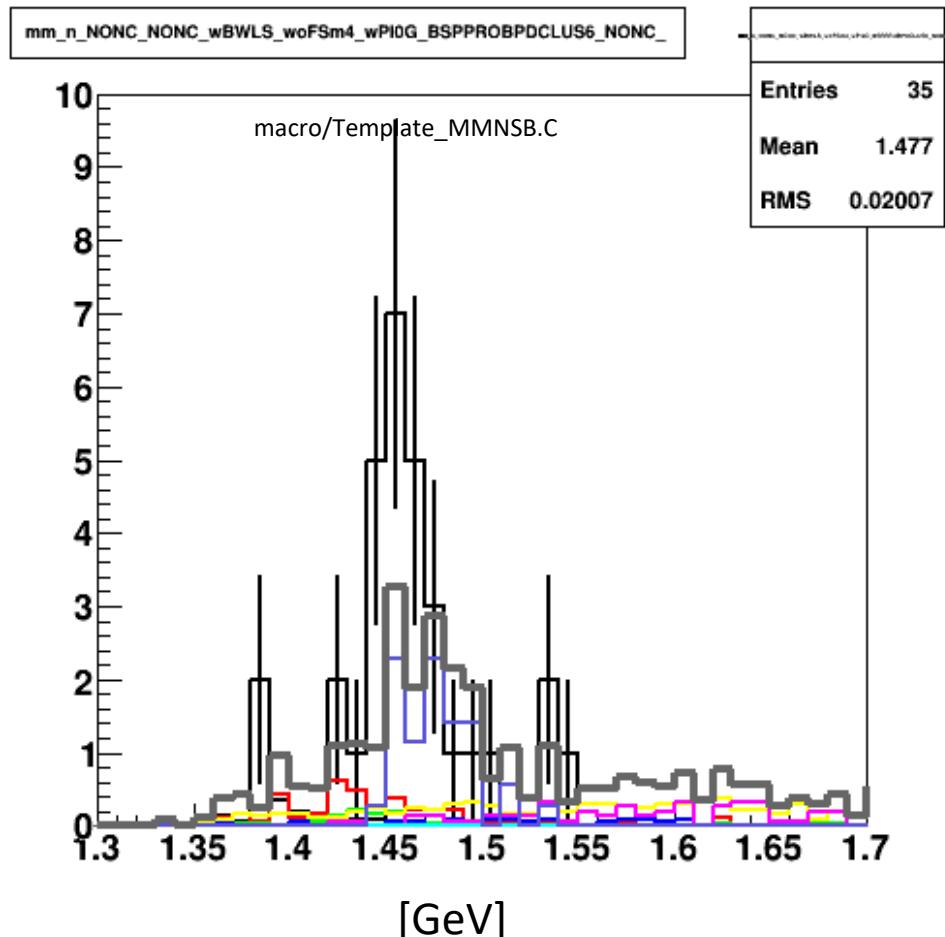
- $K-d \rightarrow n \Sigma^+ \pi^-$

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step K-decay

- Σ^- from IM. (n, π^-) is rejected
- Λ -Side from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$ (Λ side-band)



† Data

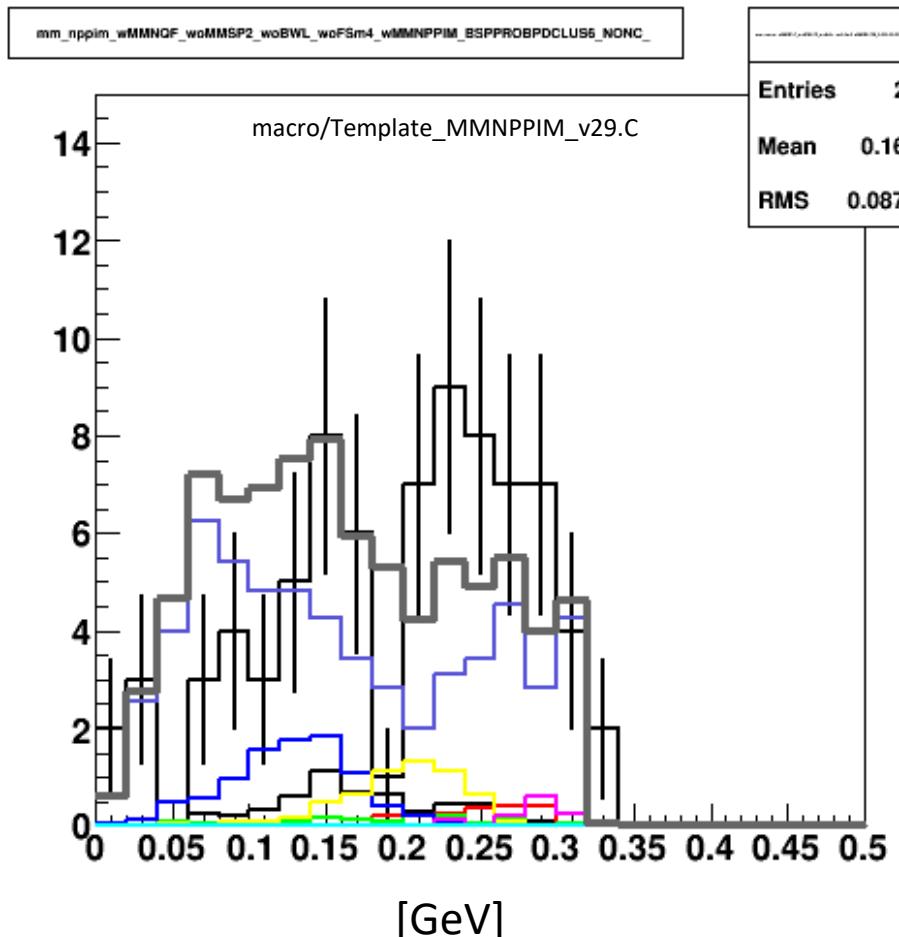
- $K-d \rightarrow n \Sigma^+ \pi^-$

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step K-decay

MM. $d(K^-, np\pi^-)$

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, np\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select



† Data

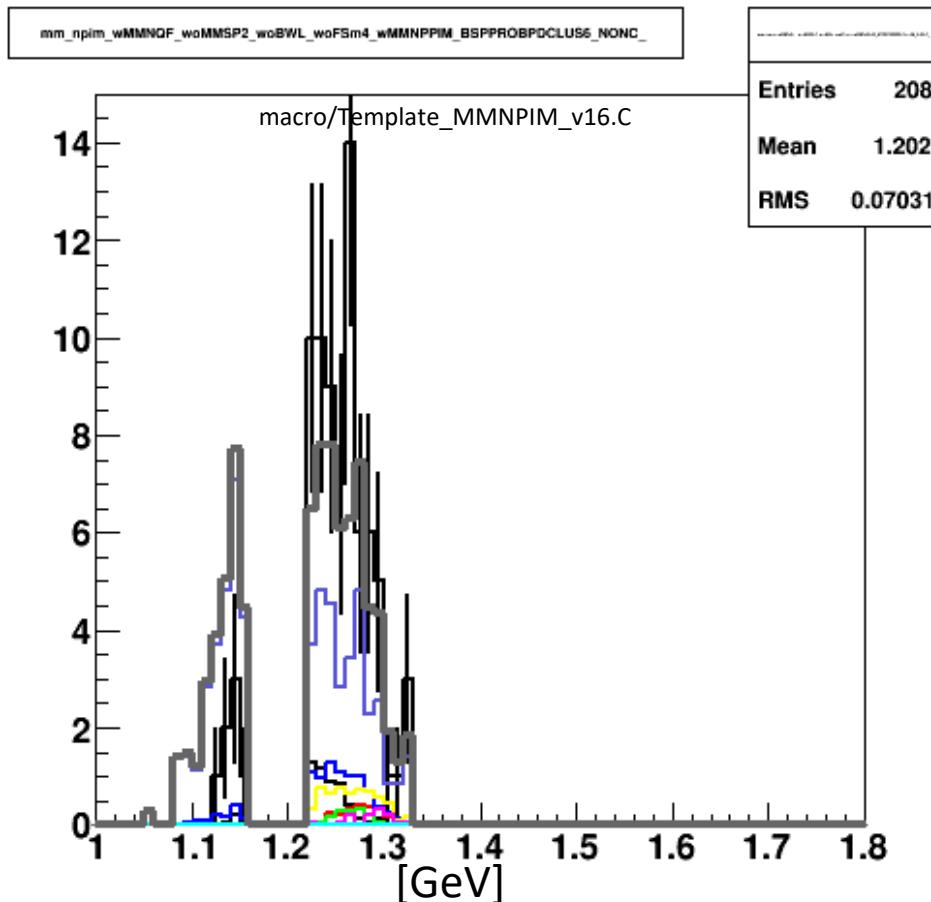
- $K-d \rightarrow n \Sigma^+ \pi^-$

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- $K-d \rightarrow n K-p$

MM. $d(K^-, n\pi^-)$

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select



† Data

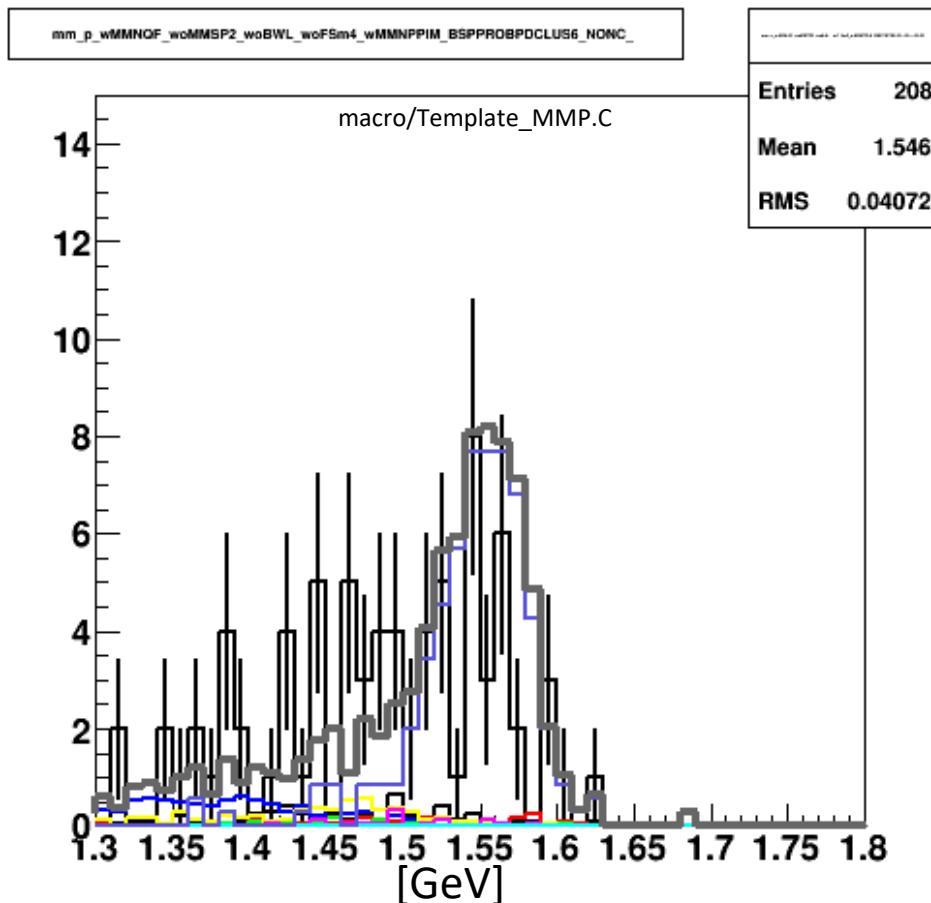
- $K^- d \rightarrow n \Sigma^+ \pi^-$

- $K^- d \rightarrow n \Sigma^0 \pi^0$
- $K^- d \rightarrow n \Lambda \pi^0$

- $K^- d \rightarrow p \Lambda \pi^-$
- $K^- d \rightarrow p \Sigma^0 \pi^-$
- $K^- d \rightarrow p \Lambda \pi^- \pi^0$
- $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
- $K^- d \rightarrow n K^- p$

MM. $d(K^-, p)$

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select



† Data

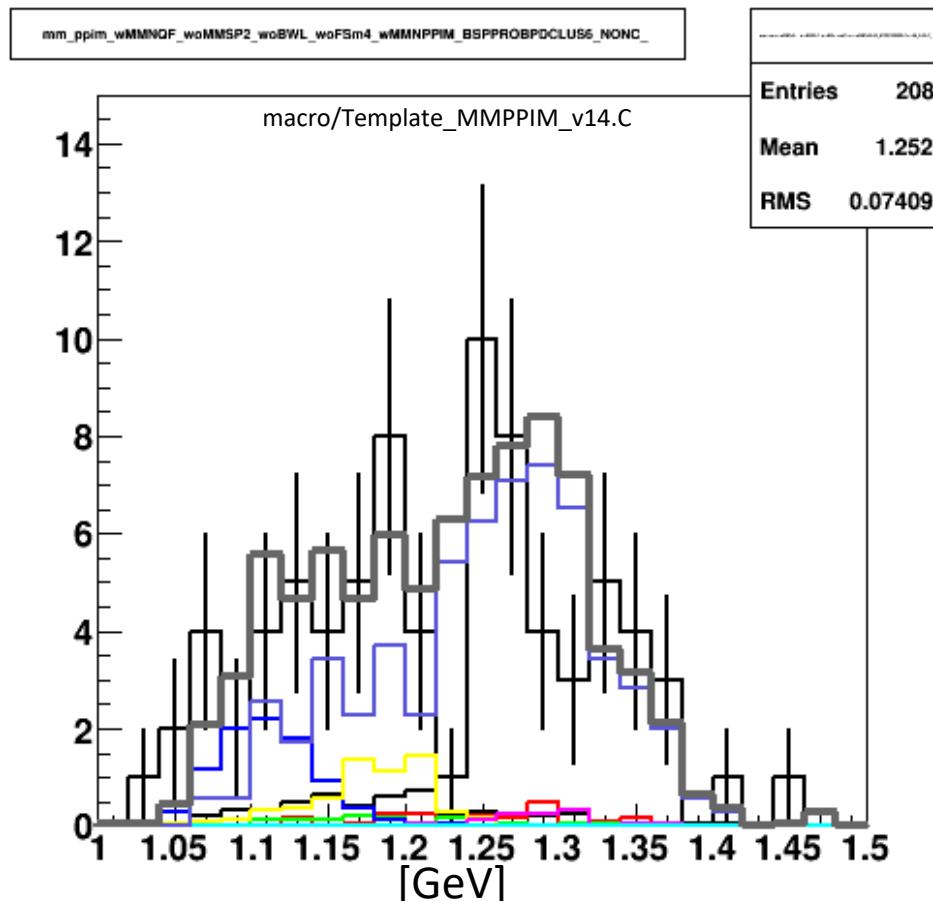
- $K^- d \rightarrow n \Sigma^+ \pi^-$

- $K^- d \rightarrow n \Sigma^0 \pi^0$
- $K^- d \rightarrow n \Lambda \pi^0$

- $K^- d \rightarrow p \Lambda \pi^-$
- $K^- d \rightarrow p \Sigma^0 \pi^-$
- $K^- d \rightarrow p \Lambda \pi^- \pi^0$
- $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
- $K^- d \rightarrow n K^- p$

MM. $d(K^-, p\pi^-)$

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select



† Data

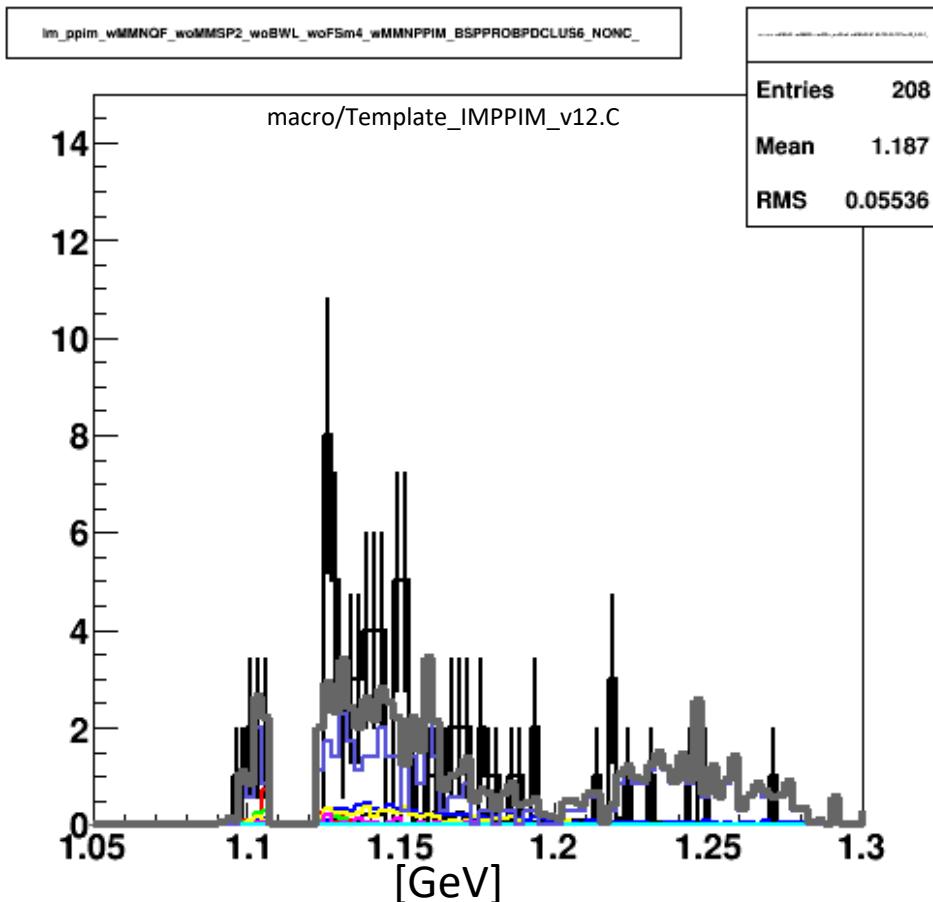
- $K^- d \rightarrow n \Sigma^+ \pi^-$

- $K^- d \rightarrow n \Sigma^0 \pi^0$
- $K^- d \rightarrow n \Lambda \pi^0$

- $K^- d \rightarrow p \Lambda \pi^-$
- $K^- d \rightarrow p \Sigma^0 \pi^-$
- $K^- d \rightarrow p \Lambda \pi^- \pi^0$
- $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
- $K^- d \rightarrow n K^- p$

IM. (p, π^-)

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\rho\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select



† Data

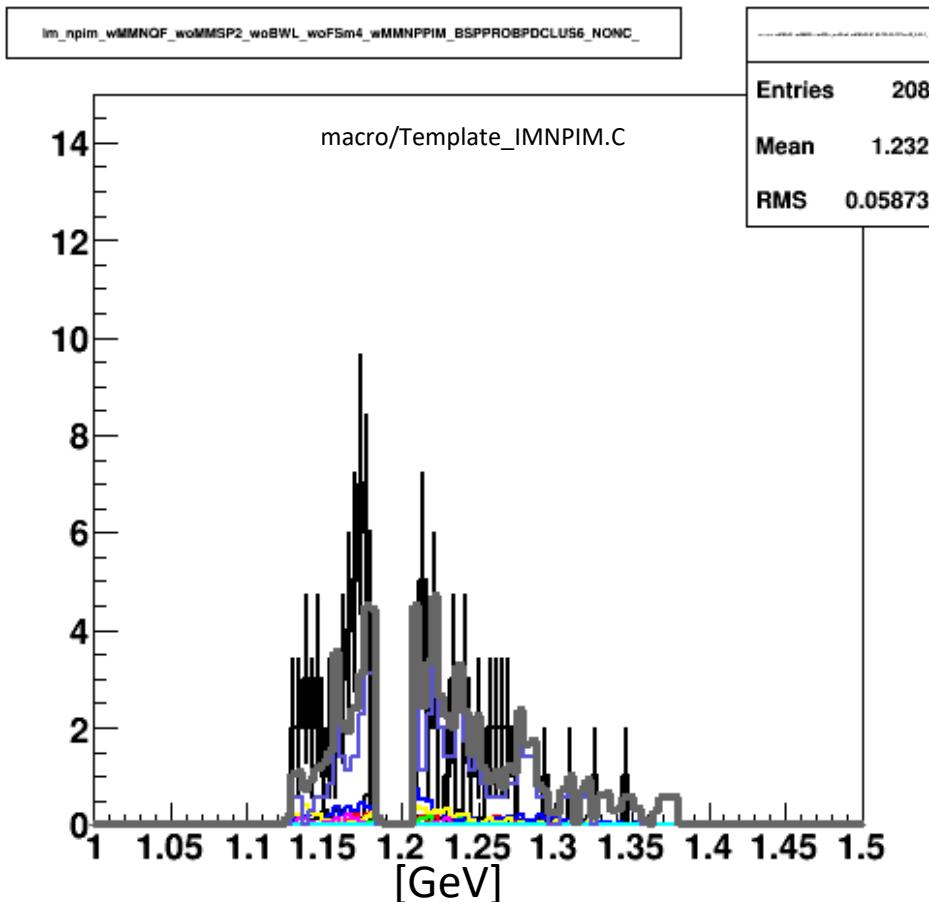
- $K-d \rightarrow n \Sigma^+ \pi^-$

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- $K-d \rightarrow n K-p$

IM. (n, π^-)

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select



† Data

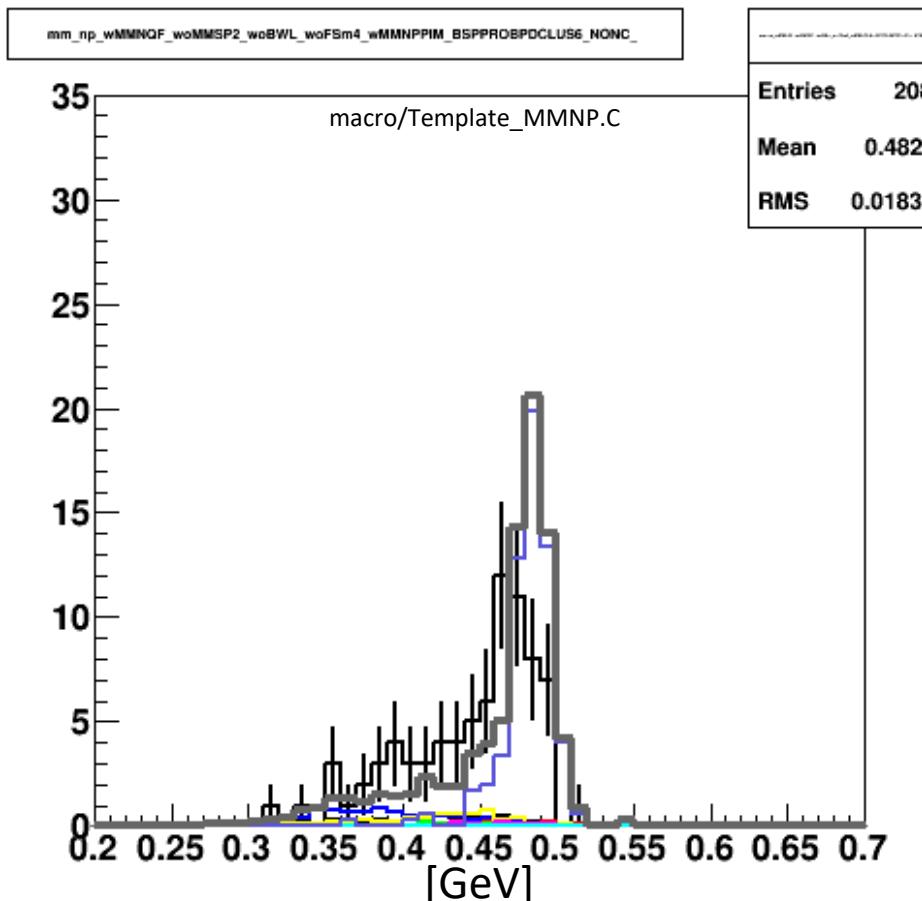
- $K-d \rightarrow n \Sigma^+ \pi^-$

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- $K-d \rightarrow n K-p$

MM. $d(K^-, np)$

- Σ^- from IM. (n, π^-) is rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\rho\pi^-)$
- $d(K^-, n) 1.43 \sim 1.50$ select



† Data

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

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

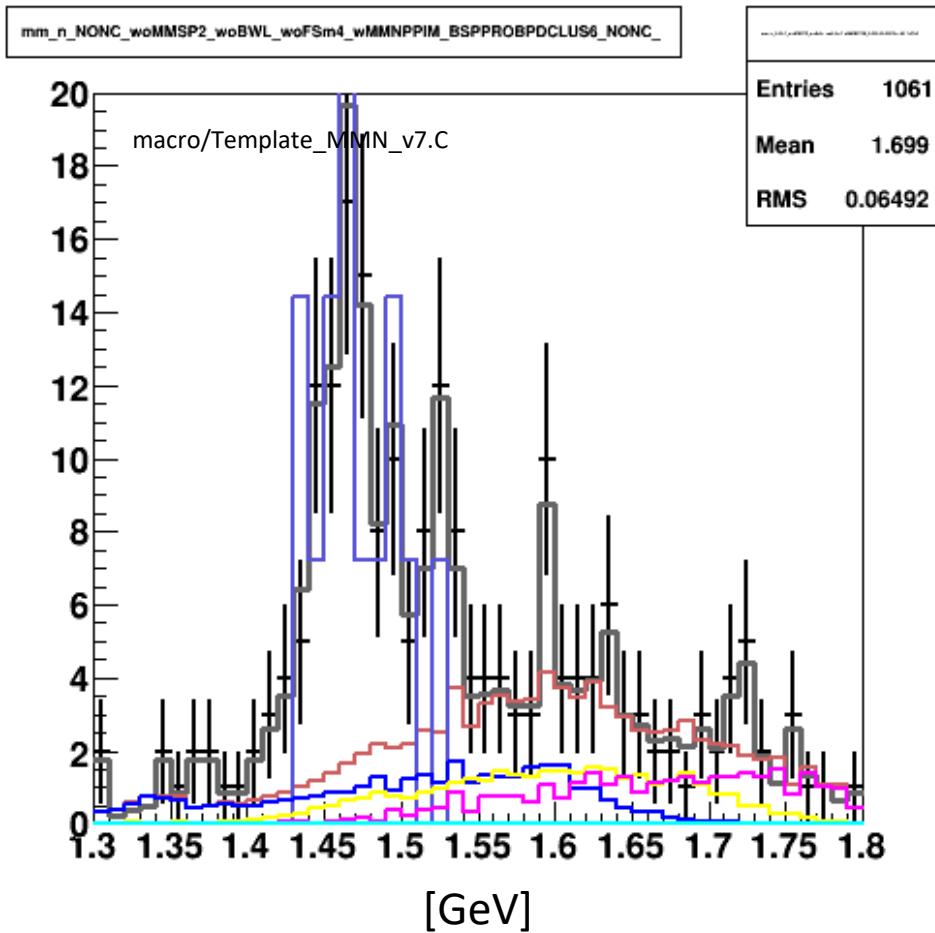
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- $K-d \rightarrow n K-p$

BG SIM estimation

- $K^- d \rightarrow p Y \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^-$
 - $K^- d \rightarrow p \Sigma^0 \pi^-$
 - $K^- d \rightarrow p \Lambda \pi^- \pi^0$
 - $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - $Y\pi^-$ distribution use data shape from MM. $d(K^-, p)$
- 1step K^- decay

Fitting of MM. $d(K_-, n)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K_-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K_-, n\pi\pi^-)$



† Data

- $K-d \rightarrow p \bar{\Lambda} \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 1step K- decay
- Fit Result

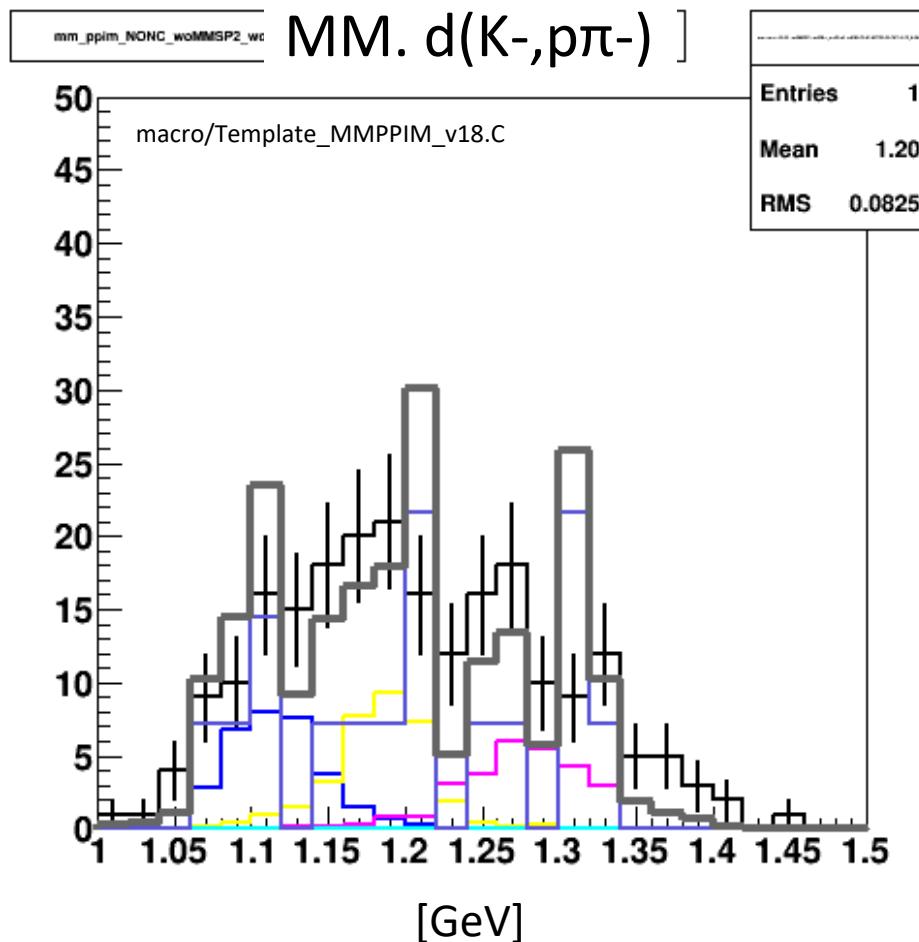
- The relative ratio of 4 components in $K-d \rightarrow p \bar{\Lambda} \pi^-$ is fixed by fitting of MM. $d(K_-, p\pi^-)$
- Scaling factors of SIM ($K-d \rightarrow p \bar{\Lambda} \pi^-$, 1step K- decay) are free

Fit Range
1.30 ~ 1.80 GeV

Chi2/ndf = 24.6/50

Fitting result

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$

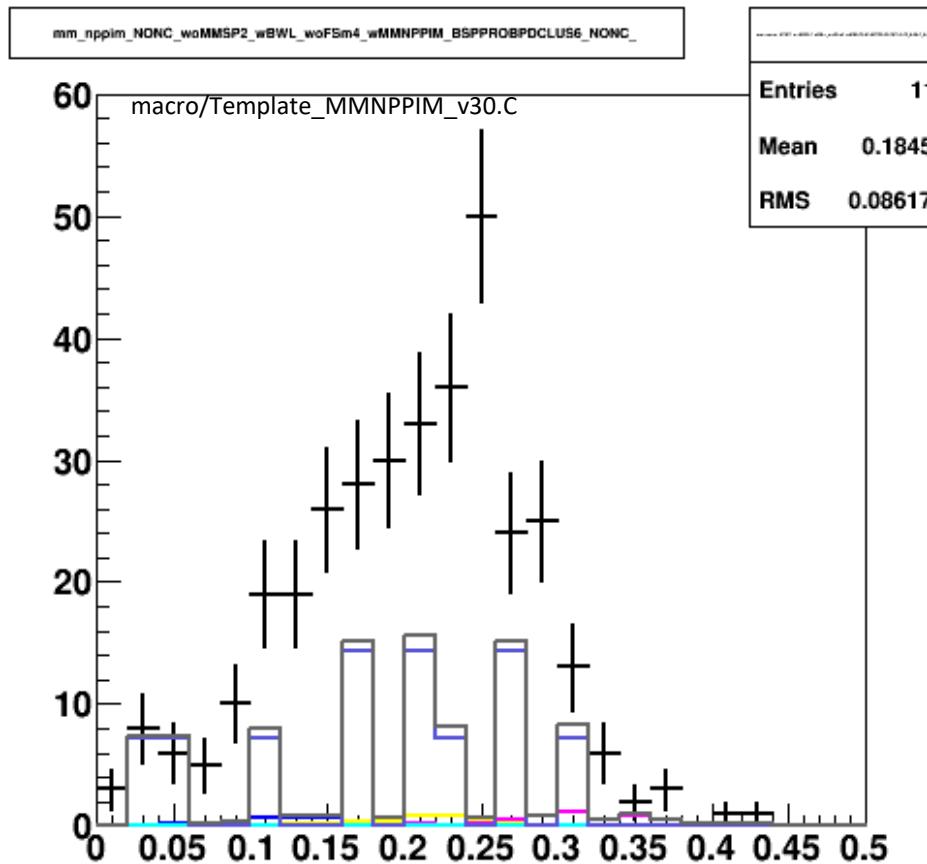


† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 1step K^- decay
- SUM

MM. $d(K^-, n\Lambda)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) selected
- $0 < d(K^-, n\pi^-)$



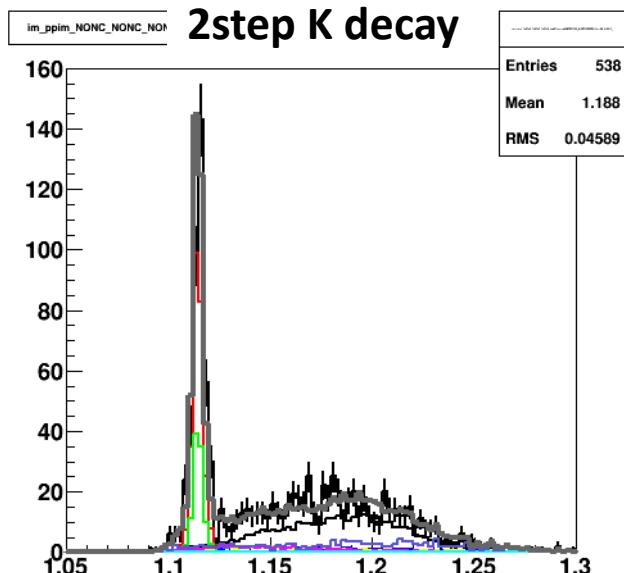
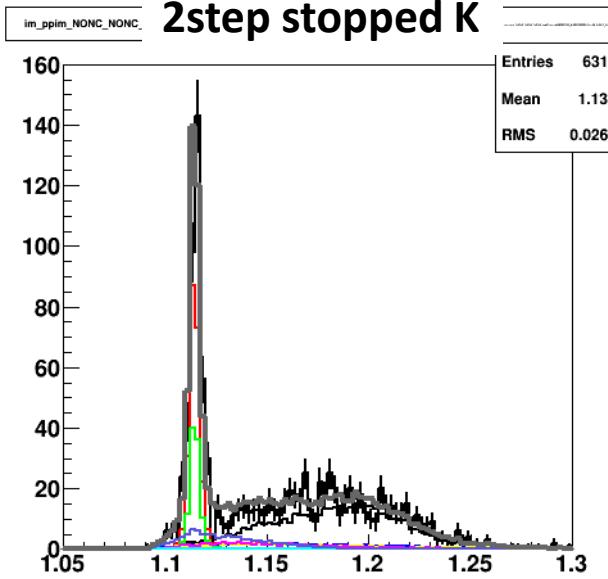
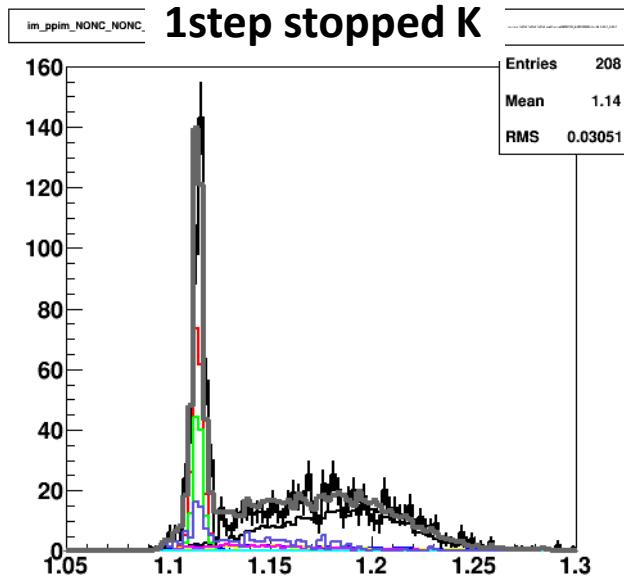
† Data

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 1step K- decay
- SUM

Fitting fails due to small statistics of SIM (1step K- decay)

Summary of K-scatter reaction

Summary of IM. (p, π^-)

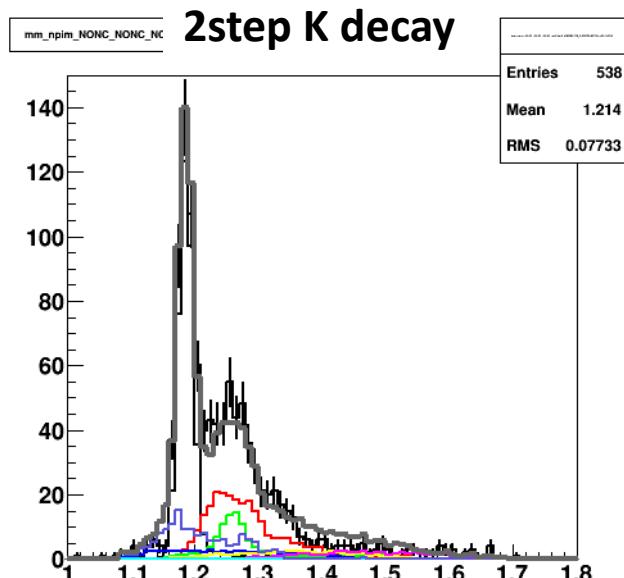
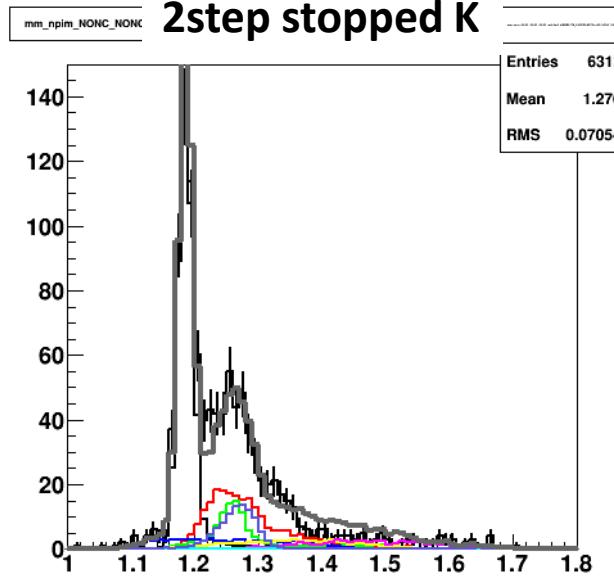
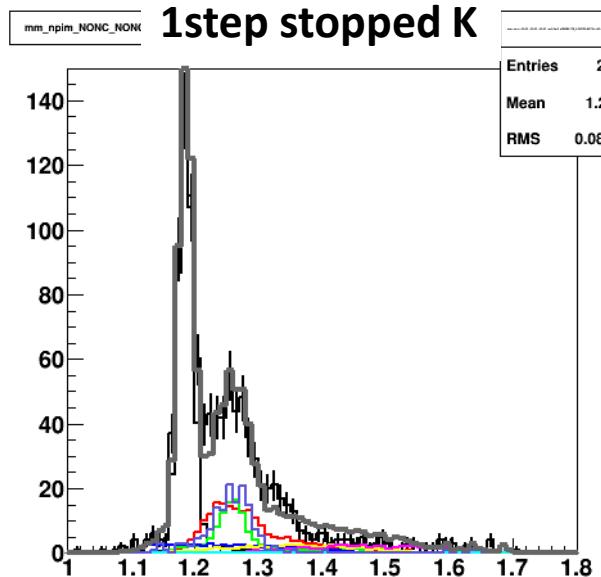


† Data

- $K-d \rightarrow n \Sigma 0 \pi 0$
- $K-d \rightarrow n \Lambda \pi 0$
- Fit Result
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma 0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi 0$
- $K-d \rightarrow p \Sigma 0 \pi^- \pi 0$
- $K-$ scatter
- SUM

- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K-, np\pi^-) < 0.30$

Summary of $d(K^-, n\pi^-)$

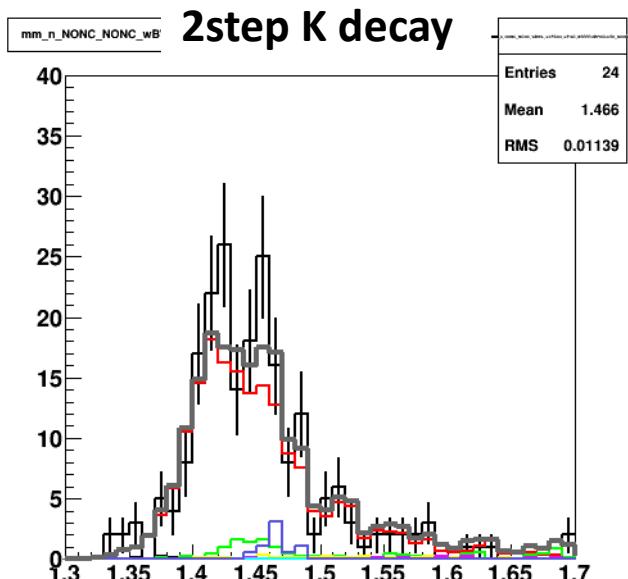
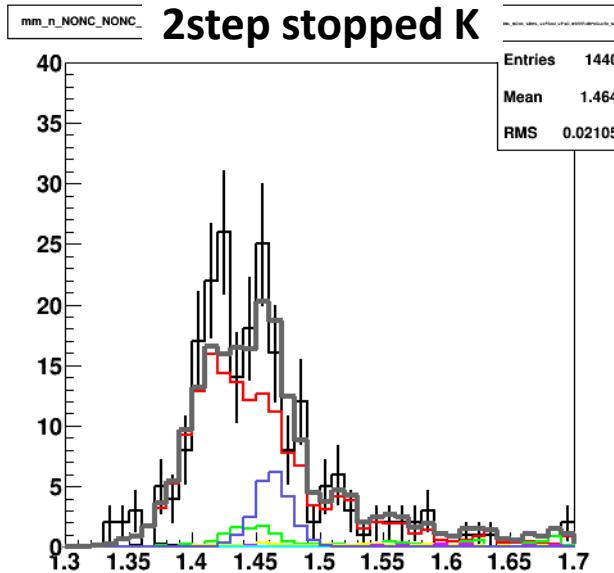
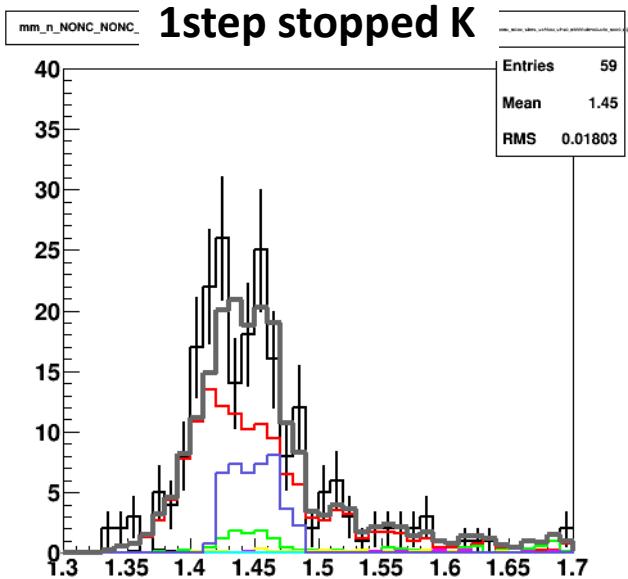


† Data

- $K-d \rightarrow n \Sigma 0 \pi 0$
- $K-d \rightarrow n \Lambda \pi 0$
- Fit Result
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma 0 \pi^-$
- $K-d \rightarrow p \Lambda \pi-\pi 0$
- $K-d \rightarrow p \Sigma 0 \pi-\pi 0$
- $K-$ scatter
- SUM

- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K^-, n\pi^-) < 0.30$

Summary of $d(K^-, n)$

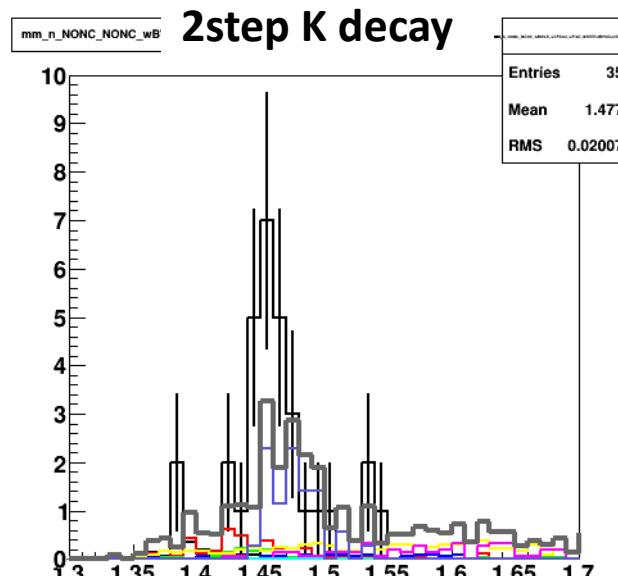
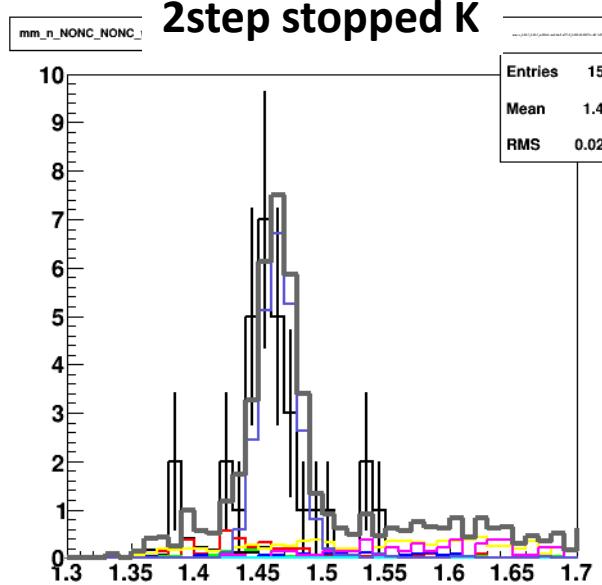
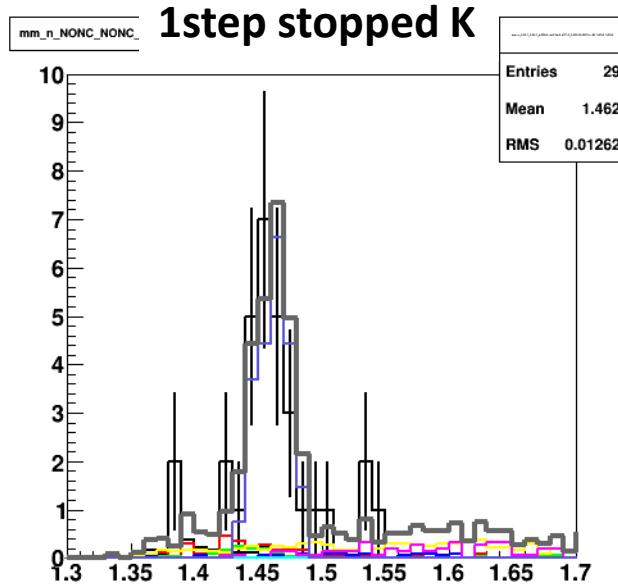


† Data

- $K-d \rightarrow n \Sigma 0 \pi 0$
- $K-d \rightarrow n \Lambda \pi 0$
- Fit Result
- $K-d \rightarrow p \Lambda \pi -$
- $K-d \rightarrow p \Sigma 0 \pi -$
- $K-d \rightarrow p \Lambda \pi - \pi 0$
- $K-d \rightarrow p \Sigma 0 \pi - \pi 0$
- $K - \text{scatter}$
- SUM

- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K^-, np\pi^-) < 0.30$

Summary of d(K-,n) Side-Band



† Data

- $K-d \rightarrow n \Sigma 0 \pi 0$
- $K-d \rightarrow n \Lambda \pi 0$
- Fit Result
- $K-d \rightarrow p \Lambda \pi -$
- $K-d \rightarrow p \Sigma 0 \pi -$
- $K-d \rightarrow p \Lambda \pi - \pi 0$
- $K-d \rightarrow p \Sigma 0 \pi - \pi 0$
- $K- \text{scattered}$
- SUM

- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K-, np\pi^-) < 0.30$

Event Reduction

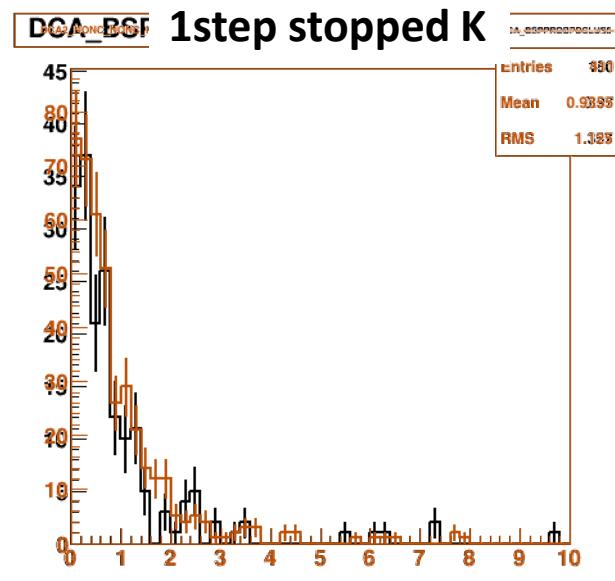
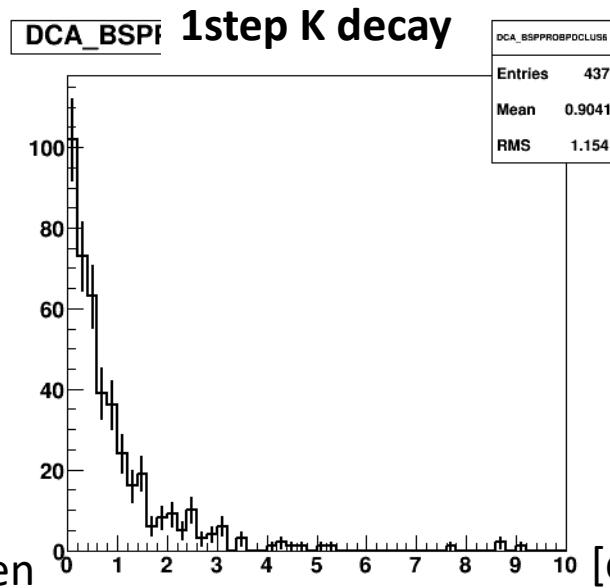
	1step K-decay	2step K-decay	1step K-stopped	2step K-stopped
Generate & NC Forward Accept	60000000	60000000	60000000	60000000
NC > 8 MeV	7420690	6992560	7432890	6990180
momentum analysis	180	1633	437	8944
$d(K^-, np \pi^-) > 0$	40	652	250	7673
BG (w/o Λ , w/o Σ^- , w/o Σ^+)	16	248	104	3699

0.124	0.117	0.124	0.117
0.000024	0.000234	0.000059	0.001280
0.222	0.399	0.572	0.858
0.400	0.380	0.416	0.482

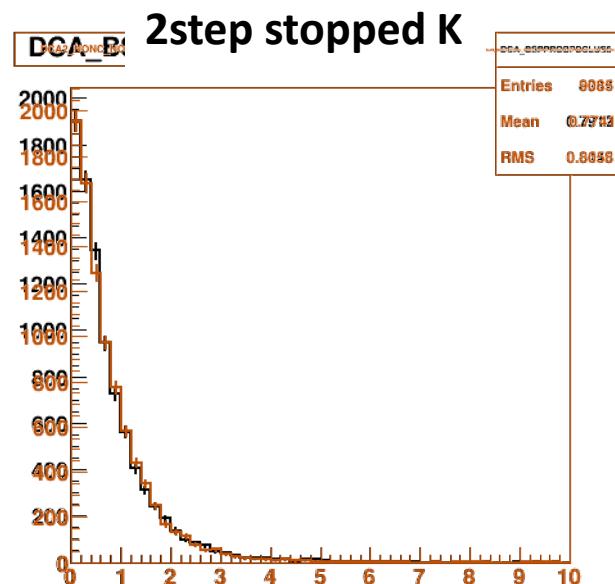
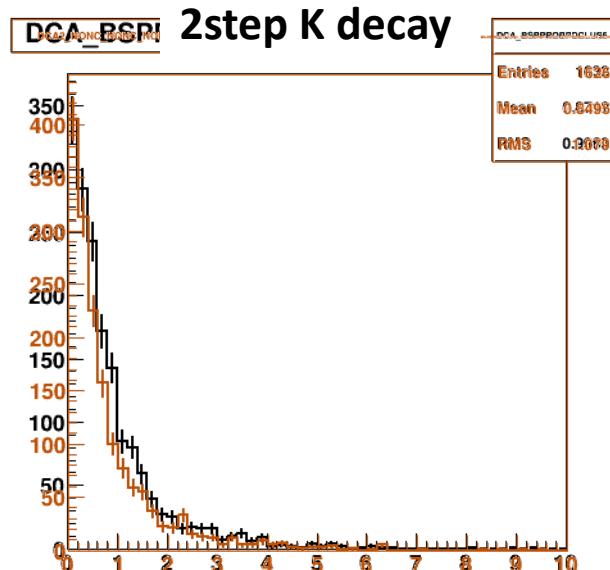
DCA of BPC track & π^- CDS Track

Beam
Backward

- After p π -,n analysis procedure



No difference between those reactions

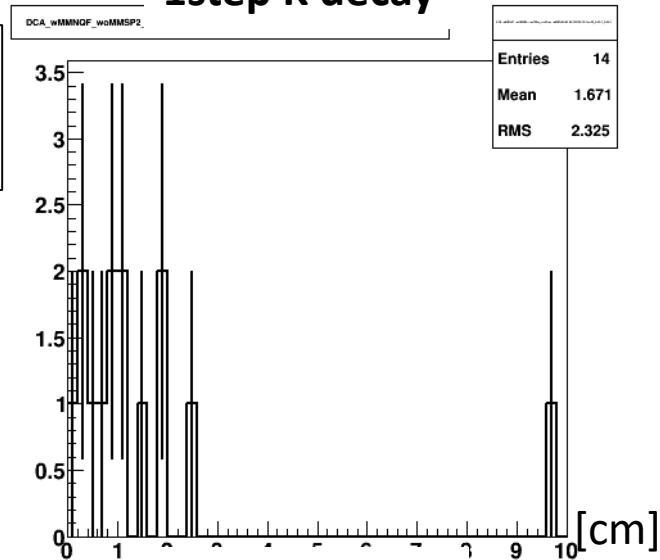


DCA of BPC track & π^- CDS Track

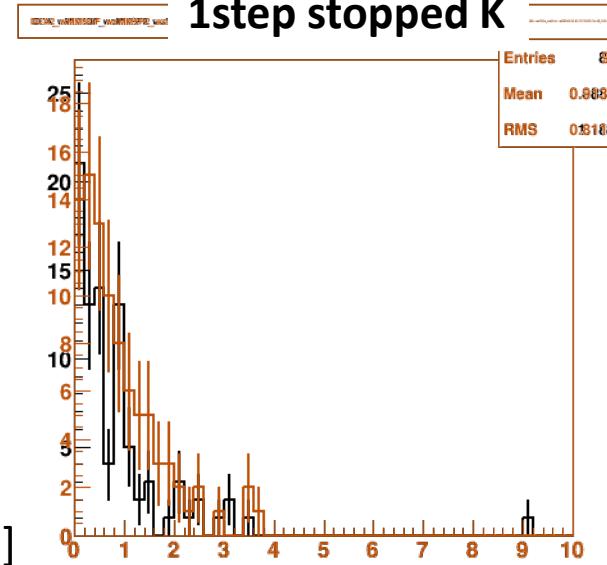
Beam
Backward

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **$1.43 \sim 1.50$ selected**

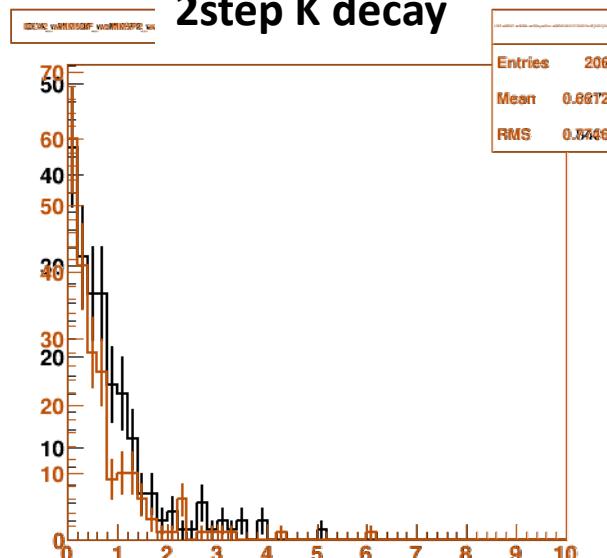
1step K decay



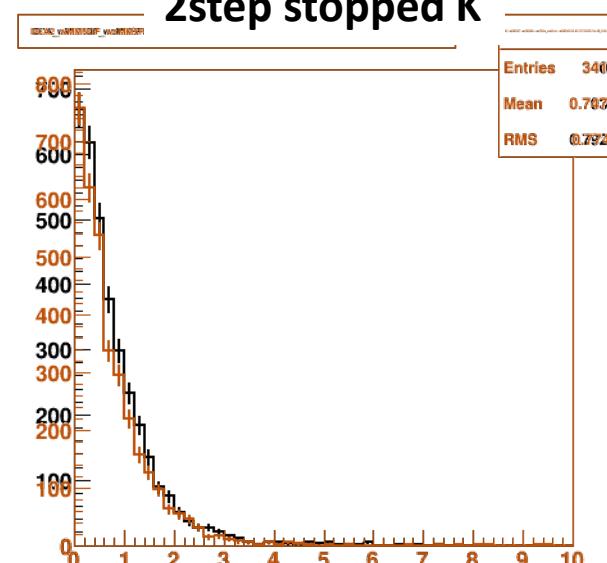
1step stopped K



2step K decay



2step stopped K

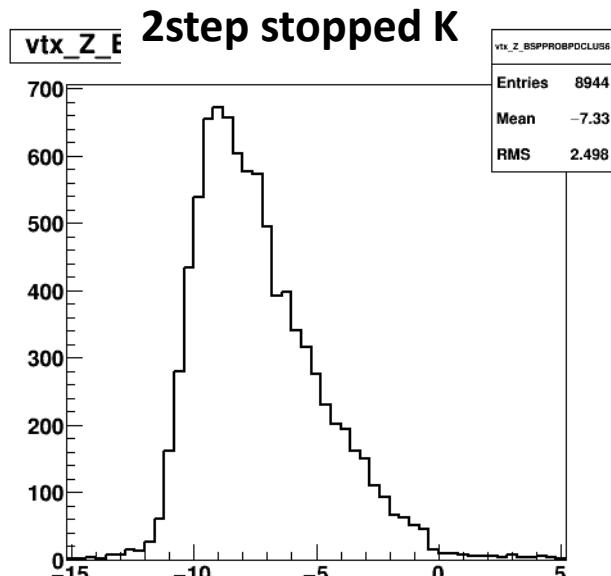
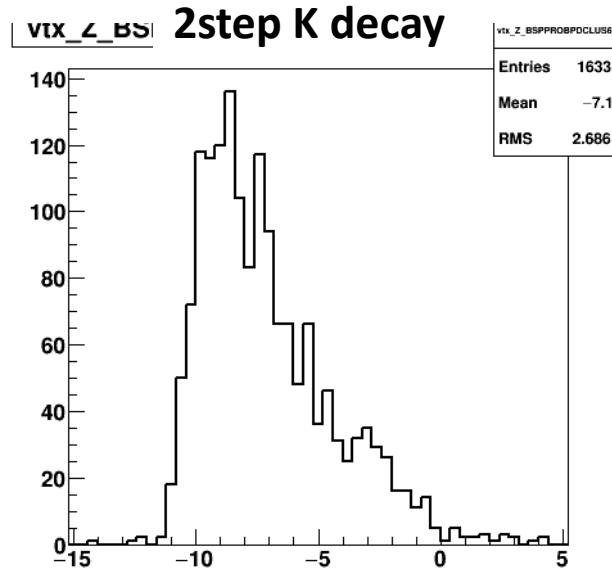
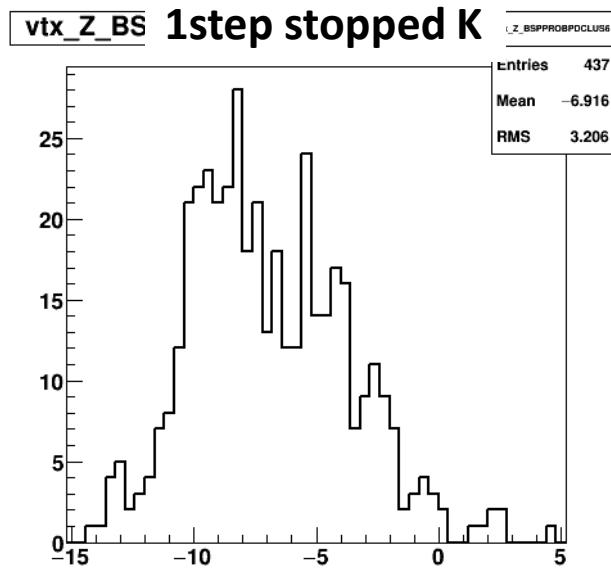
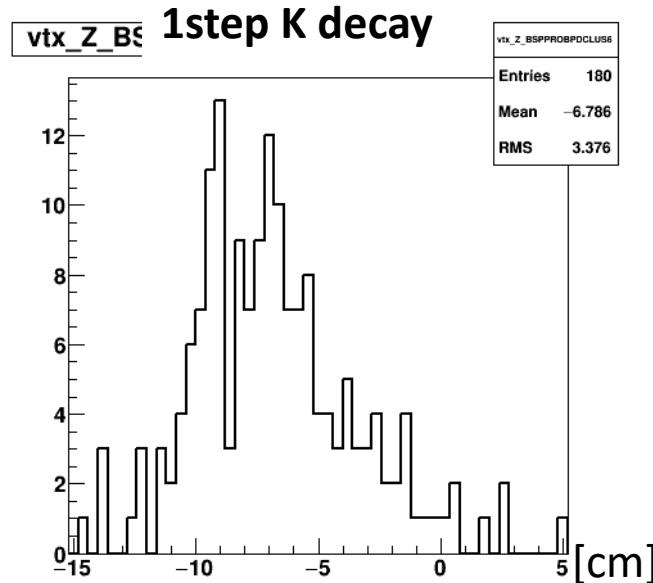


Vertex Z of BPC track & π^- CDS Track

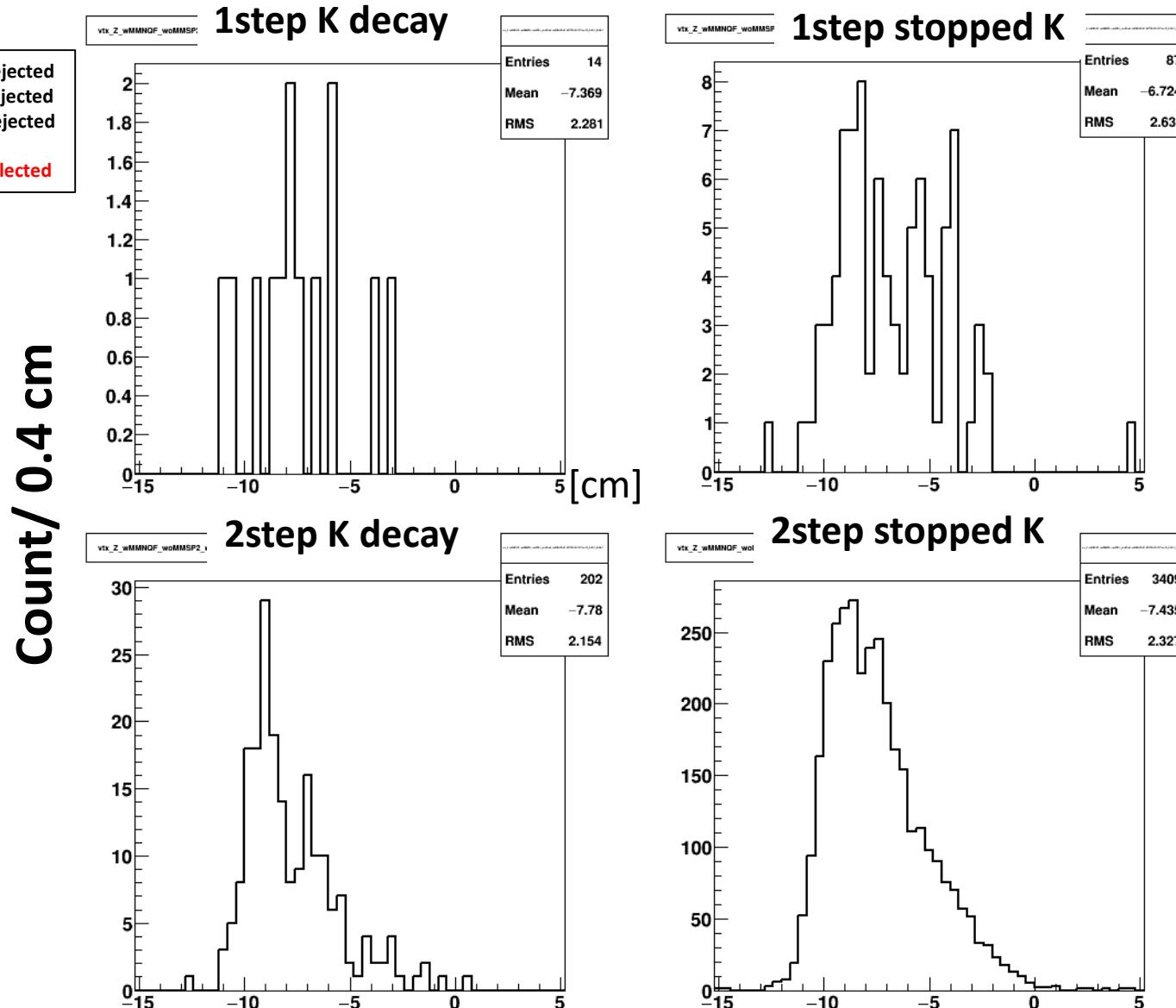
- After $p \pi, n$ analysis procedure

Count / 0.4 cm

1 step stopped K
seems be difference

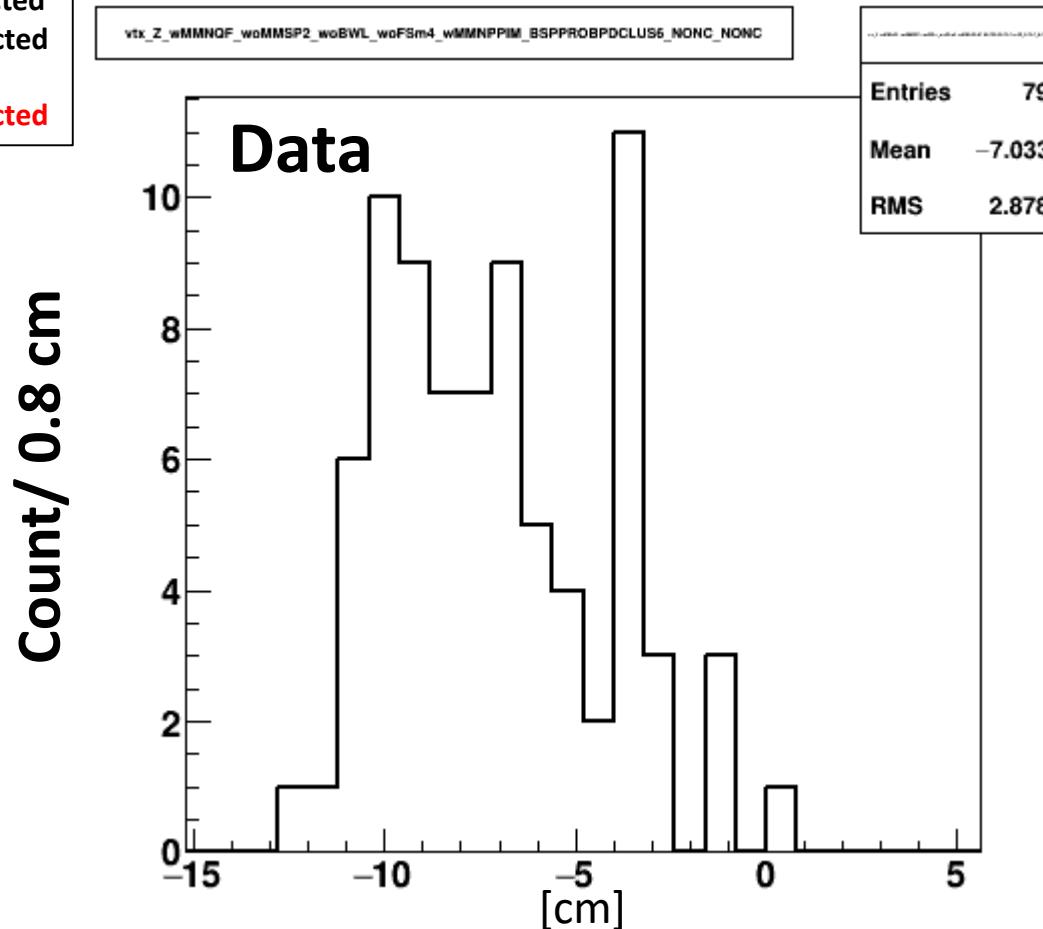


Vertex Z of BPC track & π^- CDS Track



Vertex Z of BPC track & π^- CDS Track

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K, n\pi^-)$
- $d(K, n)$ **1.43~1.50 selected**

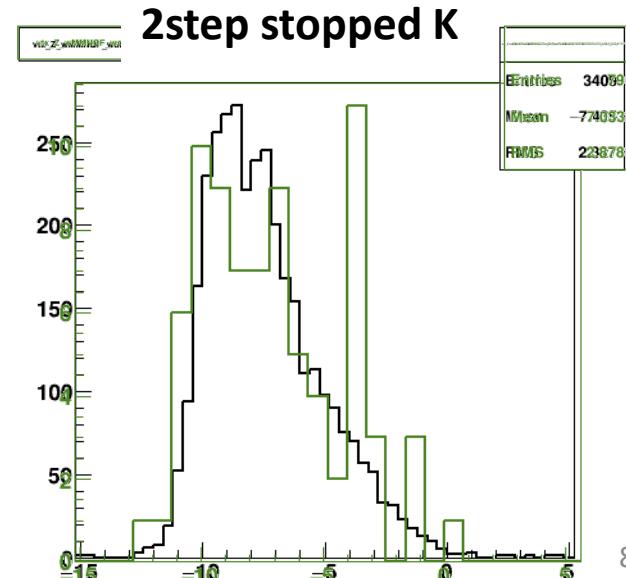
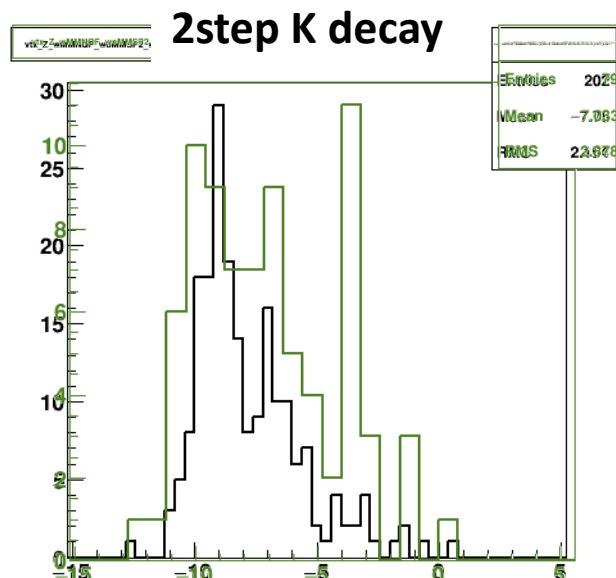
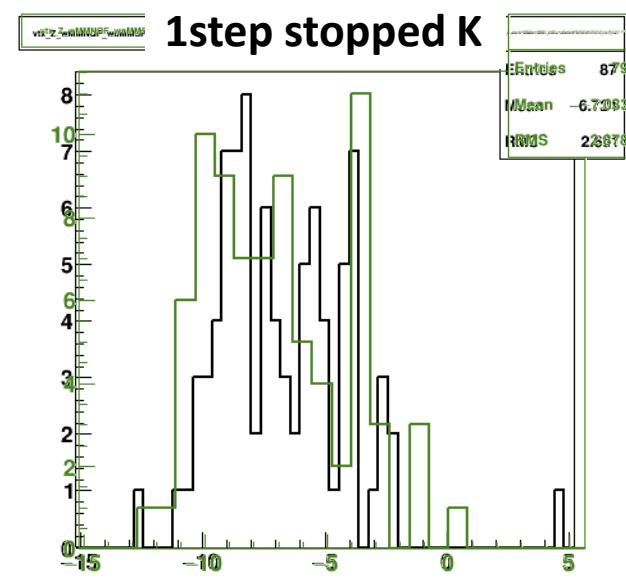
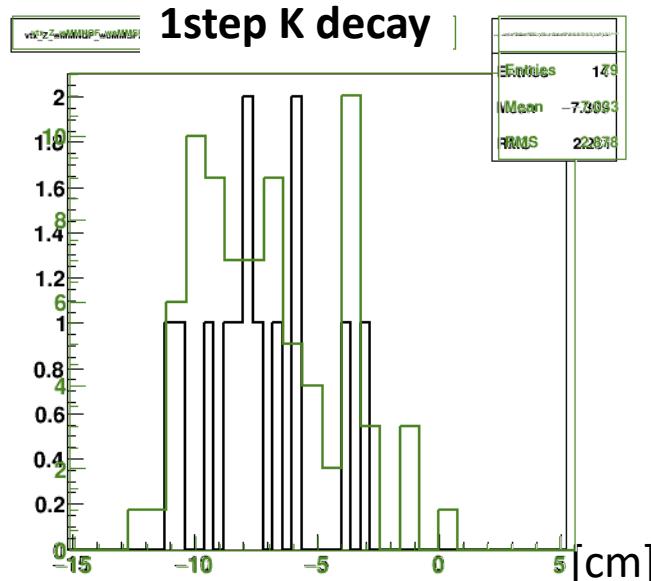


Distribution seems like **2step stopped K one**

Overlap with Data

Vertex Z of BPC track & π^- CDS Track

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

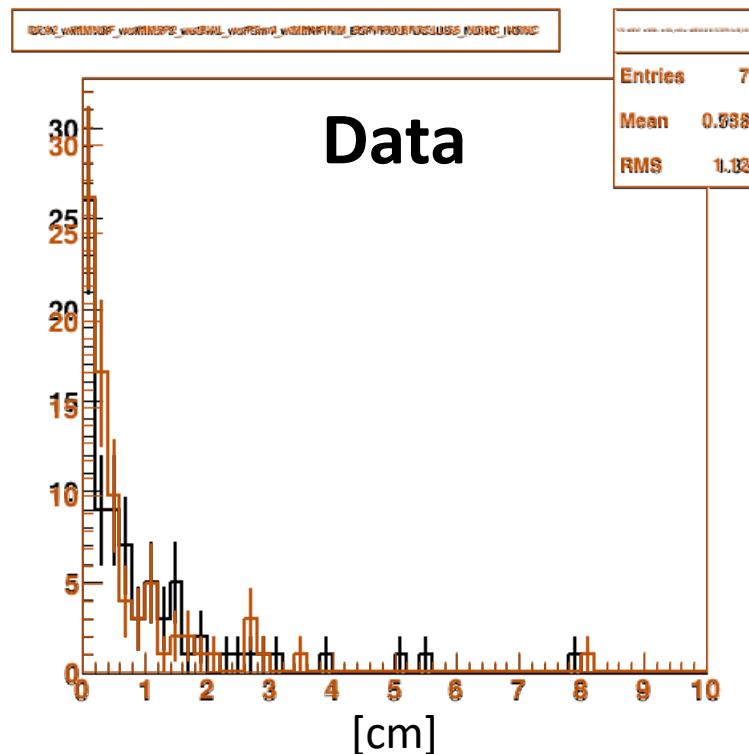


DCA of BPC track & π^- CDS Track

Beam
Backward

BG QF event

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**

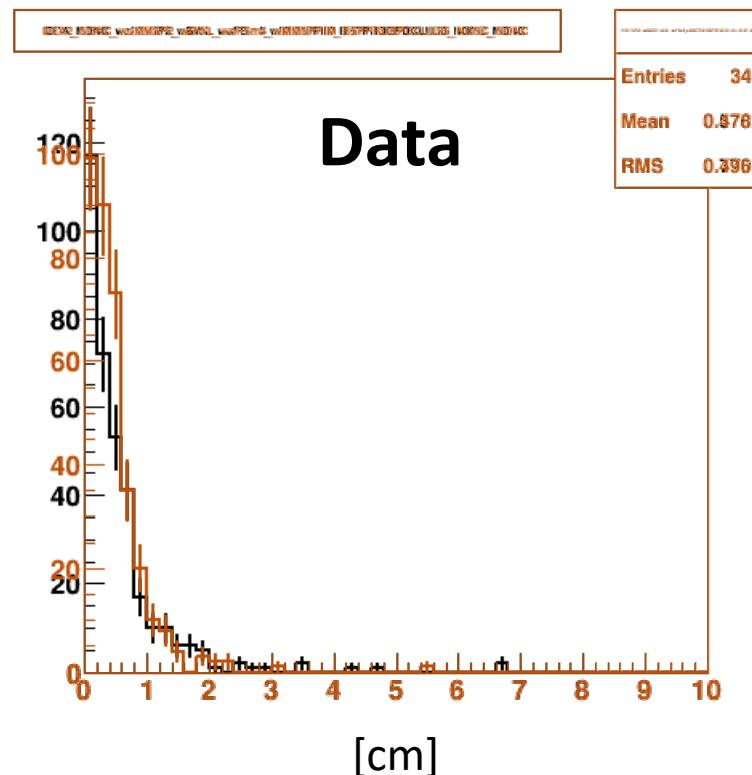


DCA of BPC track & π^- CDS Track

Beam
Backward

Λ event

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) selected
- $0 < d(K^-, n\pi^-)$



To do

- Acceptance estimation of $K-d \rightarrow \Sigma^0\pi^0$ (update)
 - Selection of NC hit segment
 - Proton momentum w/ vertex iteration
- SIM of K-decay before Stopped K
- Vertex of BG QF region (data)
- Acceptance estimation of K- re-scatter reaction

Re-analysis 9

- Difference from Re-analysis 8
 - Selection of NC hit segment
 - Proton momentum w/ vertex iteration
 - BG estimation by $K^- d \rightarrow p \gamma \pi^-$ & K scatter reaction

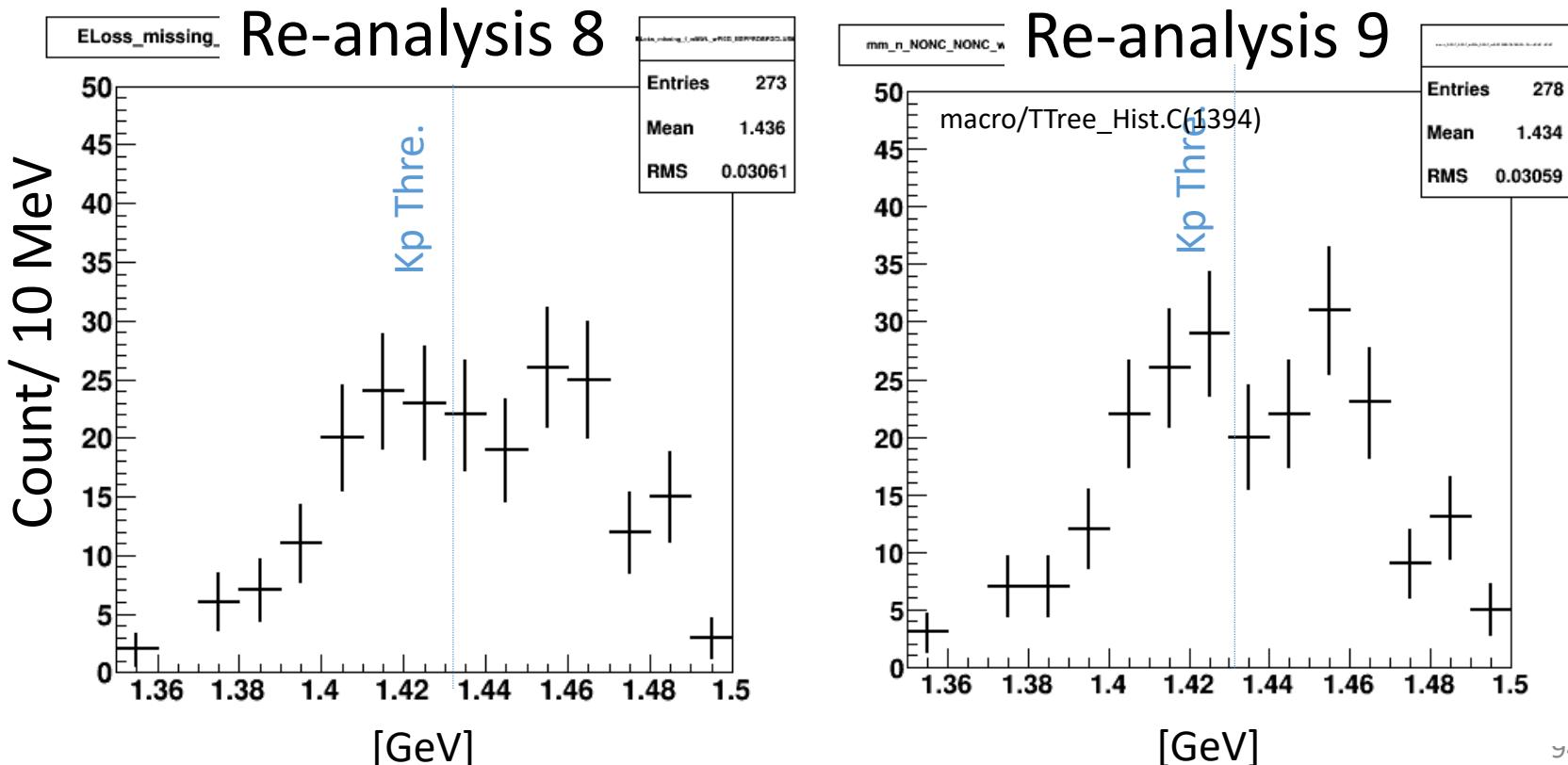
$d(K^-, n)\Lambda\bar{\Lambda} \pi^0$ missing mass

Λ selection from p, π - invariant mass

$d(K^-, n\Lambda)\Lambda\bar{\Lambda} X$ $0.18 < X < 0.30$ GeV

w/o subtraction of BG in Λ

w/o subtraction $\Lambda\pi^0$ contribution



Re-analysis 9

$d(K_-, n)\Lambda\bar{\Sigma}^0\pi^0$ missing mass

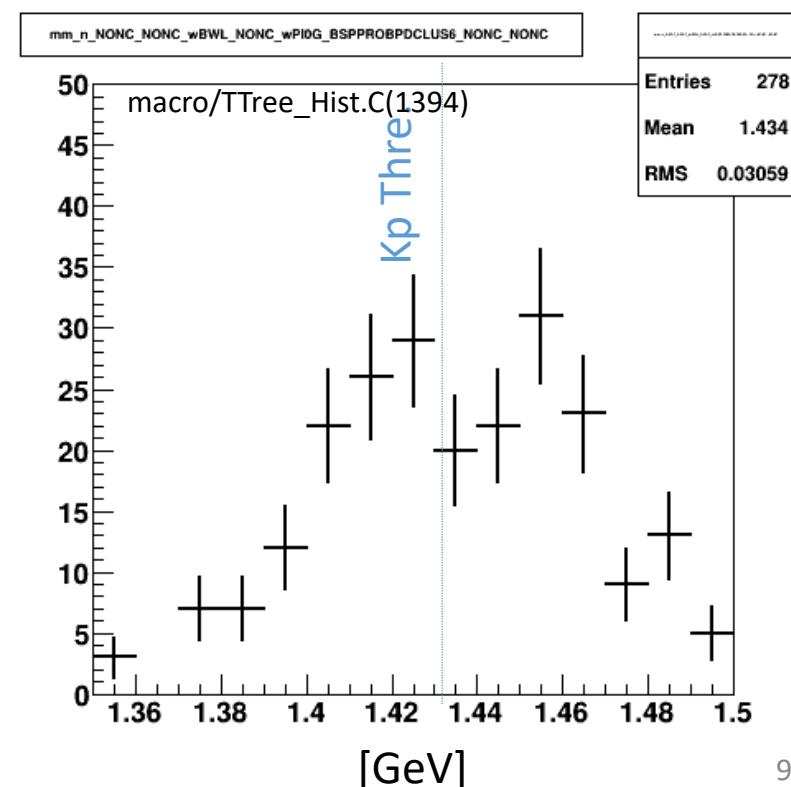
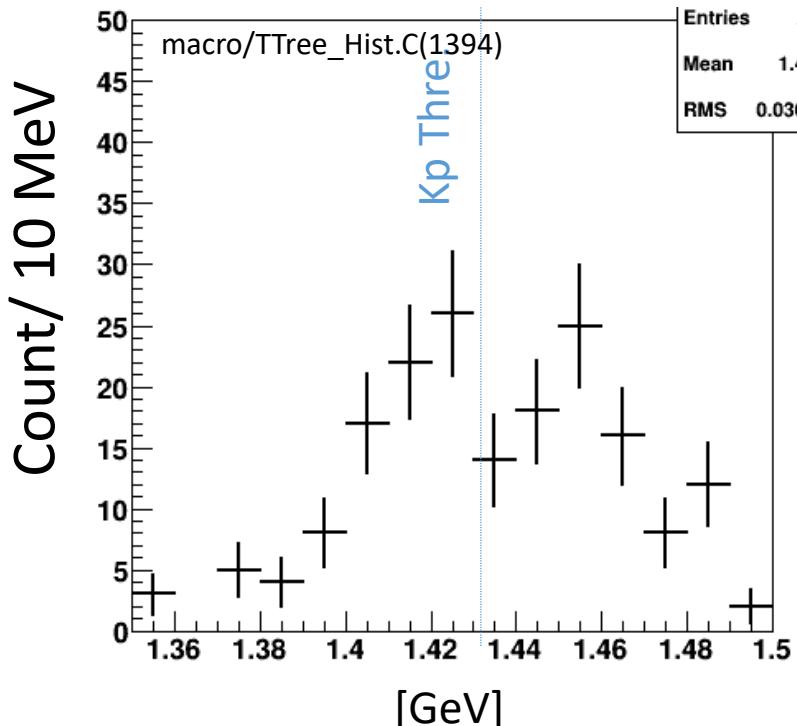
Λ selection from p, π - invariant mass

$d(K_-, n\Lambda)X$ $0.18 < X < 0.30$ GeV

w/o subtraction of BG in Λ

w/o subtraction $\Lambda\pi^0$ contribution

$+\Sigma^-$ from IM.(n, π^-) rejected

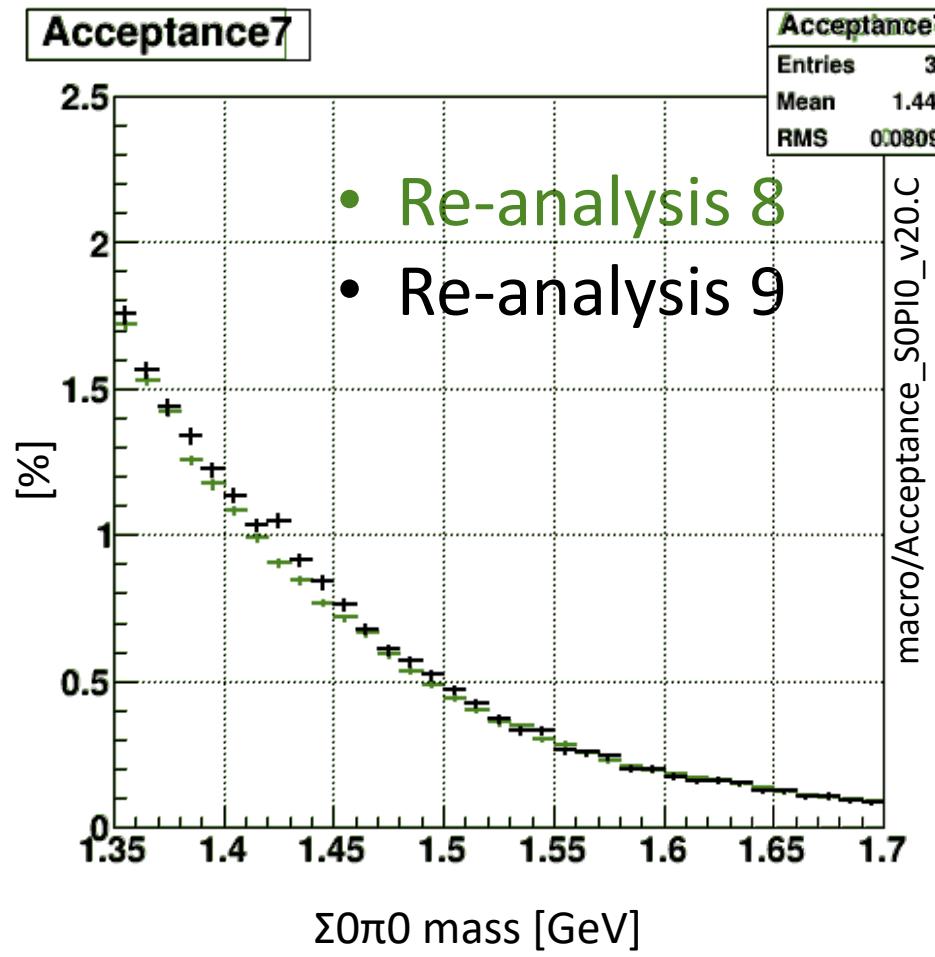


Acceptance estimation

- Sample ;
 - dE (NC) > 8 MeV –at least 1 segment
 - First neutron is through NC
 - Upstream condition (T_0 multi =1, Beam track defining..)
 - BVC, CVC veto in sample



- Accept event
 - p, π - invariant mass Λ selection
 - $d(K, n\Lambda)/X \quad 0.18 < X < 0.30 \text{ GeV}$



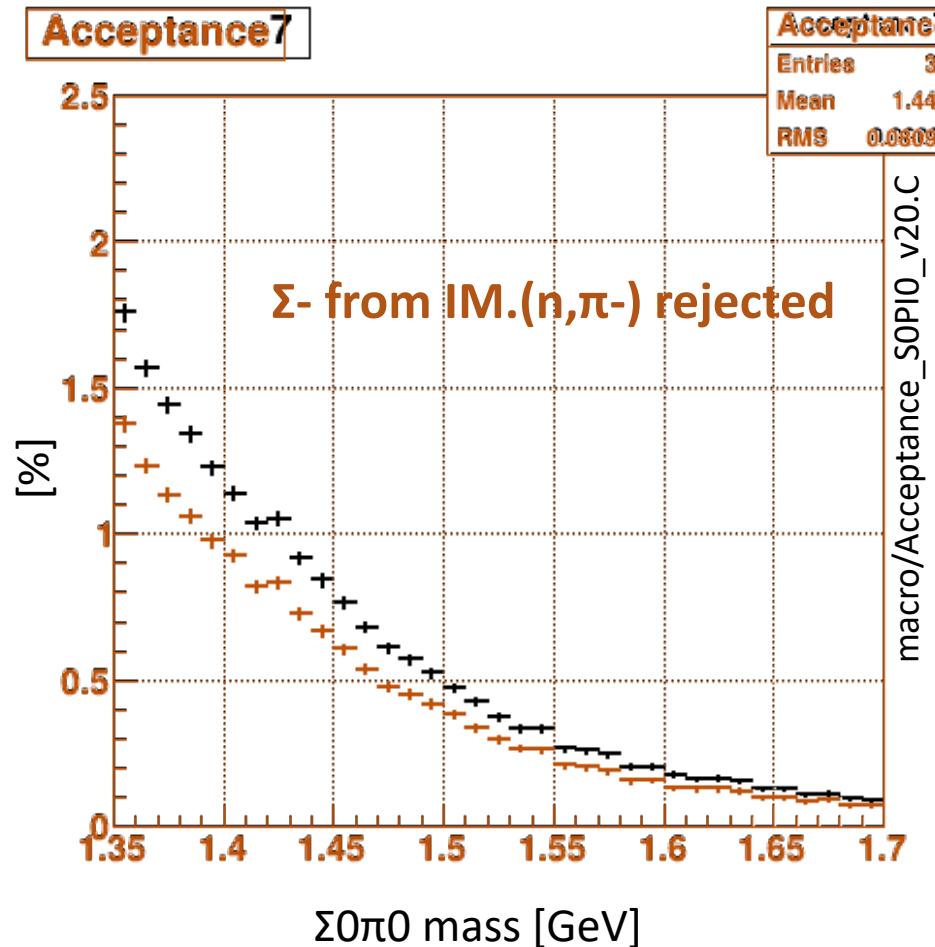
Hardly changed

Acceptance estimation

- Sample ;
 - dE (NC) > 8 MeV –at least 1 segment
 - First neutron is through NC
 - Upstream condition (T_0 multi =1, Beam track defining..)
 - BVC, CVC veto in sample



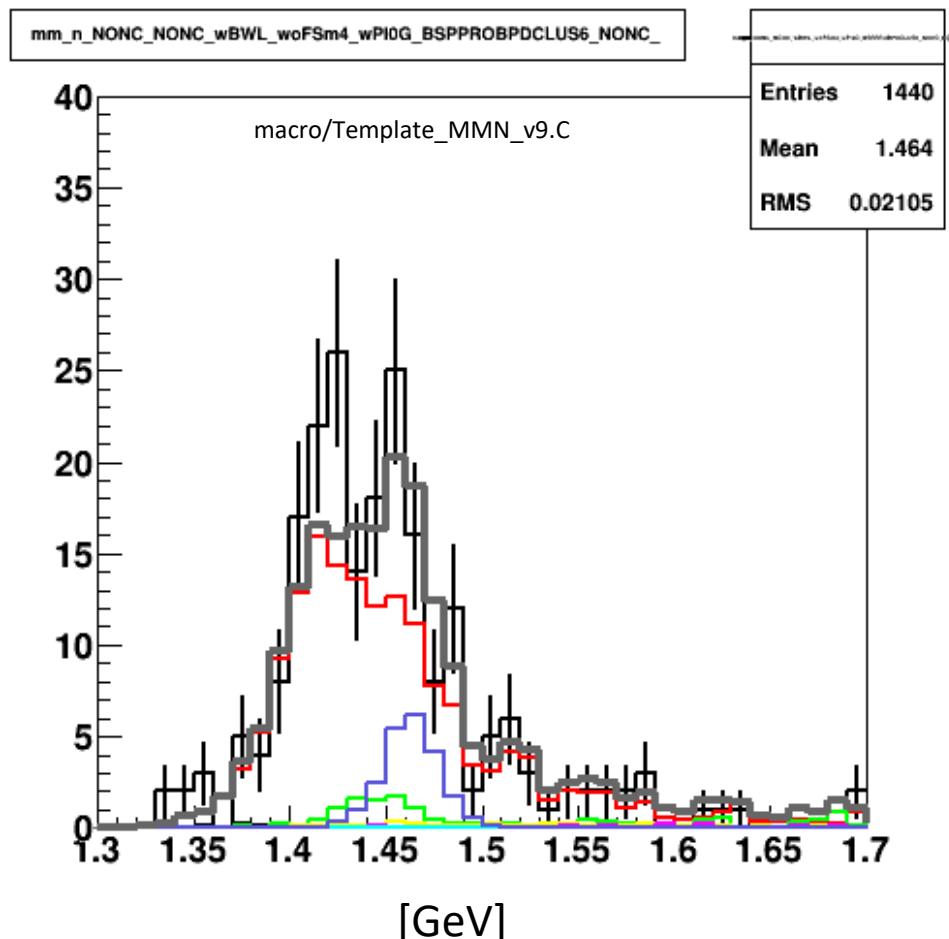
- Accept event
 - p, π - invariant mass Λ selection
 - $d(K^-, n\Lambda)^+ X^-$ $0.18 < X < 0.30$ GeV
 - **Σ - from IM.(n,π-) rejected**



- Lumi ; 8083 ± 160 [/ μ b]
 - Scaler Kaon 58.3 G
 - Survival ratio 0.314 ± 0.000350
 - DAQ eff 0.7708 ± 0.0000128
 - Trig. KCDH1 0.9527 ± 0.0003
 - Trig. Neutral 0.9999 ± 0.0000067
- $\Omega\text{-nc}$; $0.0214832 \pm 0.000207563$ [sr]
- $\varepsilon\text{-nc}$; 0.291 ± 0.015
- $\varepsilon\text{-bpc}$; 0.999 ± 0.000
- $\varepsilon\text{-cdc}$; 0.977 ± 0.004
- Acc ; simulation (including BR ($\Sigma 0 \pi 0 \rightarrow p\pi - \gamma\pi 0$; 0.639))

- Σ - from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$



† Data

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

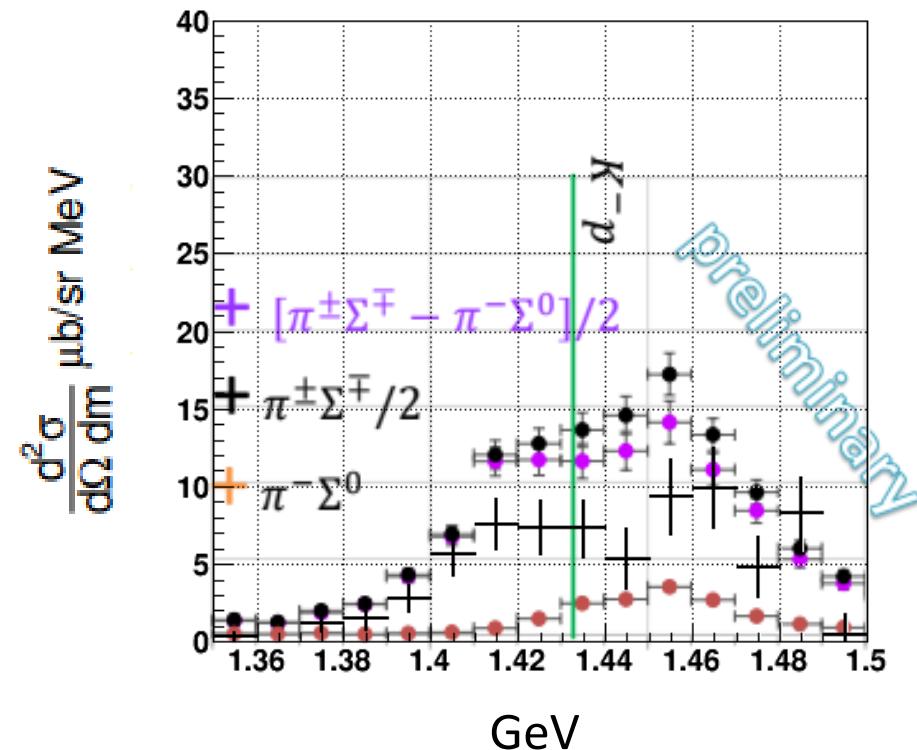
- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K

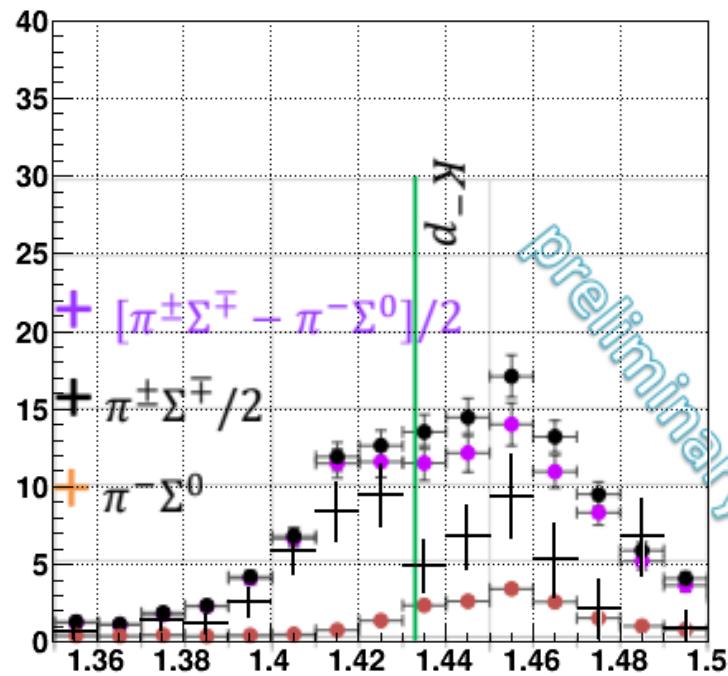
Cross section

- Subtraction
 - 2step Stopped K
 - $K-d \rightarrow n \wedge \pi 0$

Re-analysis 8



Re-analysis 9



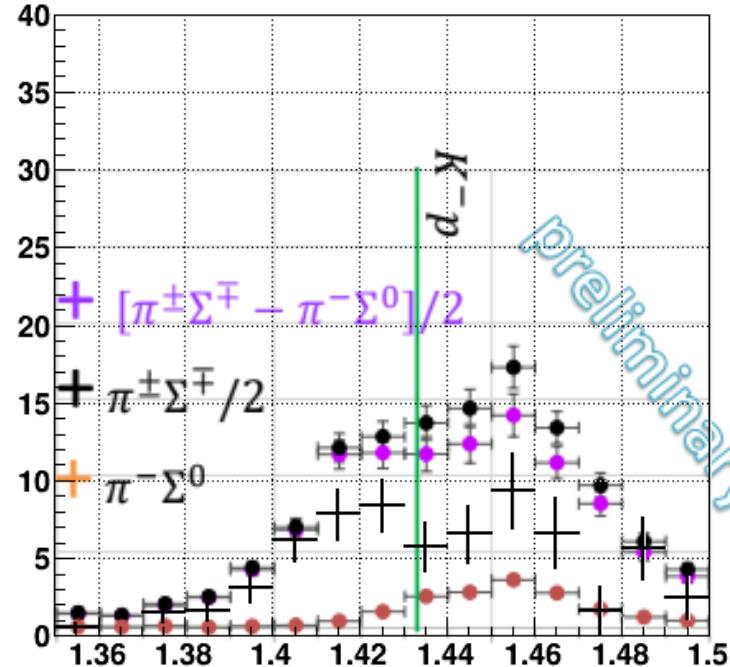
macro/CrossSection_SOP10_v27.C

Cross section

- Subtraction
 - 2step Stopped K
 - $K-d \rightarrow n \wedge \pi 0$

w/o Σ^- rejection

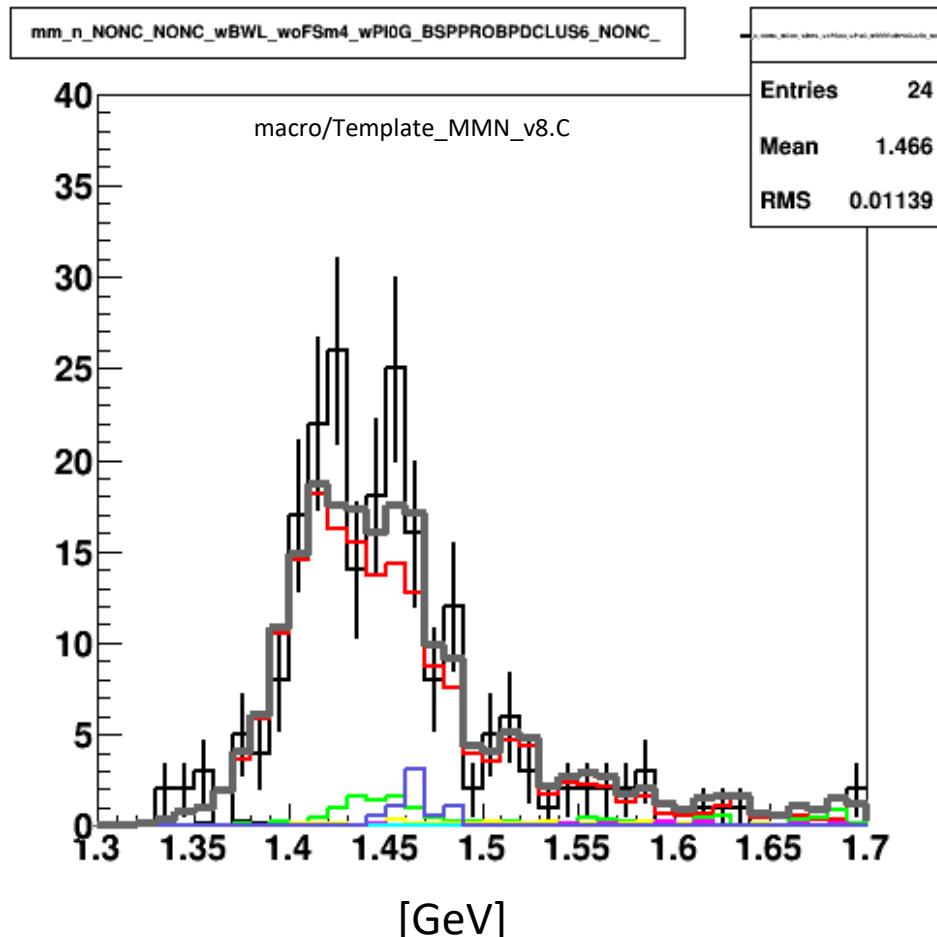
Re-analysis 9



macro/CrossSection_SOP10_v29.C

- Σ - from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.18 < d(K^-, n p \pi^-) < 0.30$

MM. $d(K^-, n)$



† Data

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

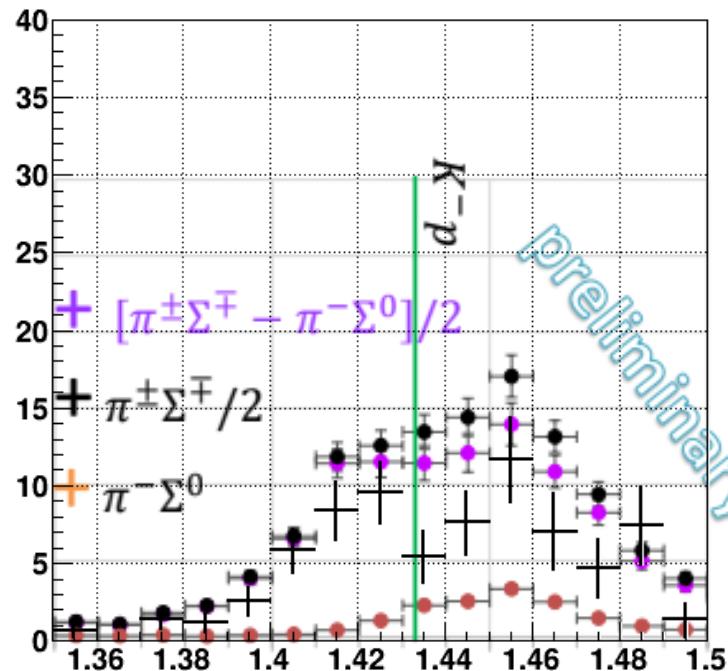
- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step K-decay

Cross section

- Subtraction
 - 2step K- decay
 - K-d \rightarrow n Λ π^0

Re-analysis 9



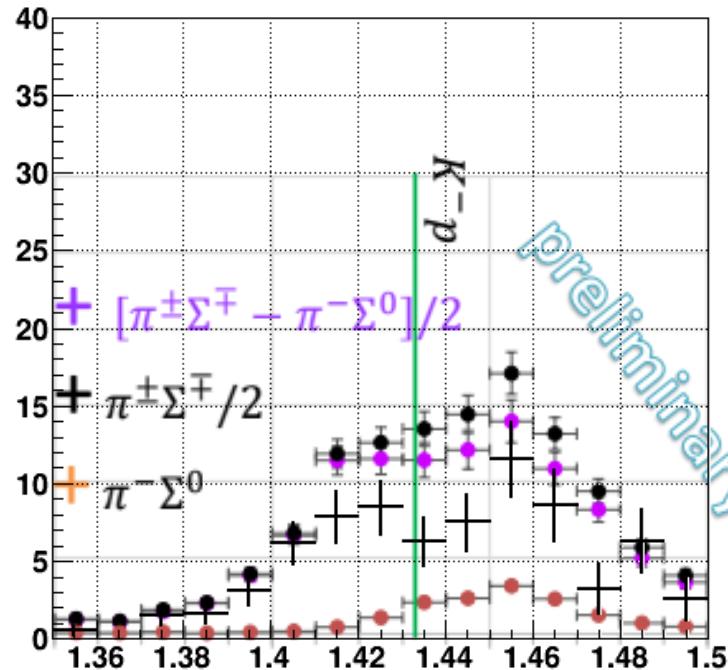
macro/CrossSection_SOP10_v28.C

Cross section

w/o Σ - rejection

- Subtraction
 - 2step K- decay
 - K-d \rightarrow n Λ π^0

Re-analysis 9

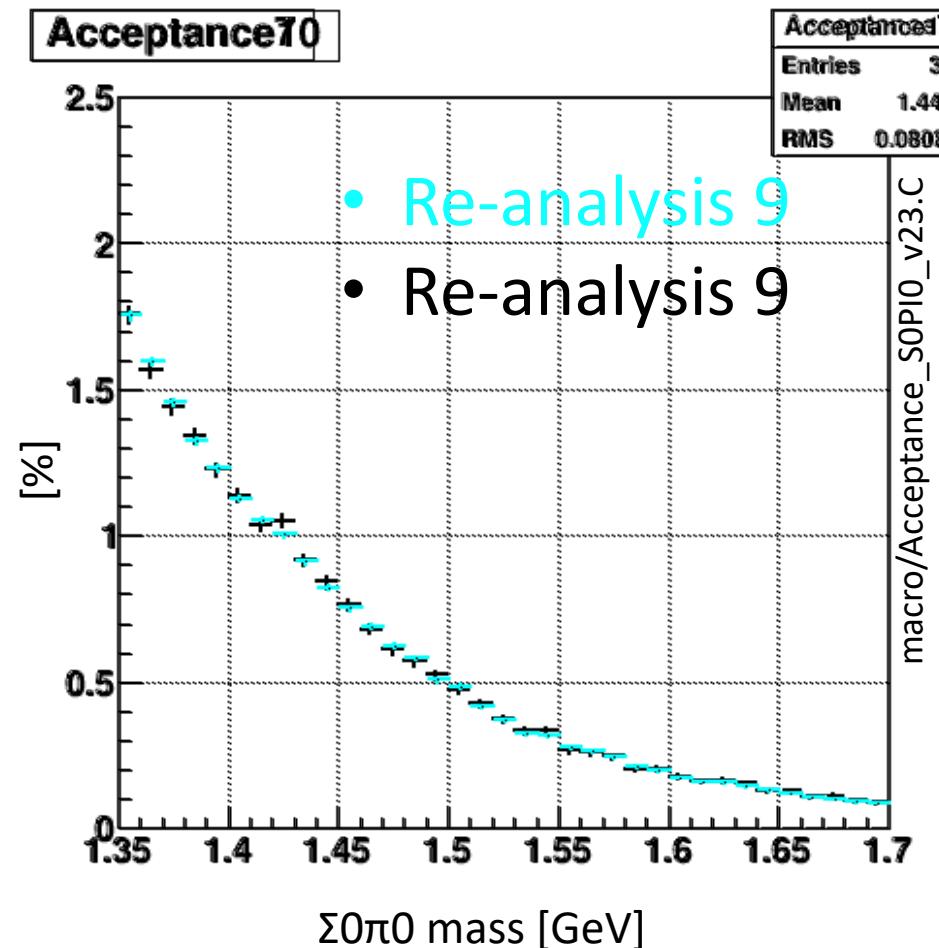


macro/CrossSection_SOPI0_v30.C

Re-analysis 9 sim data is 4 times as P.94

Acceptance estimation

- Sample ;
 - dE (NC) > 8 MeV –at least 1 segment
 - First neutron is through NC
 - Upstream condition (T_0 multi =1, Beam track defining..)
 - BVC, CVC veto in sample



The dump structure around 1.43 GeV has disappeared

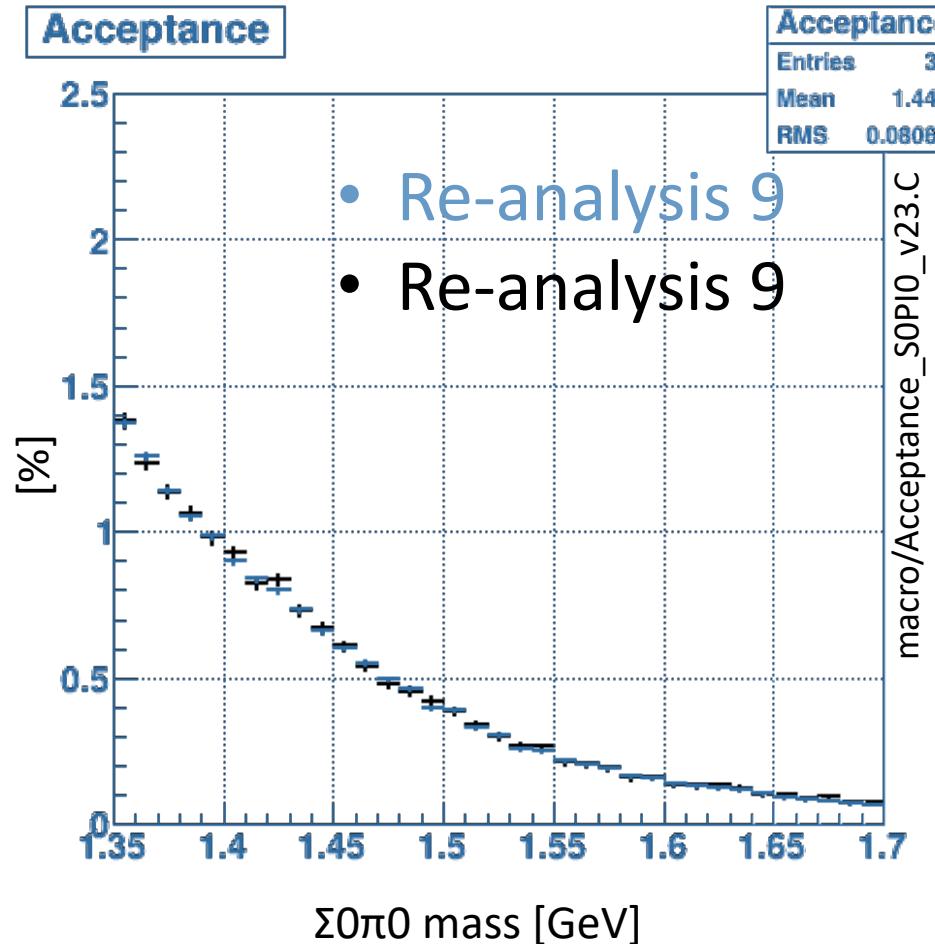
Re-analysis 9 sim data is 4 times as P.94

Acceptance estimation

- Sample ;
 - dE (NC) > 8 MeV –at least 1 segment
 - First neutron is through NC
 - Upstream condition (T_0 multi =1, Beam track defining..)
 - BVC, CVC veto in sample



- Accept event
 - p, π - invariant mass Λ selection
 - $d(K^-, n\Lambda)/X' 0.18 < X < 0.30$ GeV
 - Σ - from IM.(n, π) rejected



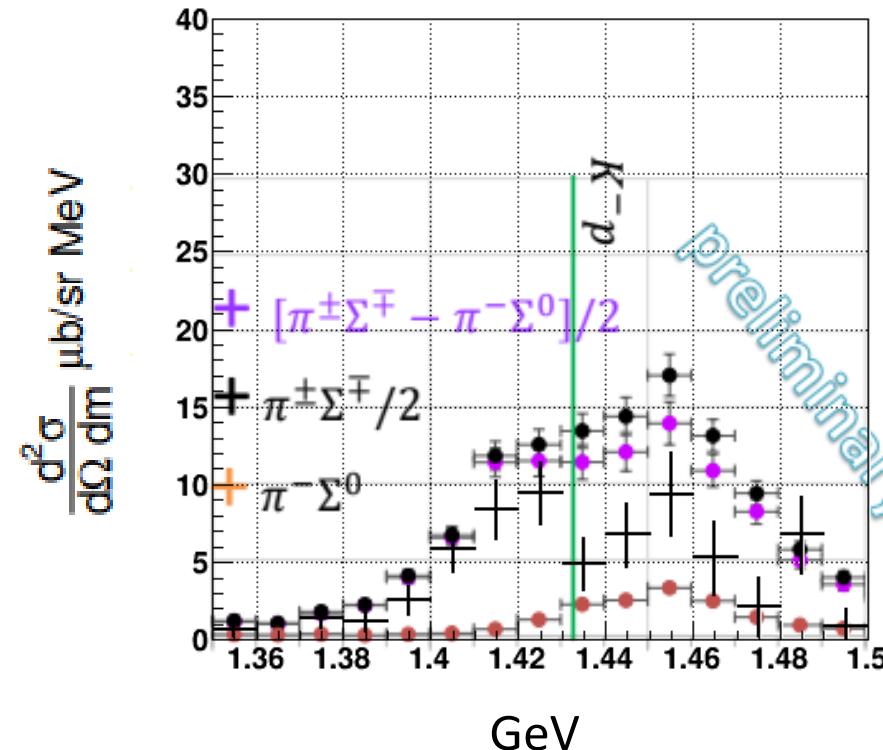
The dump structure around 1.43 GeV has disappeared

Re-analysis 9 sim data is 4 times as P.94

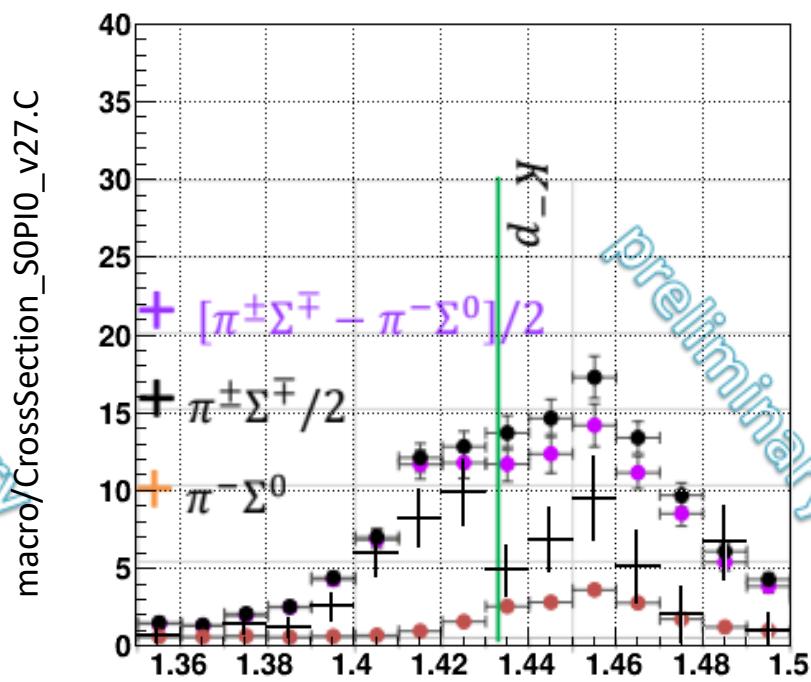
Cross section

- Subtraction
 - 2step Stopped K
 - $K-d \rightarrow n \Lambda \pi^0$

Re-analysis 9



Re-analysis 9



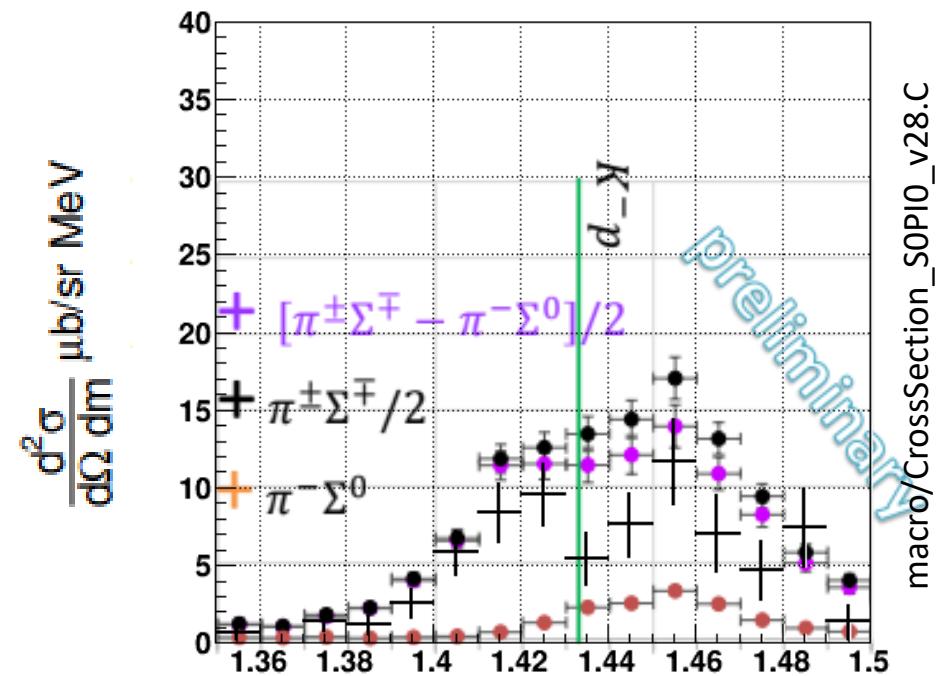
macro/CrossSection_SOPI0_v31.C

Re-analysis 9 sim data is 4 times as P.94

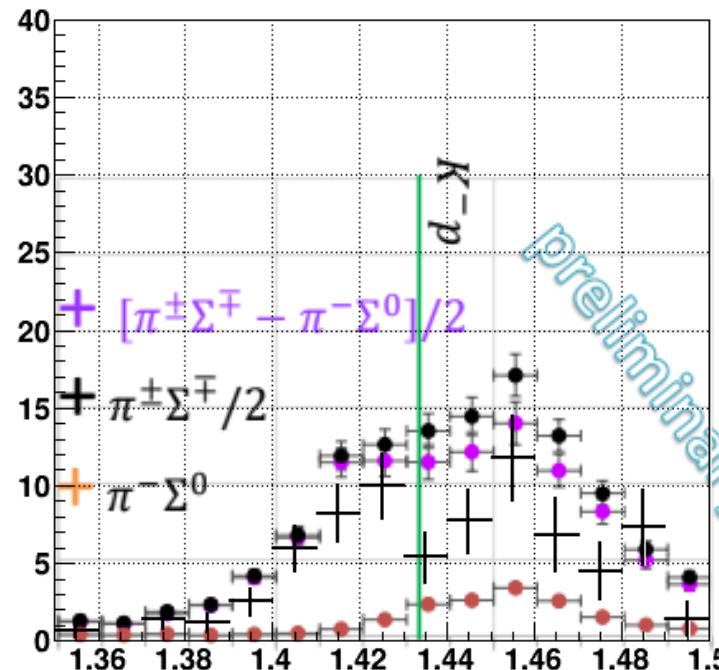
Cross section

- Subtraction
 - 2step K- decay
 - K-d \rightarrow n Λ π^0

Re-analysis 9



Re-analysis 9



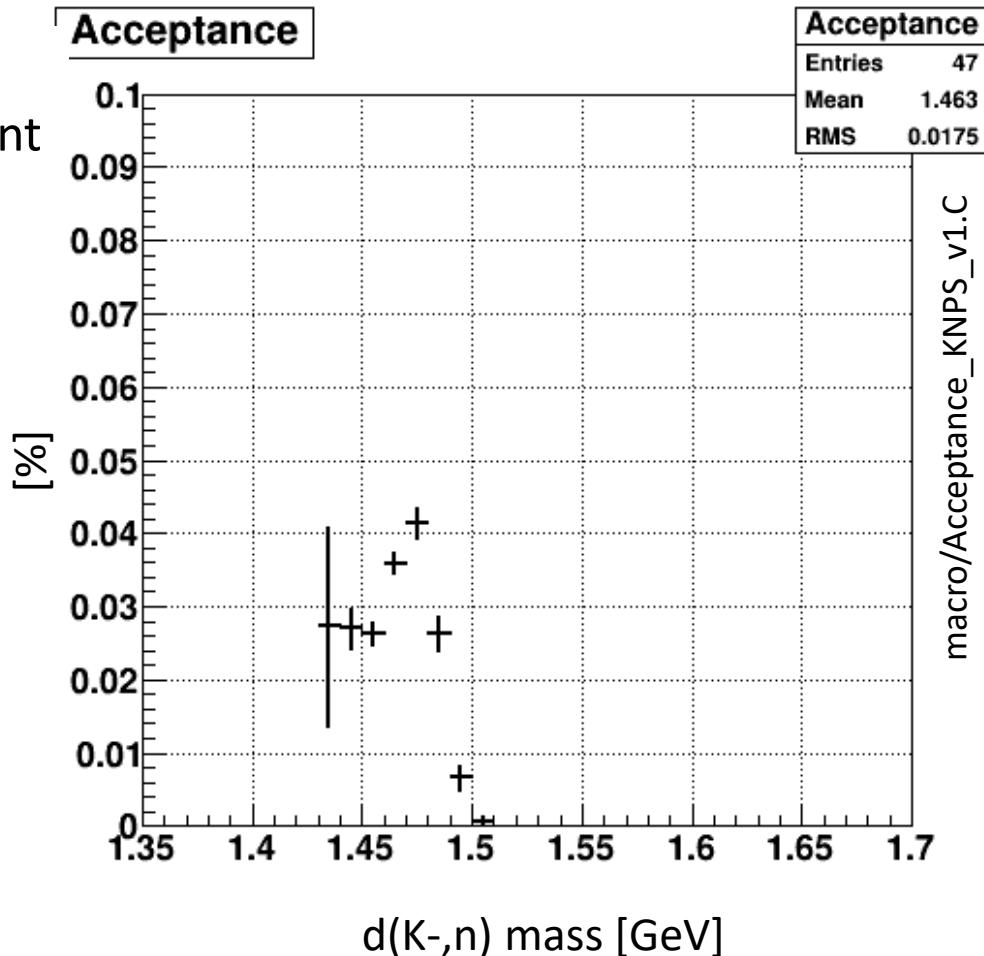
Acceptance estimation

- 2step Stopped K

- Sample ;
 - $dE(\text{NC}) > 8 \text{ MeV}$ –at least 1 segment
 - First neutron is through NC
 - Upstream condition ($T_0 \text{ multi} = 1$, Beam track defining..)
 - BVC, CVC veto in sample

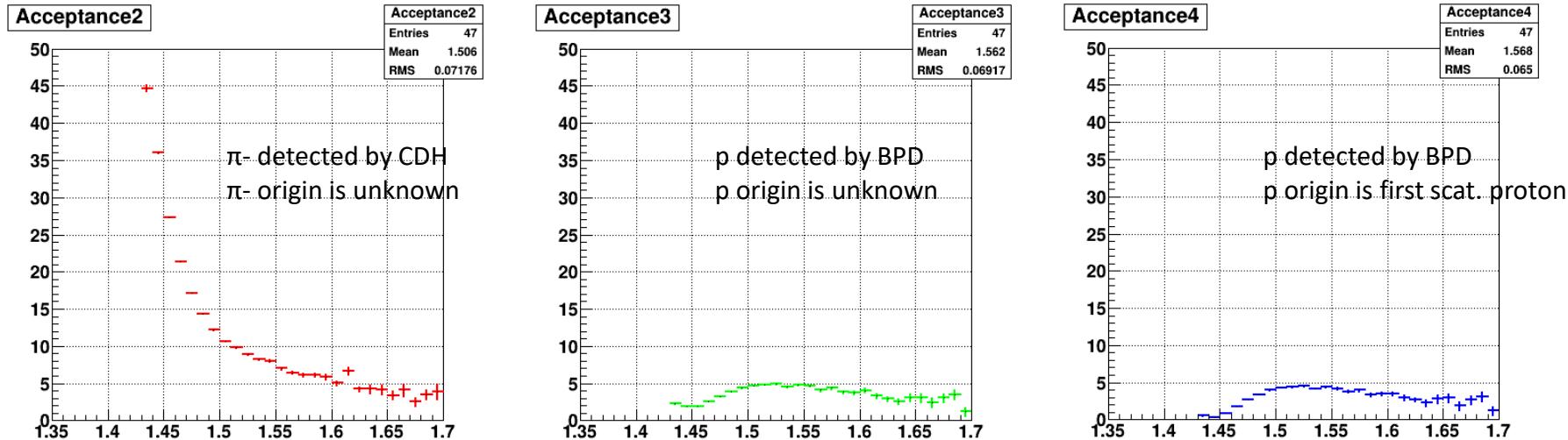


- Accept event
 - p, π - invariant mass Λ selection
 - $d(K^-, n\Lambda)''X''$ $0.18 < X < 0.30 \text{ GeV}$
 - Σ - from IM.(n, π) rejected

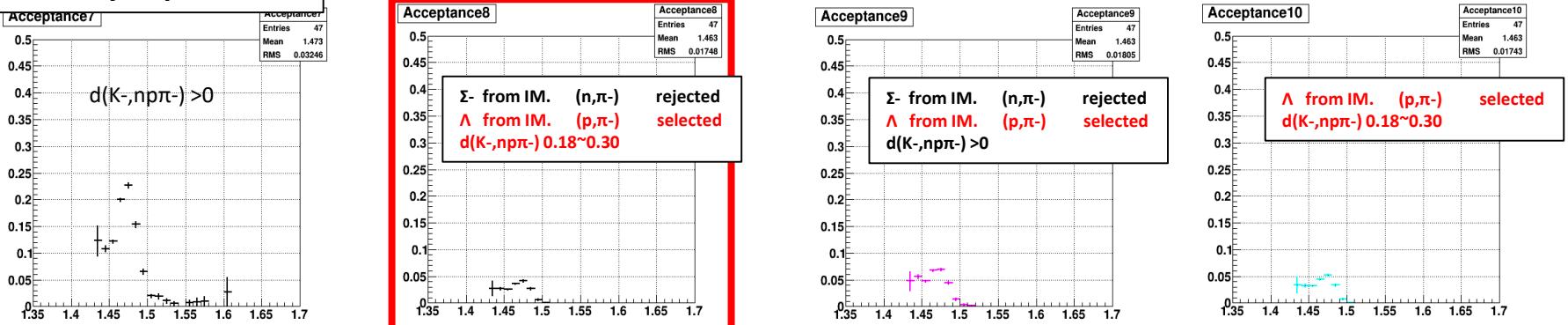


Acceptance estimation

- 2step Stopped K



- After $p\pi^-, n$ analysis procedure



$d(K^-, n)$ mass [GeV]

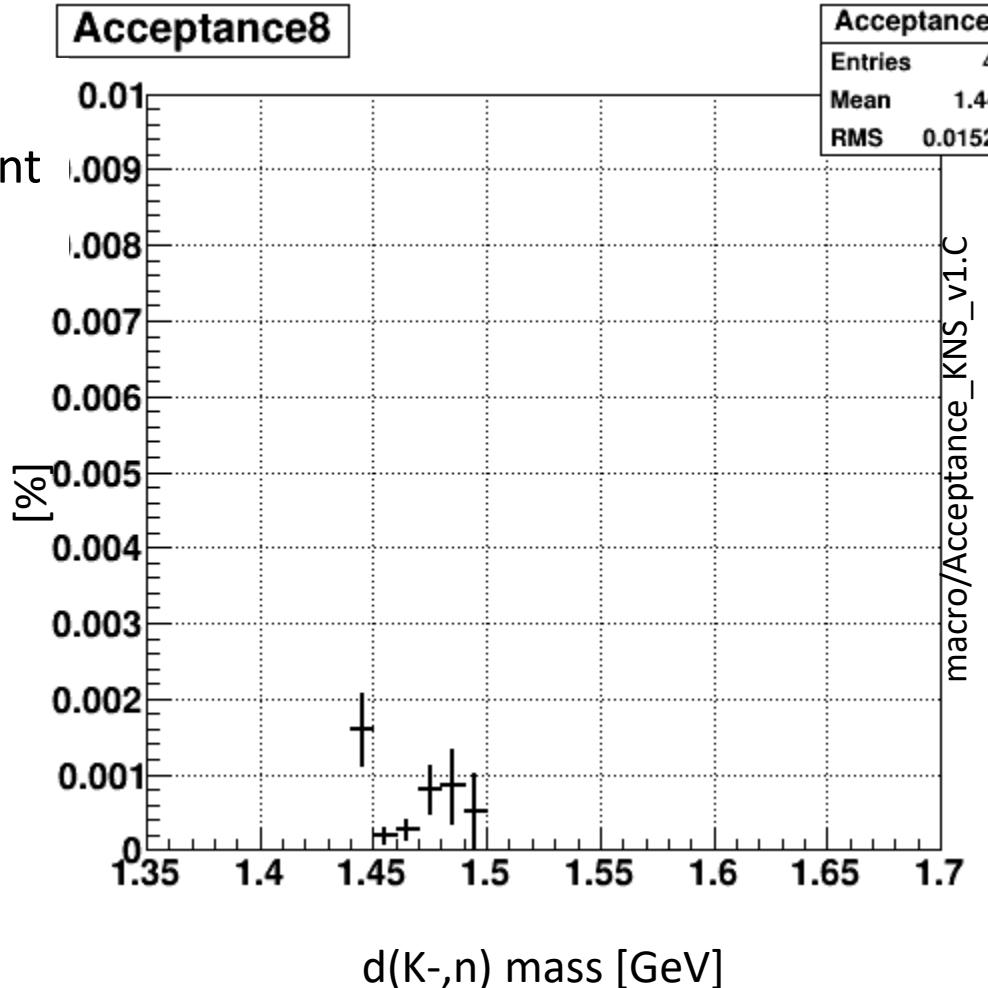
Acceptance estimation

- **1step Stopped K**

- Sample ;
 - $dE(\text{NC}) > 8 \text{ MeV}$ –at least 1 segment
 - First neutron is through NC
 - Upstream condition ($T_0 \text{ multi} = 1$, Beam track defining..)
 - BVC, CVC veto in sample

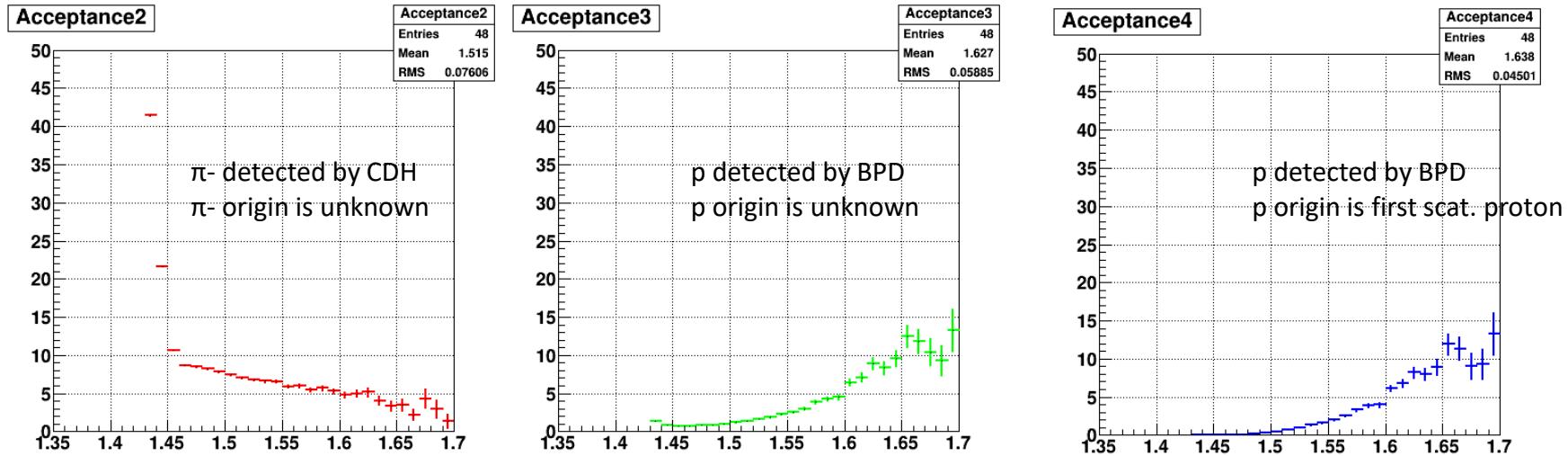


- Accept event
 - p, π - invariant mass Λ selection
 - $d(K^-, n\Lambda)''X''$ $0.18 < X < 0.30 \text{ GeV}$
 - Σ - from IM.(n, π) rejected

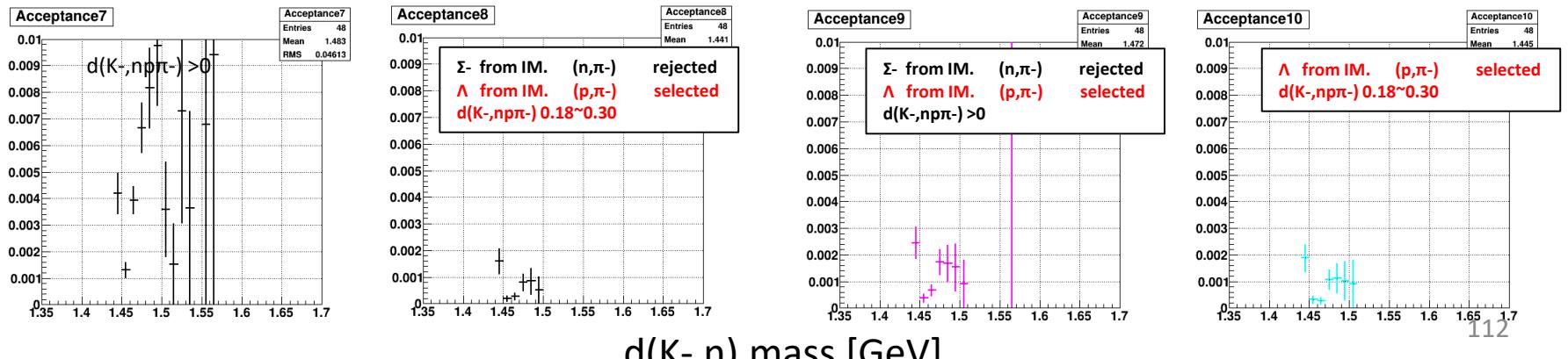


Acceptance estimation

- 1step Stopped K

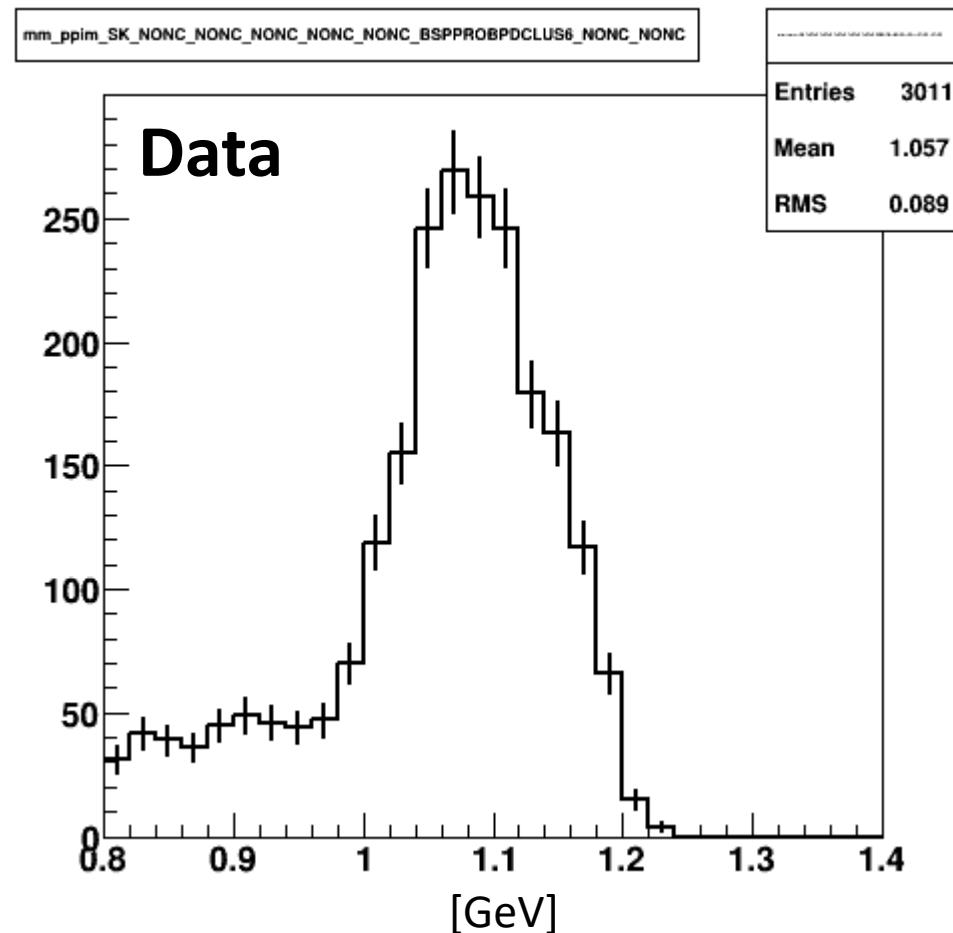


- After $p\pi^-, n$ analysis procedure



MM. $d(K^-_{\text{stopped}}, p\pi^-)$

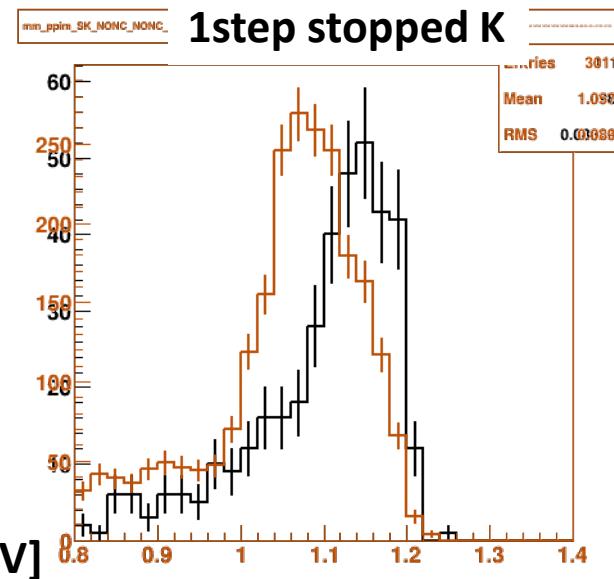
- After $p\pi^-, n$ analysis procedure



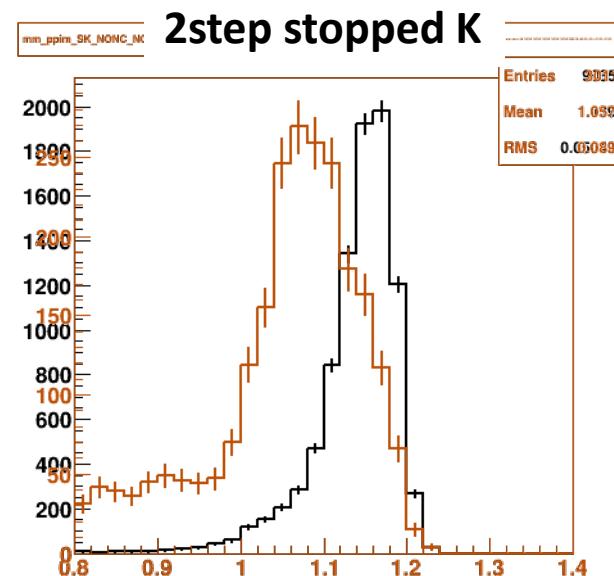
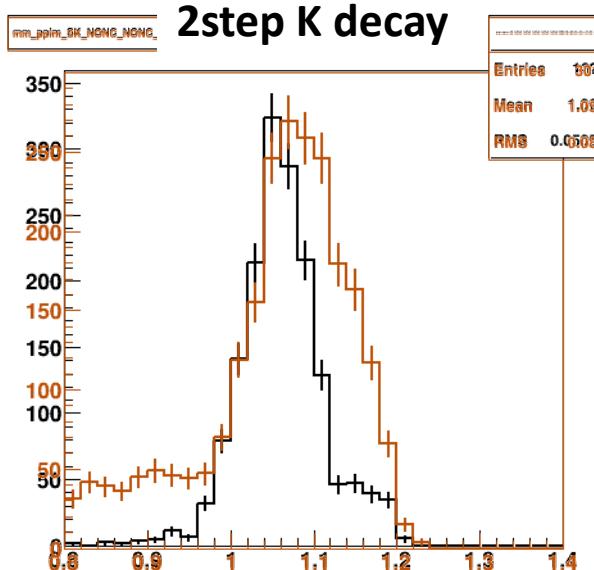
MM. $d(K_{\text{stopped}}, p\pi^-)$

1step K decay

- After $p\pi^-, n$ analysis procedure

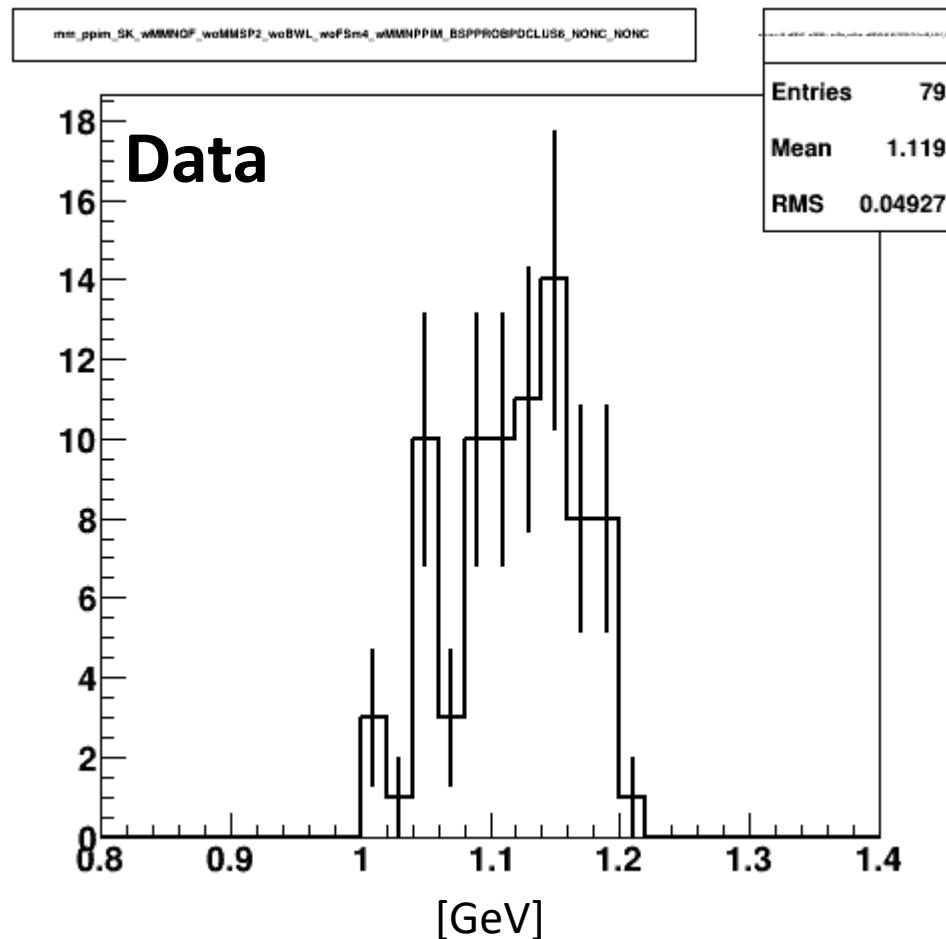


2step K decay



MM. $d(K_-, \text{stopped}, p\pi^-)$

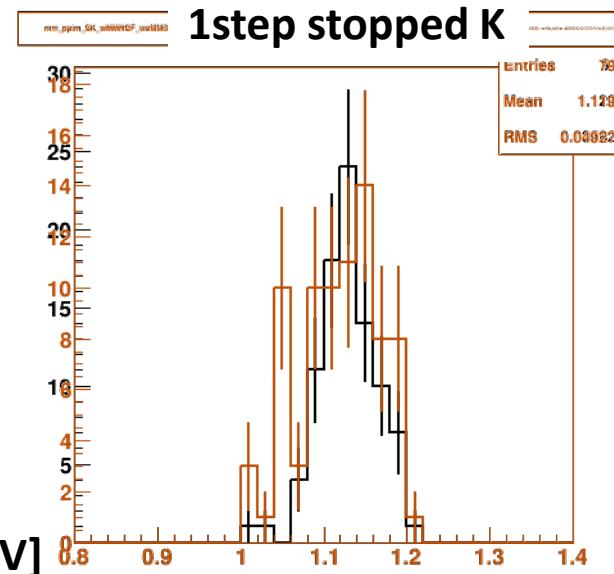
- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K_-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K_-, n\pi^-)$
- $d(K_-, n)$ **1.43~1.50 selected**



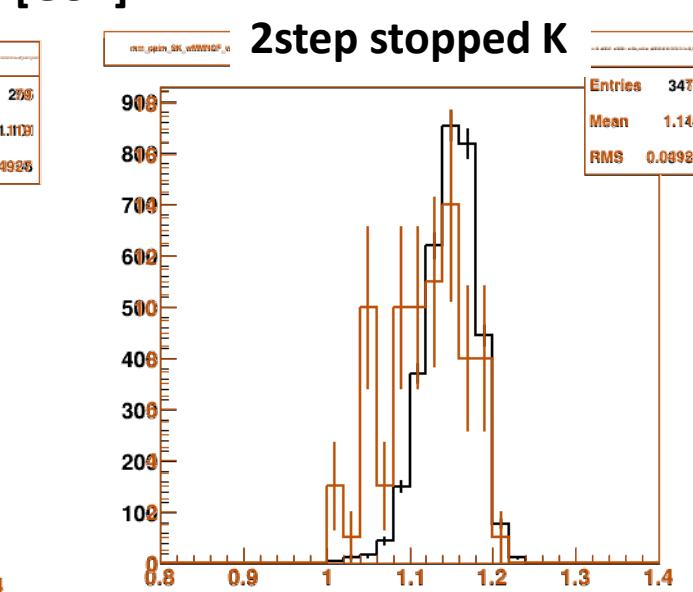
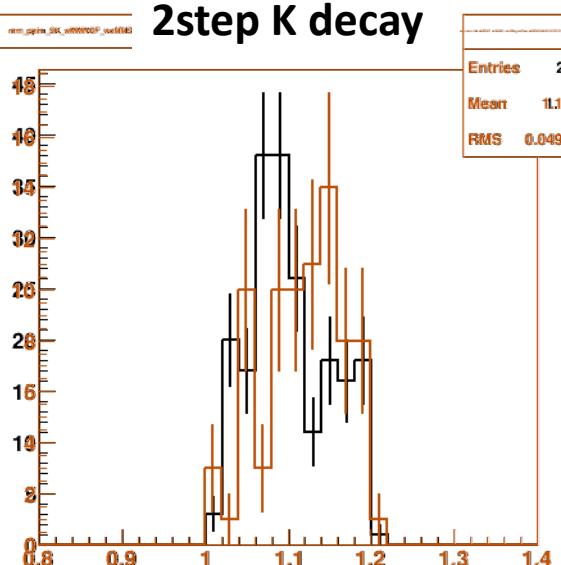
MM. $d(K^-_{\text{stopped}}, p\pi^-)$

1step K decay

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^+)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 selected**



2step K decay

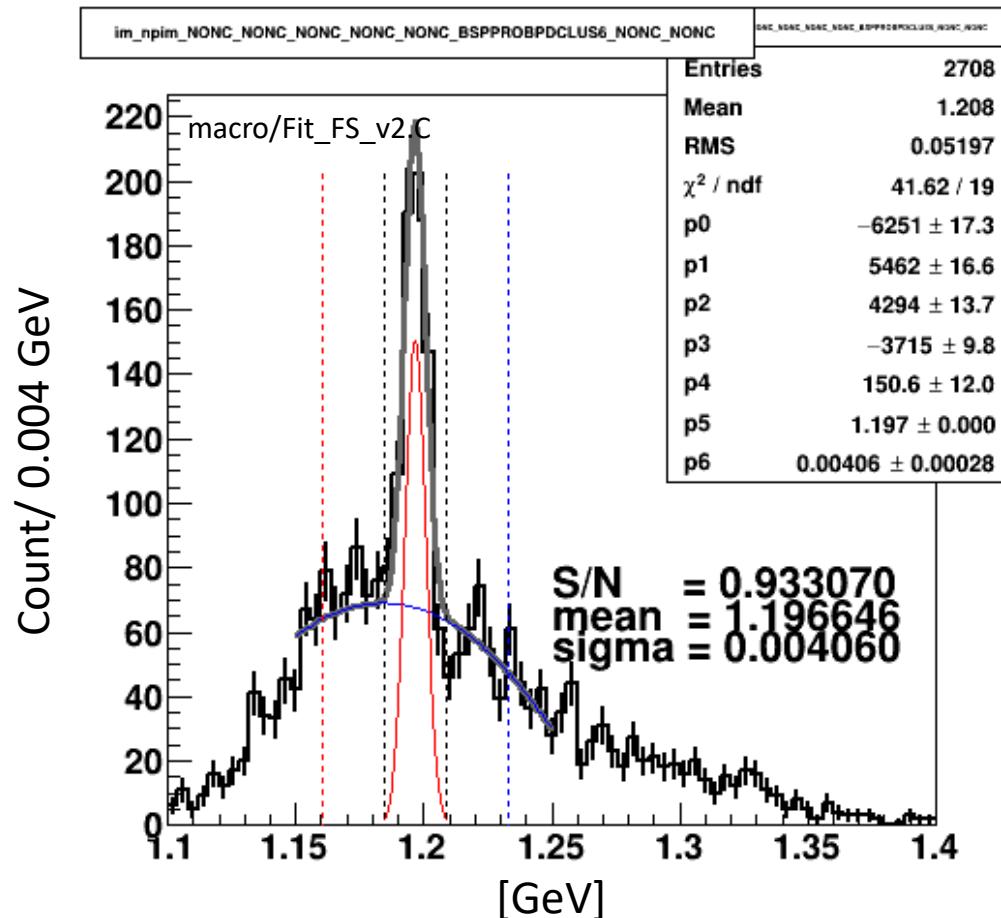


Re-analysis 3 ($d(K^-, n)^{\prime\prime}\Sigma^+\pi^-$)

Difference from Page 458 (Re-analysis 2)

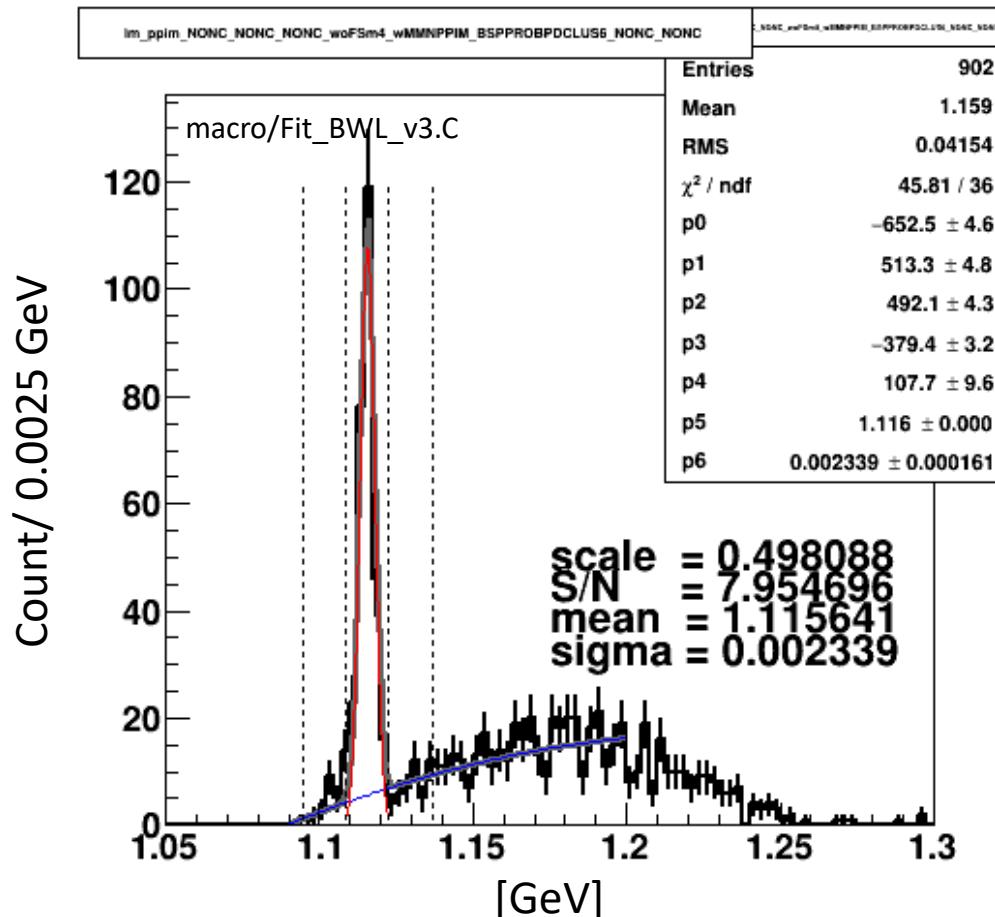
- Same condition as $d(K^-, n)^{\prime\prime}\Sigma^0\pi^0$ Re-analysis 9
 - Analysis procedure -> $\Sigma^+\pi^-$ mode
 - Fiducial -> tight

IM.(n, π^-)



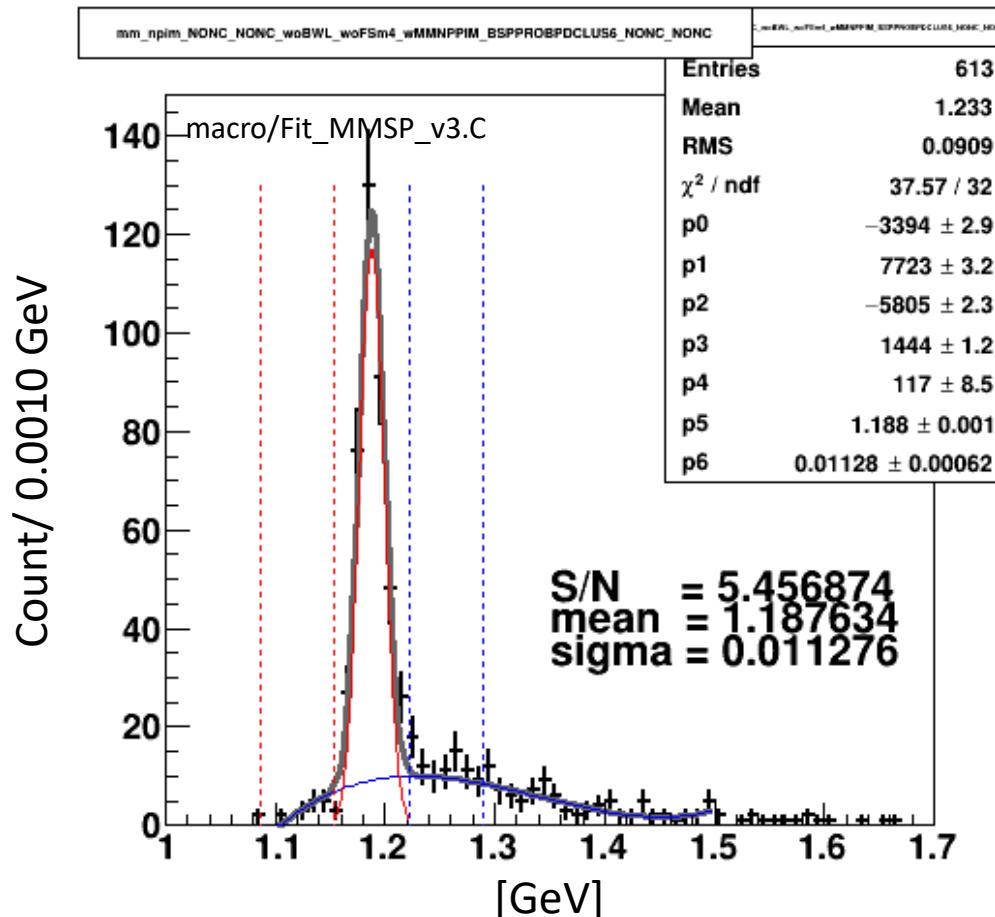
IM.(p, π^-)

- $0 < d(K, \eta\pi^-)$
- Σ^- from IM. (n, π^-) rejected



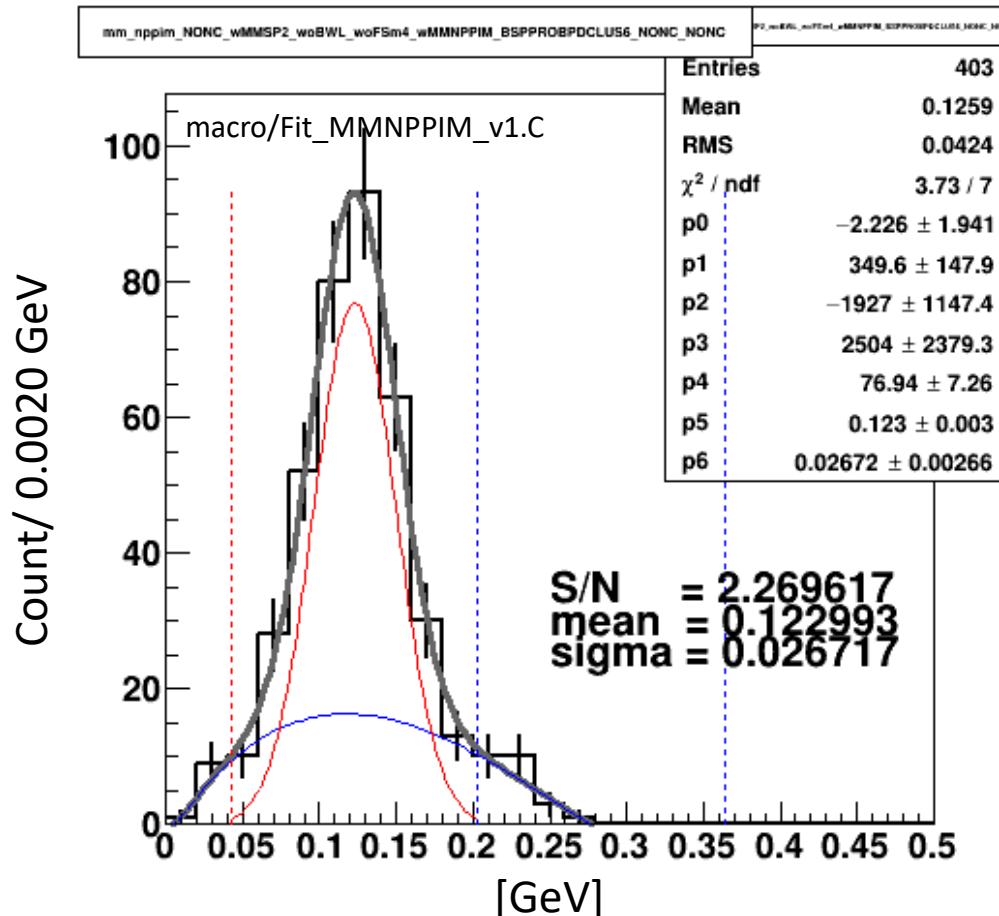
MM.d(K-,nπ-)

- $0 < d(K^-, n\pi^-)$
- Σ^- from IM. (n, π^-) rejected
- Λ from IM. (p, π^-) rejected



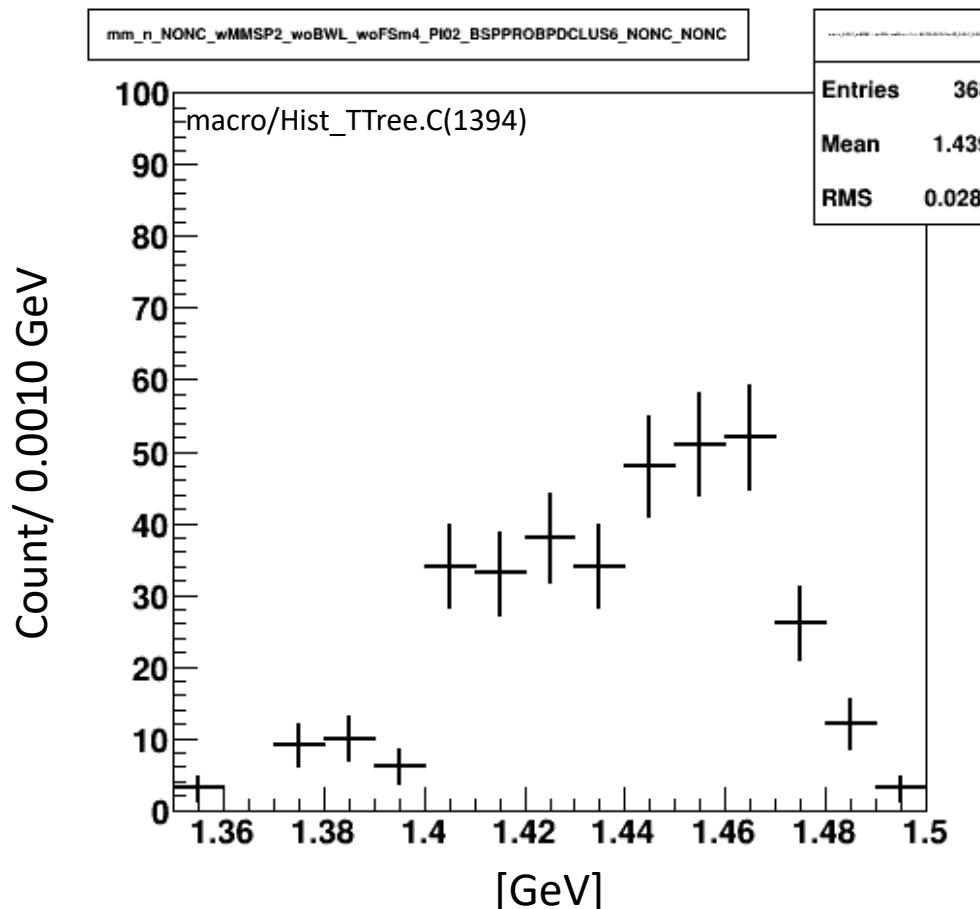
MM.d(K-,npπ-)

- $0 < d(K\text{-}, np\pi^-)$
- Σ^- from IM. (n, π^-) rejected
- Λ from IM. (p, π^-) rejected
- Σ^+ from MM. $d(K\text{-}, np\pi^-)$ selected



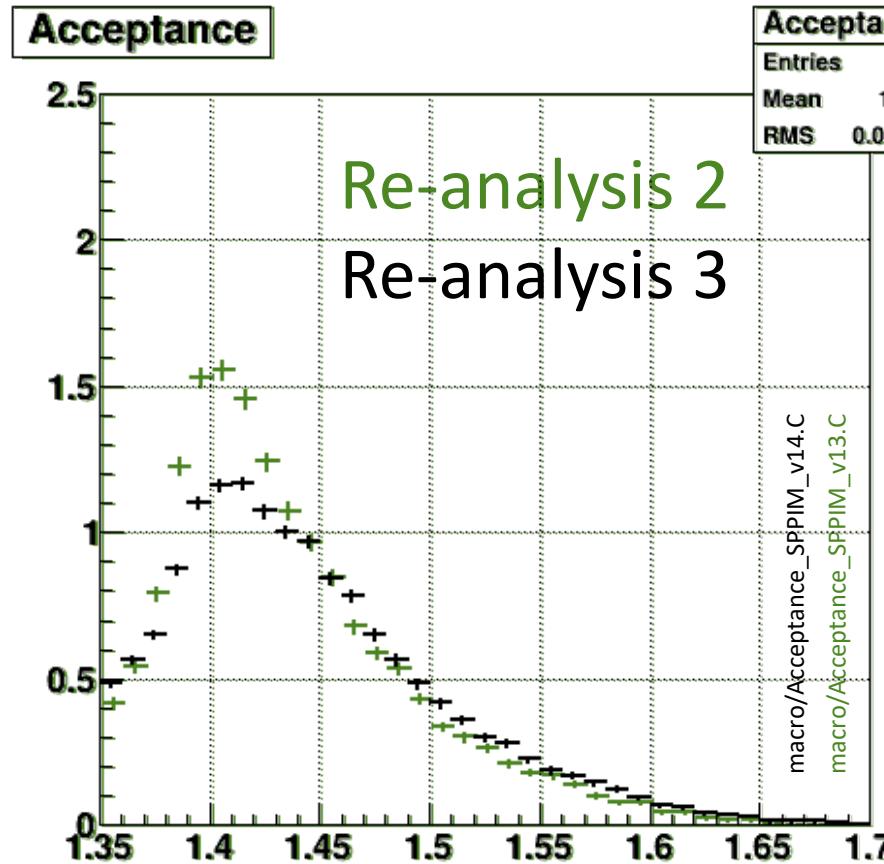
MM.d(K-,n)

- $0 < d(K^-, n\pi^-)$
- Σ^- from IM. (n, π^-) rejected
- Λ from IM. (p, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ selected
- π^0 from MM. $d(K^-, n\pi^-)$ selected



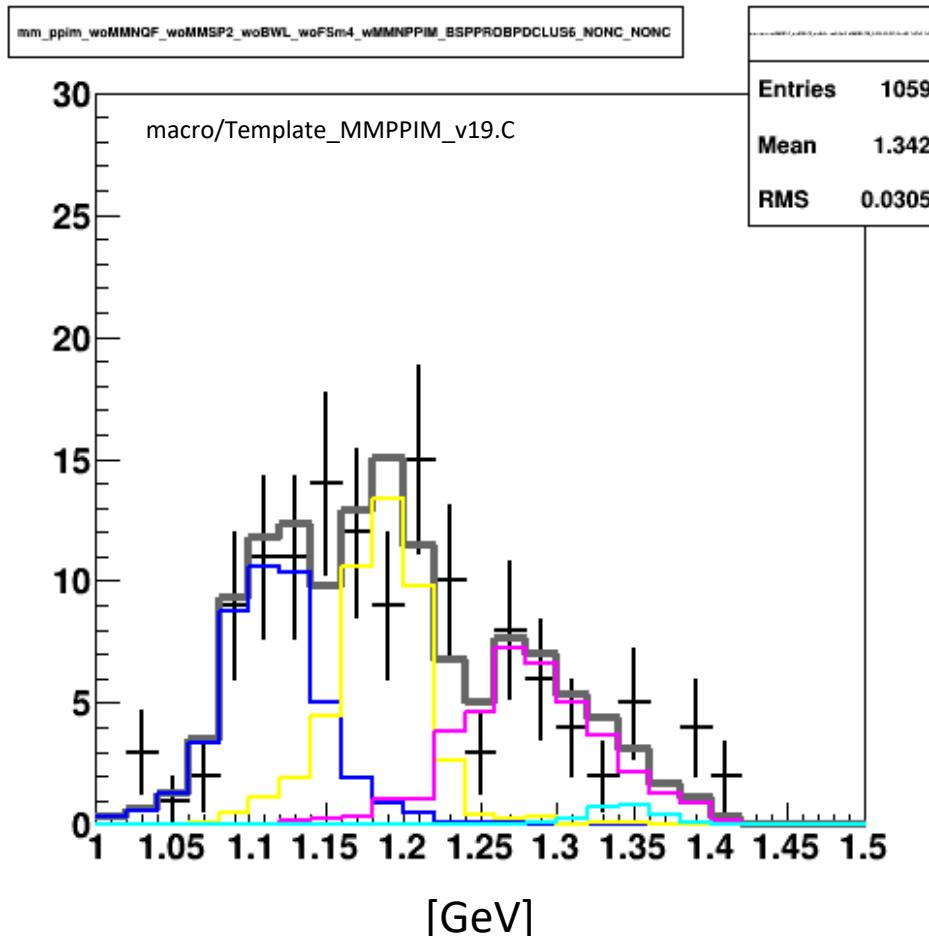
Acceptance estimation

- Sample ;
 - dE (NC) > 8 MeV –at least 1 segment
 - First neutron is through NC
 - Upstream condition
 - (T_0 multi =1, Beam track defining..)
 - BVC, CVC veto in sample (Re-analysis 2)
-
- Σ^- from IM. (n, π^-) rejected
 - Λ from IM. (p, π^-) rejected
 - Σ^+ from MM. $d(K^-, n\pi^+)$ selected
 - π^0 from MM. $d(K^-, n\pi^+\pi^-)$ selected



Fitting of MM. $d(K^-, p\pi^-)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$
- $d(K^-, n)$ **1.43~1.50 rejected**



† Data (analysis for SPPIM)

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- Fit Result

Scaling factor of SIM is free

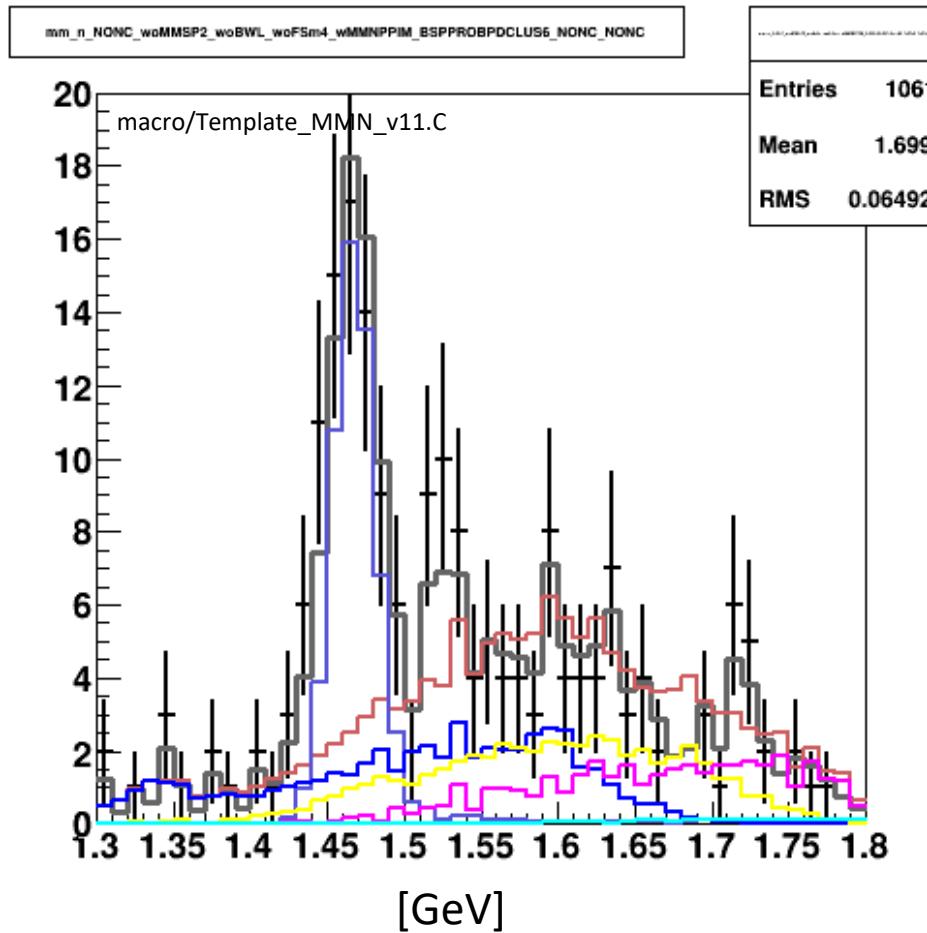
Fit Range

1.00 ~ 1.50 GeV

$\text{Chi}^2/\text{ndf} = 30.3/25$

Fitting of MM. $d(K_-, n)$

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K_-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K_-, n\pi\pi^-)$



† Data (analysis for SPPIM)

- $K-d \rightarrow p Y \pi$
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K
- Fit Result

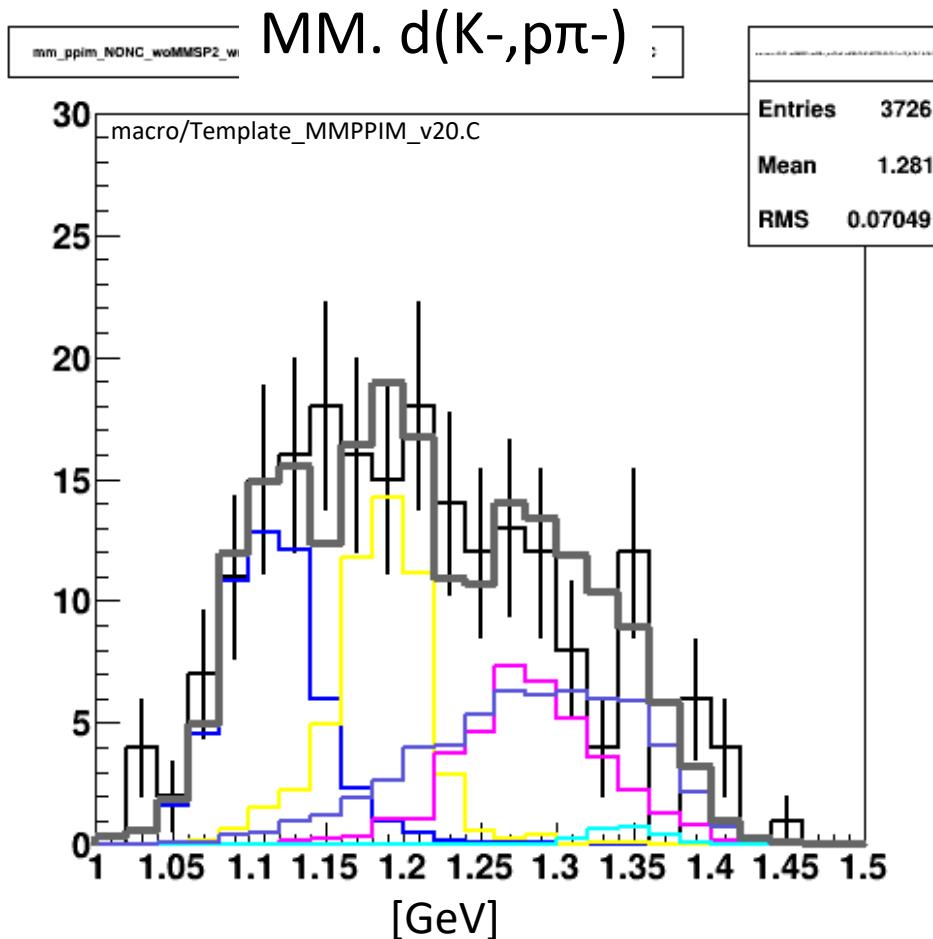
- The relative ratio of 4 components in $K-d \rightarrow p Y \pi$ is fixed by fitting of MM. $d(K_-, p\pi^-)$
- Scaling factors of SIM ($K-d \rightarrow p Y \pi$, 2step Stopped K) are free

Fit Range
1.30 ~ 1.80 GeV

$\text{Chi}^2/\text{ndf} = 43.2/50$

Fitting result

- Σ^- from IM. (n, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ rejected
- Λ from IM. (p, π^-) rejected
- $0 < d(K^-, n\pi^-)$



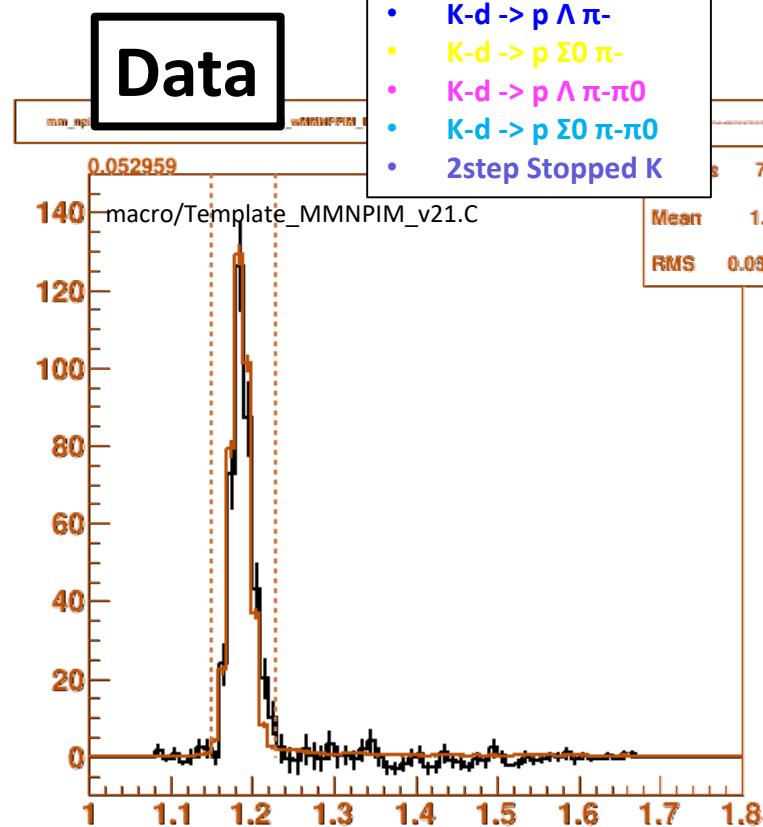
† Data (analysis for SPPIM)

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K
- SUM

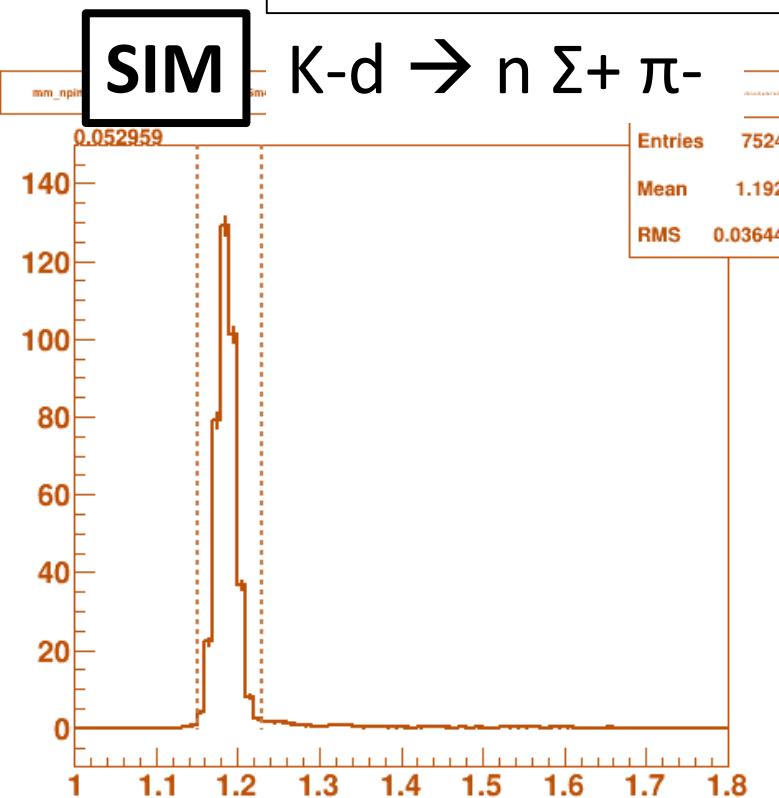
$K-d \rightarrow n \Sigma^+ \pi^-$;

Scaled by event # of $d(K-,n\pi)^{\prime\prime}\Sigma^+$ "

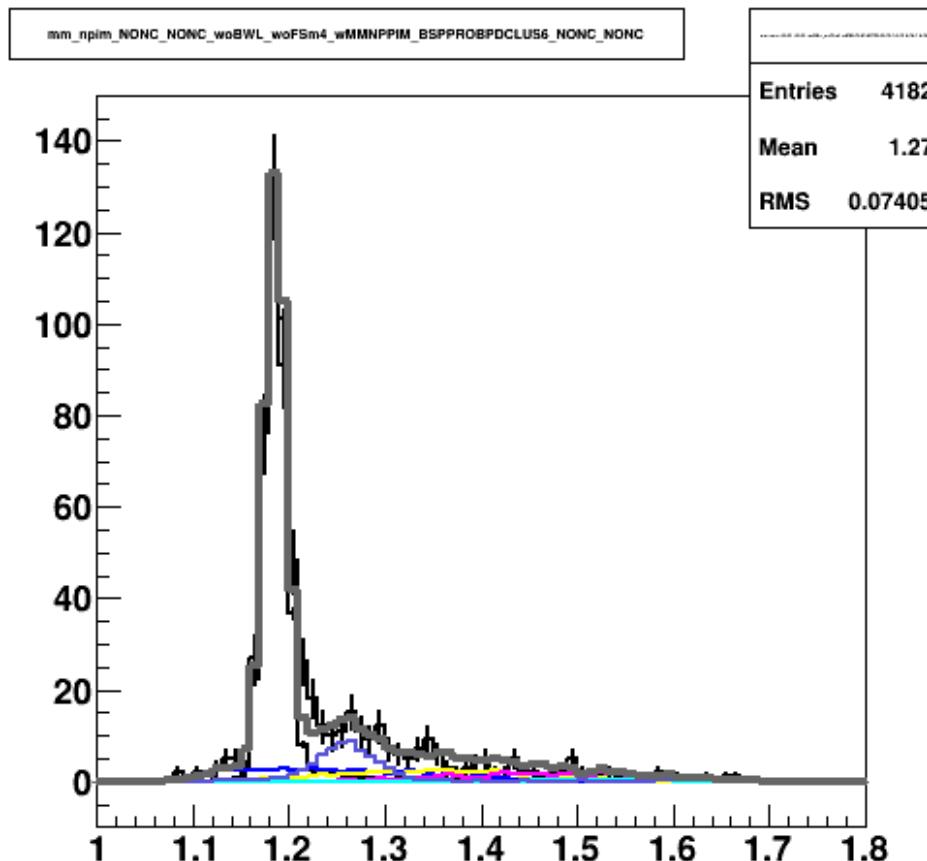
(analysis for SPPIM)



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K-, n\pi\pi^-)$



MM. $d(K^-, n\pi^-)$ w/ BG components



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$

† Data (analysis for SPPIM)

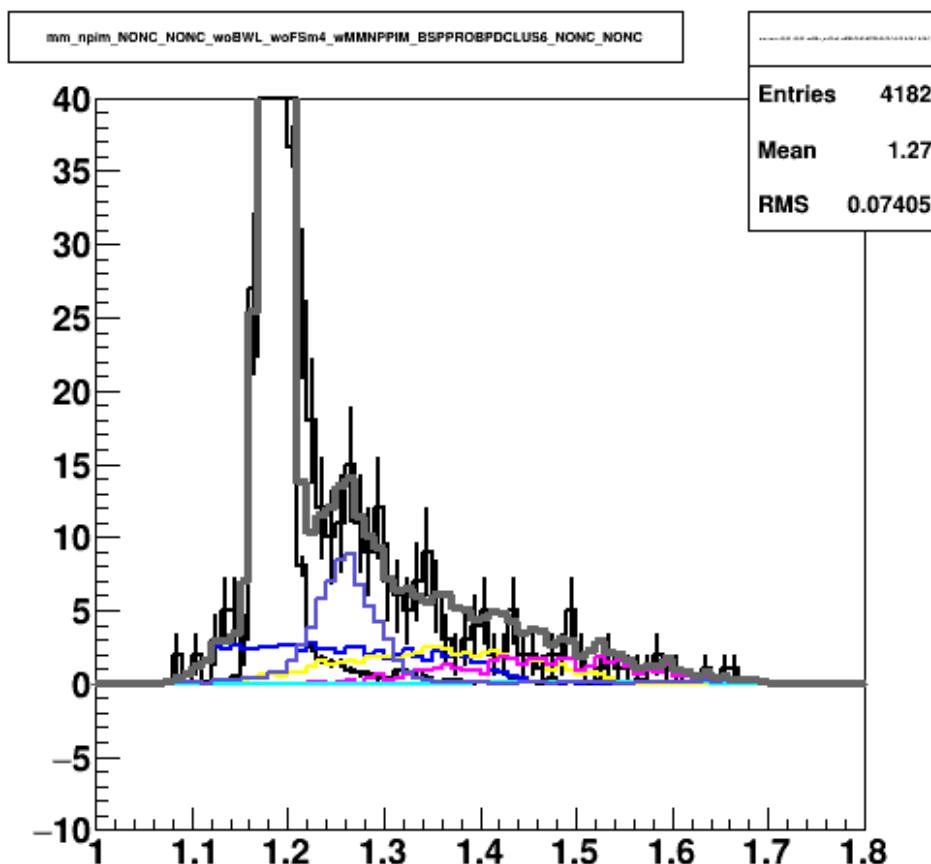
- $K-d \rightarrow n \Sigma^+ \pi^-$

BG

- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K
- SUM

The tail of Σ^+ seems to be explained by these BGs

MM. $d(K^-, n\pi^-)$ w/ BG components



- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, n\pi^-)$

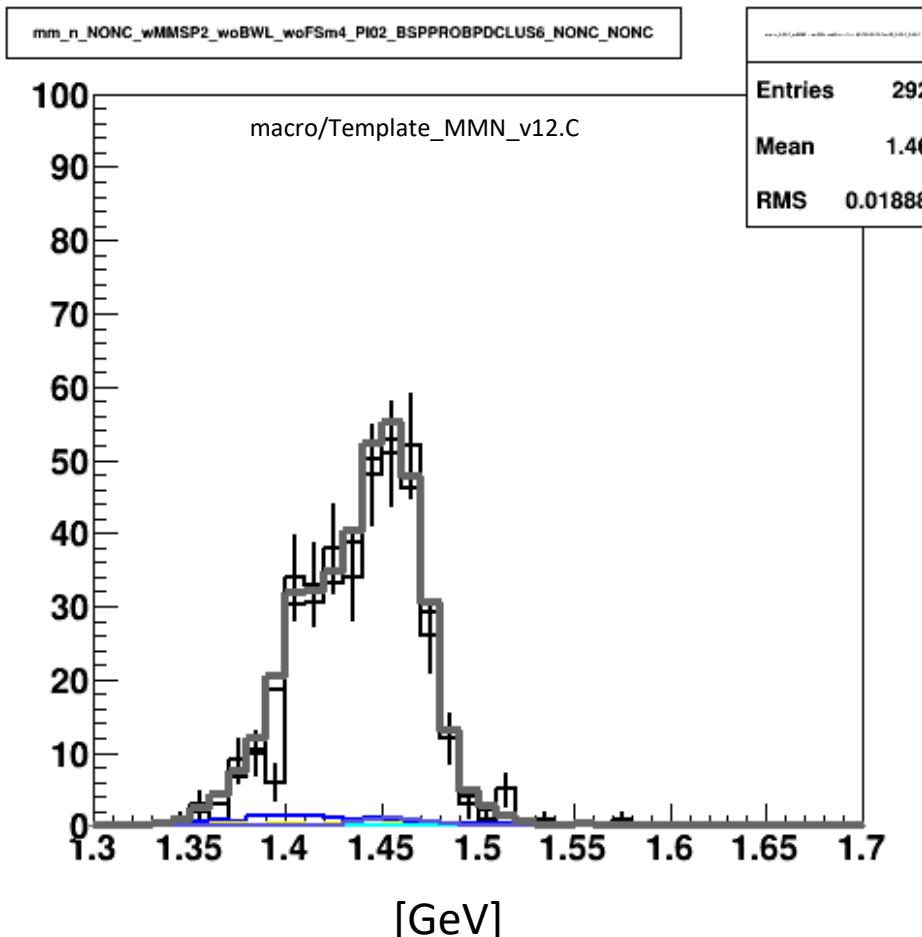
† Data (analysis for SPPIM)

- $K-d \rightarrow n \Sigma^+ \pi^-$
- **BG**
 - $K-d \rightarrow p \Lambda \pi^-$
 - $K-d \rightarrow p \Sigma^0 \pi^-$
 - $K-d \rightarrow p \Lambda \pi^- \pi^0$
 - $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
 - **2step Stopped K**
 - **SUM**

The tail of Σ^+ seems to be explained by these BGs

MM. $d(K^-, n)$

- Σ^- from IM. (n, π^-) rejected
- Λ from IM. (p, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ selected
- π^0 from MM. $d(K^-, n\rho\pi^-)$ selected



† Data (analysis for SPPIM)

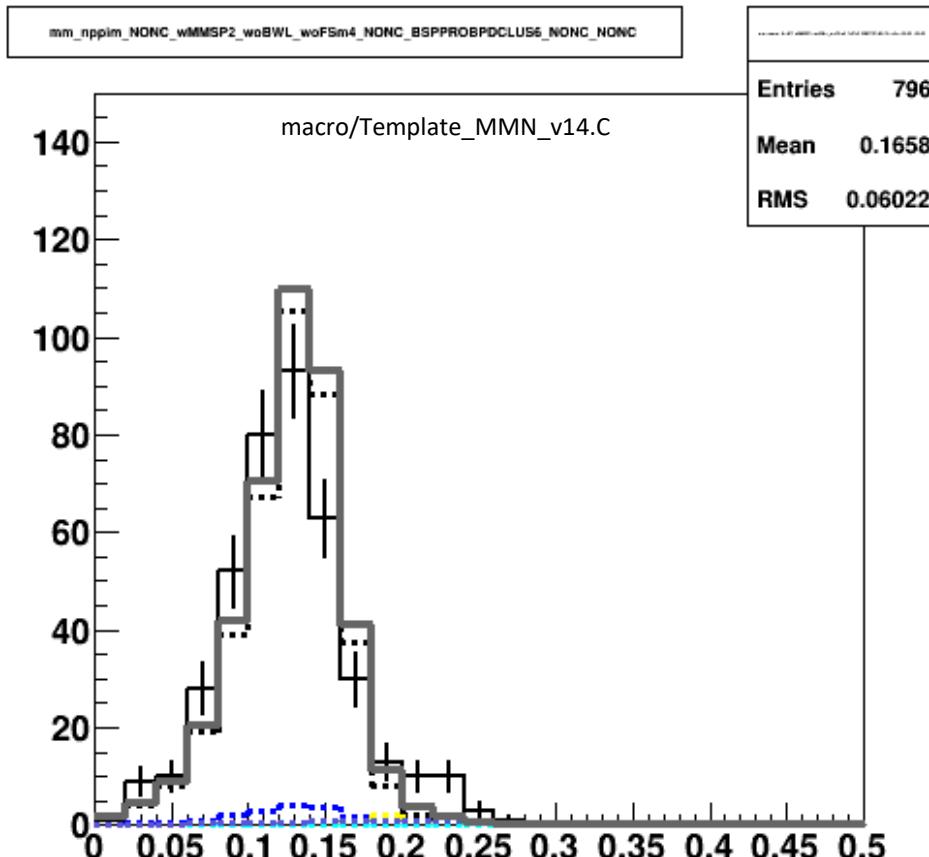
- $K^- d \rightarrow n \Sigma^+ \pi^-$

- $K^- d \rightarrow n \Sigma^0 \pi^0$
- $K^- d \rightarrow n \Lambda \pi^0$

- $K^- d \rightarrow p \Lambda \pi^-$
- $K^- d \rightarrow p \Sigma^0 \pi^-$
- $K^- d \rightarrow p \Lambda \pi^- \pi^0$
- $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K

MM. $d(K^-, np\pi^-)$

- $0 < d(K^-, np\pi^-)$
- Σ^- from IM. (n, π^-) rejected
- Λ from IM. (p, π^-) rejected
- Σ^+ from MM. $d(K^-, np\pi^-)$ selected



[GeV]

- BG contamination is estimated to be small
- Fitting of P.121 overestimate BG

† Data (analysis for SPPIII)

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

- $K-d \rightarrow n \Sigma^0 \pi^0$
- $K-d \rightarrow n \Lambda \pi^0$

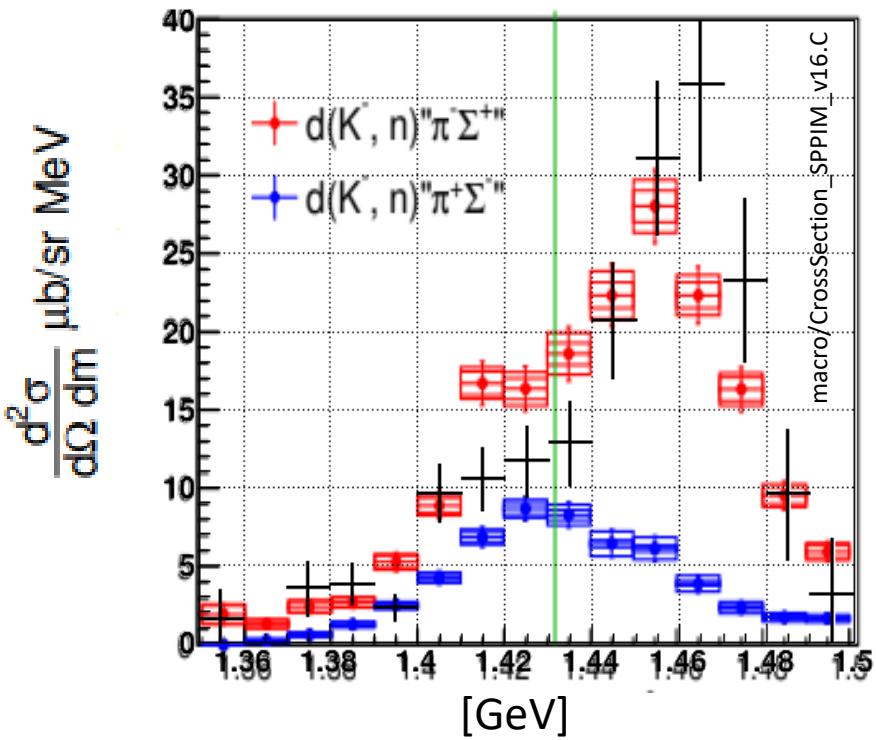
- $K-d \rightarrow p \Lambda \pi^-$
- $K-d \rightarrow p \Sigma^0 \pi^-$
- $K-d \rightarrow p \Lambda \pi^- \pi^0$
- $K-d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K

Cross Section

- Σ^- from IM. (n, π^-) rejected
- Λ from IM. (p, π^-) rejected
- Σ^+ from MM. $d(K^-, n\pi^-)$ selected
- π^0 from MM. $d(K^-, p\pi^-)$ selected

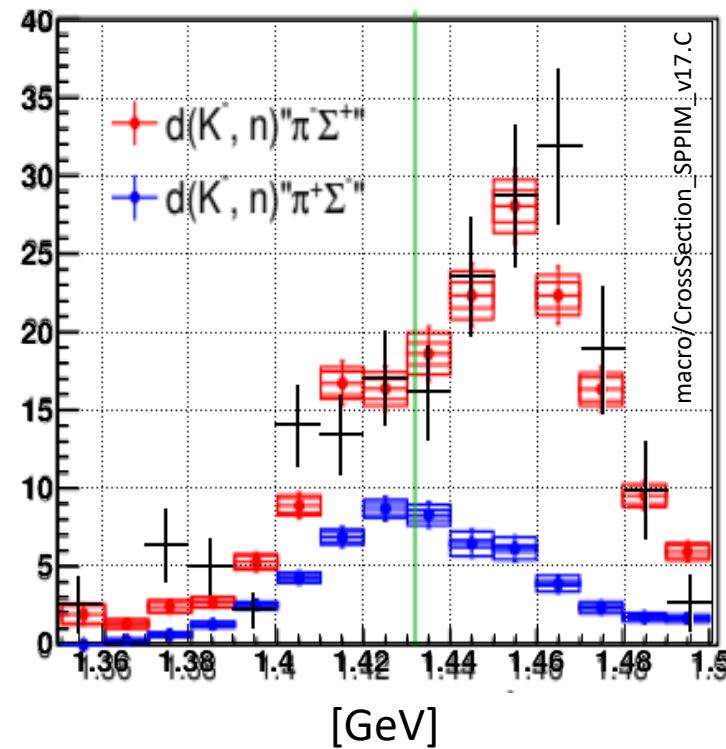
- Subtraction
 - Sideband of Σ^+ from MM. $d(K^-, n\pi^-)$

Re-analysis 2



- Subtraction
 - 2step Stopped K
 - $K-d \rightarrow p \Lambda \pi^-$

Re-analysis 3



Re-analysis 2 ($d(K^-, n)^*\Lambda\pi^0$)

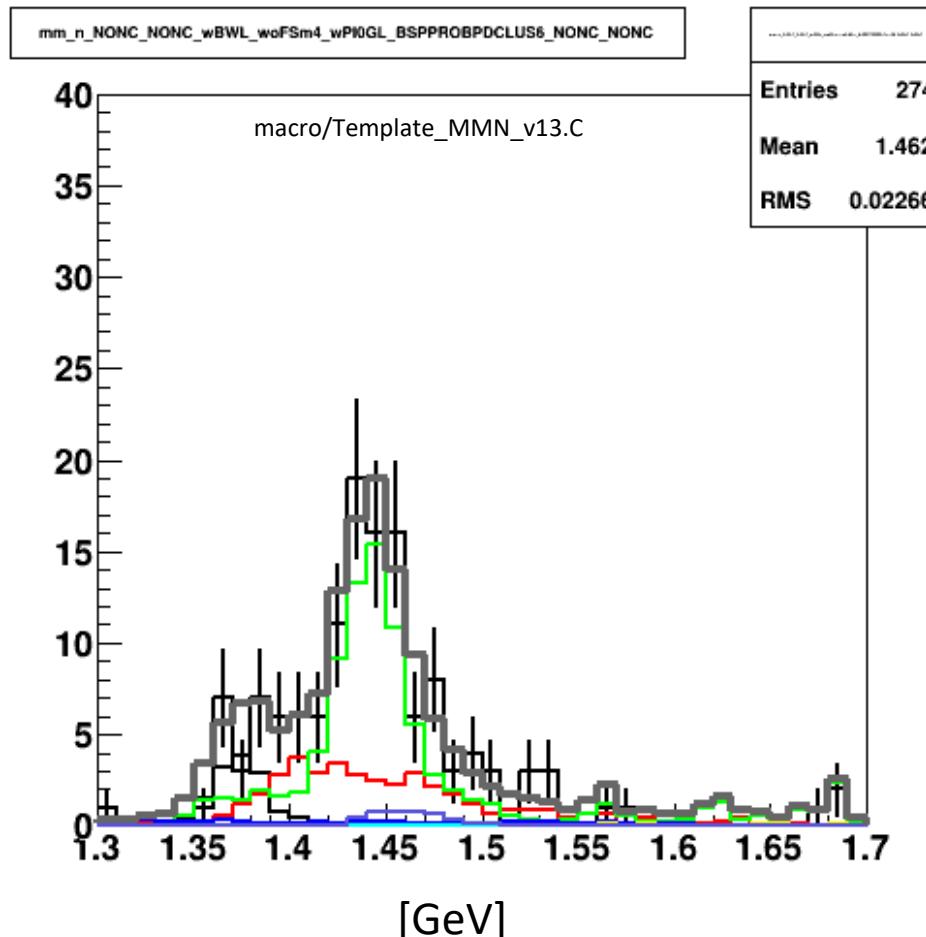
Difference from Page 489 (analysis 1)

- Same condition as $d(K^-, n)^*\Sigma^0\pi^0$ Re-analysis 9
- w/ subtracted by $K-d \rightarrow n \Sigma^+ \pi^-$
- w/ rejection of Σ^- from IM.(n, π^-)

→ Before, these BGs are estimated
by the side-band of Λ from IM.(p, π^-)

- Σ - from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is selected
- $0.00 < d(K^-, n p \pi^-) < 0.18$

MM. $d(K^-, n)$



† Data

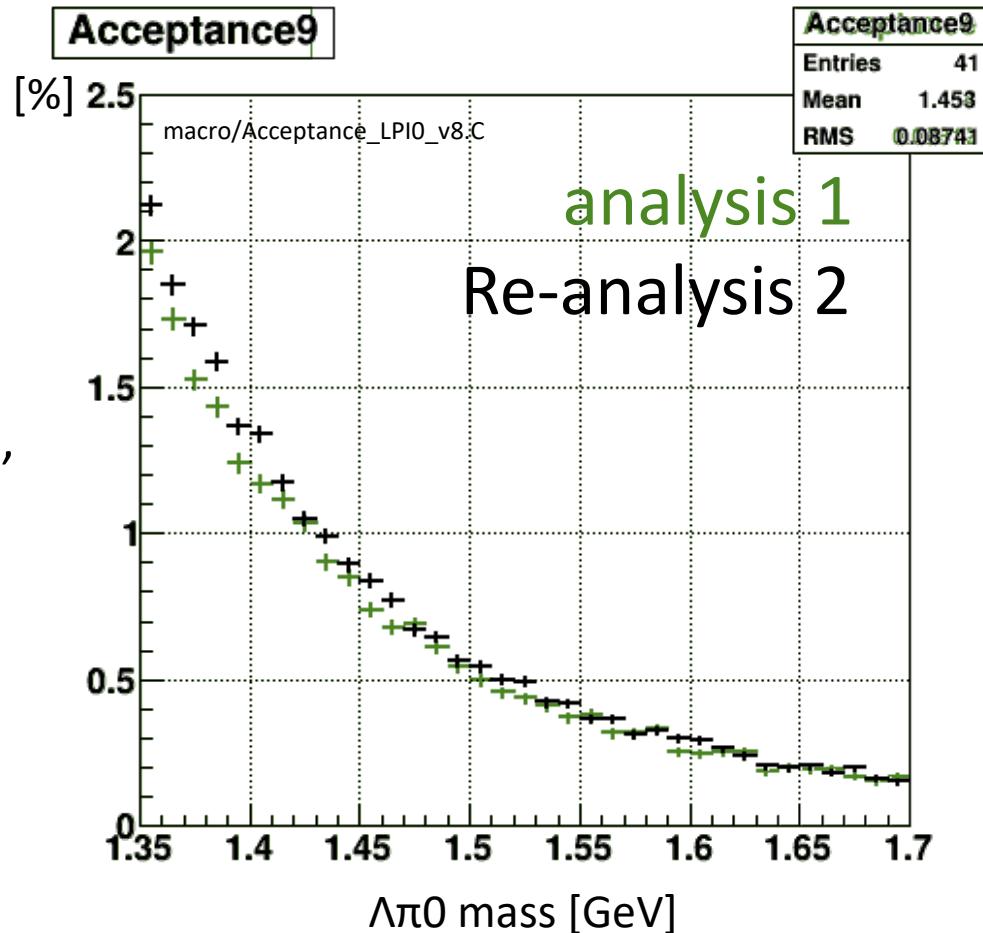
- $K^- d \rightarrow n \Sigma^+ \pi^-$

- $K^- d \rightarrow n \Sigma^0 \pi^0$
- $K^- d \rightarrow n \Lambda \pi^0$

- $K^- d \rightarrow p \Lambda \pi^-$
- $K^- d \rightarrow p \Sigma^0 \pi^-$
- $K^- d \rightarrow p \Lambda \pi^- \pi^0$
- $K^- d \rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K

Acceptance estimation

- Sample ;
 - dE (NC) > 8 MeV –at least 1 seg
 - First neutron is through NC
 - Upstream condition (T_0 multi =1,
Beam track defining..)
 - BVC, CVC veto in sample



- p, π - invariant mass Λ selection
- $d(K^-, n\Lambda)^* X^* X < 0.18$ GeV

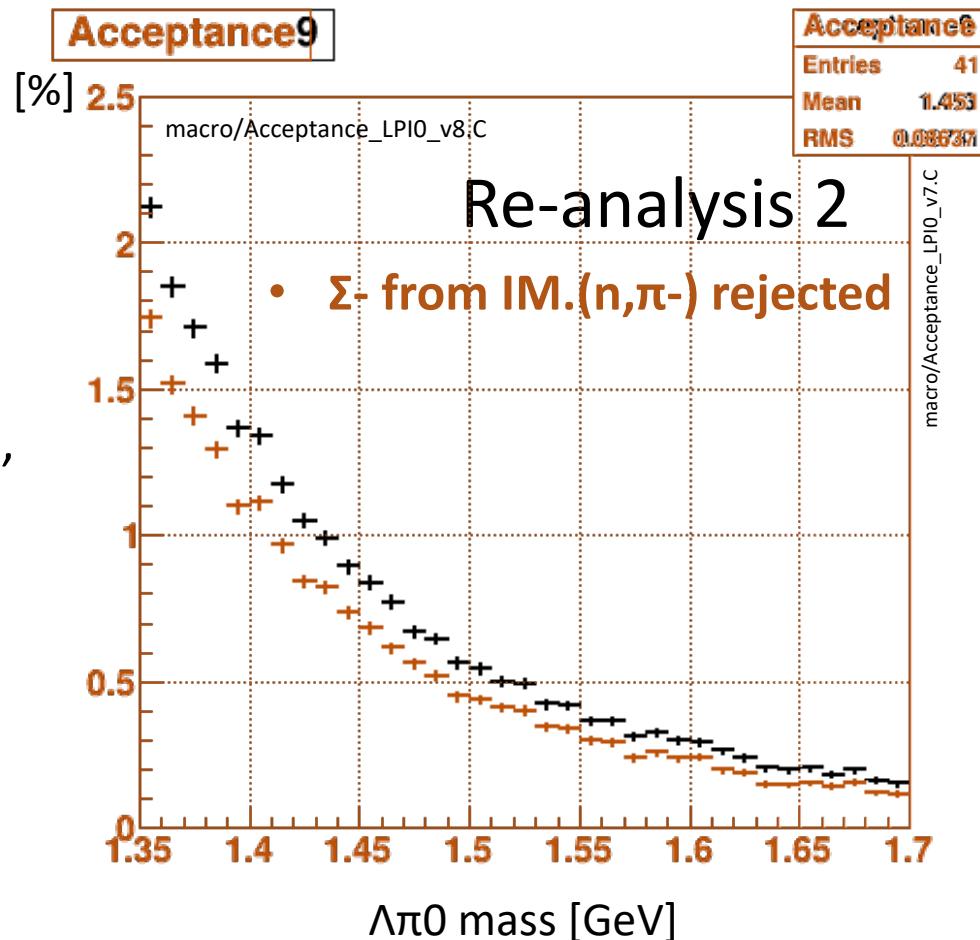
- Almost the same as previous analysis
- Acceptance curve is not smooth. Statistics seems not enough^{b5}

Acceptance estimation

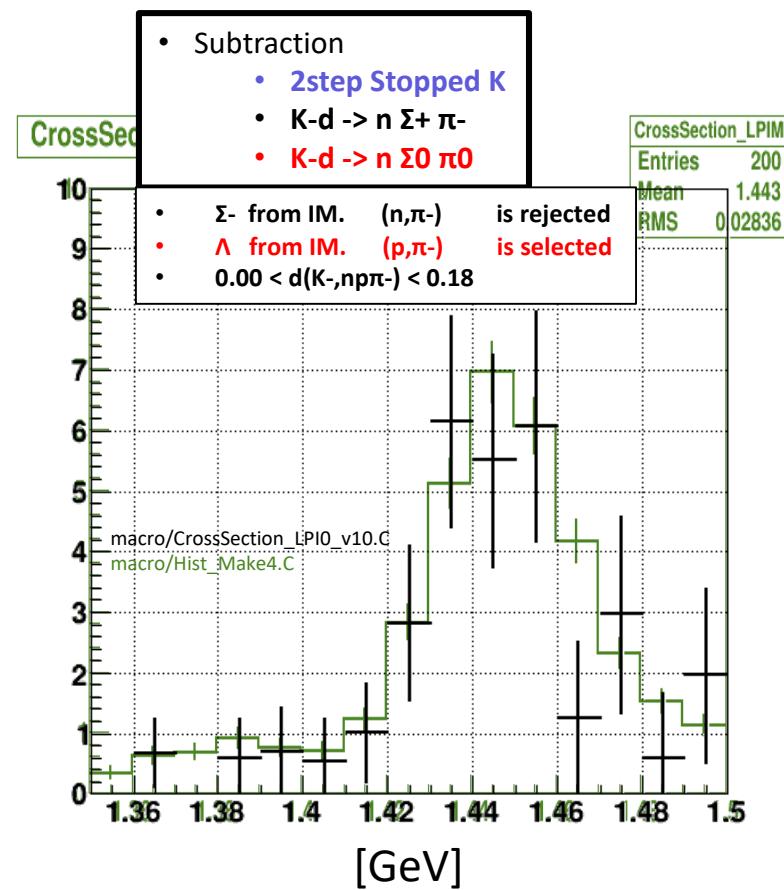
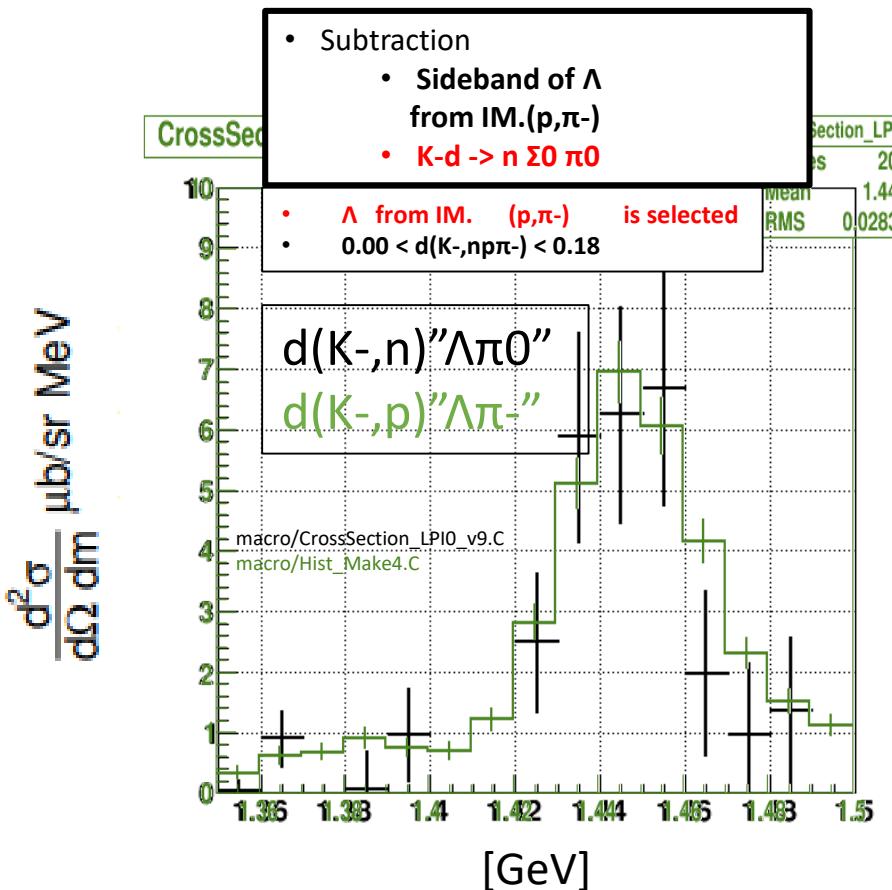
- Sample ;
 - dE (NC) > 8 MeV –at least 1 seg
 - First neutron is through NC
 - Upstream condition (T_0 multi =1,
Beam track defining..)
 - BVC, CVC veto in sample



- p, π - invariant mass Λ selection
- $d(K^-, n\Lambda)^* X^* \quad 0 < X < 0.18 \text{ GeV}$
- **Σ^- from IM.(n, π^-) rejected**



$d(K\text{-},n)\text{"}\Lambda\pi0\text{"}$ Cross Section



- Almost the same as previous analysis
- Luminosity & efficiencies same as $d(K\text{-},n)\text{"}\Sigma 0 \pi0\text{"}$
- $\Lambda\pi0 : \Lambda\pi^- \sim 1 : 1$ 2 times difference from the calculation

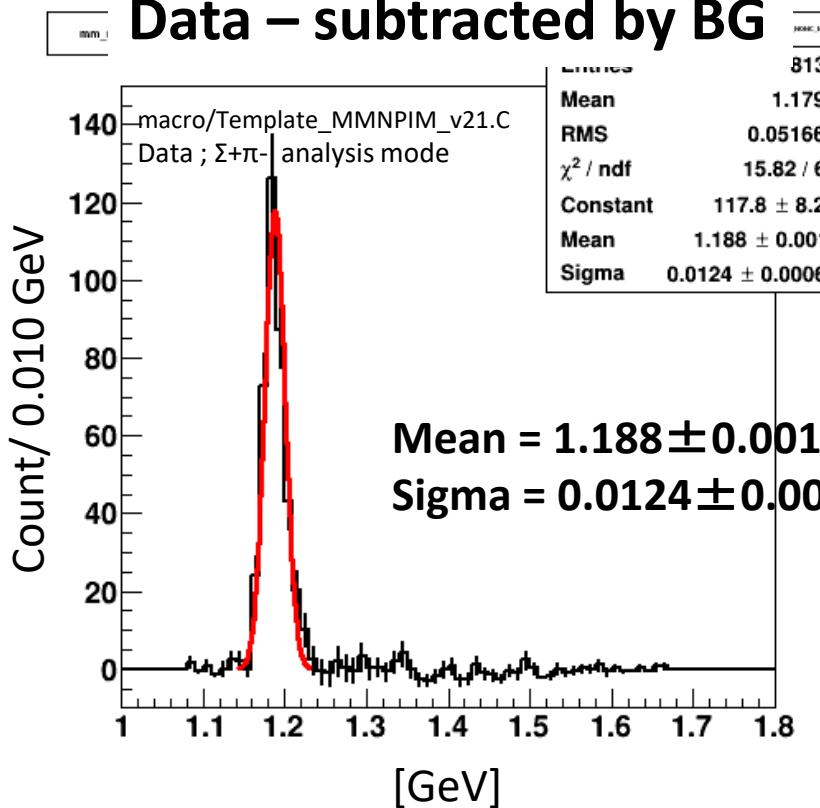
Comparison of Data & SIM

- MM. $d(K^-, p\pi^-)\Sigma^+$

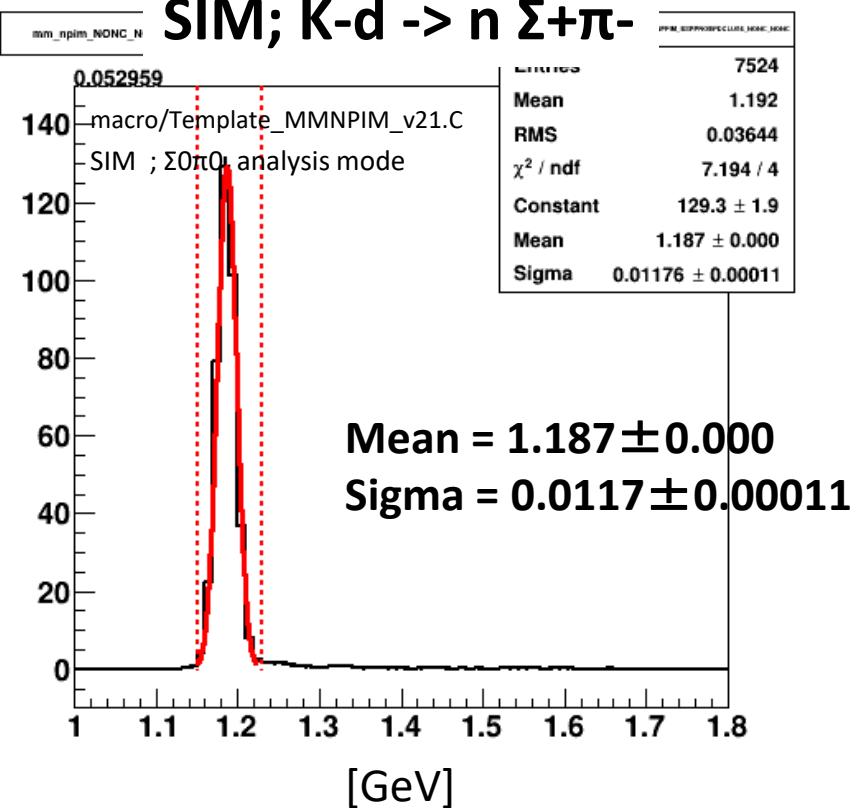


- Σ^- from IM. (n, π^-) is rejected
- Λ from IM. (p, π^-) is rejected
- $0 < d(K^-, p\pi^-)$

Data – subtracted by BG



SIM; $K-d \rightarrow n \Sigma^+ \pi^-$



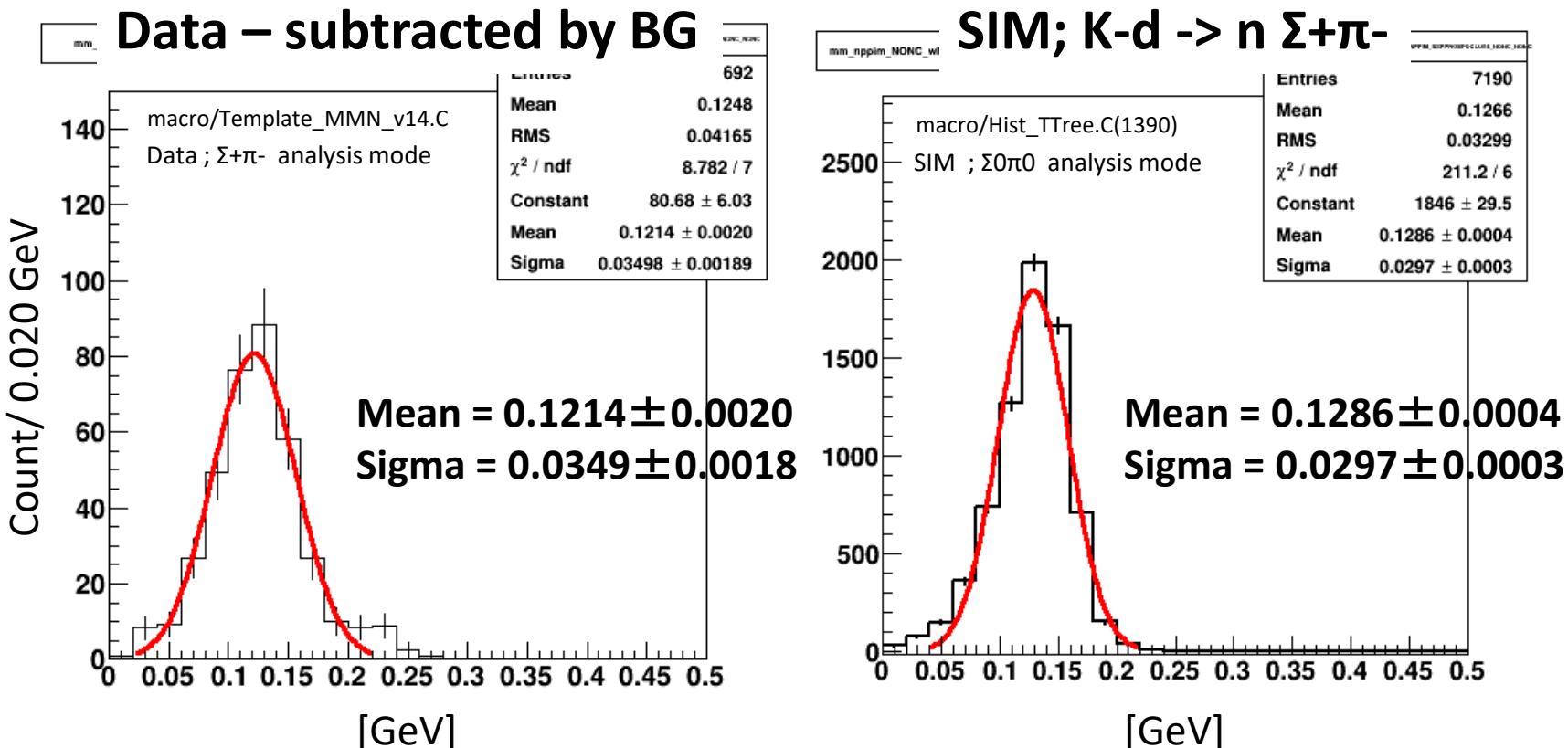
- Data & SIM are consistent

Comparison of Data & SIM

- MM. $d(K^-, n\bar{p}\pi^-)$ "π0"

BG	
•	$K-d \rightarrow p \Lambda \pi^-$
•	$K-d \rightarrow p \Sigma \pi^-$
•	$K-d \rightarrow p \Lambda \pi-\pi^0$
•	$K-d \rightarrow p \Sigma \pi^-\pi^0$
•	2step Stopped K

- $0 < d(K^-, n\bar{p}\pi^-)$
- Σ^- from IM. (n, π^-) rejected
- Λ^- from IM. (p, π^-) rejected
- Σ^+ from MM. $d(K^-, n\bar{p}\pi^-)$ selected



- SIM distribution seems asymmetric
- SIM resolution is a little better than data

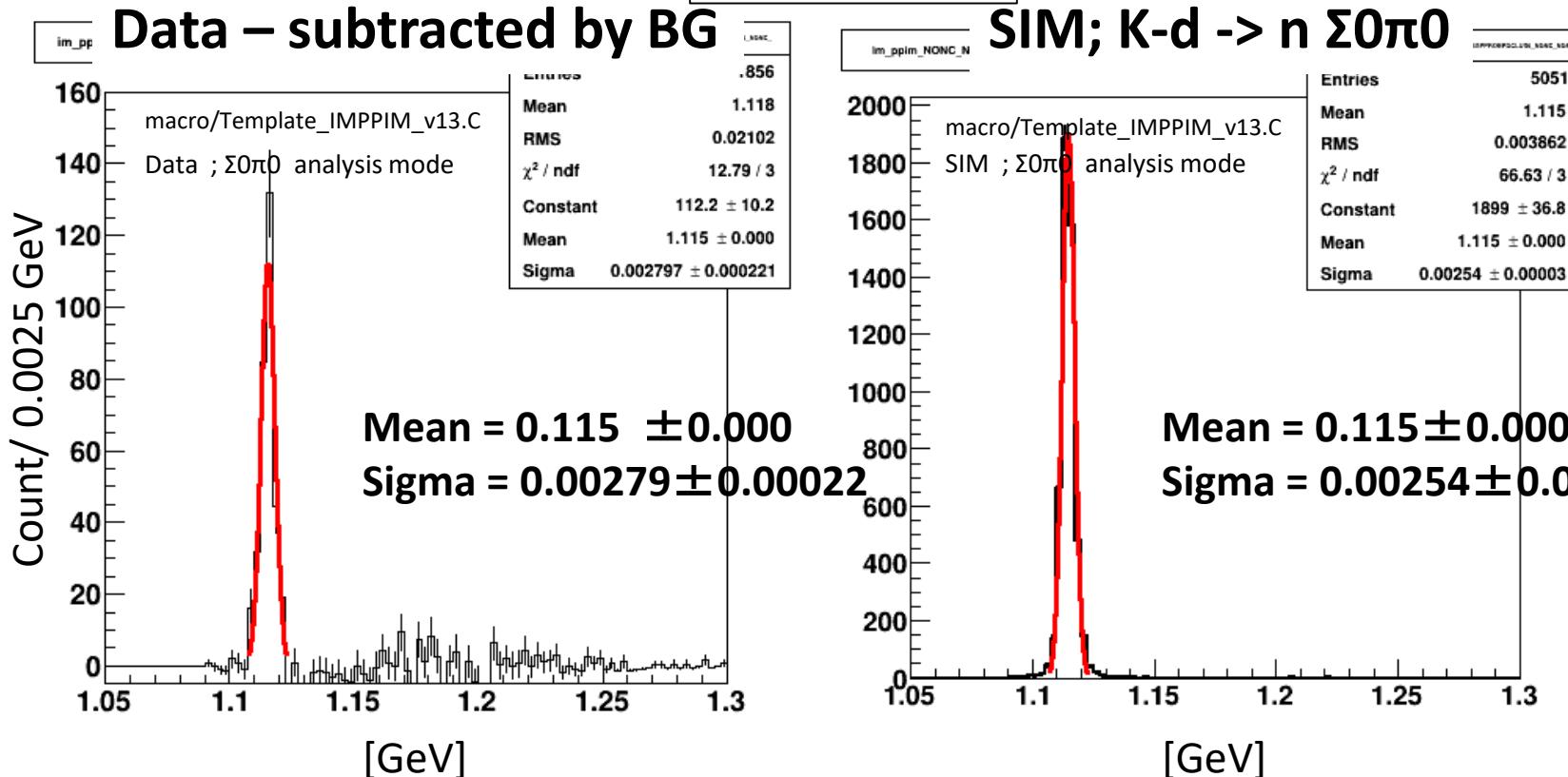
Comparison of Data & SIM

- IM.(p, π^-) Λ

BG

- K-d $\rightarrow n \Sigma^+ \pi^-$
- K-d $\rightarrow p \Lambda \pi^-$
- K-d $\rightarrow p \Sigma^0 \pi^-$
- K-d $\rightarrow p \Lambda \pi^- \pi^0$
- K-d $\rightarrow p \Sigma^0 \pi^- \pi^0$
- 2step Stopped K

- $0 < d(K, \eta \rho \pi^-)$
- Σ^- from IM. (n, π^-) rejected



- Data & SIM are consistent

To do

- Difference of $d(K_-, n p \pi^-) \pi^0$ between Data & SIM
 - dependence on $d(K_-, n)$
- Acceptance estimation of $\Sigma + \pi^-$
 - Why so changed from previous analysis (Re-analysis 2)?
- Mass region of $\Sigma 0 \pi^0$ from the data spectrum for SIM
 - Cut of 1.55~1.70 – overestimation due to few data event
- Check the difference of IM. (n, π^-) Σ^- between Data & SIM
- Check the analysis correction of proton momentum w/ vertex iteration for $\Sigma + \pi^-$ mode
- $K_- "n" \rightarrow K_- n$, K_- re-scatter event
 - MM. $d(K\text{-stopped}, p\pi^-)$ of Λ -tag event for the hint of $2N$ abs
- Summary of studies up to now