K^-d 反応の異なる運動量移行領域での $\pi^{\pm}\Sigma^{\mp}$ 不変質量分布

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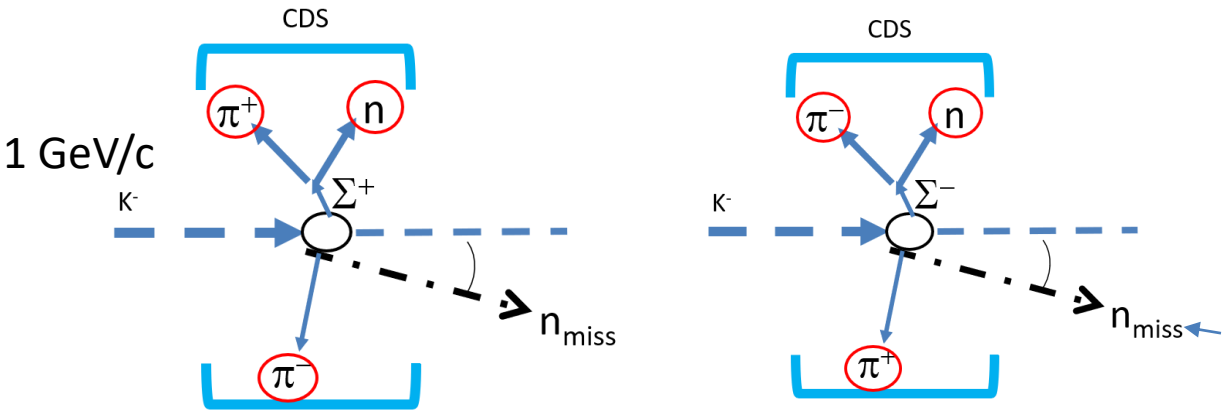
for the J-PARC E31 collaboration

q vs $\pi^{\pm}\Sigma^{\mp}$ Invariant Mass analysis

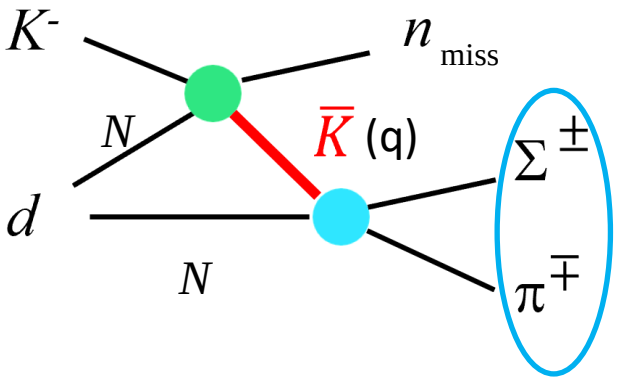
Inspired by the J-PARC E15 ("K^-pp" search) analysis (PRC 102 (2020) 044002)



ID by Missing mass
0~90° (CM) acceptable

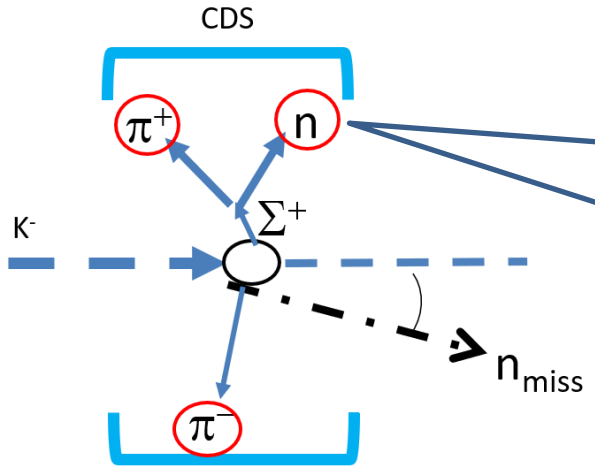
Momentum Transfer : $q = |\vec{K^-} - \vec{n}_{miss}|$

- recoiled kaon ($\overline{K}$) momentum in 2 step process
  - ⟶ KN interaction as a function of q
  - ⟶ Possible discussion about size



Detect by the CDS

Neutron ID by Cylindrical Detector System.

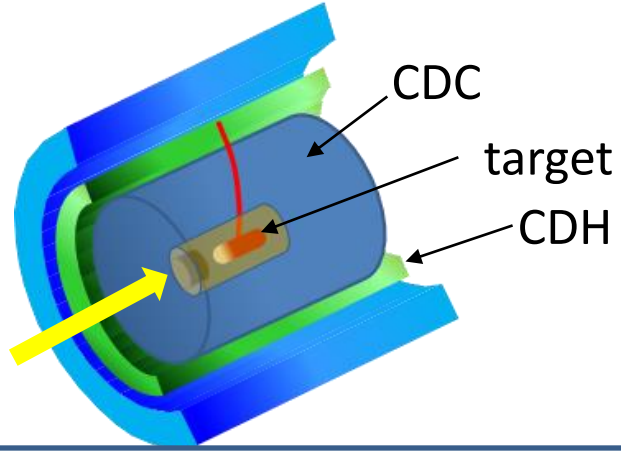


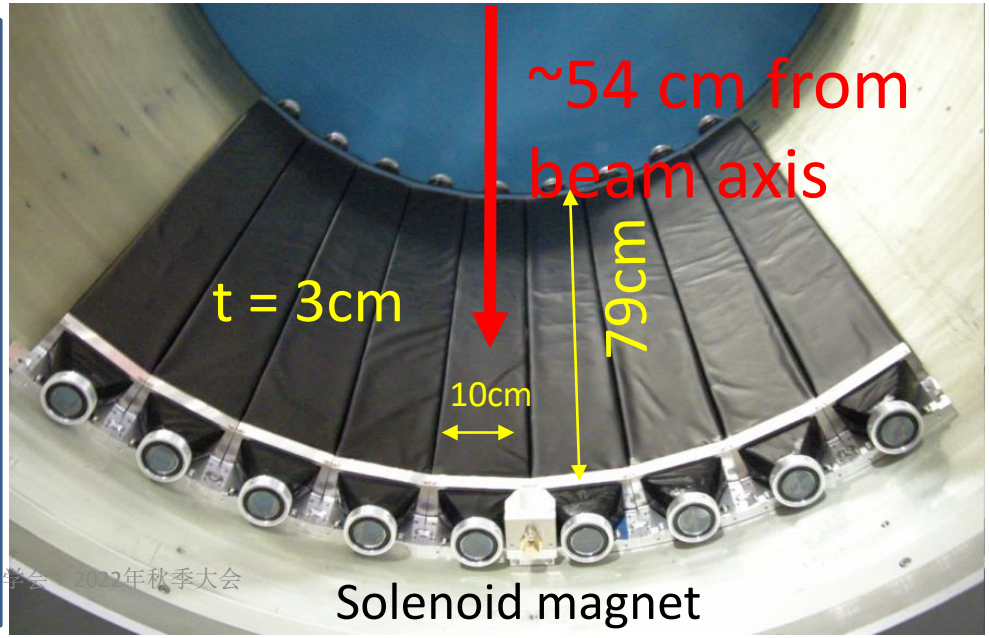
Neutron ID by thin scintillation counter (t=3 cm)

n detection efficiency : 5-10 %

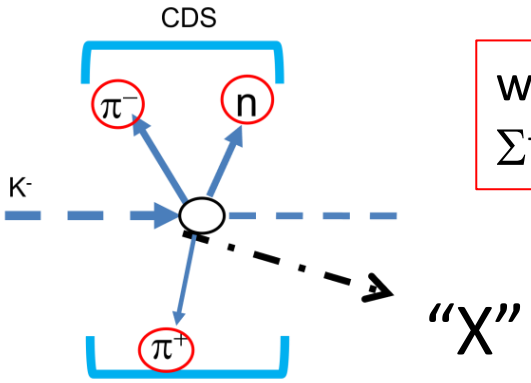
Cylindrical Detector Hodoscope (CDH)

Cylindrical Detector System
(Solenoid Field 0.7 T)



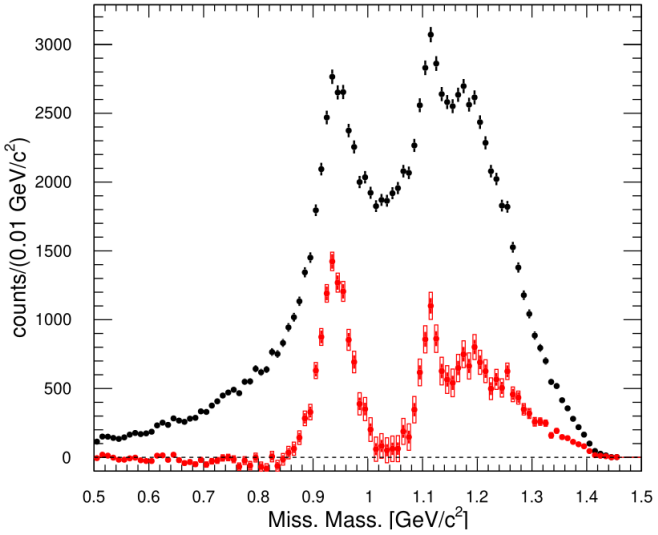


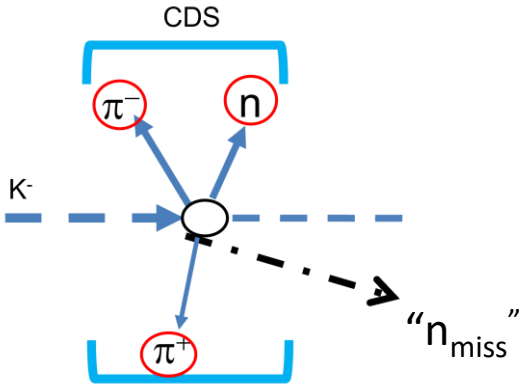
$\pi^{\pm}\Sigma^{\mp}$n state ID



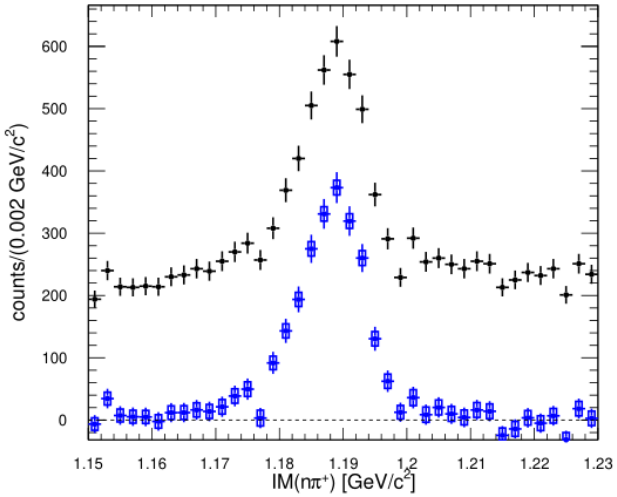
when
Σ^+ or Σ^- or $\overline{K}^0$ found

d(K⁻ , $\pi^+\pi^-$ n)"X" Missing Mass

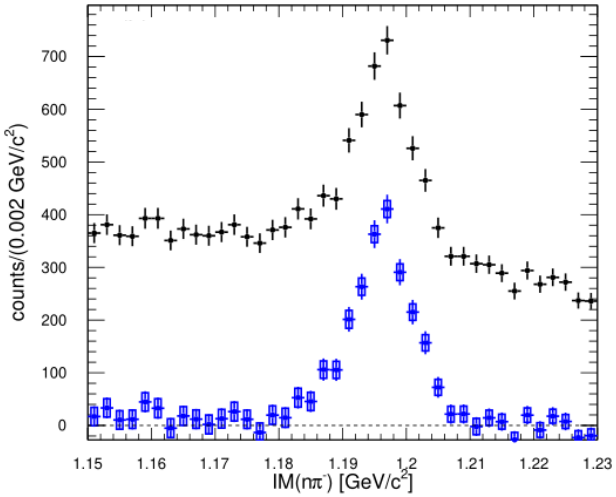




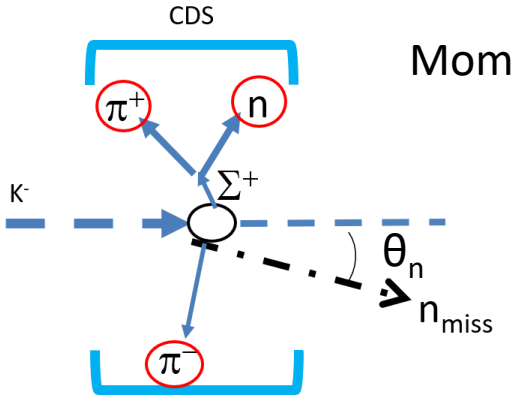
Invariant Mass ($n\pi^+$)



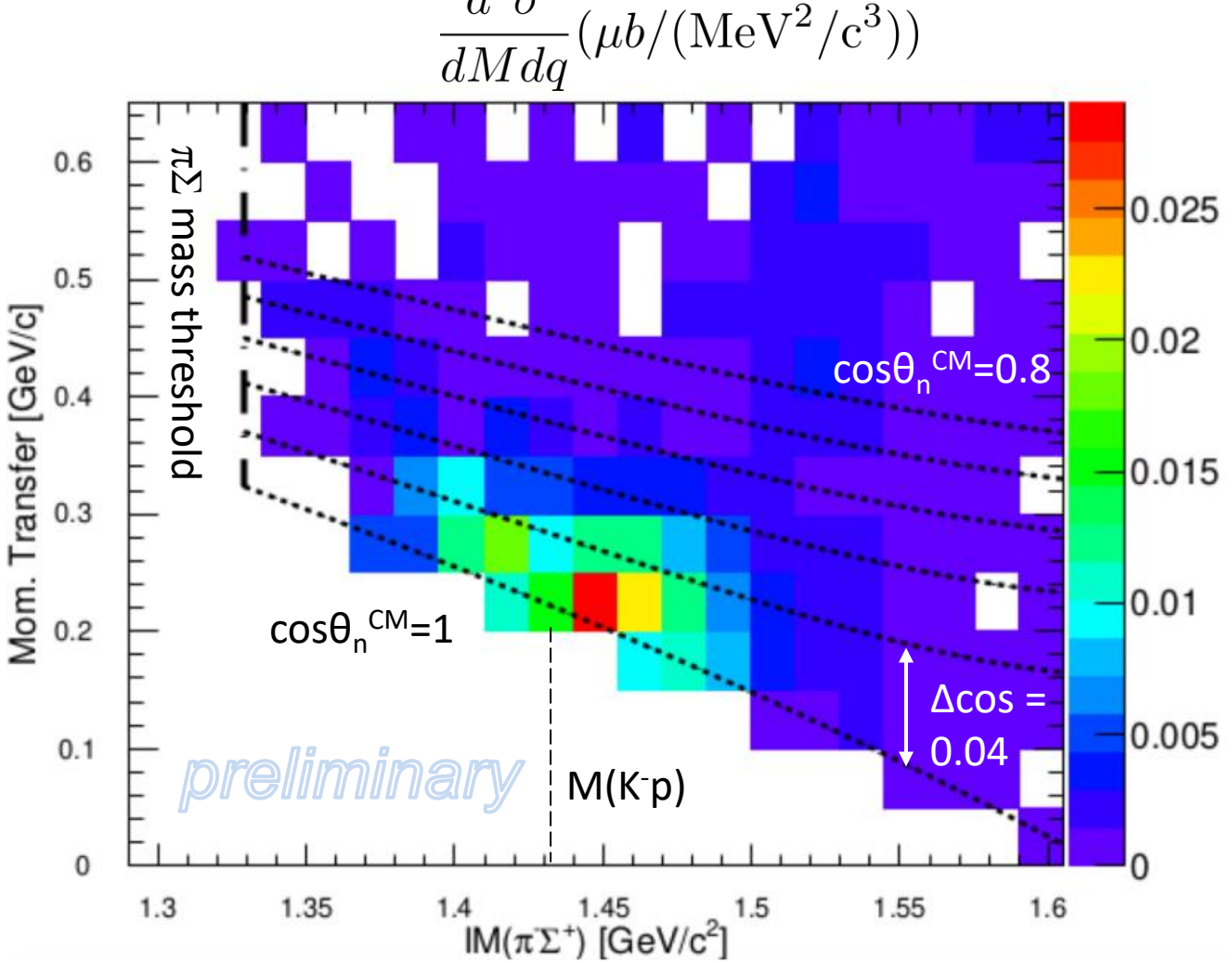
Invariant Mass ($n\pi^-$)



q vs IM($\pi^-\Sigma^+$) cross section

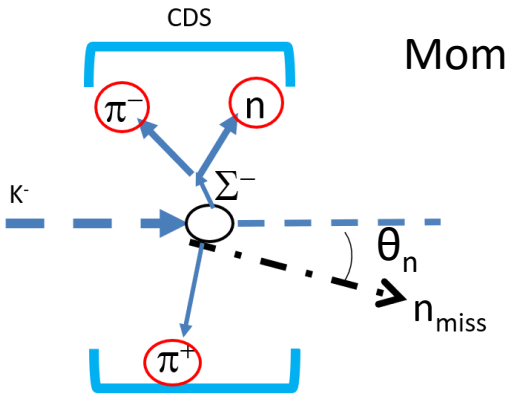


Mom. Transfer(q) = $|\vec{K^-} - \vec{n}_{miss}|$



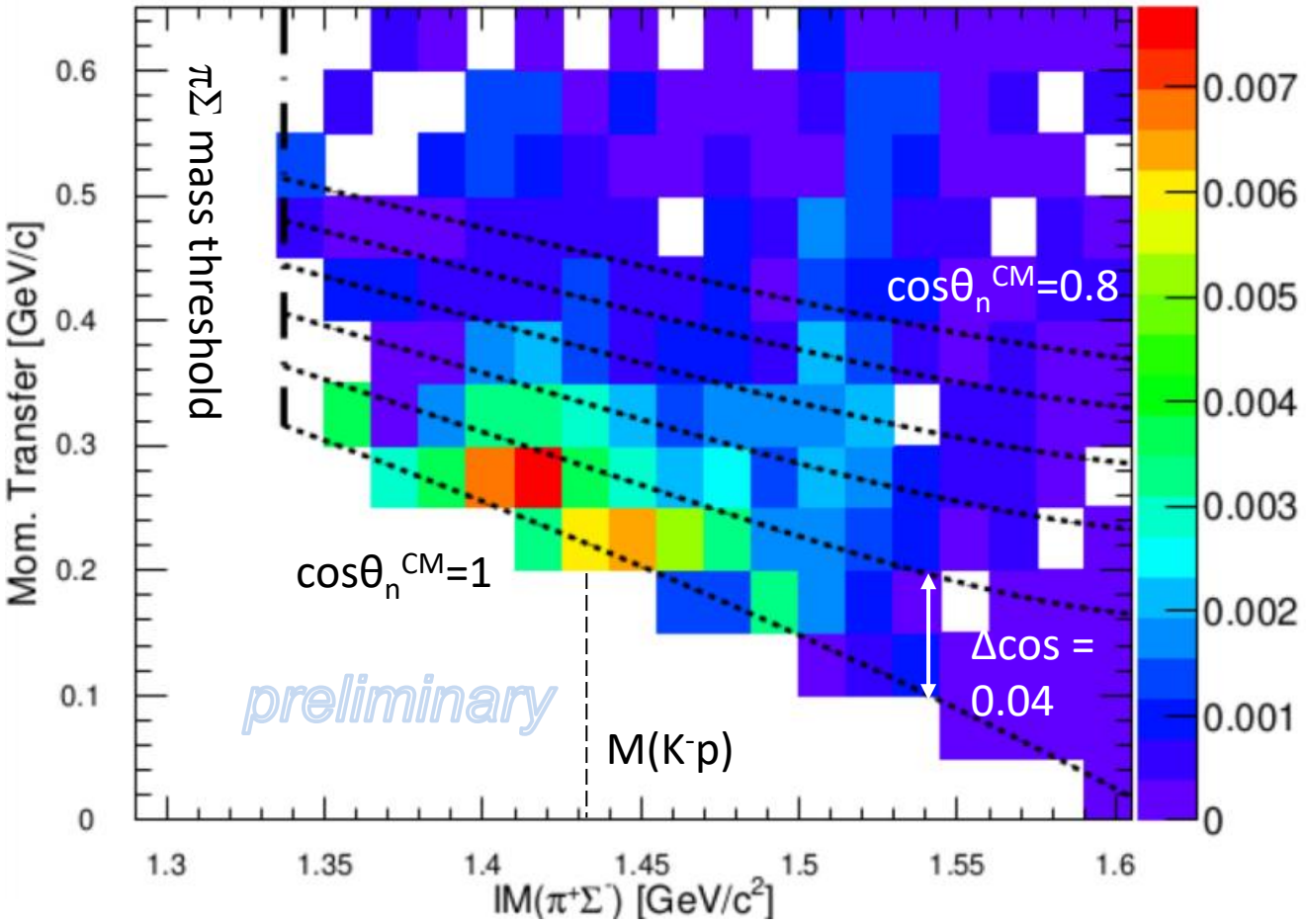
Large C.S. at small neutron scattering angle
(= small q)

q vs IM($\pi^+\Sigma^-$) cross section



Mom. Transfer(q) = $|\vec{K^-} - \vec{n}_{miss}|$

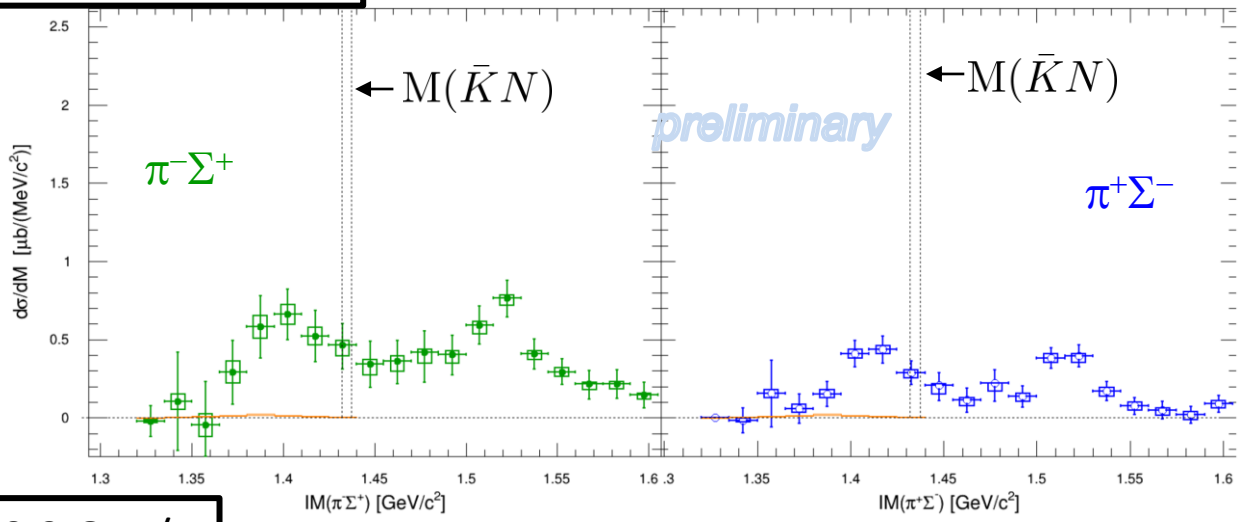
$$\frac{d^2\sigma}{dMdq}(\mu b/(\mathrm{MeV}^2/c^3))$$



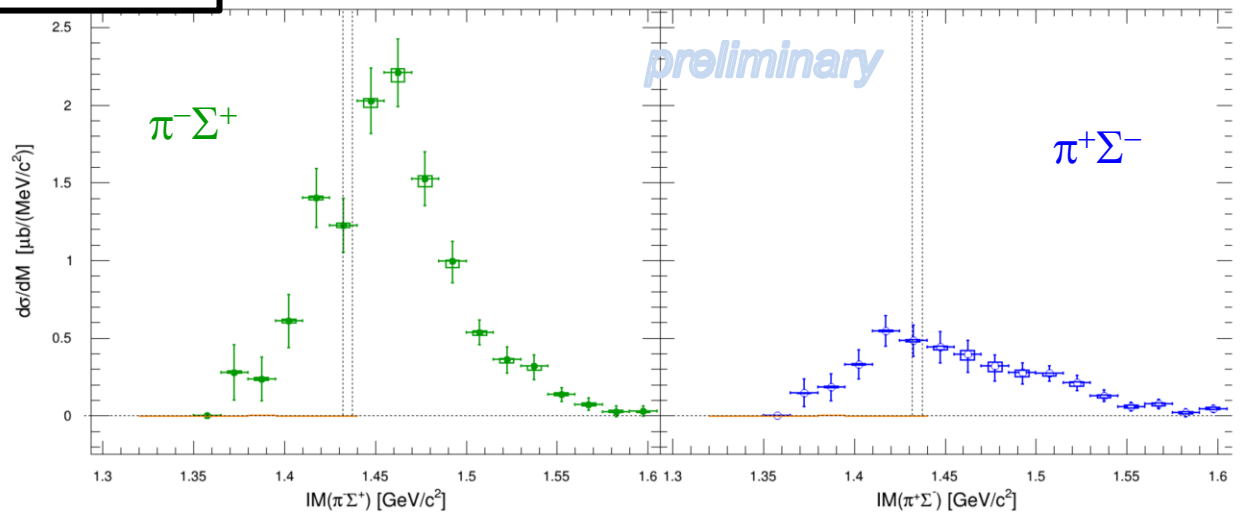
Large C.S. at small neutron scattering angle
(= small q)

IM($\pi^{\mp}\Sigma^{\pm}$) spectrum

0.3 < q < 0.65 GeV/c

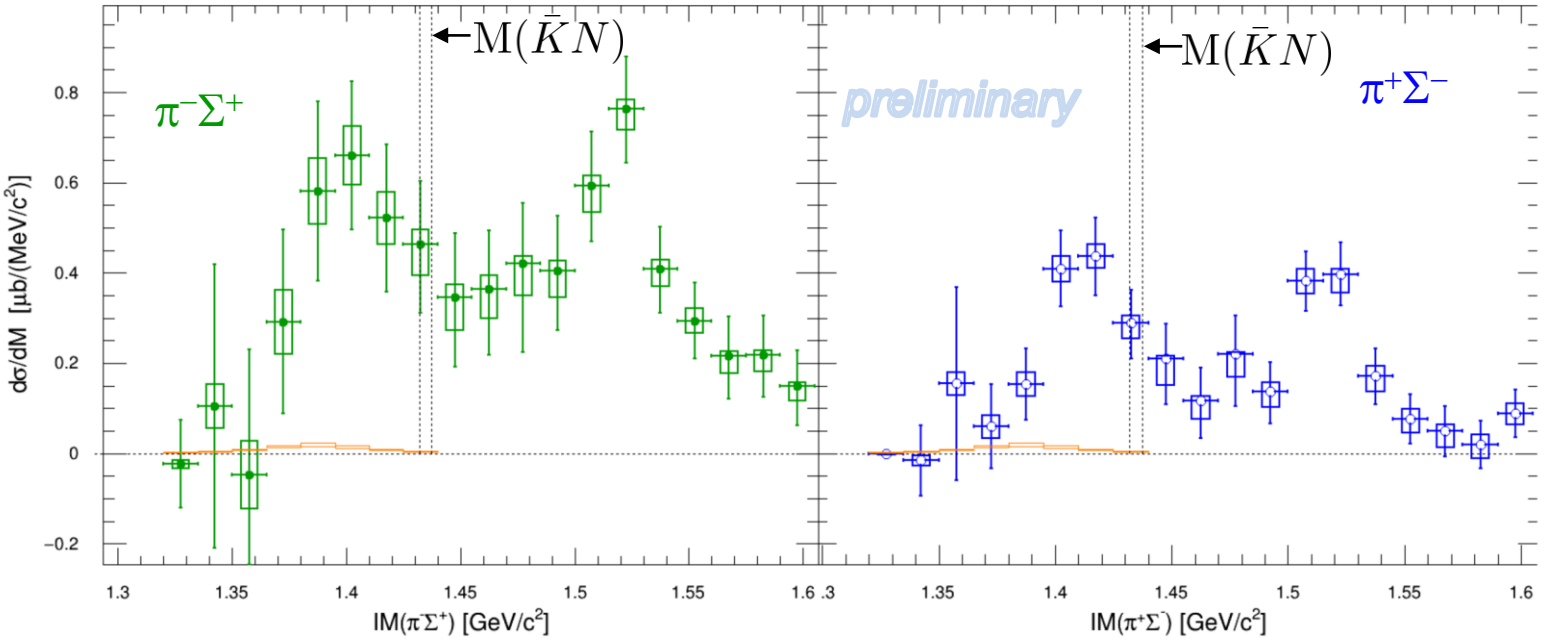


q < 0.3 GeV/c



IM($\pi^{\mp}\Sigma^{\pm}$) spectrum (large q region)

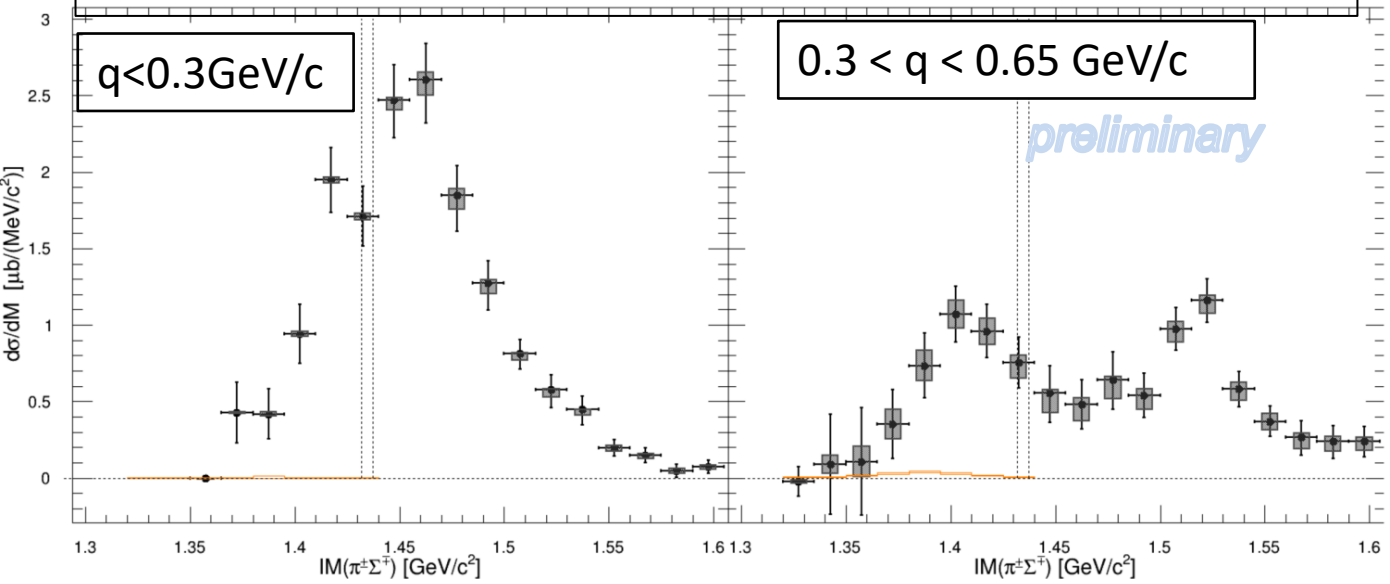
0.3 < q < 0.65 GeV/c



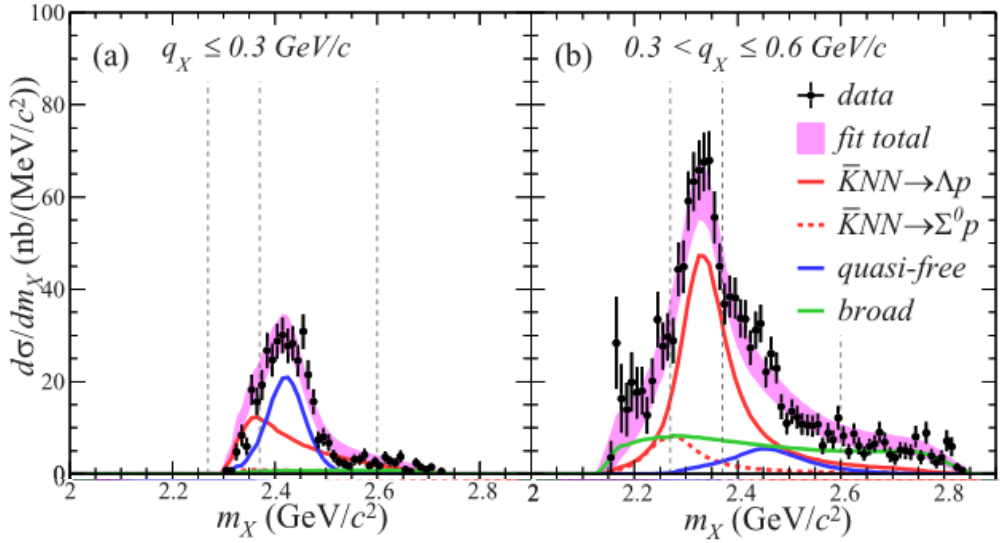
- Λ(1520)(3/2-) seen -> d-wave contribution
- $\Sigma(1385)^0(3/2+) \rightarrow \pi^{\pm}\Sigma^{\mp}$ (B.R. 12 %)

  estimated from $K^-d \rightarrow \Sigma(1385)^-p \rightarrow \Lambda\pi^- p$ × 1/2 (Isospin relation)

$\pi^-\Sigma^+ + \pi^+\Sigma^-$ charge sum spectrum



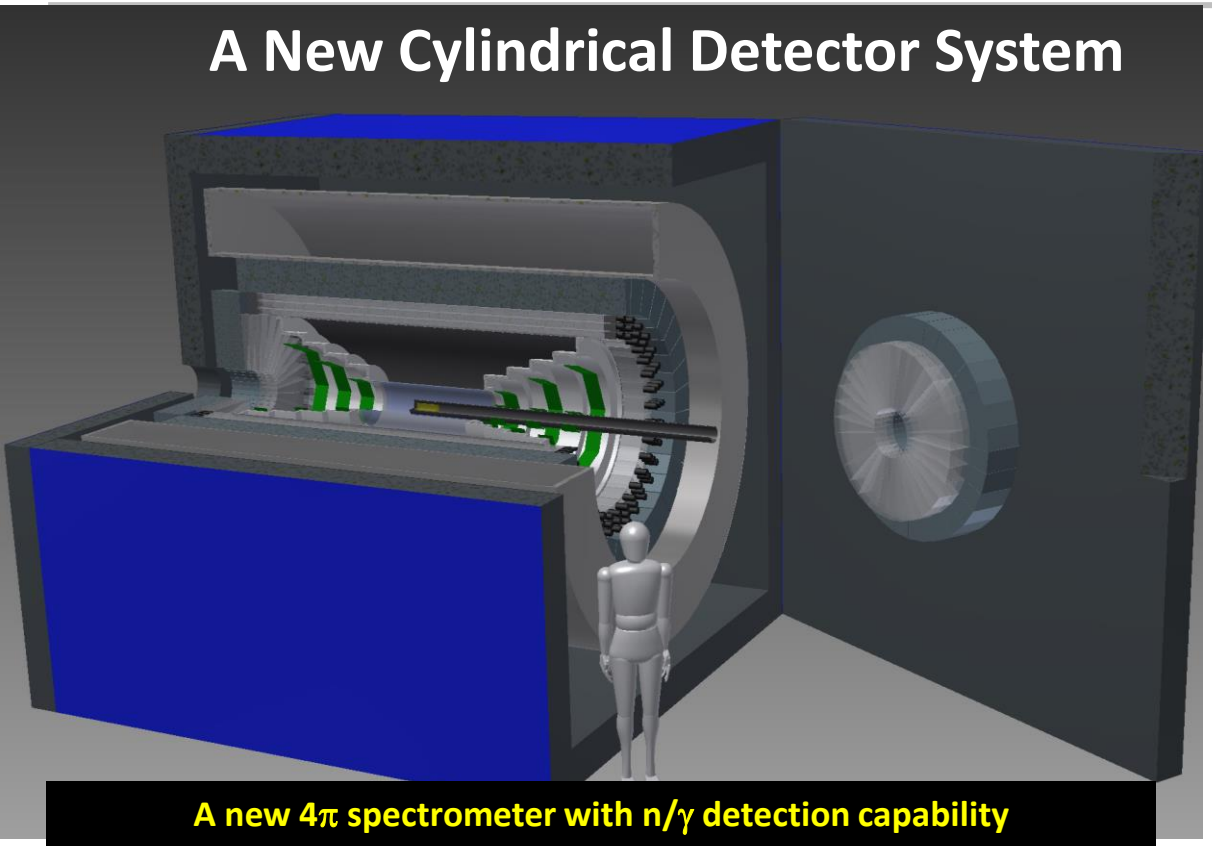
3He(K⁻, Λp)n PRC 102, 044002 (2020)



Different structure from "K⁻pp" in the spread of "q"

Important to understand both q distribution in a unified way

Future plan



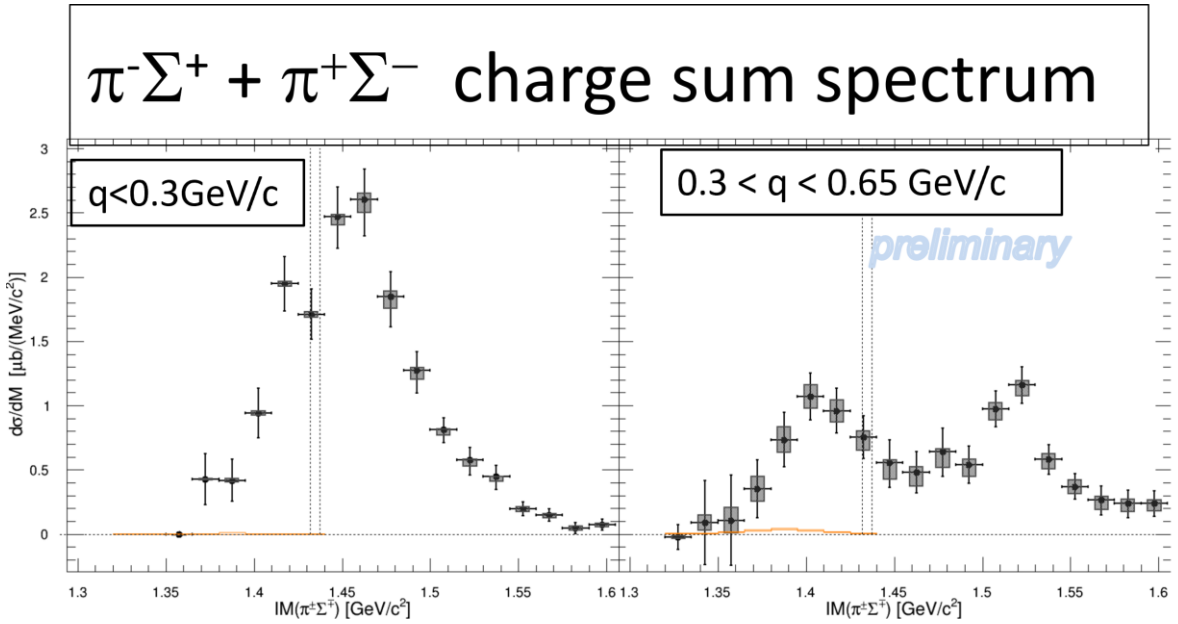
Ref:
E80 proposal (Search for K-ppn -> Λd/Λpn)
https://j-parc.jp/researcher/Hadron/en/pac_2007/pdf/P80_2020-10.pdf

High statistic data of K^-d

$\bar{K}N$ interaction:
q vs C.S.(Λ1405)

まとめ

K^-d 反応で生じる $\pi^{\pm}\Sigma^{\mp}$ 不変質量分布の運動量移行依存性を測定した

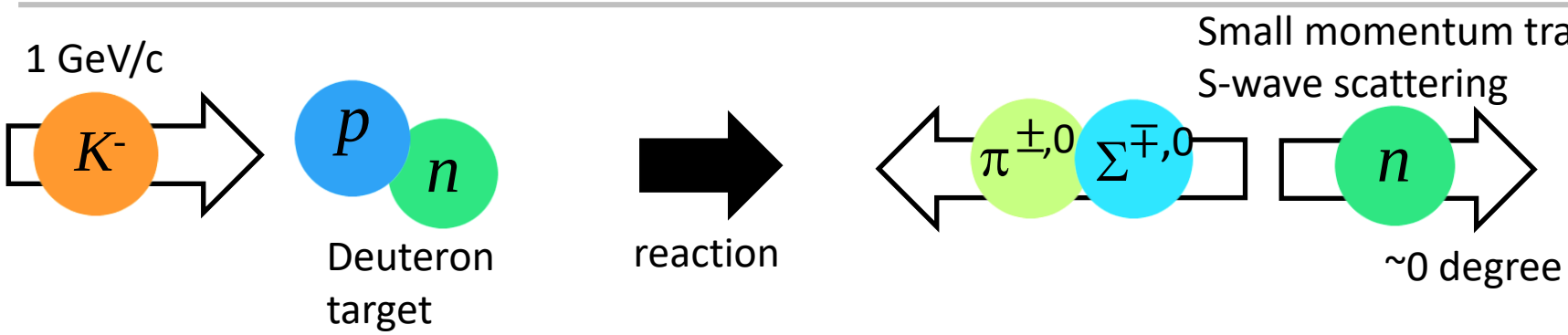


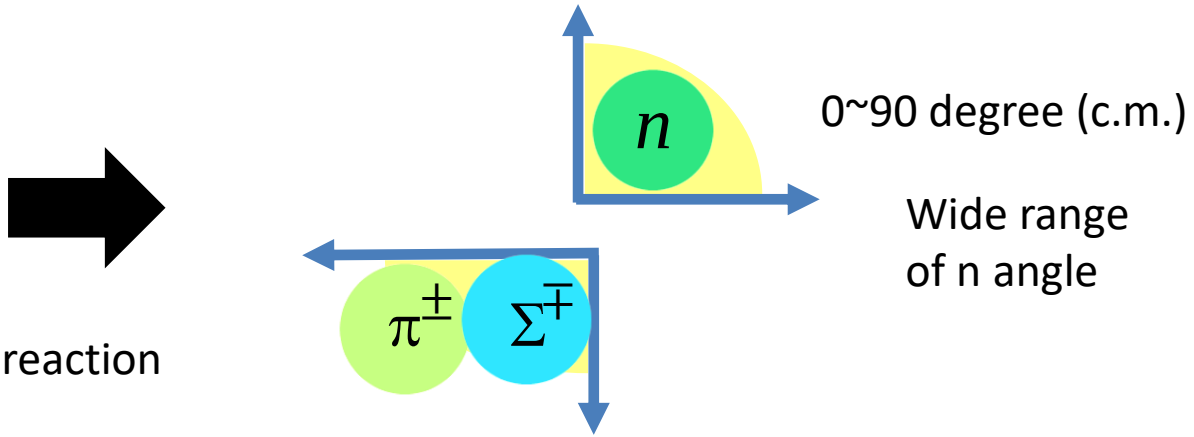
今後：

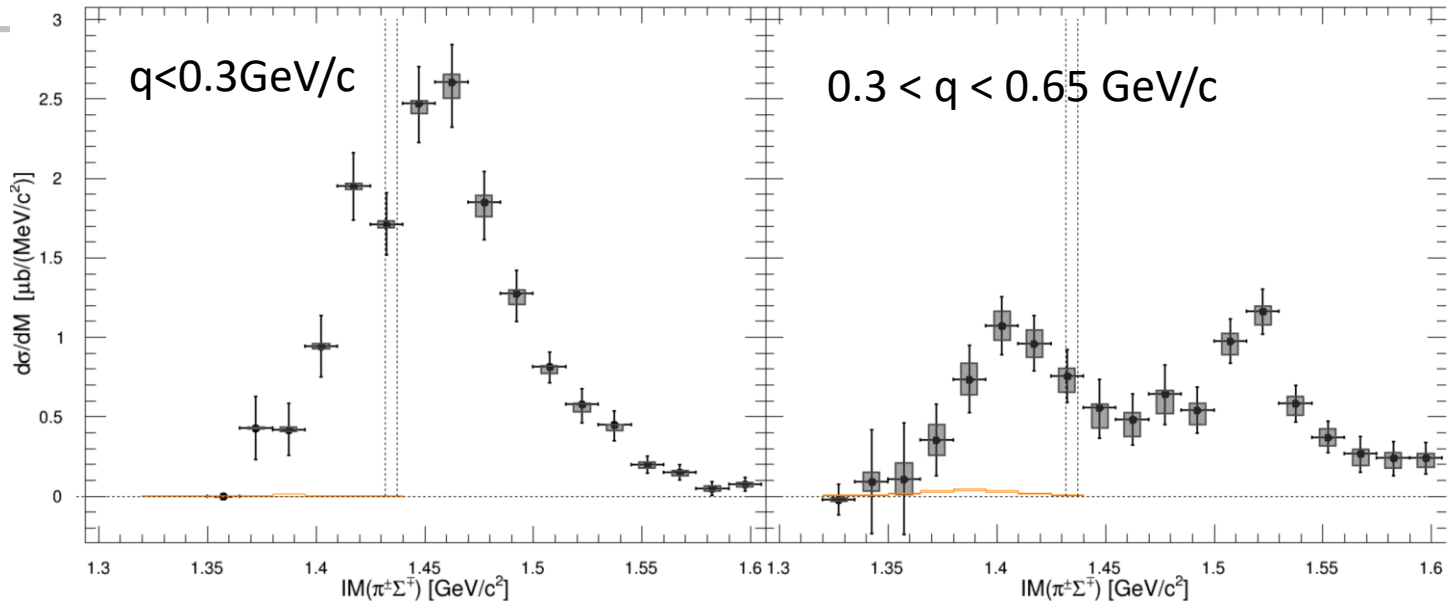
角分布も理論と比較

backup

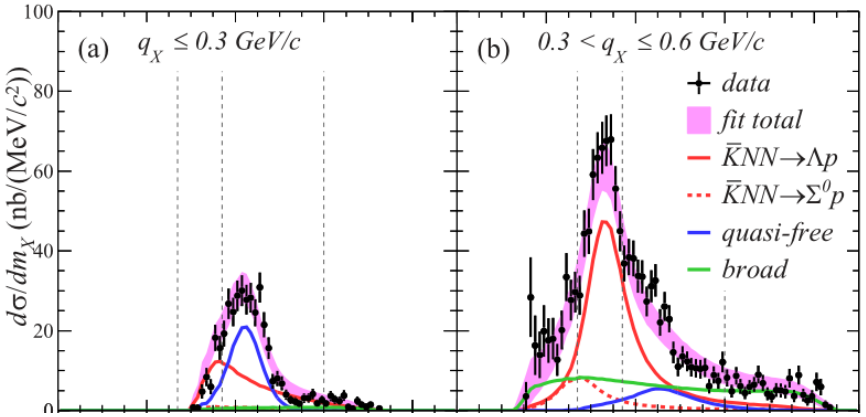
E31 analysis in different kinetic regions





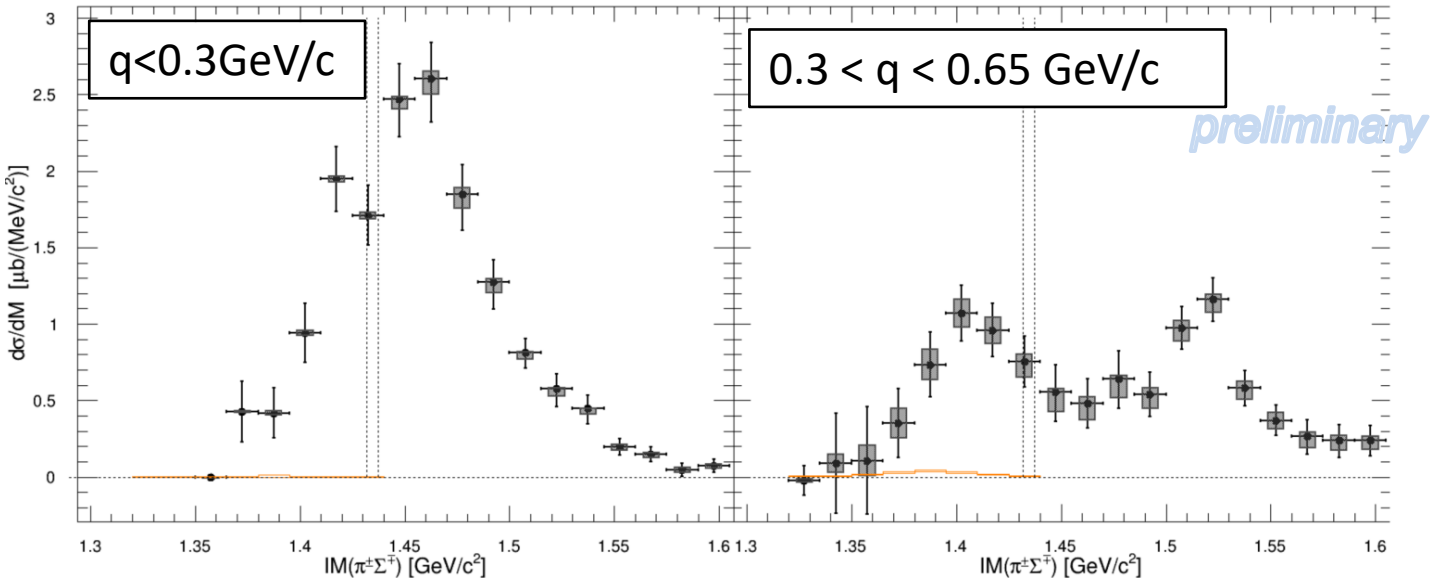


3He(K−, Λp)n PRC 102, 044002 (2020)



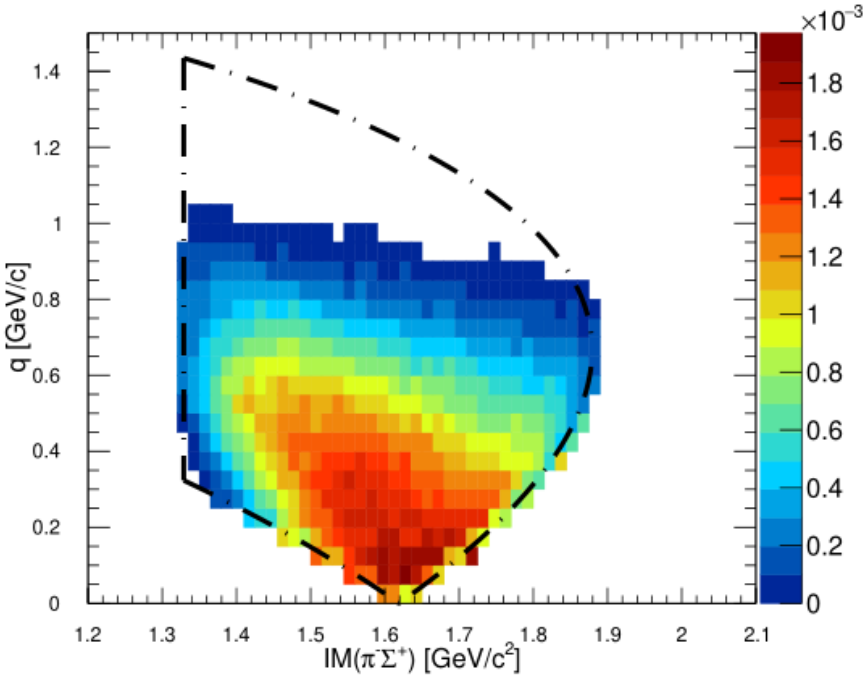
Λ(1405)はK-ppのbuilding blockではない？

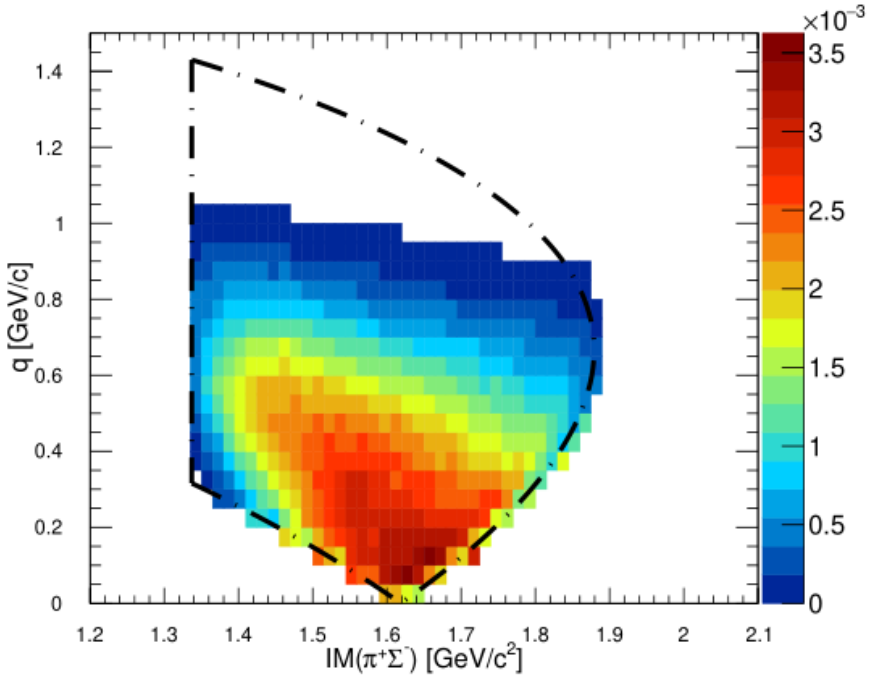
$\pi^-\Sigma^+ + \pi^+\Sigma^-$ charge sum spectrum



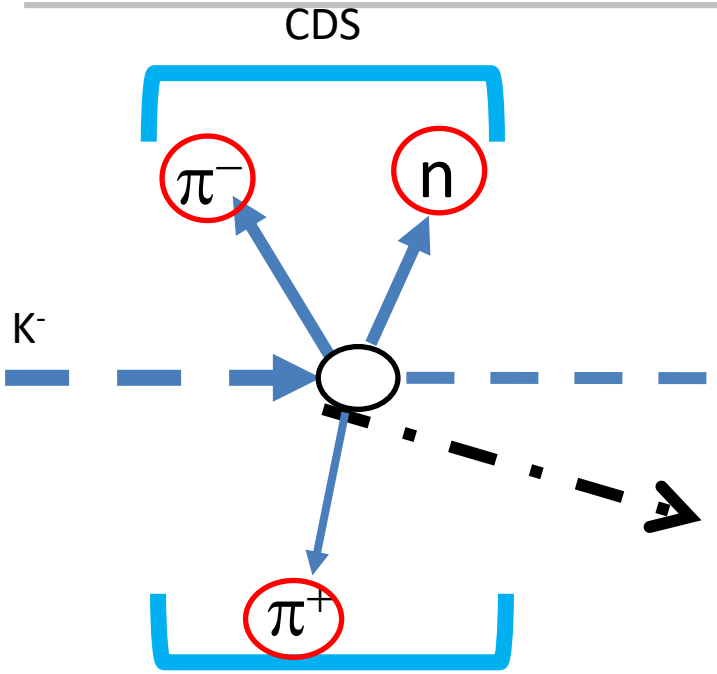
dσ/dM ~ $A|T_2^{I=0}|^2 + B|T_2^{I=1}|^2$

Acceptance map





カンペ



q=0.3 , M = 1.42
Θn = 11° (lab) ,17° (CM)

q=0.65 , M = 1.42
Θn = 36° (lab) ,57° (CM)