

# Production of $\Sigma(1385)$ at $p(4.5)p$

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# Outlines:

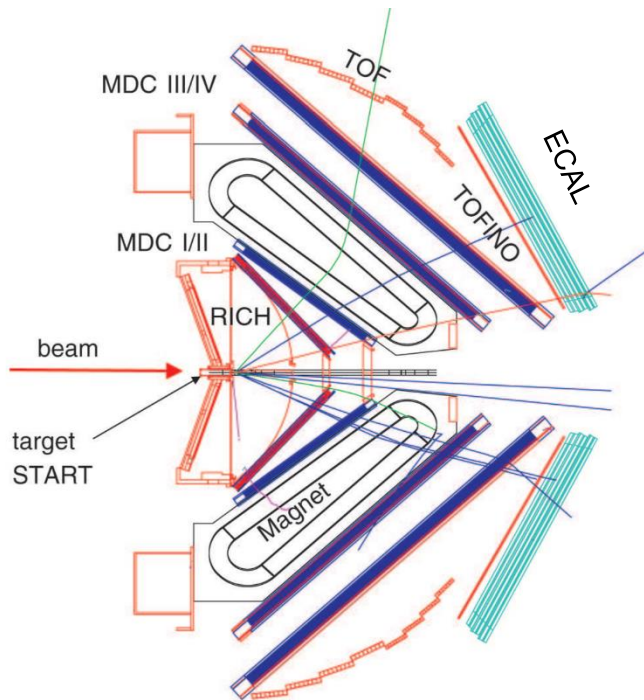
- Introduction.
- HADES spectrometer.
- Analysis strategy.
- Summary and outlook.

# Introduction:

- **Ultimate Goal:** Measurements of the *electromagnetic decays* of excited hyperons provide an important insight into their structure.
- *Investigation of the  $\Sigma(1385)^+$  resonance via its hadronic decay.*
- its investigation can supply some important information concerning the  $\Sigma(1385)^0$ .
- Also the line shapes of the two resonances should at least be similar, what can serve as a cross check for the  $\Sigma(1385)^0$  reconstruction.
- In addition the *hyperon reconstruction* will benefit from the proposed *Forward Detector* extending the HADES acceptance to forward direction essential for the reconstruction of the proton from hyperon decays.

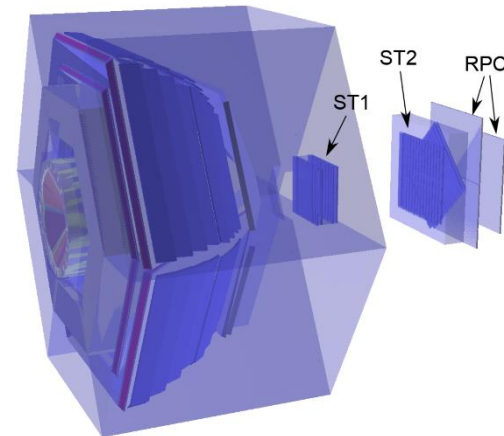
# HADES Spectrometer and future forward detector:

HADES

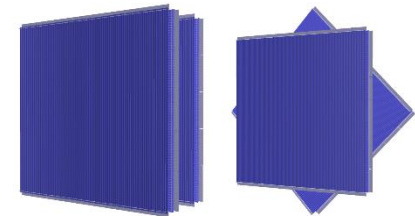


Forward Detector

➤ Polar angle  $0.5^\circ - 6.5^\circ$

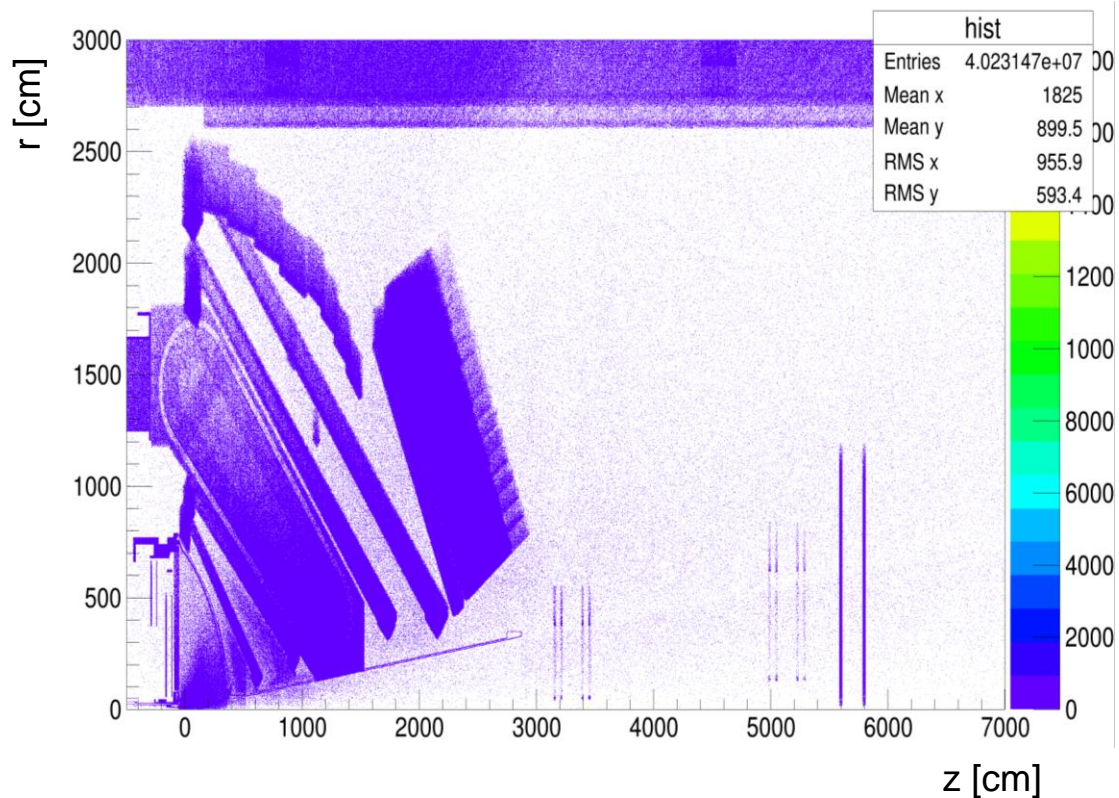
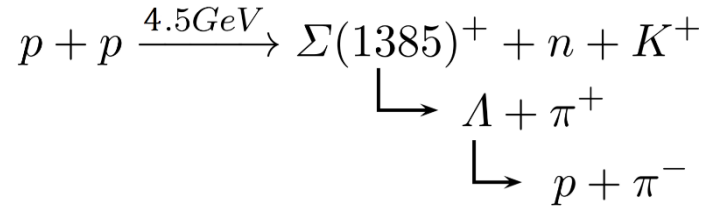


➤ Eight double layers 0, 90, 0, 90, and 0, 90, +45, -45



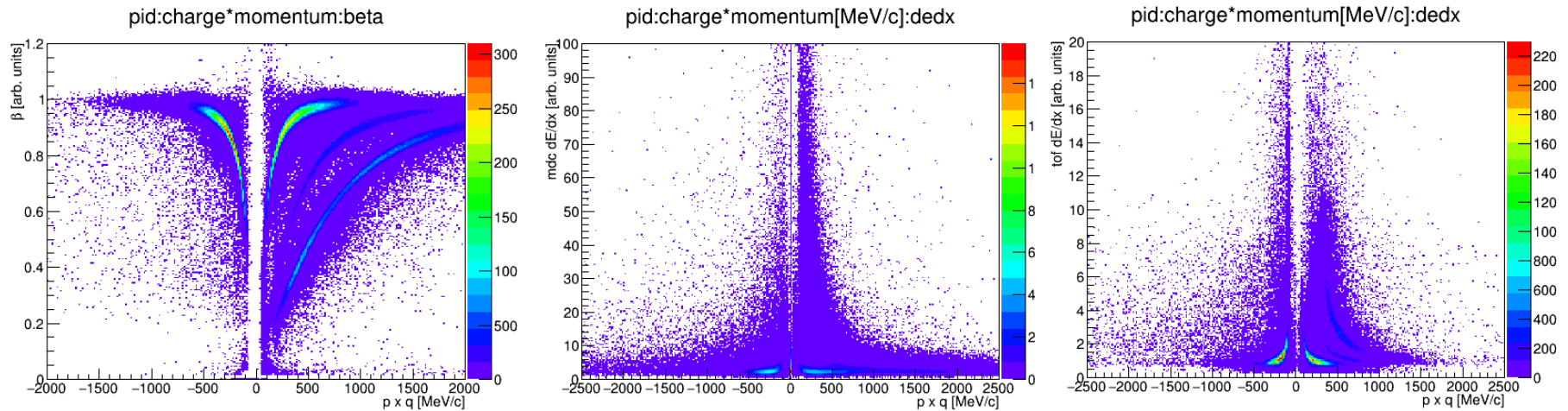
# Analysis Strategy:

- Production of  $\Sigma(1385)^+$  (Pluto++) 1 million events:



# Analysis Strategy:

- Utilize energy loss and velocity information to train an artificial neural network (ANN) to identify signal particles.

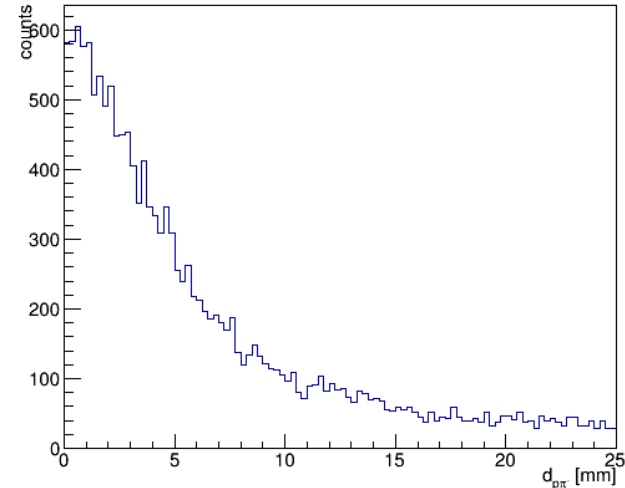
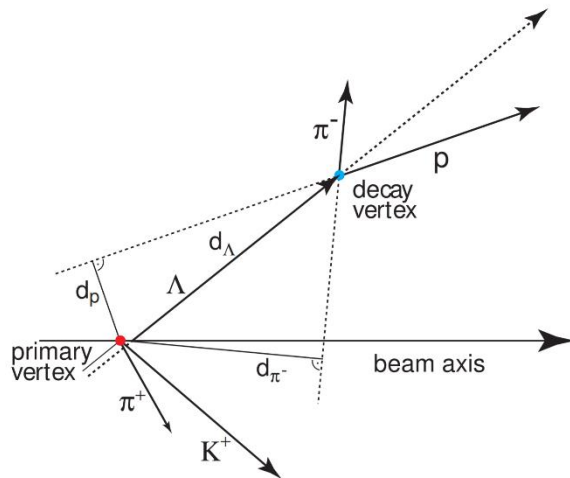


# Analysis Strategy:

- Lambda Reconstruction:

- **Primary vertex:** intersection between  $\pi^+$  and  $K^+$  tracks.

- **Decay vertex:** intersection between  $\pi^-$  and P tracks.



Distance of secondary vertex to primary vertex

$$d_{\Lambda} > 15 \text{ mm}$$

Minimum distance between proton and  $\pi^-$  track

$$d_{p\pi^-} < 20 \text{ mm}$$

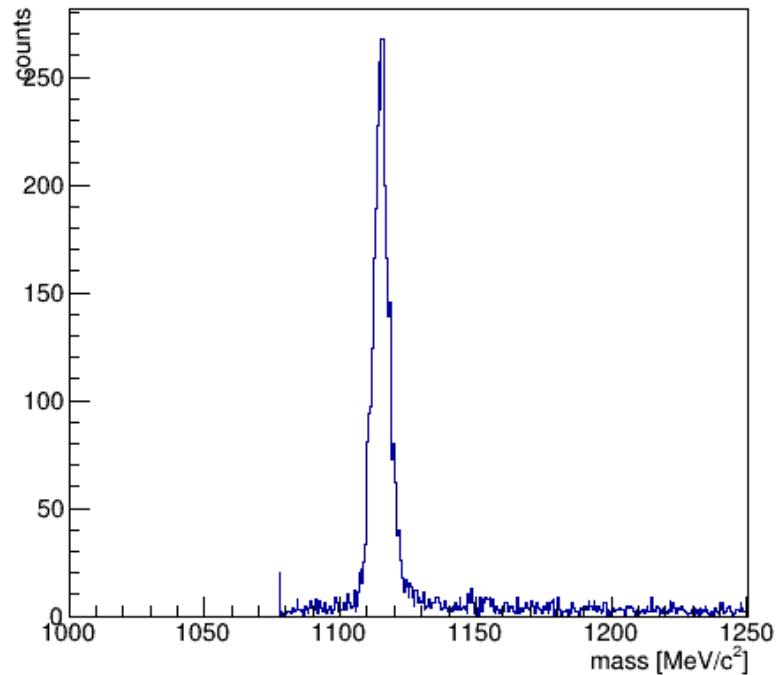
Distance of  $\pi^-$  track to primary vertex

$$d_{\pi^-} > d_p$$

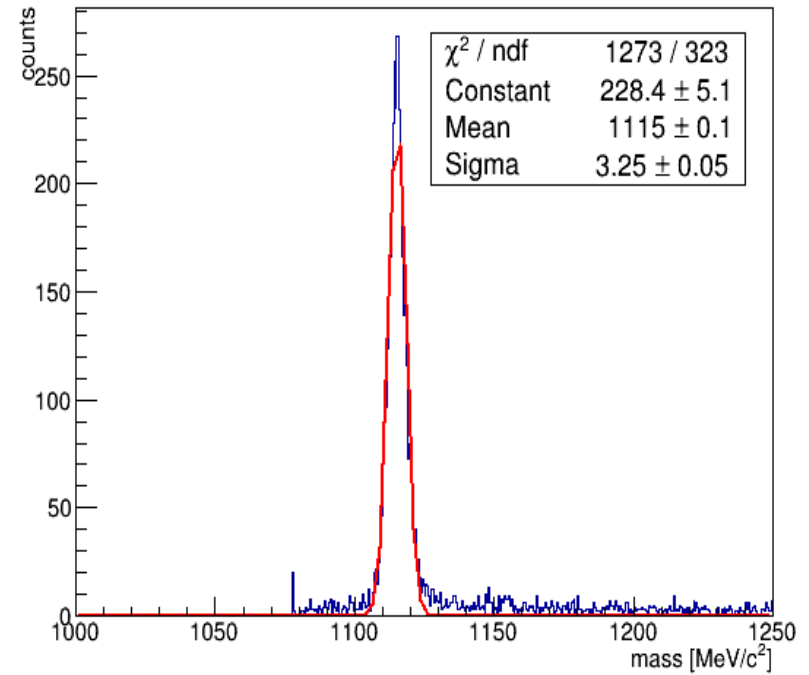
# Analysis Strategy:

- Lambda Reconstruction:

$\Lambda$  invariant mass



$\Lambda$  invariant mass

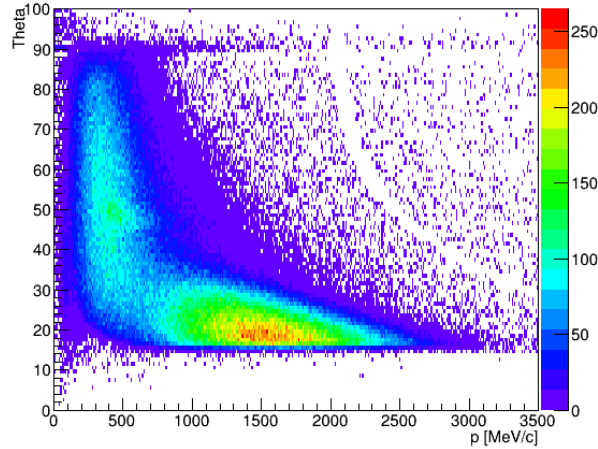




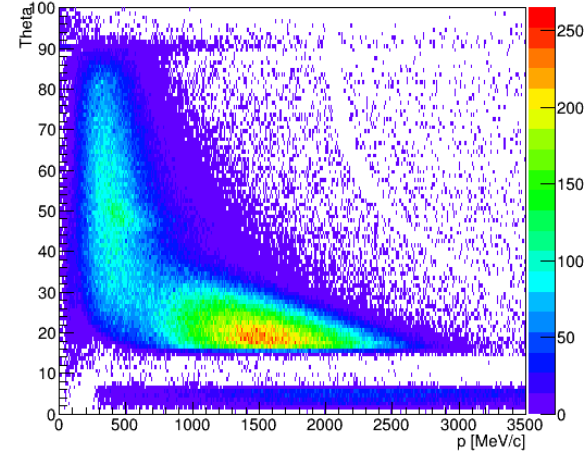
# Analysis Strategy:

- Lambda Reconstruction with Forward Detector:

P+ HADES

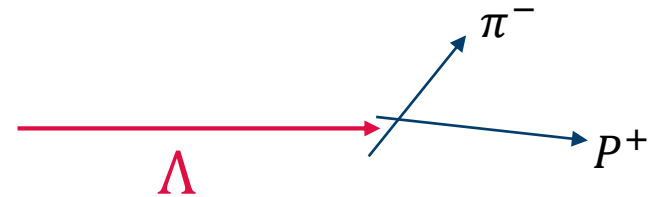
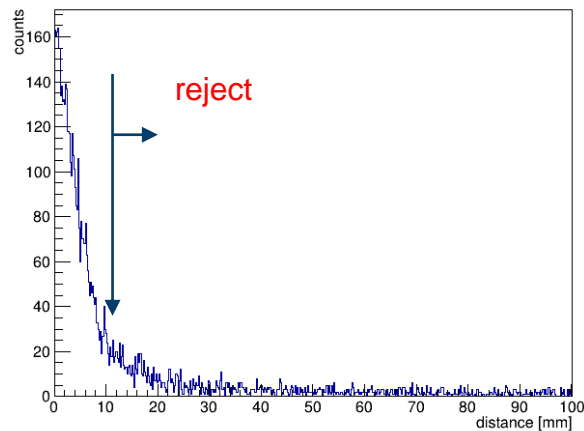


P+ HADES+FwDet



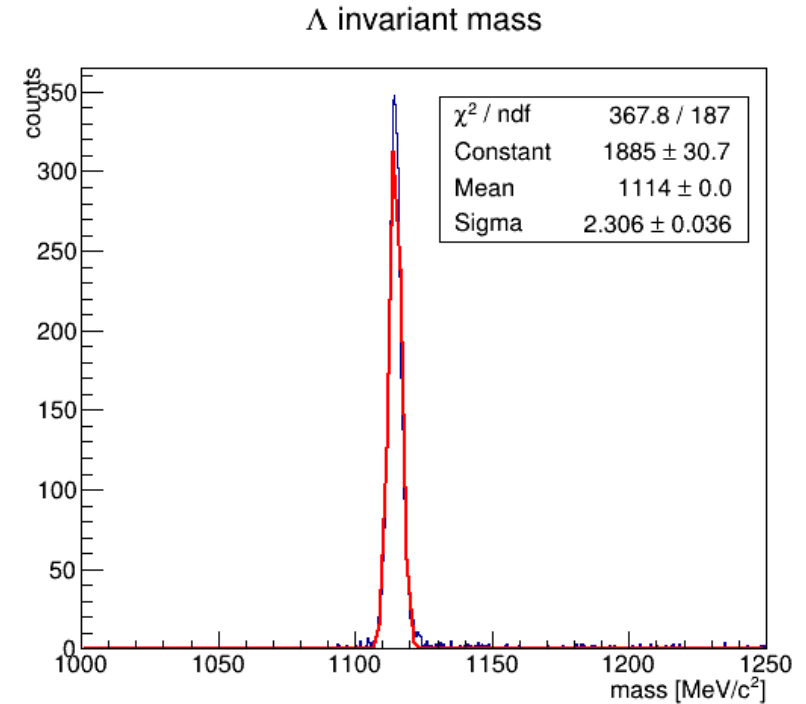
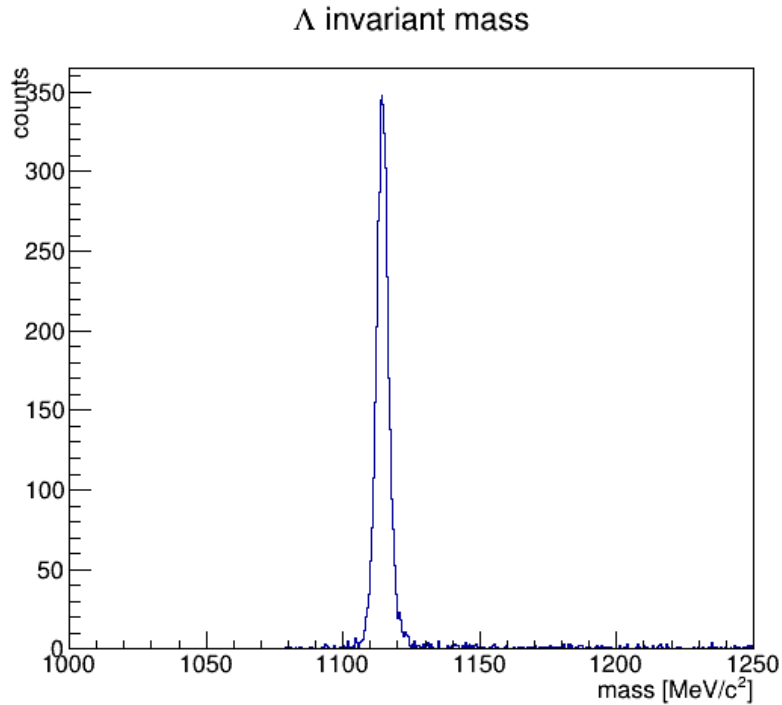
➤ *combine all tracks from the forward detector and  $\pi^-$  from HADES.*

Distance between tracks (hades, FwDet)



# Analysis Strategy:

- Lambda Reconstruction (HADES+FwDet):



# Analysis Strategy:

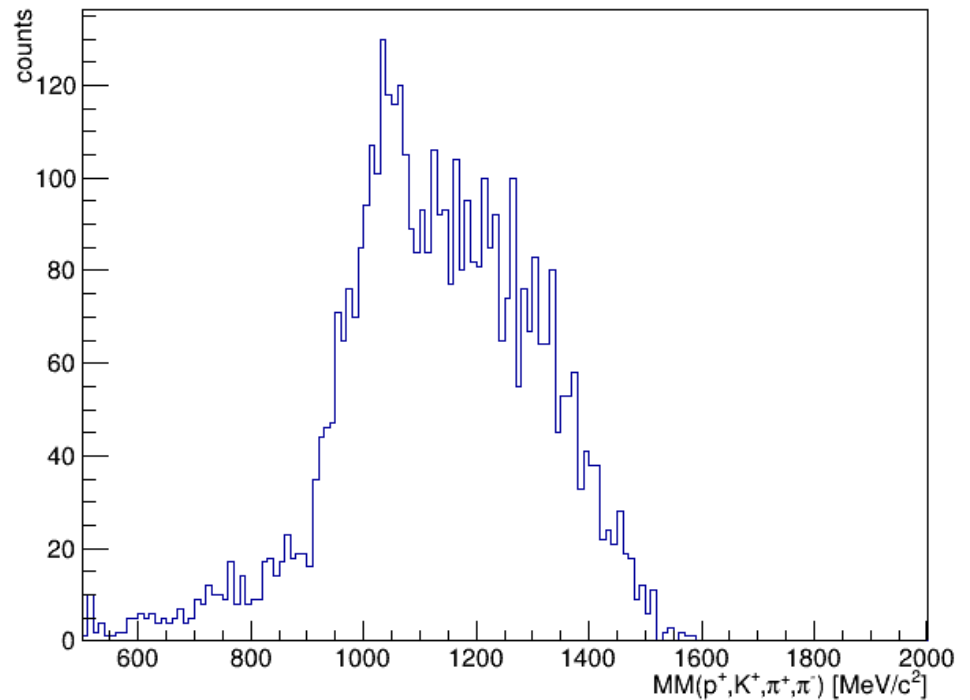
- Sigma Reconstruction:

➤ *selection of the neutron:*

$$m_{miss} = \frac{1}{c^2} \sqrt{\left(E_b + E_t - \sum_{i=1}^n E_i\right)^2 - \left(\vec{p}_b + \vec{p}_t - \sum_{i=1}^n \vec{p}_i\right)^2 c^2}$$

➤ *Cut on the missing mass:*

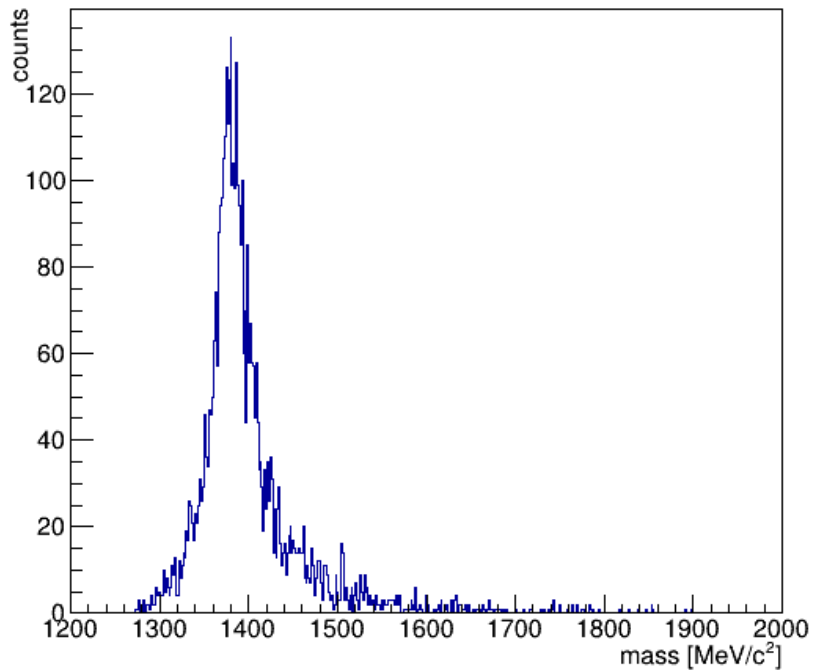
$$800 < MM(P^+K^+\pi^+\pi^-) < 1000 \text{ MeV}/c^2$$



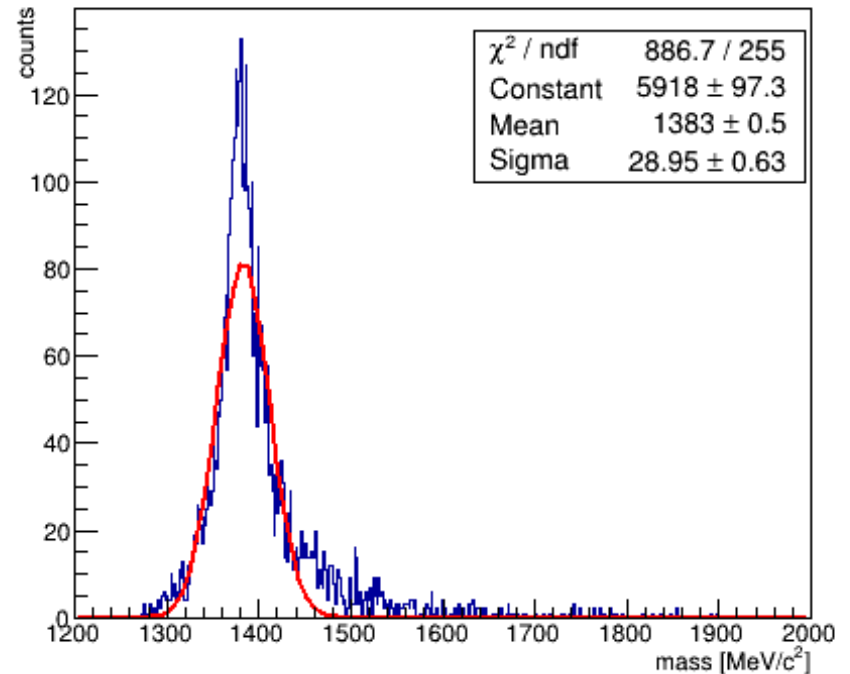
# Analysis Strategy:

- Sigma Reconstruction:

$\Sigma(1385)^+$  invariant mass



$\Sigma(1385)^+$  invariant mass



# Summary and Outlook:

- Starting the analysis of  $\Sigma(1385)^+$  at beam momentum 4.5 GeV.
- Study of the proposed forward detector
  
- Simulation of  $\Sigma(1385)^+$  to real/virtual photon decays.
- Optimizing the analysis strategy to real/virtual photon decays.
- Including background processes

## References:

- J. Siebenson, Technische Universität München (2013)

Strange baryonic resonances below the KN threshold - Results from p+p reactions at the HADES experiment

- REPORT on  $\Xi$  and  $\Lambda$  production with the use of Pluto framework  
UPDATE

<https://indico.gsi.de/event/6041/>