



Status Update on Hyperons

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PANDA CM 21-3
October 27th, 2021



Outline

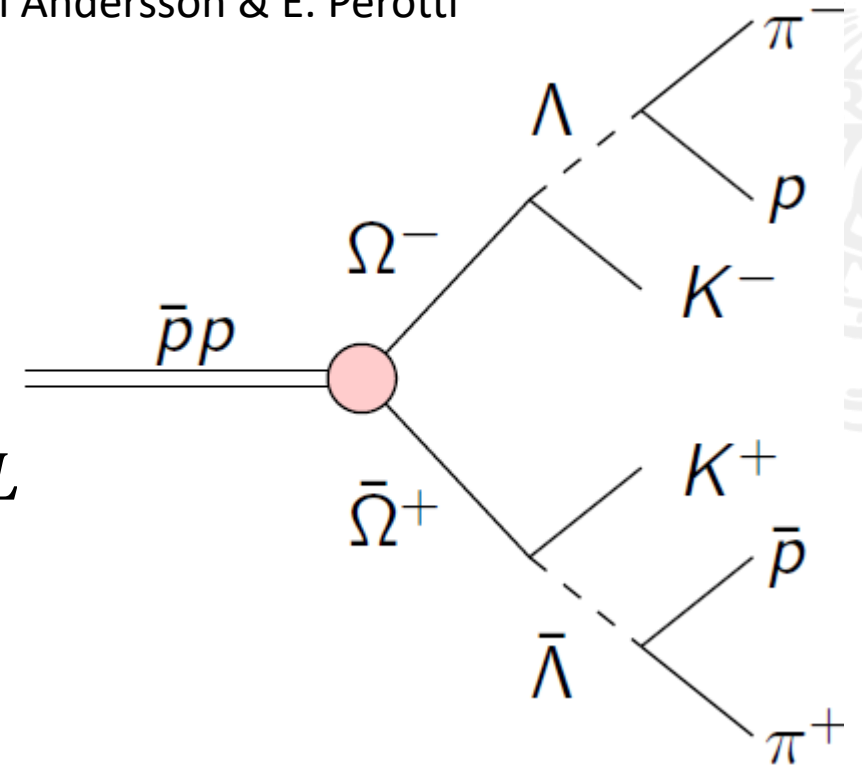
- Recent / current work
- What is coming next



Polarisation in $\bar{\Omega}^+ \Omega^-$

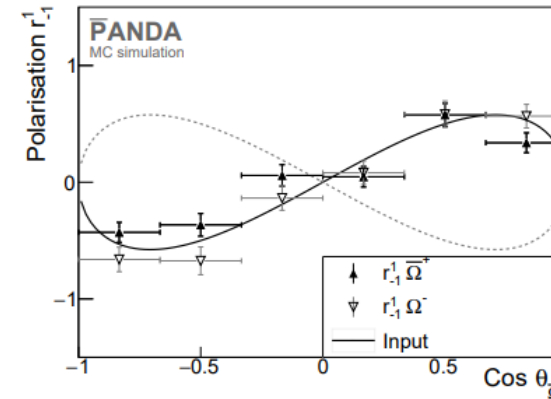
- Decays: $\Omega^- \rightarrow \Lambda K$, $\Lambda \rightarrow \pi^- p$
- Fifteen polarisation parameters:
 $r_M^L, L = 1, 2, 3, M = -L$
- Eight are zero due to symmetry
- Angular distribution of first decay $\Omega^- \rightarrow \Lambda K$:

$$\begin{aligned}
 I(\theta_\Lambda, \phi_\Lambda) = & \frac{1}{4\pi} \left[1 + \frac{\sqrt{3}}{2} (1 - 3 \cos^2 \theta_\Lambda) r_0^2 - \frac{3}{2} \sin^2 \theta_\Lambda \cos 2\phi r_2^2 + \frac{3}{2} \sin 2\theta_\Lambda \cos \phi r_1^2 \right. \\
 & - \frac{1}{40} \alpha \sin \theta_\Lambda (8\sqrt{15} r_{-1}^1 \sin \theta_\Lambda + 9\sqrt{10} r_{-1}^3 (3 + 5 \cos 2\theta_\Lambda \sin \phi_\Lambda) \\
 & \left. + 30(3r_2^3 \sin 2\phi_\Lambda \sin 2\theta_\Lambda + \sqrt{6} r_3^3 \sin 3\phi \sin^2 \theta_\Lambda)) \right]
 \end{aligned}$$

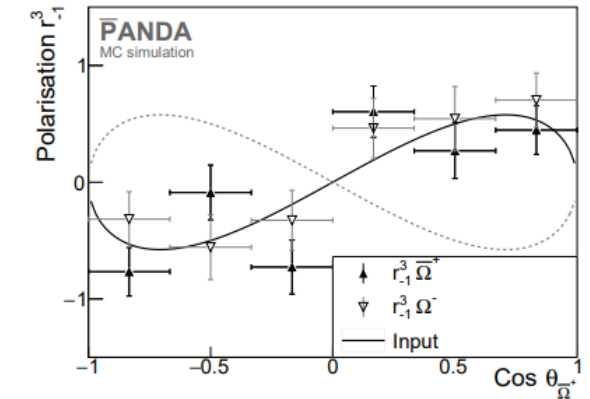


$\bar{\Omega}\Omega$ Spin Observables

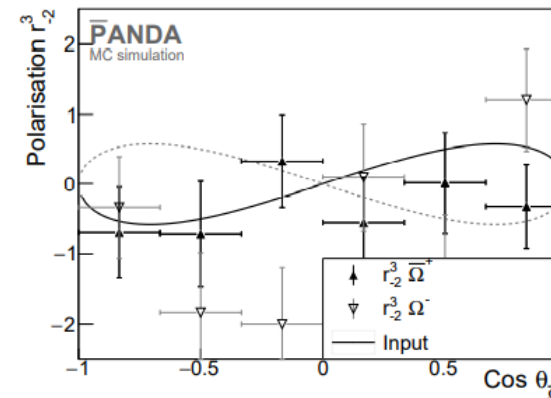
- No data on the market
- Spin density formalism for spin 3/2 case
- Different luminosity / cross-section scenarios have been studied
- Simulations have been done, release note review currently on halt



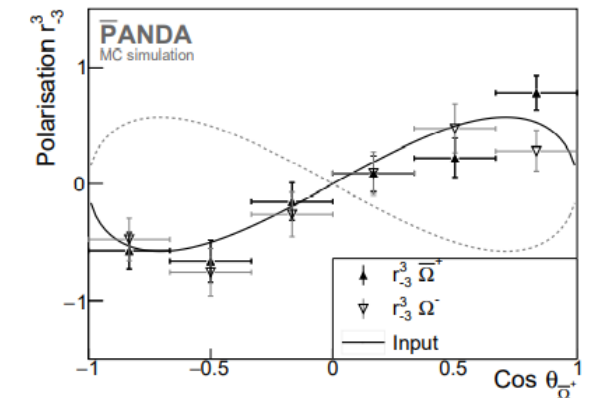
(a)



(b)



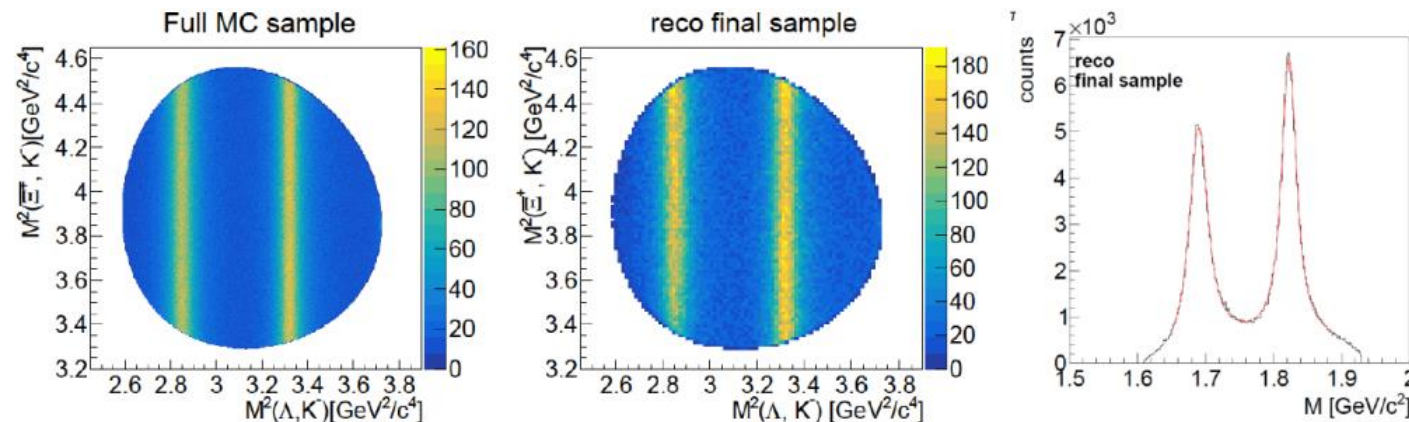
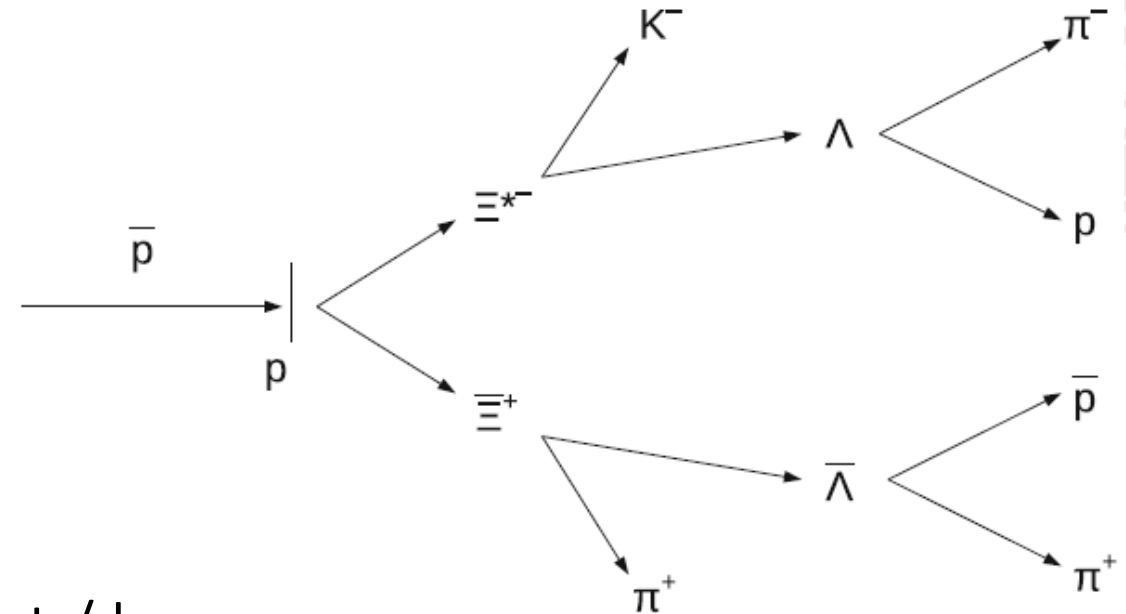
(c)



(d)

Feasibility study of $\bar{p}p \rightarrow \bar{\Xi}^+ \Lambda K^- + c.c.$

- Simplified simulation framework
- $p_{beam} = 4.6 \text{ GeV}/c$
- $\sigma = 1 \mu\text{b}$ and $L = 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$
- Results*
 - Efficiency $\sim 5\%$, $\frac{S}{B} \sim 20$
 - ~ 37000 exclusive $\bar{\Xi}^+ \Lambda K^- + c.c.$ events/day



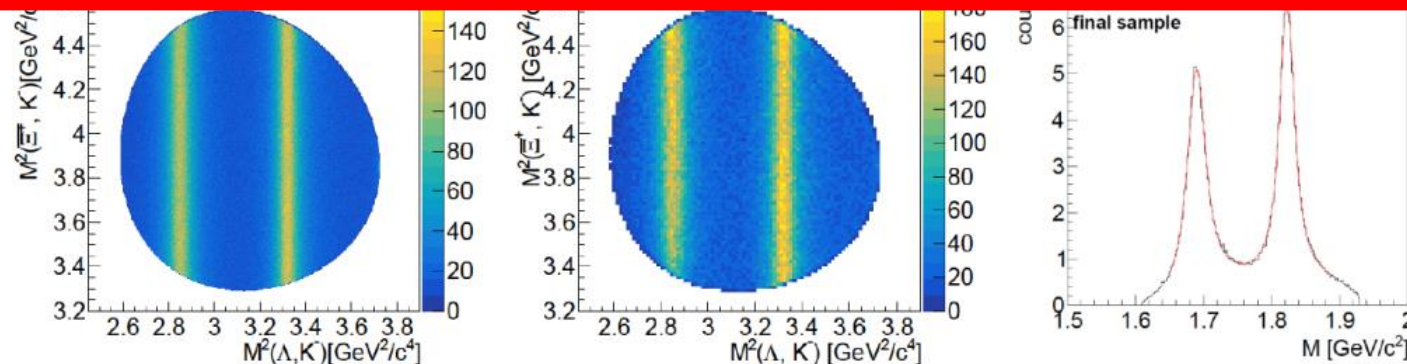
Simulations by J. Puetz
and A. Gillitzer

Feasibility study of $\bar{p}p \rightarrow \bar{\Xi}^+ \Lambda K^- + c.c.$

Prospects for Spin-Parity Determination of Excited Baryons

Paper release talk by J. Puetz

Thursday, 17:00

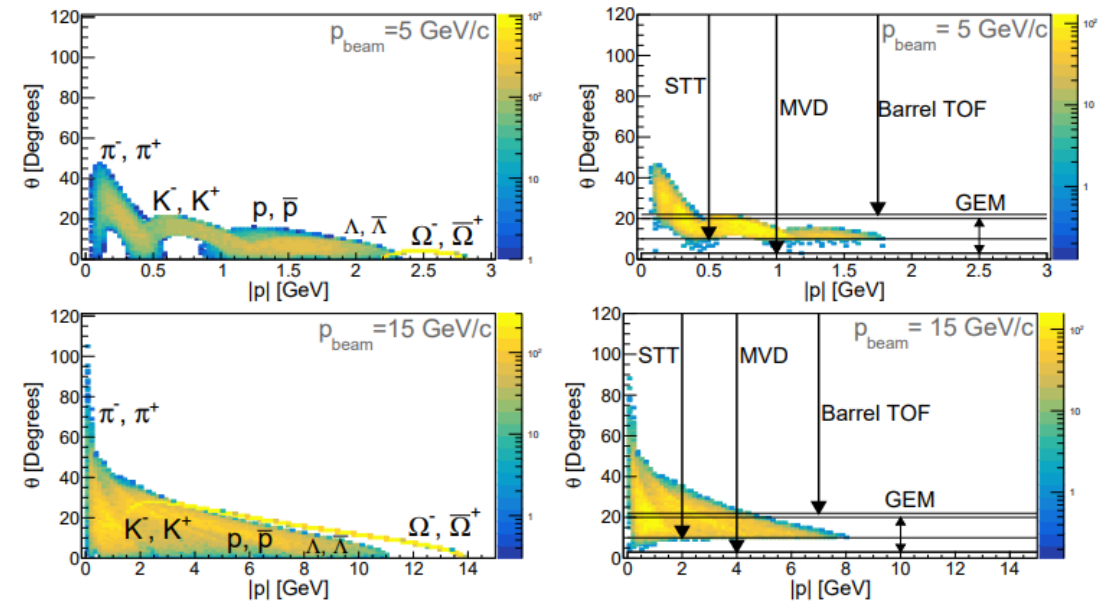
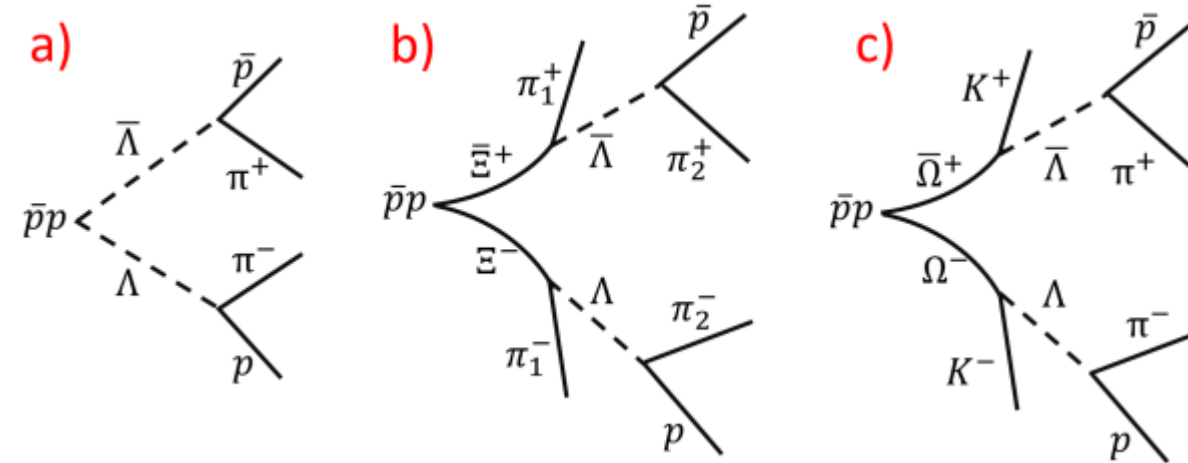


Simulations by J. Puetz
and A. Gillitzer

Detector signatures in hyperon reactions

J. Regina

- Simulation of different $\bar{Y}Y$ final states
- Thorough study of expected signatures in all relevant sub-detectors
- New: $\bar{\Omega}\Omega$ near-threshold simulations



Detector signatures in hyperon reactions

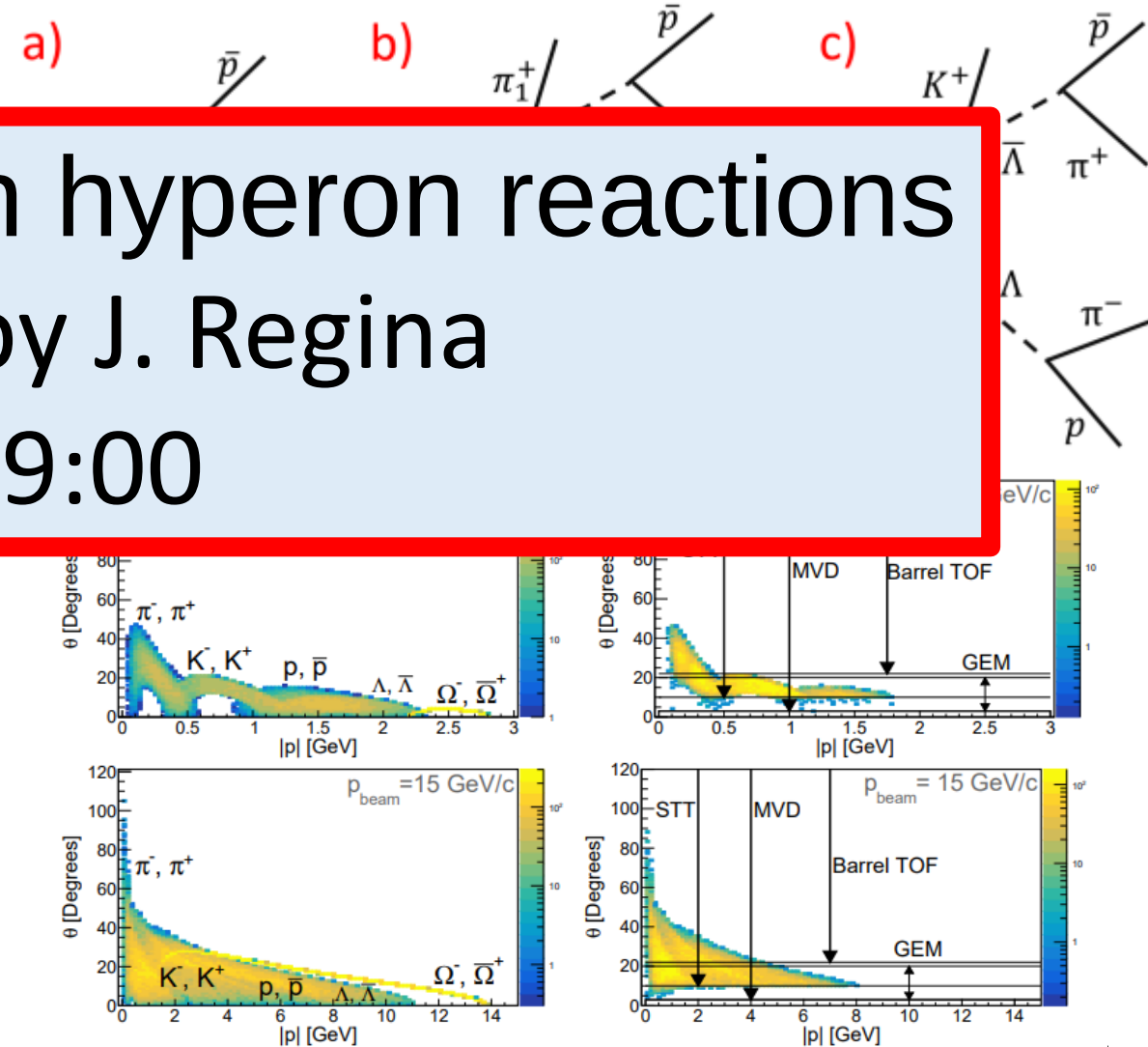
J. Regina

Detector signatures in hyperon reactions

Release talk by J. Regina

Friday, 9:00

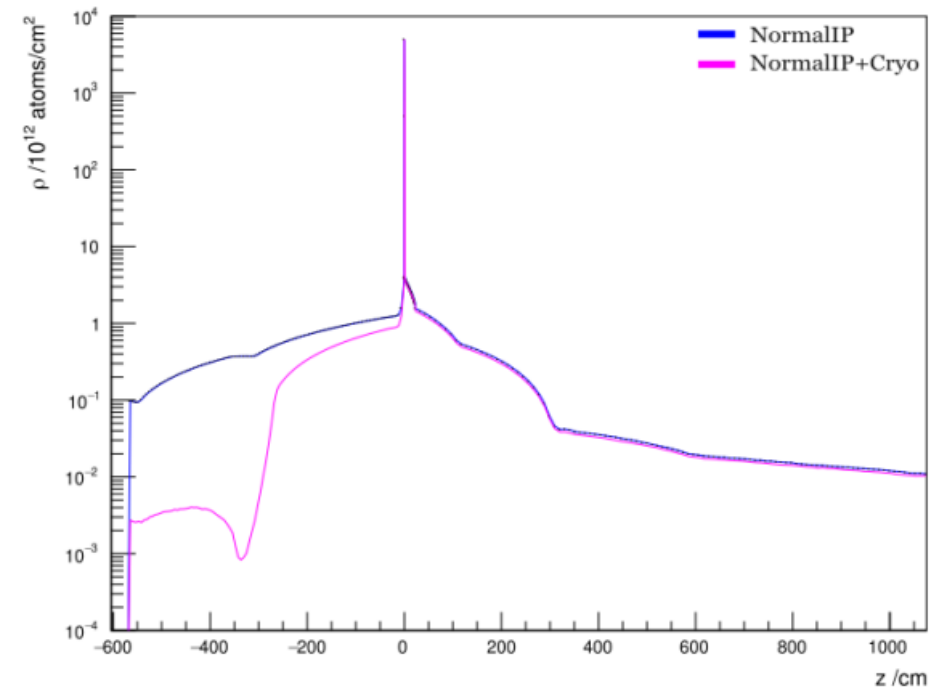
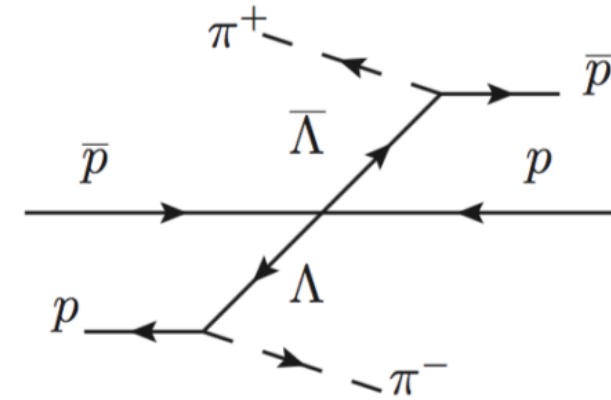
- New: $\Omega\Omega$ near-threshold simulations



Simulation studies on realistic target scenarios

A. Akram

- $\bar{\Lambda}\Lambda$ simulations with realistic gas density distributions
- Study impact on background suppression
- High relevance for processes involving displaced vertices



Simulation studies on realistic target scenarios

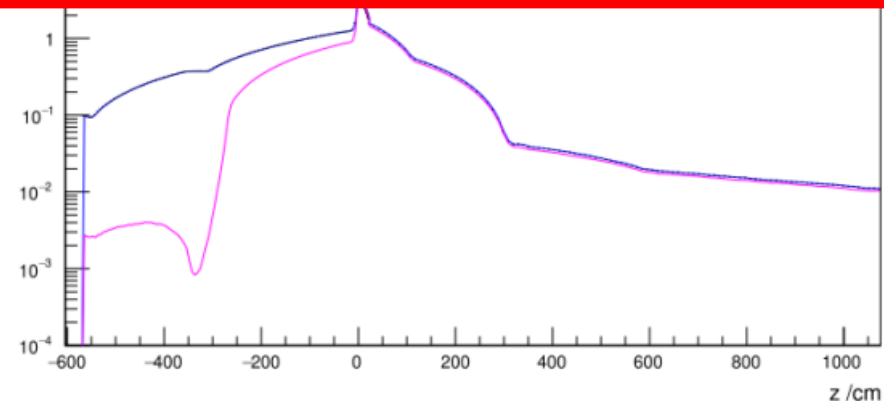
A. Akram



Simulation studies on realistic target scenarios

Release talk by A. Akram

Thursday, 15:45



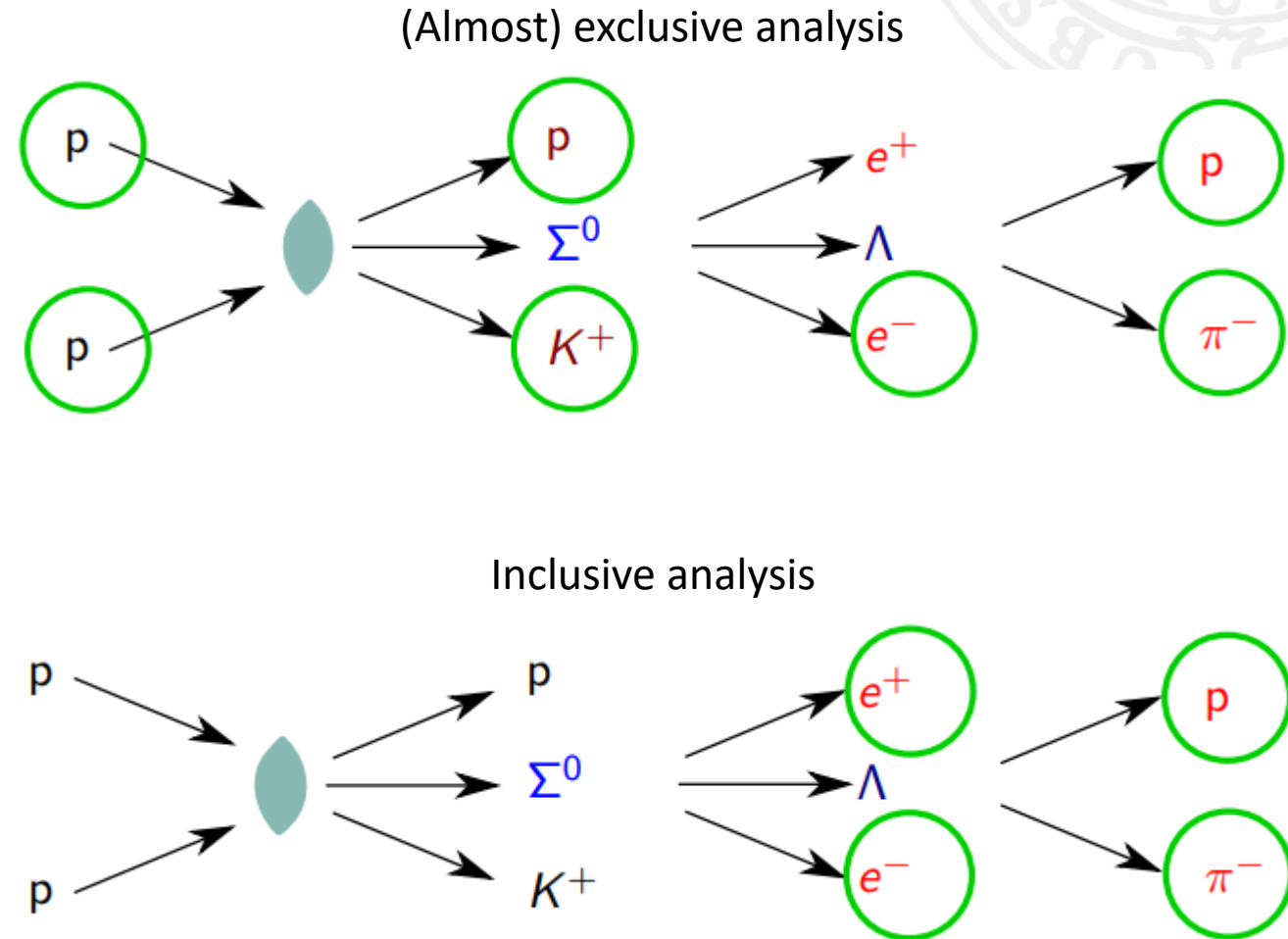
Ongoing work

TUESDAY, 26 OCTOBER			
4:30 PM	→ 5:10 PM	Investigating Σ^0 Production mechanism In $p(3.5\text{GeV})+p$ Collisions Speaker: Waleed Esmail (Forschungszentrum Jülich(FZJ))	⌚ 40m 
5:10 PM	→ 5:30 PM	Status/Progress of the Hyperatom and Hypernuclei experiments Speaker: Marcell Steinen (HI/JGU Mainz)	⌚ 20m 
5:30 PM	→ 5:50 PM	Discussion Speaker: Michael Papenbrock (Uppsala University(UU))	⌚ 20m 
WEDNESDAY, 27 OCTOBER			
9:00 AM	→ 9:20 AM	Update on the Lambda analysis using kinematic fitting Speaker: Jenny Regina (Uppsala University(UU))	⌚ 20m 
9:20 AM	→ 9:50 AM	Three-body Interactions In Hypermatter and Hypernuclei Speaker: Horst Lenske (JLU Gießen)	⌚ 30m 
9:50 AM	→ 10:10 AM	Status update on hyperons Speaker: Michael Papenbrock (Uppsala University(UU))	⌚ 20m 
10:10 AM	→ 10:30 AM	Discussion Speaker: Michael Papenbrock (Uppsala University(UU))	⌚ 20m 

Ongoing: Σ^0 Dalitz Decay with PANDA @ HADES

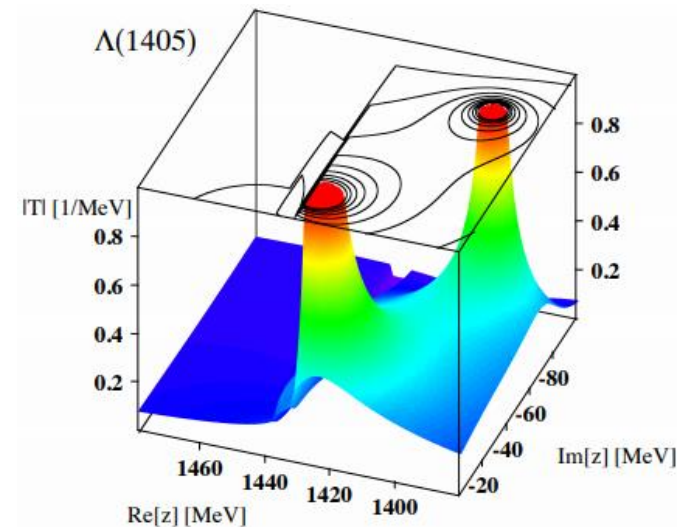
J. Rieger

- $\Sigma^0 \Lambda$ transition form factors
- Probes low- q^2 region
- Complementary analysis strategies
- Development of kinematic fitter
- HADES beam time in spring 2022



On the horizon

- $\overline{\Sigma}^0 \overline{\Lambda}$ transition form factors at PANDA
- Near-threshold simulations of various $\overline{Y} Y$ channels
- $\Lambda(1405) X$ double pole structure
 - Scan from $\overline{\Lambda} \overline{K} N$ to $\overline{\Lambda} \Sigma \pi$ threshold
 - Determine position of second pole



Summary

- Increasing understanding of PANDA's capabilities for hyperons
- Progress towards more realistic simulations
- Interesting ideas for the future
- Some open questions
 - Simulation standards
 - Secondary track reconstruction
 - What to prioritise for Phase 2

Thank you for your attention!

