Antikaon absorption in pion-induced reactions

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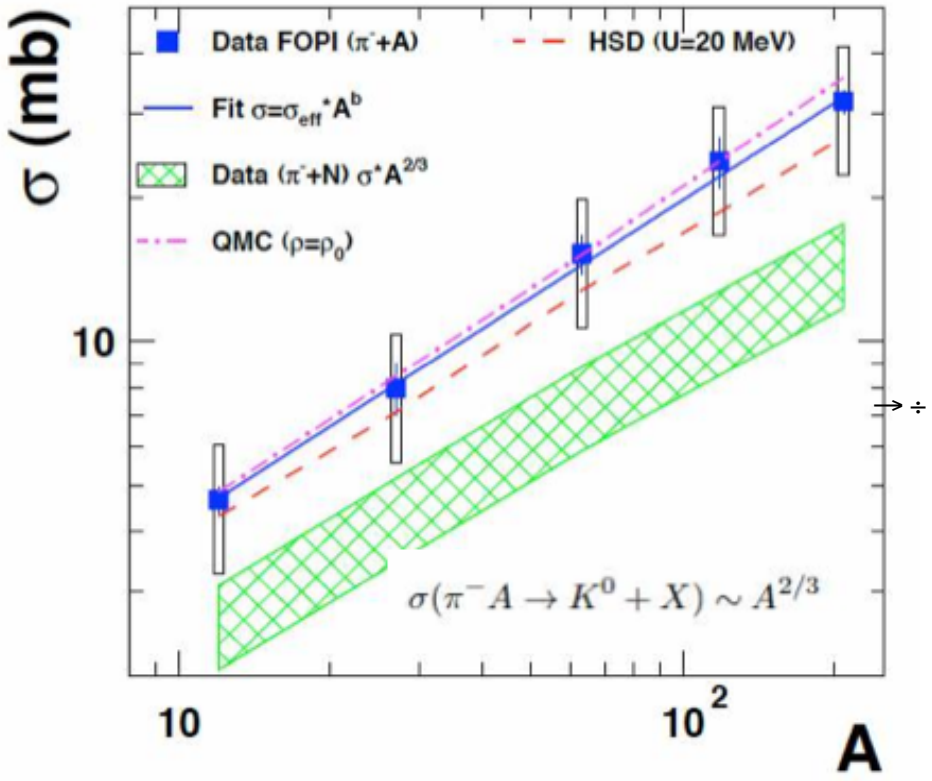
3rd Strangeness Workshop - Spring 2016

23.04.2016

K^0_S Cross-Section

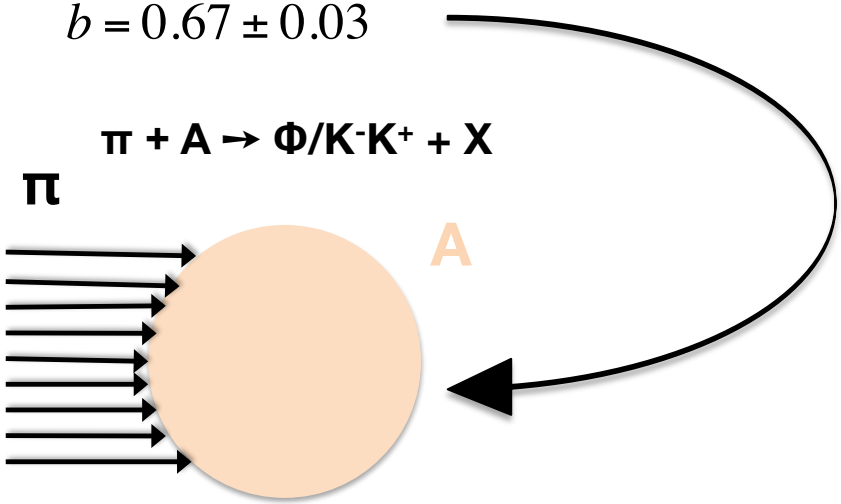
Benabderrahmane et al. Phys. Rev. Lett. Bd. 102, 182501 (2009)



$$\sigma\left(\pi^- + A \rightarrow K^0 + X\right) = \sigma_{eff} \cdot A^b$$

$$\sigma_{eff} = 0.87 \pm 0.13\ mb$$

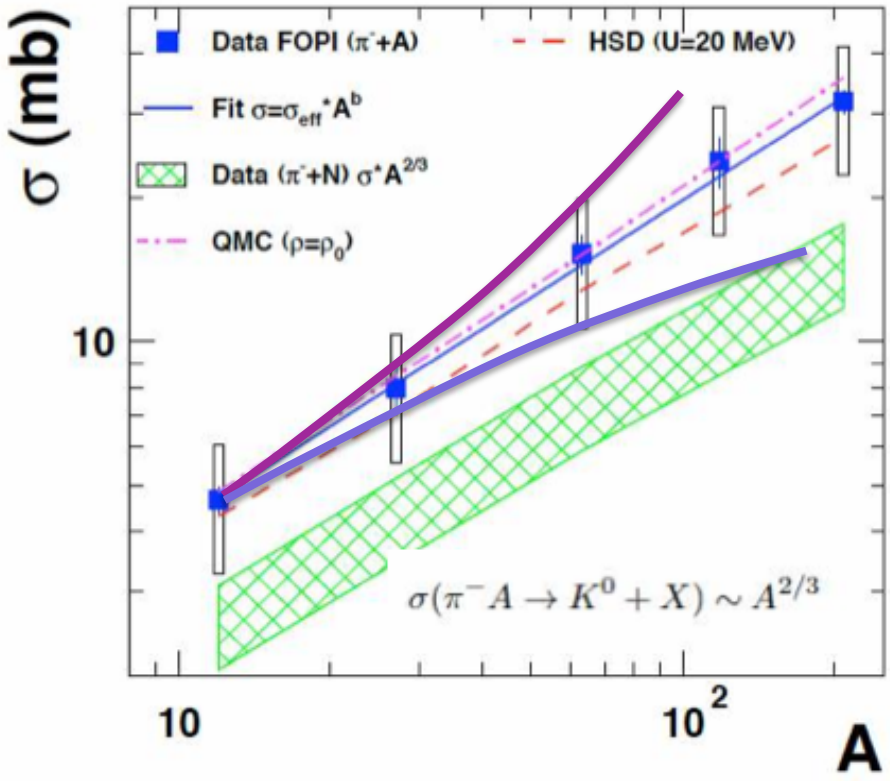
$$b = 0.67 \pm 0.03$$



→ K^0 production scales with the surface of the nucleus in pion-induced reactions

K^- in Medium

Benabderrahmane et al. Phys. Rev. Lett. Bd. 102, 182501 (2009)

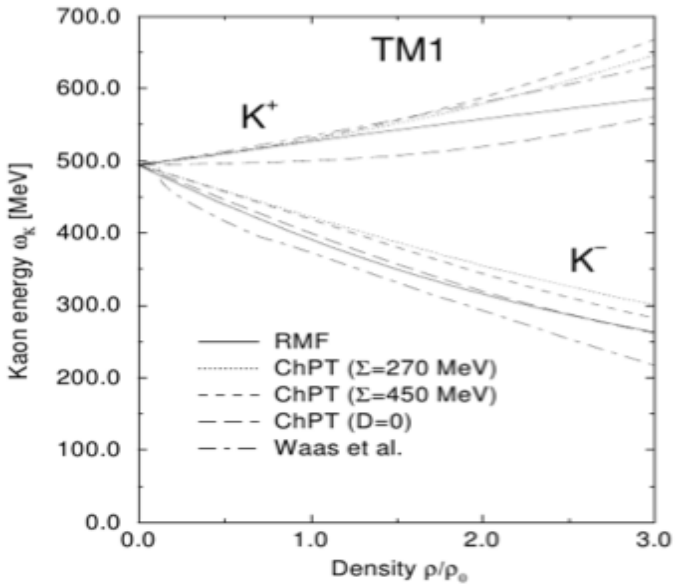


σ(K^-): Larger absorption for larger effective density

$K^- N \rightarrow Y\pi$ $\qquad$ $K^- NN \rightarrow YN$

σ(K^-): Production threshold decreases

Schaffner et al. Nucl. Phys. A 625, 325-346 (1997)



→ A dependence of K^0 and K^+ production more under control: **no in-medium absorption**

K^- in Medium

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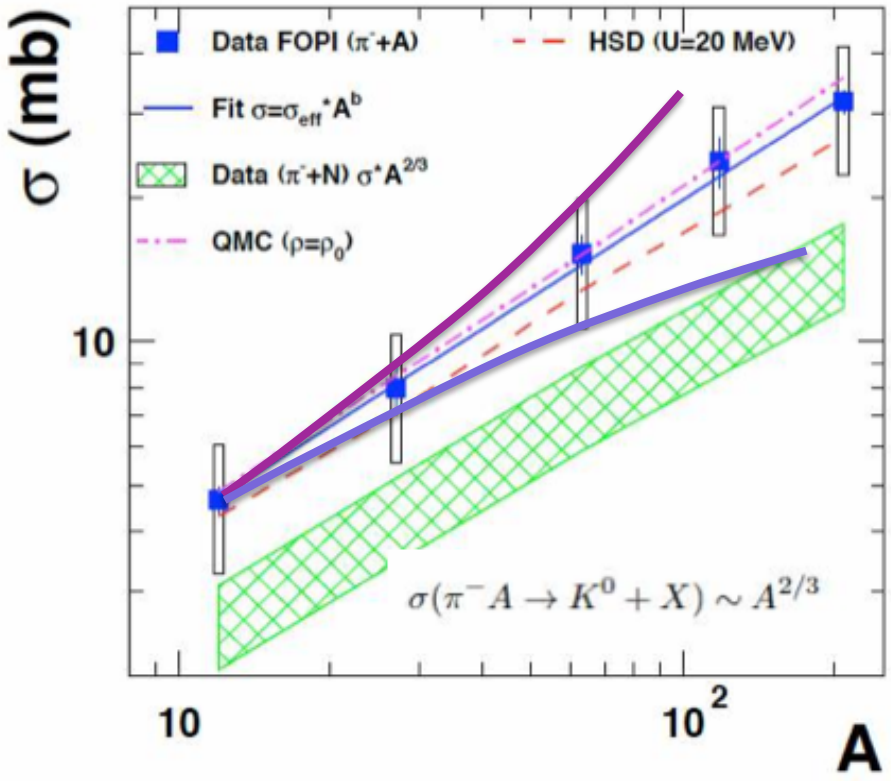

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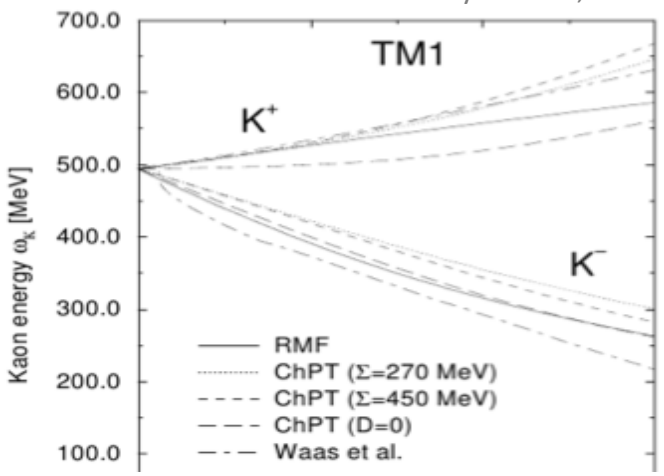
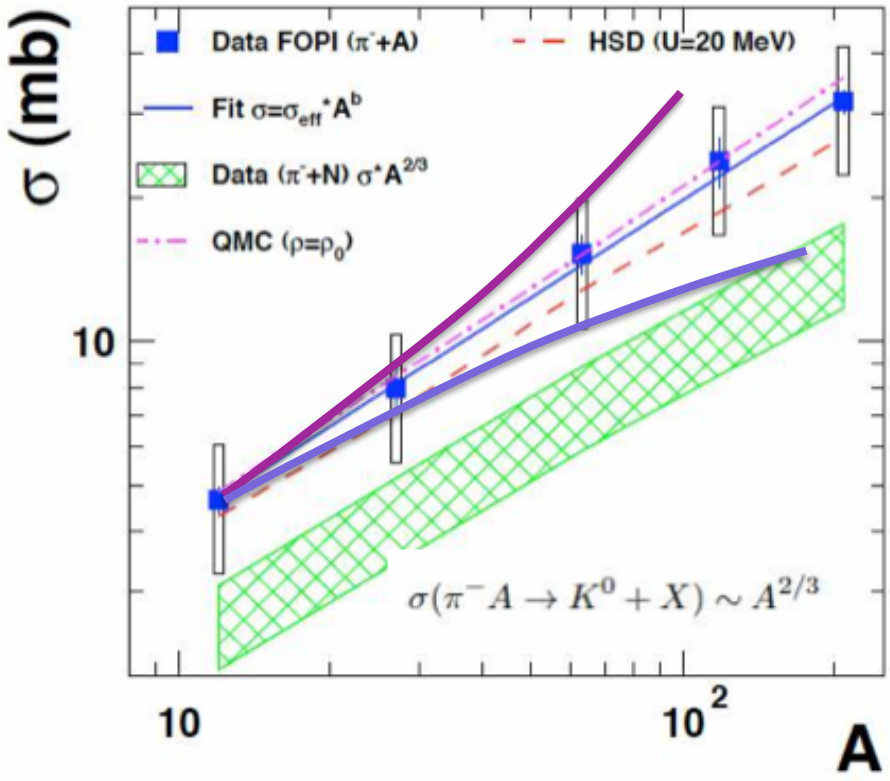


K^0_s properties: Ar + KCl, p + p, p + Nb
Agakishiev et al. Phys. Rev. Lett. C82, 044907 (2010)
Agakishiev et al. Phys. Rev. Lett. C90, 054906 (2014)

→ A dependence of K^0 and K^+ production more under control: **no in-medium absorption**

K^- in Medium

Benabderrahmane et al. Phys. Rev. Lett. Bd. 102, 182501 (2009)



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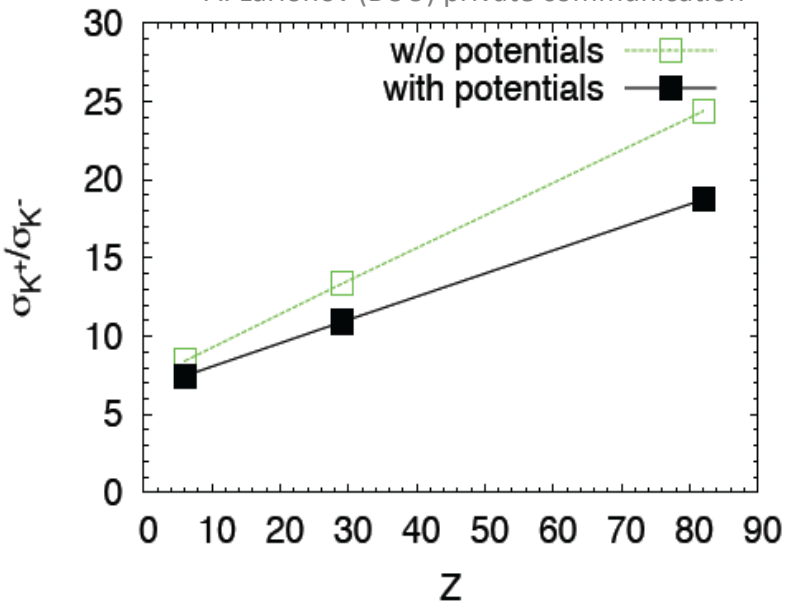
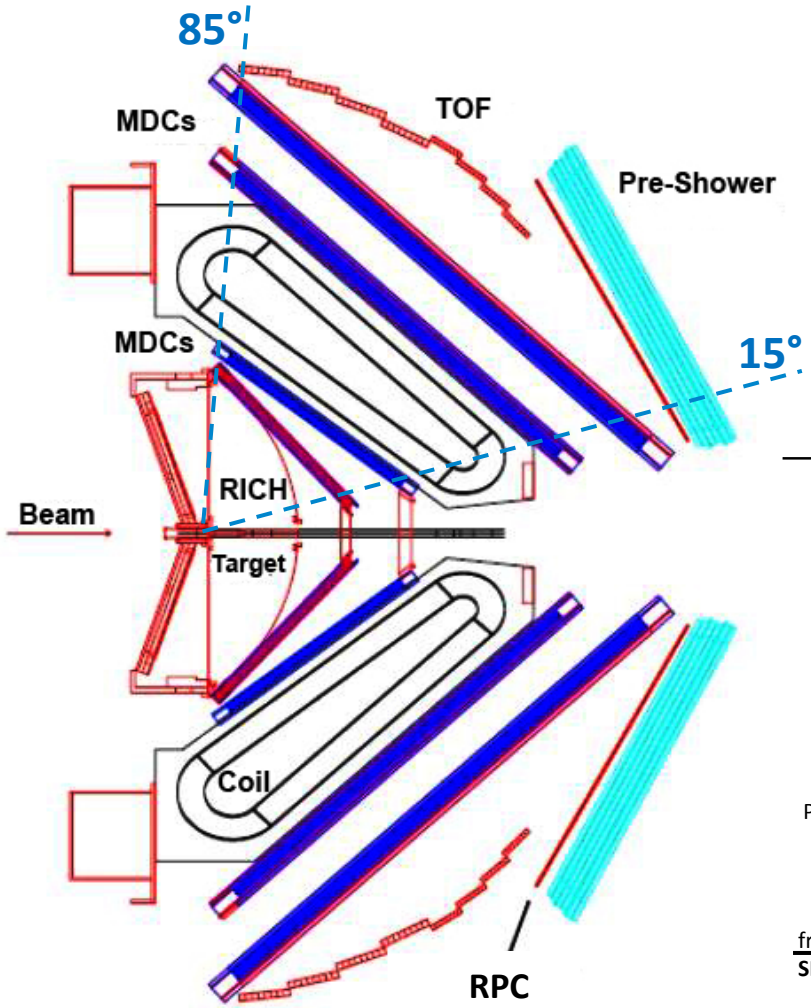
σ(K^-): Production threshold decreases

A. Larionov (BUU) private communication



$$\frac{K^-}{K^+}\left(A_{heavy}\right) \Big/ \frac{K^-}{K^+}\left(A_{light}\right)$$

HADES Experiment @ GSI (Darmstadt)



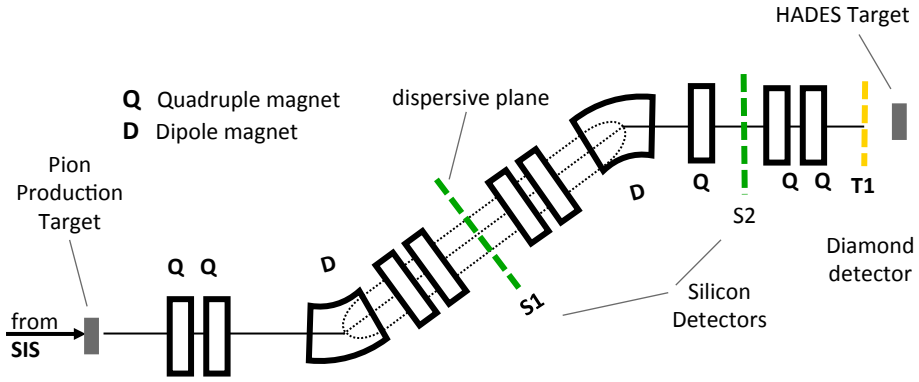
High **A**cceptance **D**i-**E**lectron **S**pectrometer:

- High acceptance for dilepton pairs
- Momentum resolution ≈ 3 %
- Particle identification via dE/dx

Secondary Pion Beam @ 1.7 GeV/c

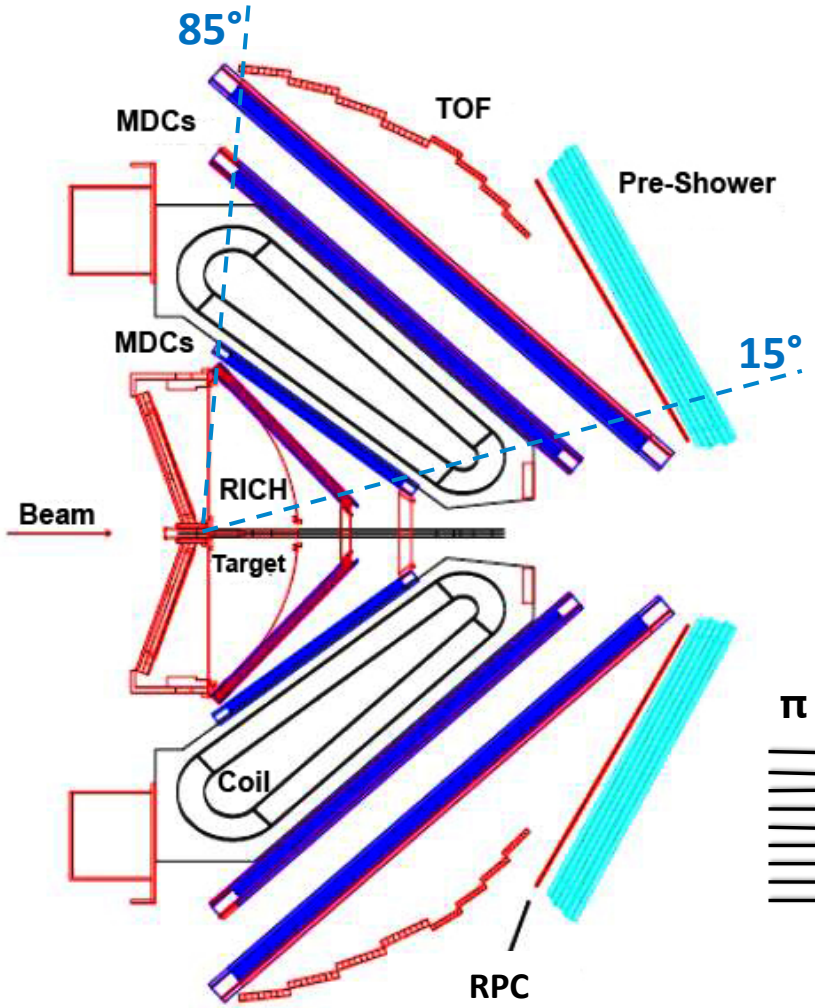
→ **CE**ntR**a**l **BE**am T**R**acker for Pi**O**n**S** @ TU Munich

- High π^- rates (up to 10^7 part./s)
- Self-triggering and $\sigma(p_\pi) < 0.5$ %



Wirth et al. Nucl. Inst. and Meth., Phy. Res. A (2016)

HADES Experiment @ GSI (Darmstadt)

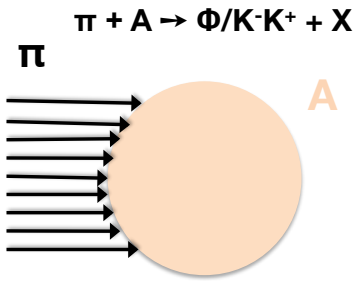


High **A**cceptance **D**i-**E**lectron **S**pectrometer:

- High acceptance for dilepton pairs
- Momentum resolution ≈ 3 %
- Particle identification via dE/dx

Secondary Pion Beam @ 1.7 GeV/c:

- 100 10^3 K^+ and 4.2 10^3 K^- in π^- + W
- 99.7 10^3 K^+ and 6.9 10^3 K^- in π^- + C



$$\frac{K^-}{K^+}(W) \Big/ \frac{K^-}{K^+}(C)(\theta, p)$$

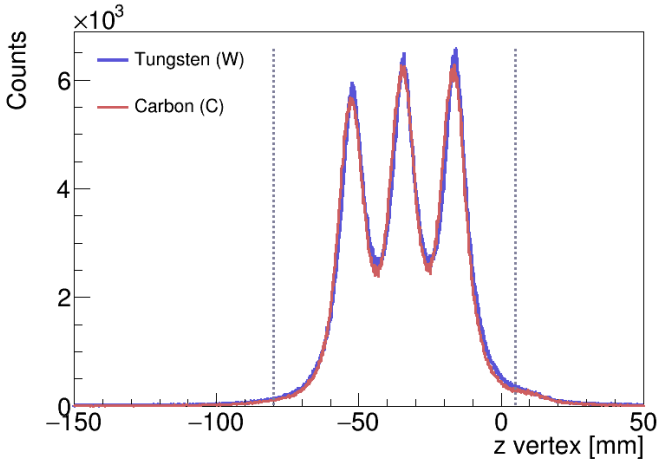
$$\phi(W)/\phi(C)(\theta)$$

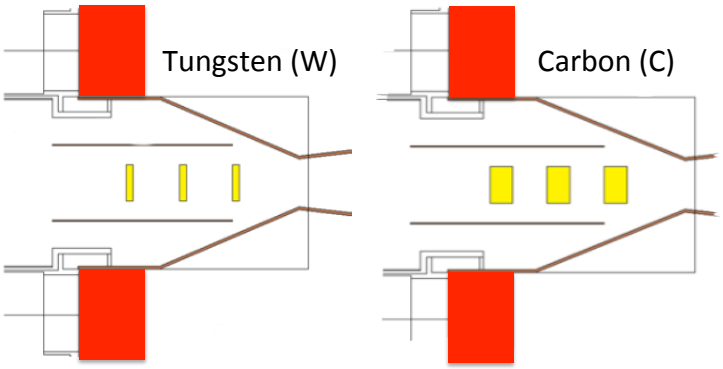
Kaon selection

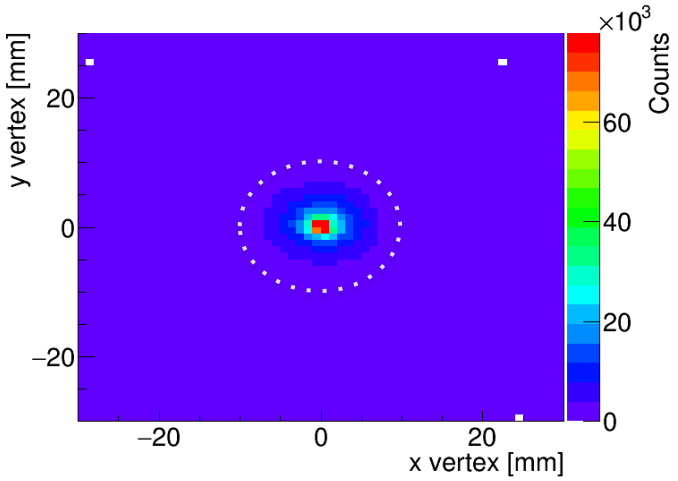
Applied cuts:

- Primary vertex:
  - - 85 < z vertex < - 5 mm
  - - 10 < x,y vertex < 10 mm
- Energy loss: $0 < dE/dx_{MDC} < 50$
- Velocity: $0 < \beta < 1$
- Particle identification via dE/dx and p

Energy loss and magnetic field correction







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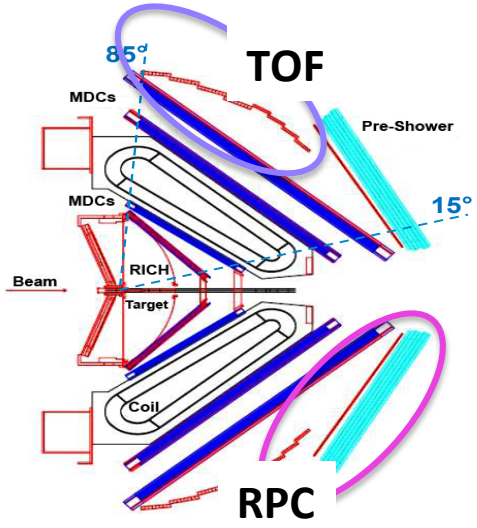
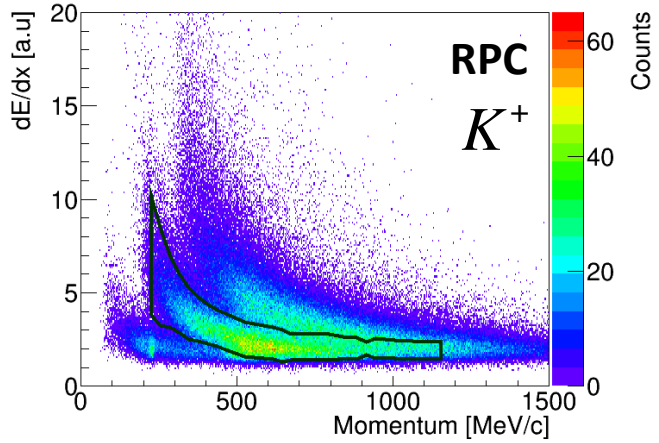
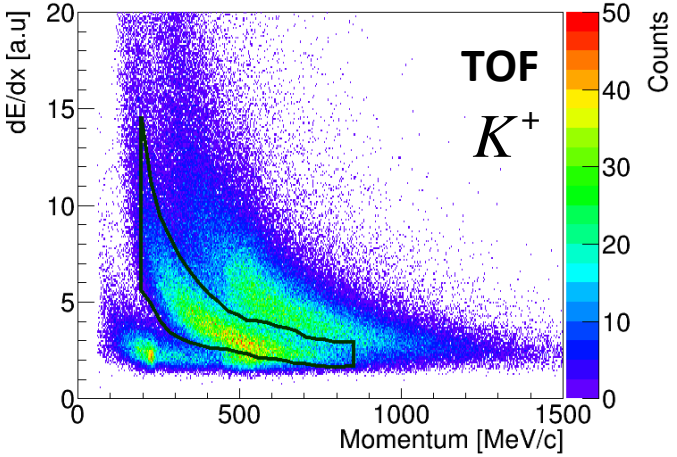
  - - 10 < x,y vertex < 10 mm
- Energy loss: $0 < dE/dx_{MDC} < 50$
- Velocity: $0 < \beta < 1$
- Particle identification via dE/dx and p (also for SIM)

Energy loss and magnetic field correction

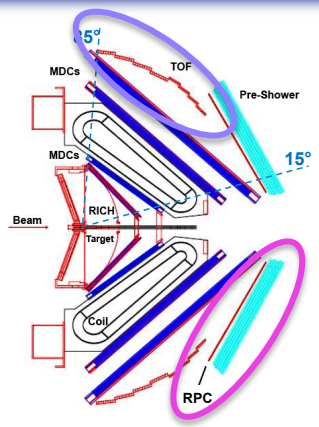


π^-+W ($m_K \pm 50$ MeV/c^2)

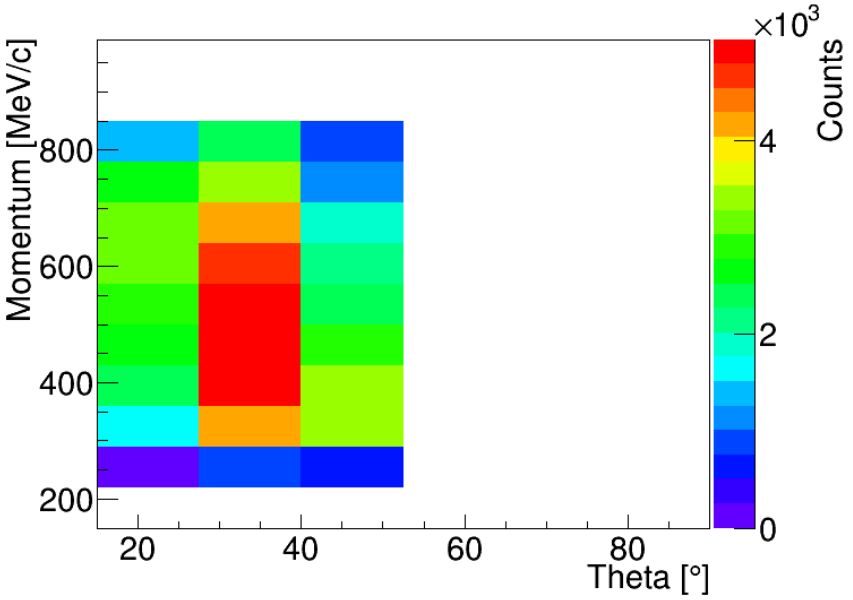




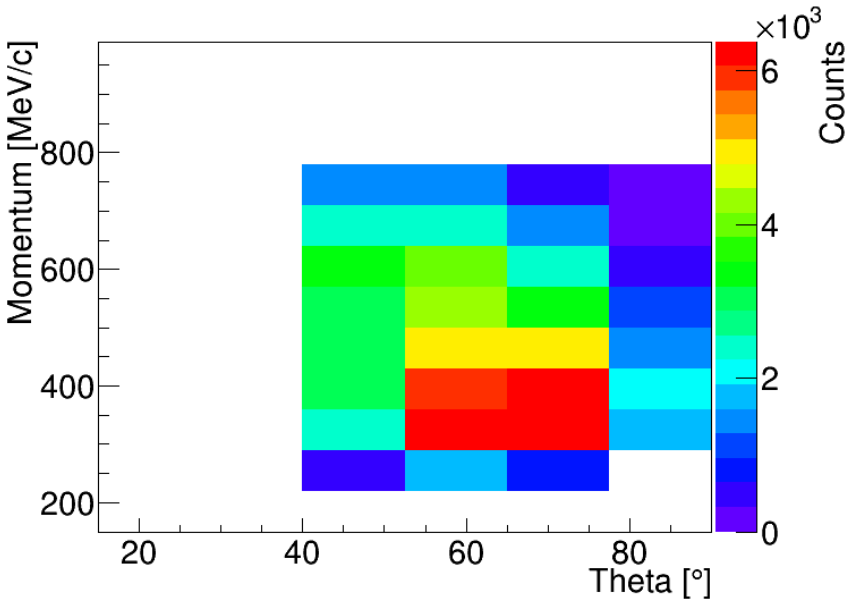
K^+ Yield in π^- W



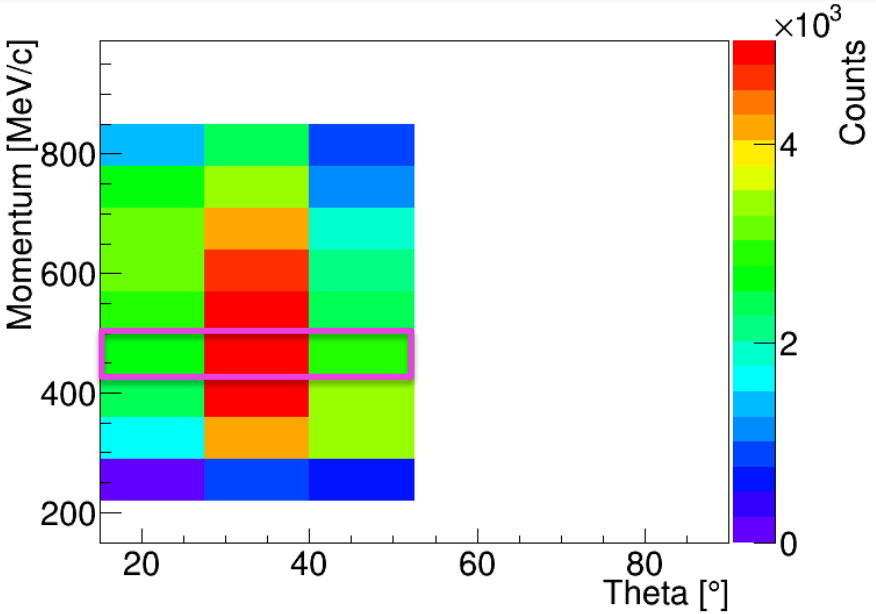
RPC

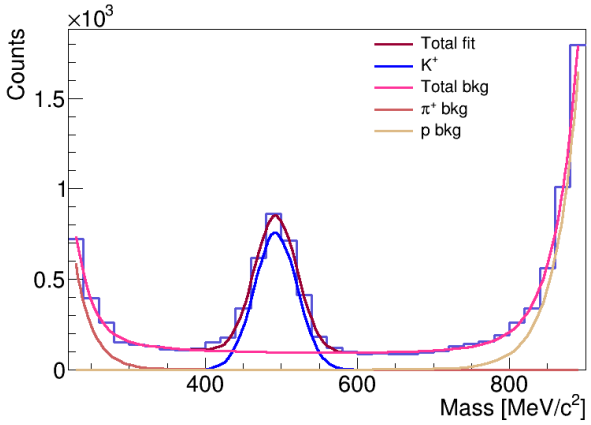


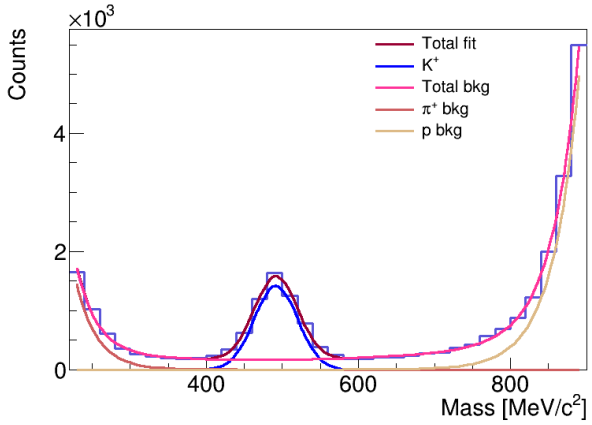
TOF

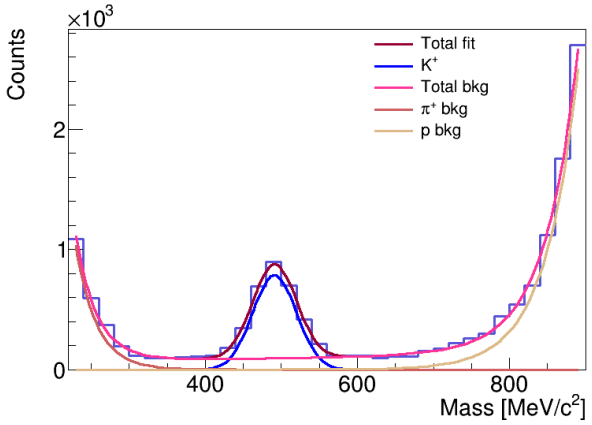


K^+ Yield in RPC (π^- W)

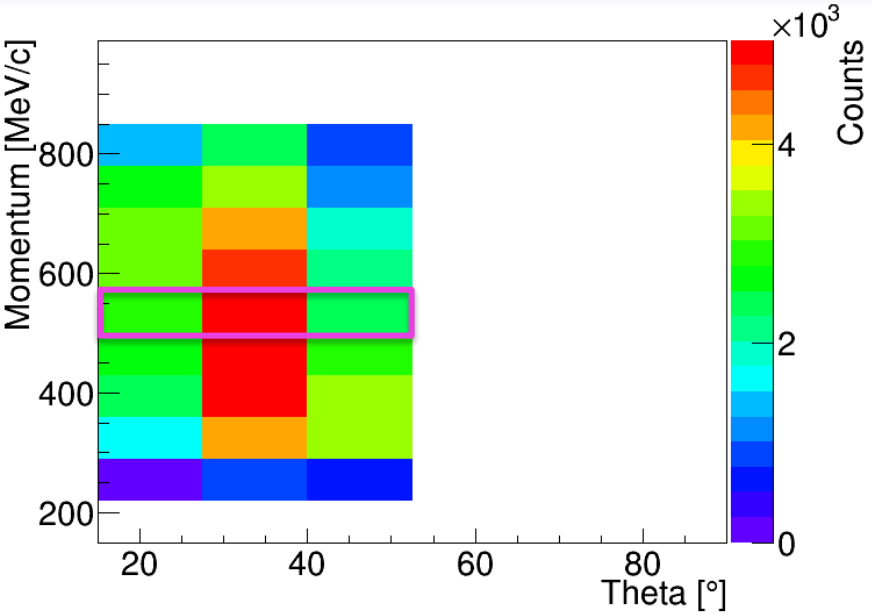


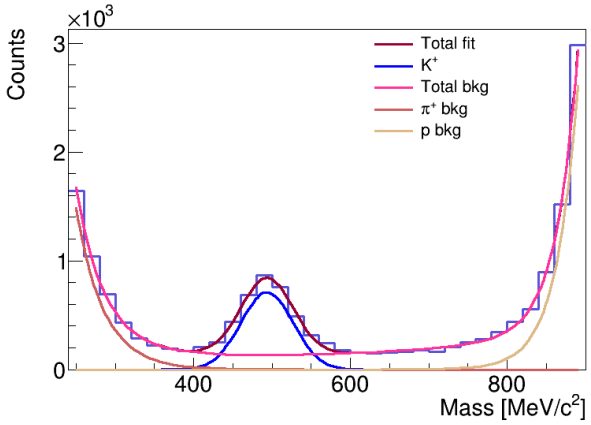


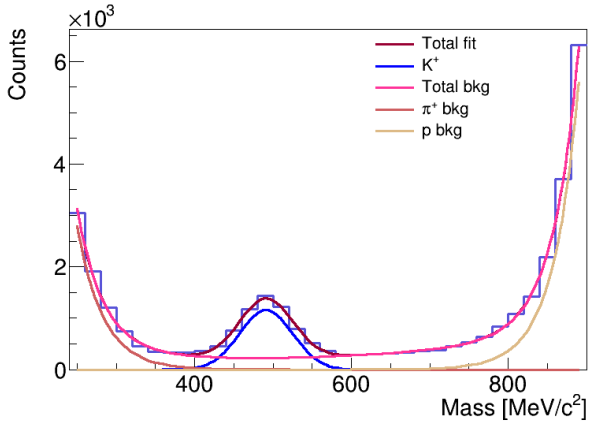


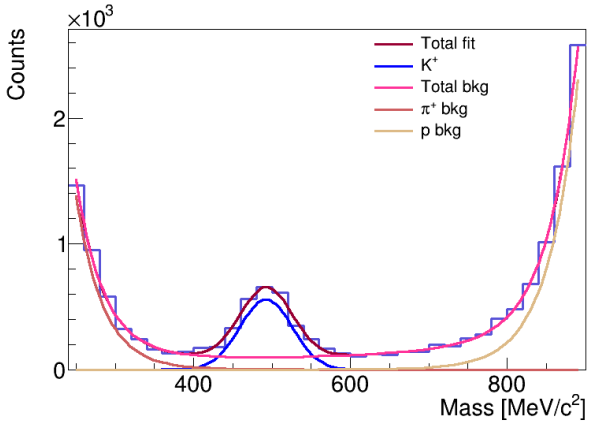


K^+ Yield in RPC (π^- W)

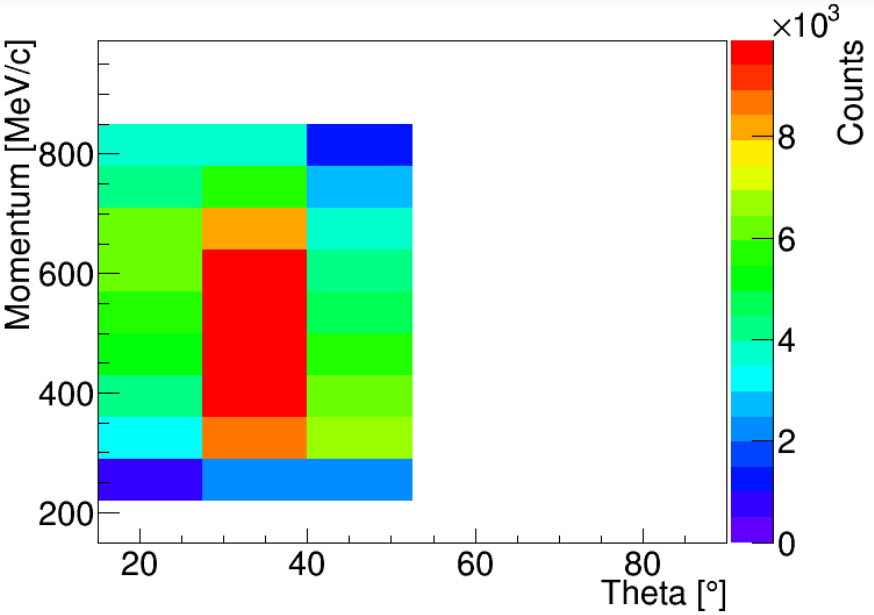


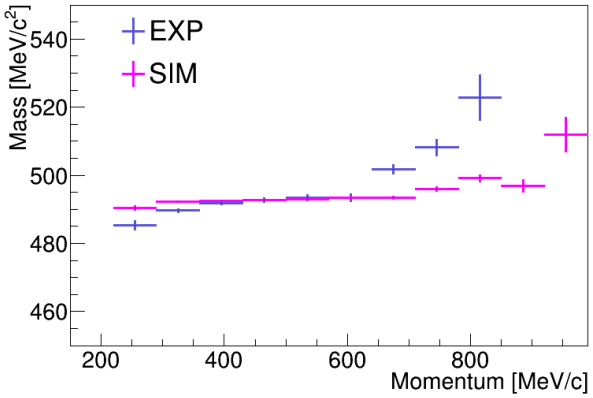


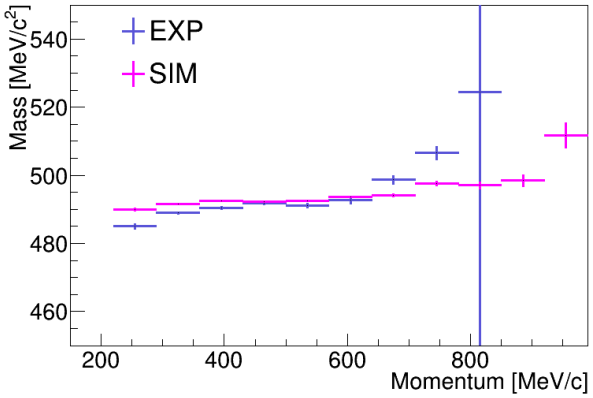


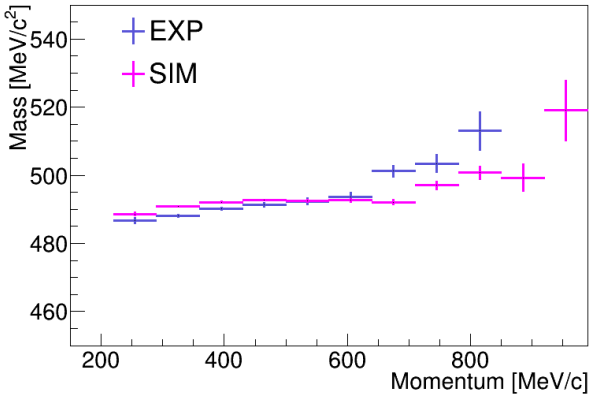


K^+ mass in RPC (π^- W)

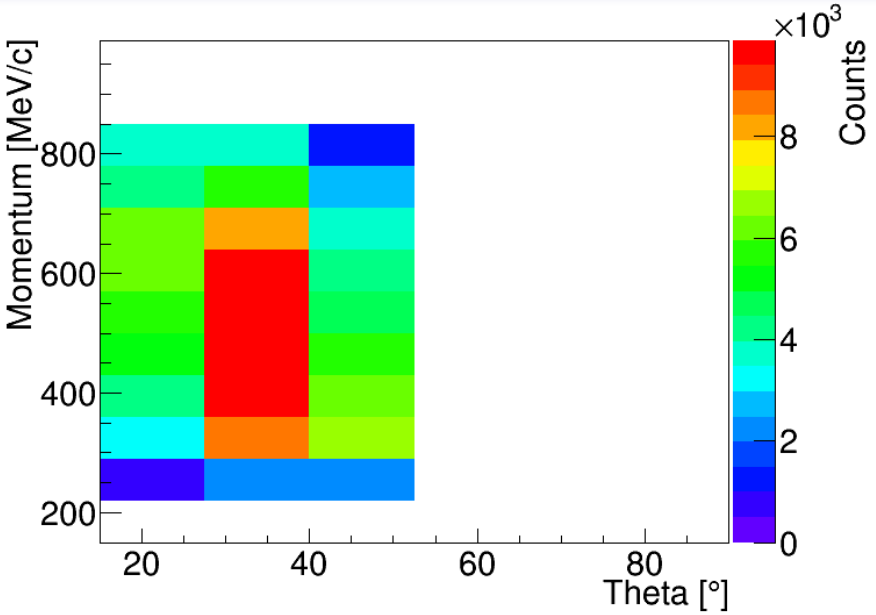


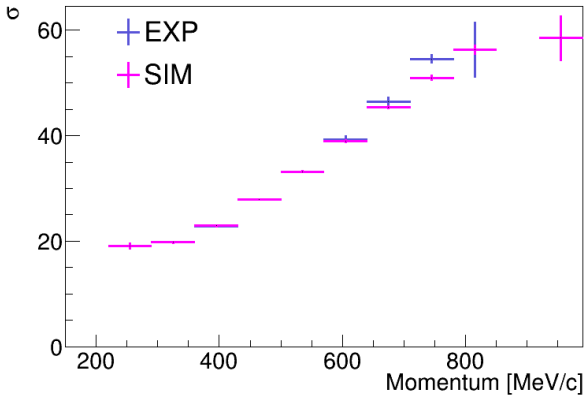


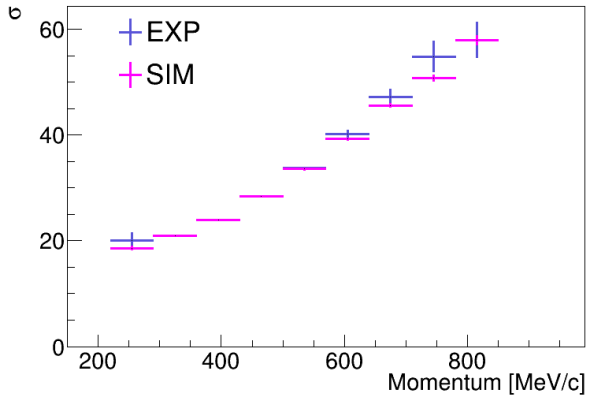


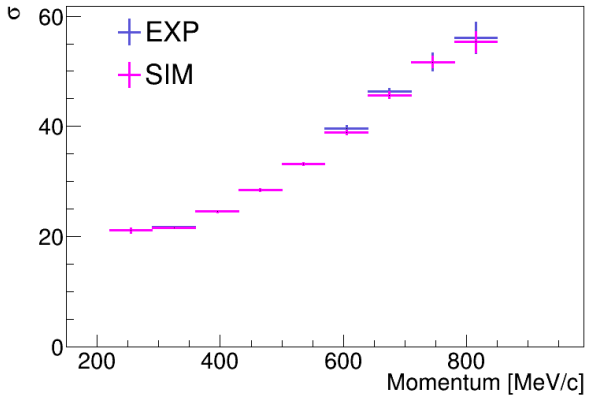


K^+ mass resolution in RPC (π^- W)

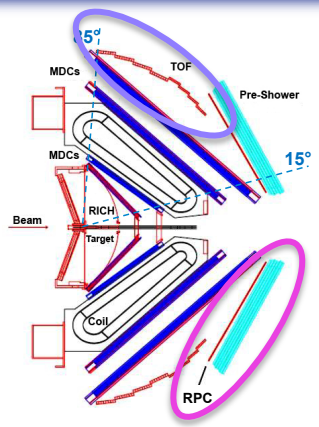




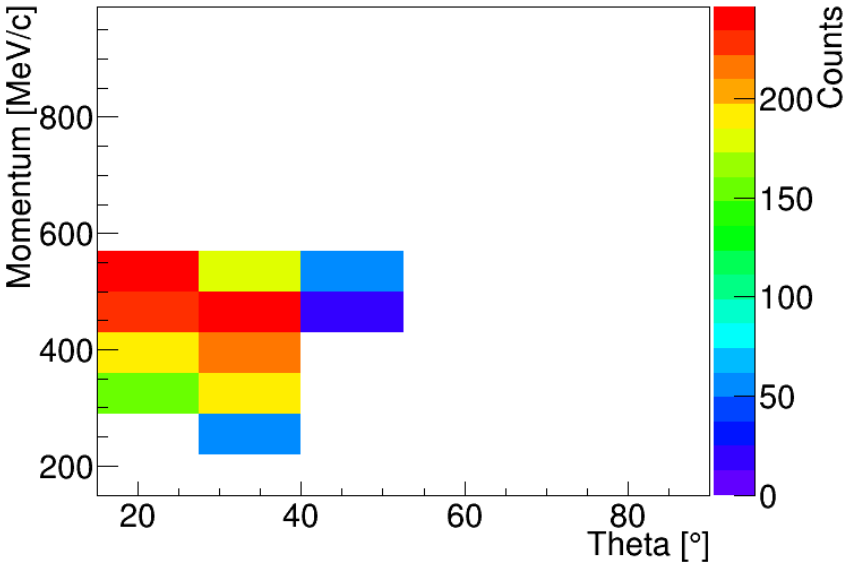




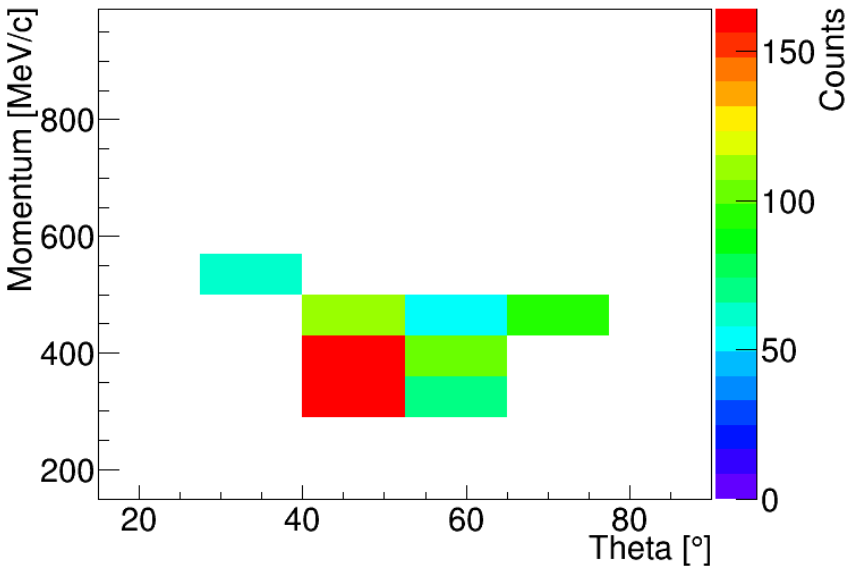
K^- Yield in π^- W



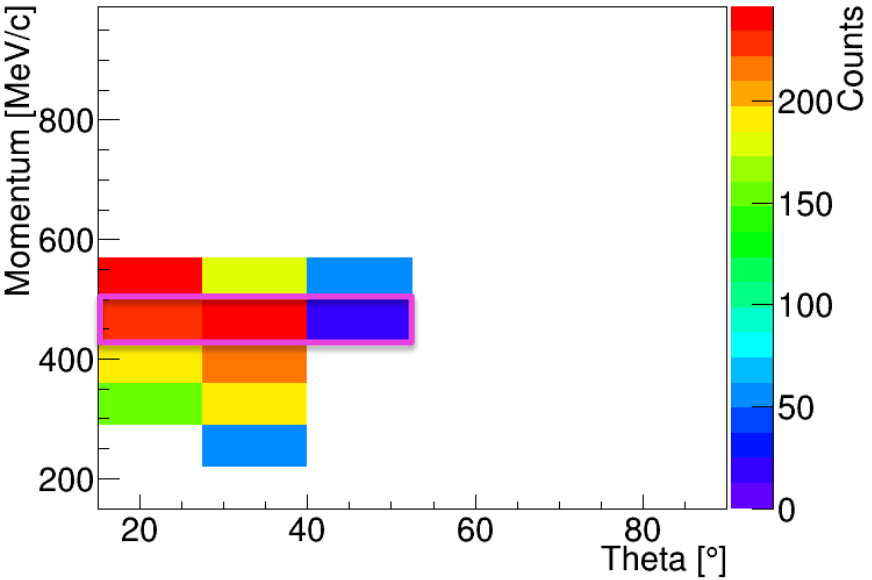
RPC

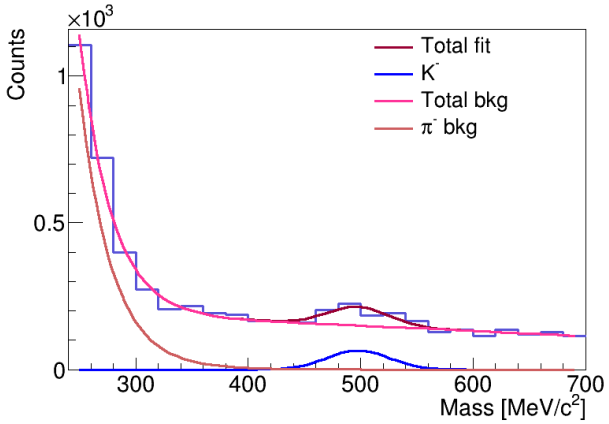


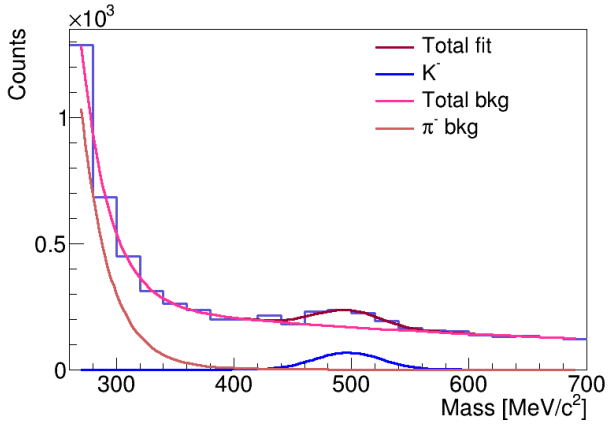
TOF

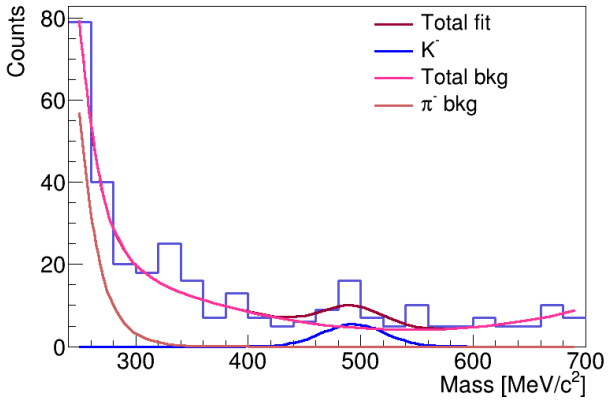


K^- Yield in RPC (π^- W)

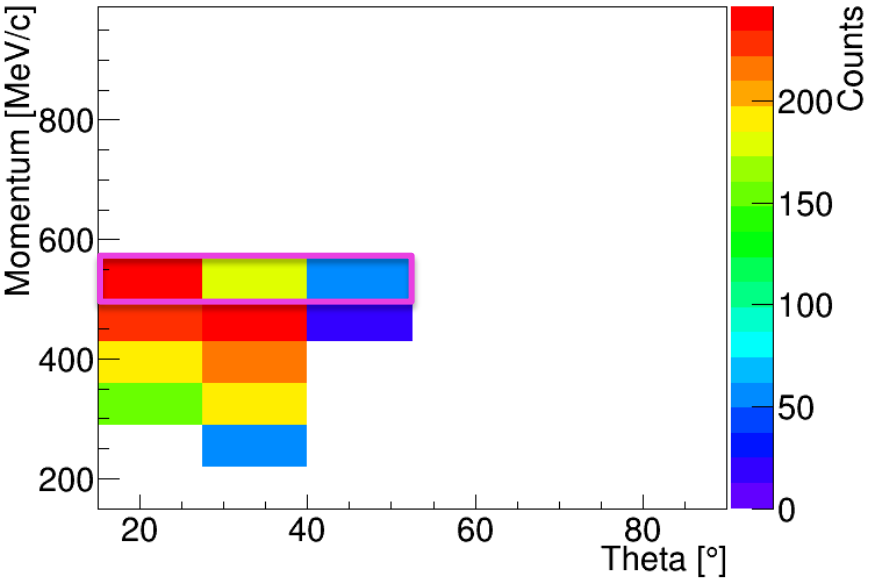


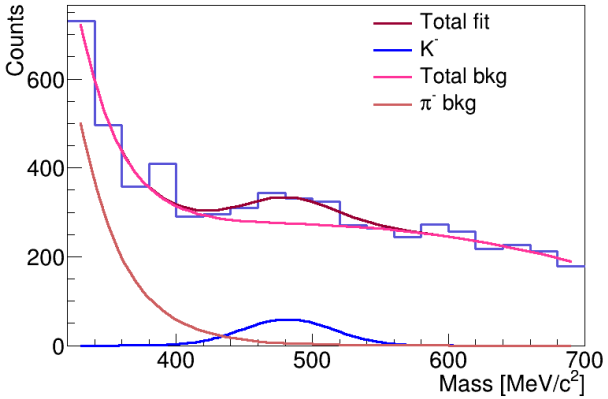


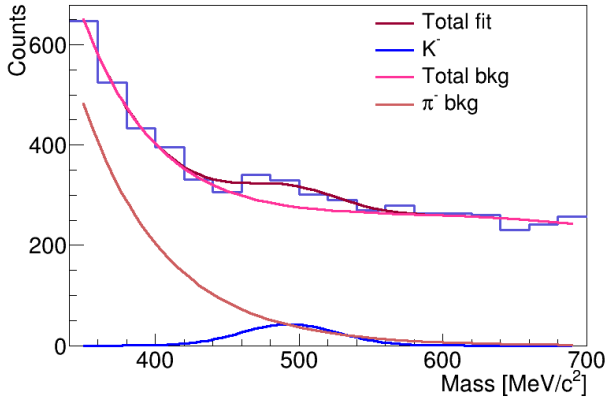


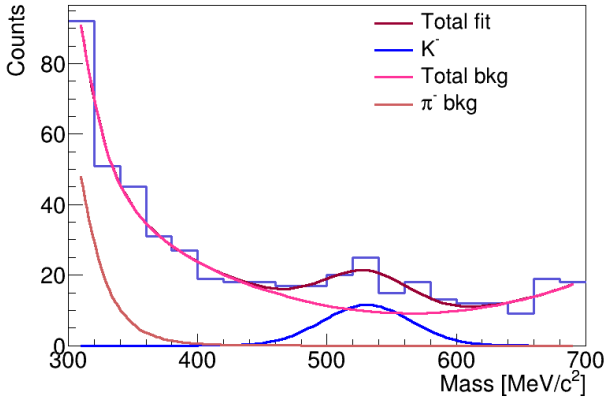


K^- Yield in RPC (π^- W)

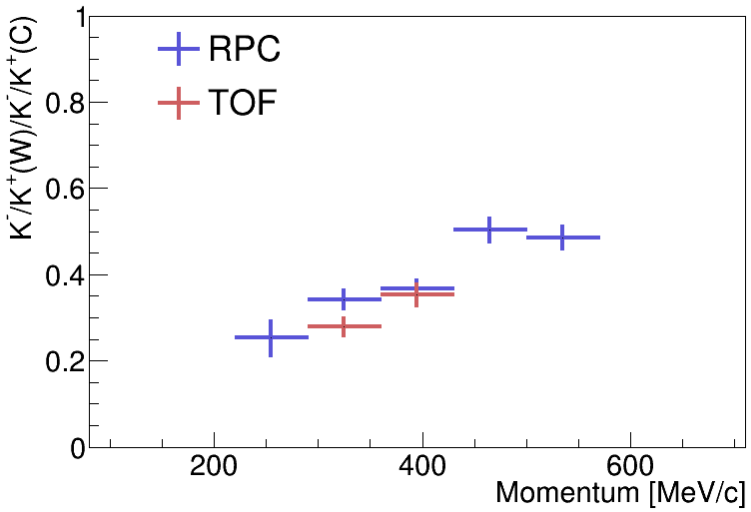


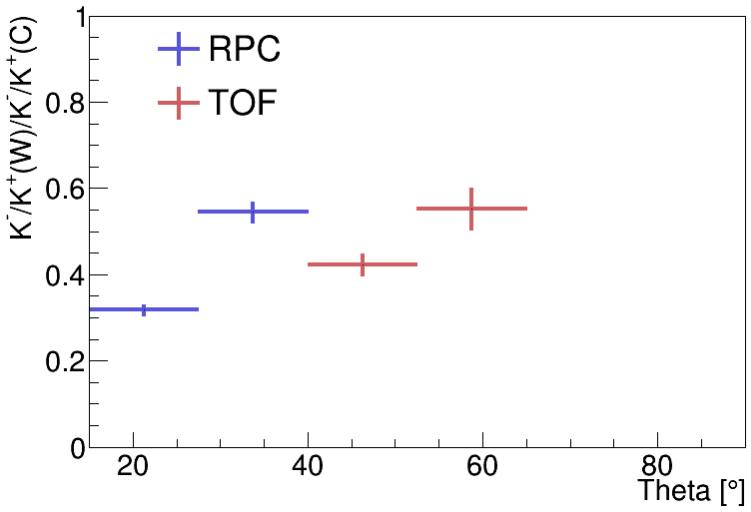






Ratios of K^-/K^+ Ratios





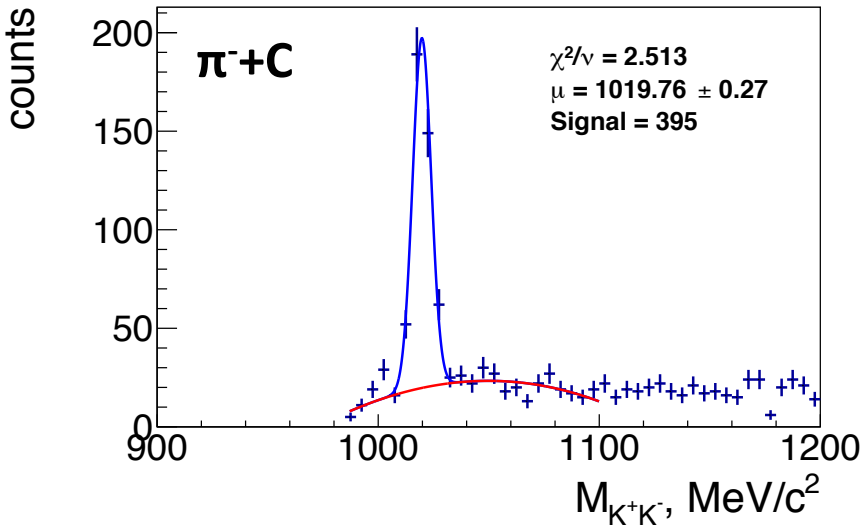
→ Evidence of K^- **disappearance**

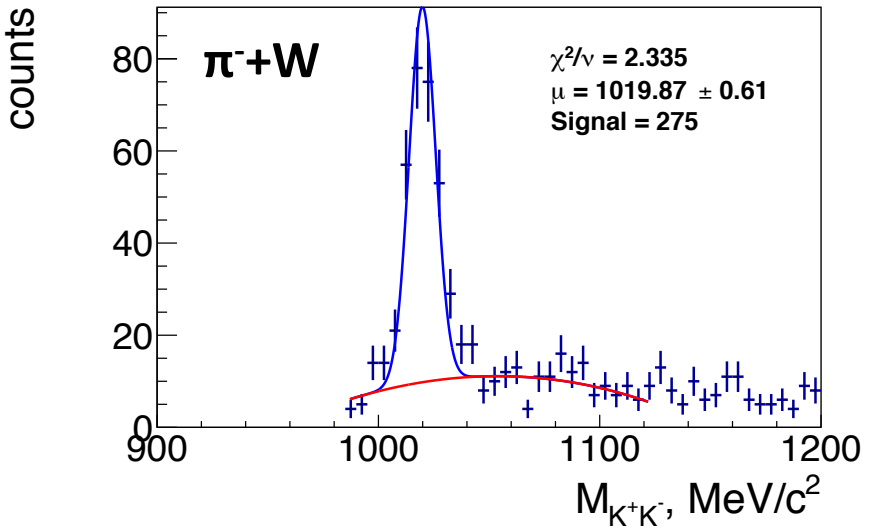
Φ Signal

Applied cuts:

- Primary vertex: - 10 < x,y vertex < 10 mm, - 65 < z vertex < - 5 mm
- Kaon mass: 450 < M_K < 500 MeV/c^2
- Velocity: 0 < β < 1
- Particle identification via dE/dx and p

Energy loss correction and magnetic field correction applied

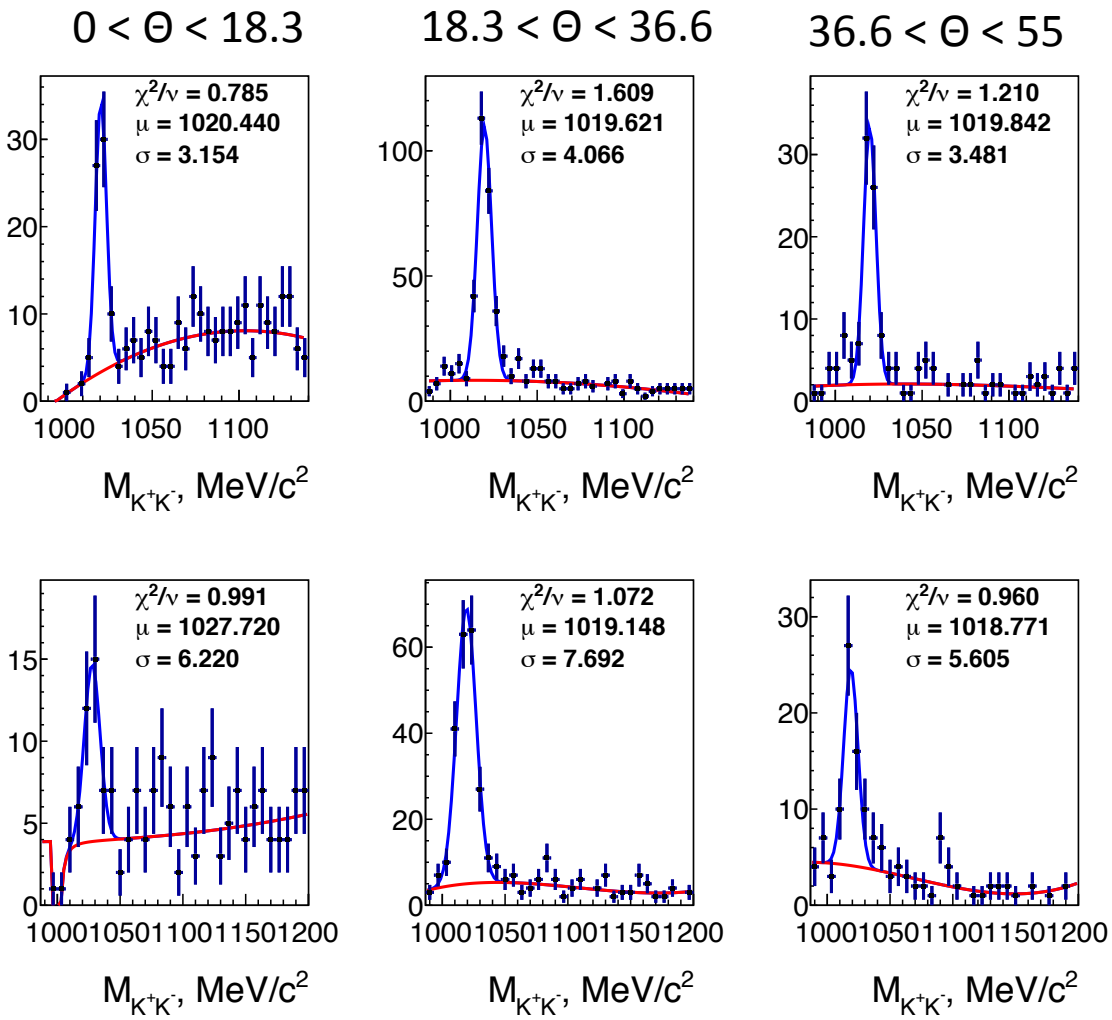




Φ Signal in 3 Θ_{lab} Bins

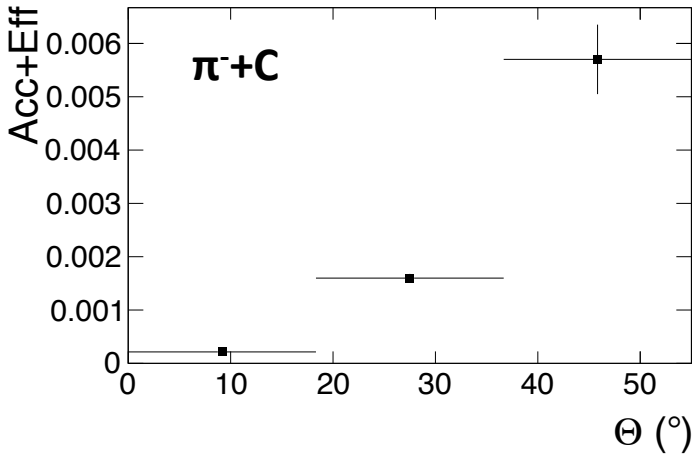
π^-+C

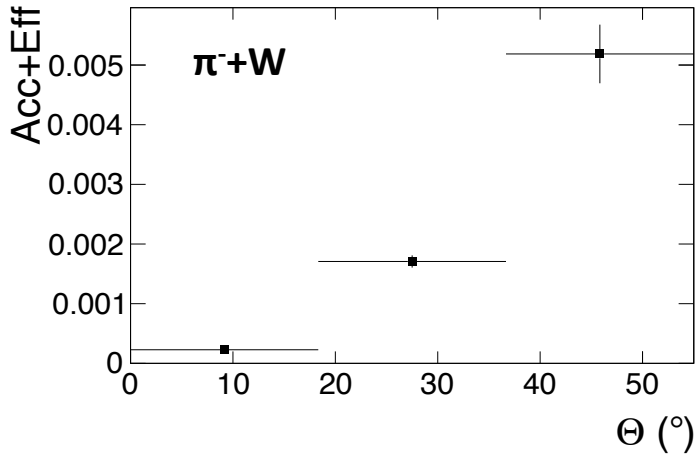
π^-+W

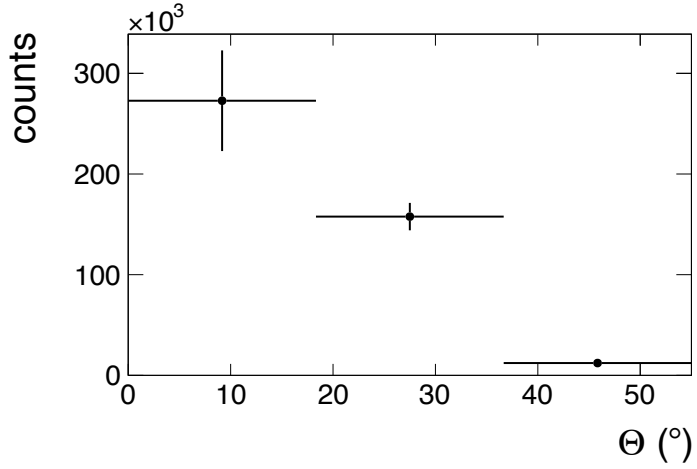


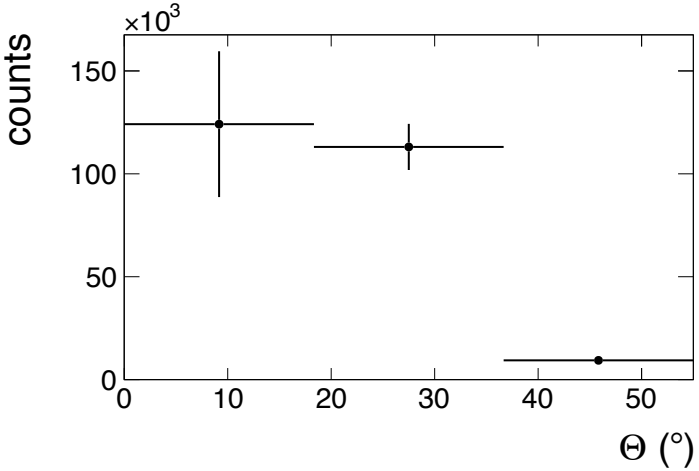
Acc+Eff Corrected Θ_{lab} Spectra of Φ

Correction done with help of GiBUU full scale simulations.







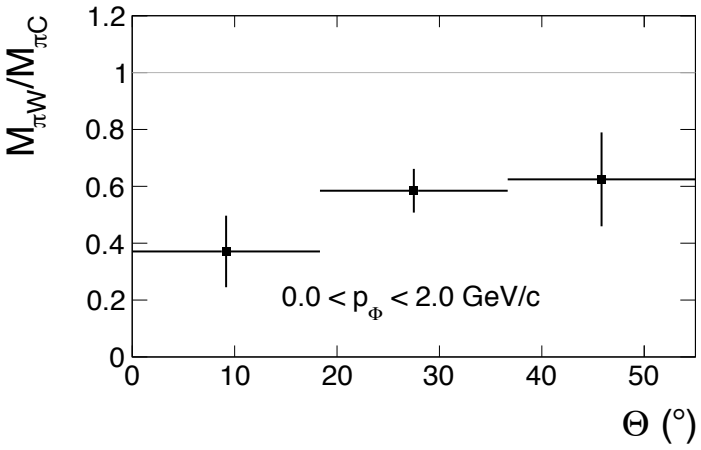


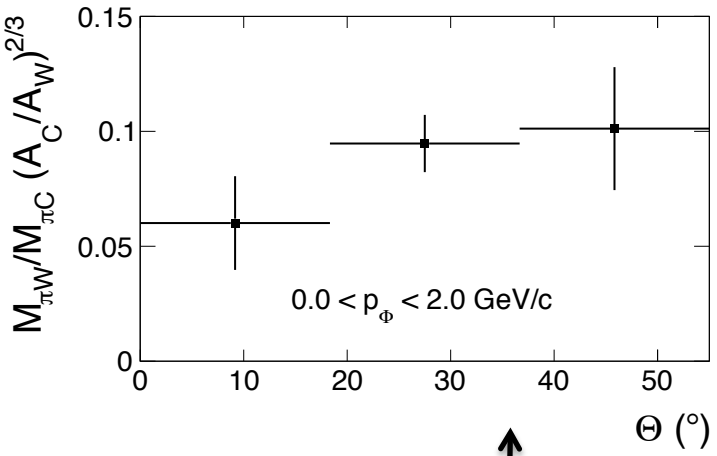
Acc+Eff Corrected Φ Ratios W/C

Both yields are normalized to record number of events:
π^-+C: 128.8 10^6, π^-+C: 158 10^6

→ Clear suppression in W compared to C

→ Due to K^- absorption in W? Due to in-medium effects?





Assuming that the particle production scales with $A^{2/3}$

Summary & Outlook

Summary:

- Systematic mass shift in EXP and SIM data
- Evidence of K^- **disappearance** in all two observables (p,Θ)
- Clear Φ suppression in W compared to C

Outlook:

- New dE/dx selection separately for EXP and SIM data
- Acceptance and efficiency correction
- Final results: ratios of ratios, cross sections

Thank you for your attention!