Reconstruction of ϕ meson and strange resonances from Au+Au at √s = 4.9 A GeV

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- PHQMD level: true and mixed-event pairs.
  Available info. Residual background.
- KFParticleFinder level: MC and ToF-based PID.
  Profile fit vs Bkgnd subtraction.
- PFSimple ↔ KFPF comparison

Introduction

- Resonances: $\tau \sim$ duration of HI collision $\rightarrow$ ① no topology (easy) ② large background (difficult)

- General aim: reconstruction of
  ϕ in K^+K^- channel (τ = 46 fm/c)
  $K^0(892)$ in $K^+\pi^-$ channel (τ = 4 fm/c)
  $\Sigma^-(1385)$ in $\Lambda\,\pi^-$ channel (τ = 5 fm/c)

- Main questions:
  - ▻ For the model, does background M_{Inv} profile from the *Event Mixing* reproduce the true bkgnd ?
  - ▻ Are few-M-events simulated samples enough to observe the strange resonances
  - ▻ Comparison between CbmKFParticleFinder and PFSimple

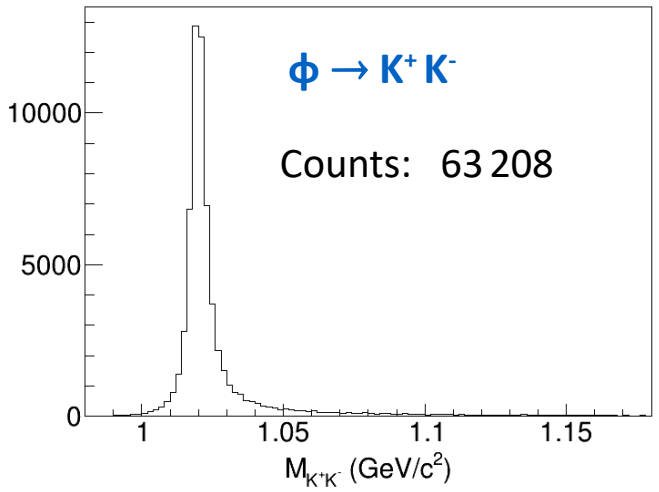
- Collisions: Au + Au @ $\sqrt{s_{NN}}$ = 4.93 A GeV
  Model: PHQMD v5.2

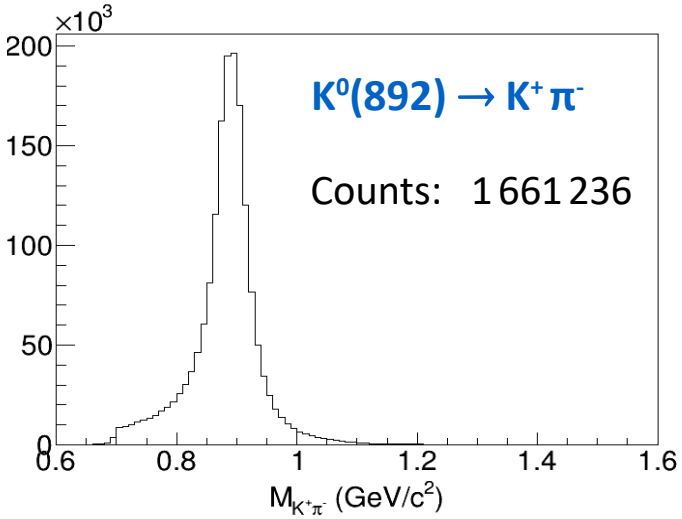
- Data: Runsets 1 … 3000 (3M events)
  CbmRoot: Jul25p1 (for KFPF - event mixing: Jul24p1)

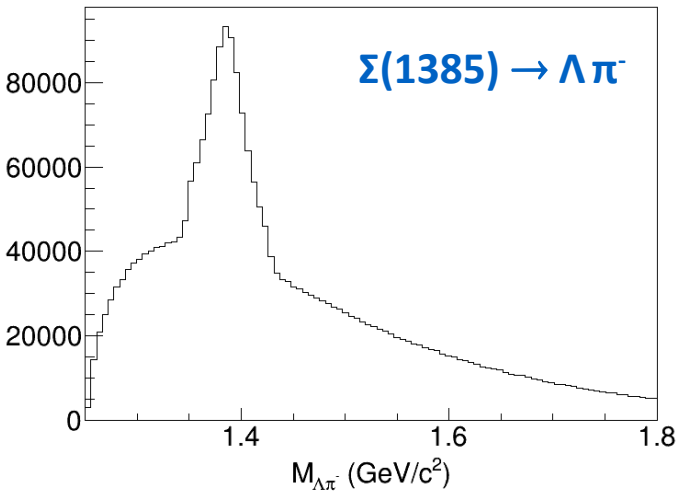
- Tools: CbmKFParticleFinder, PFSimple

ϕ and $K^0(892)$ from PHQMD

- PHQMD 5.2: improved UniGen files within runs [1 … 3000]
  allow to extract ϕ and $K^0(892)$ mesons
  even if they decayed before (or at) the end of simulation
  via info on Parent ID and Process ID.



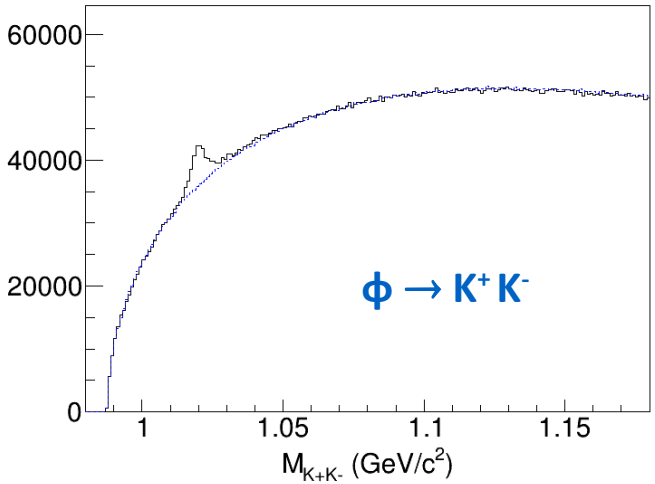


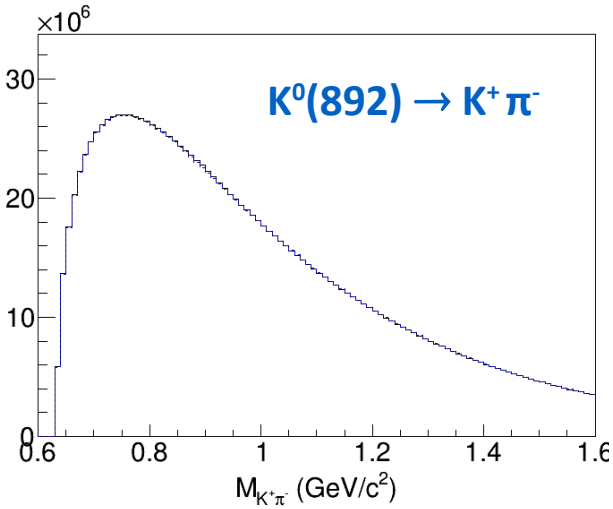


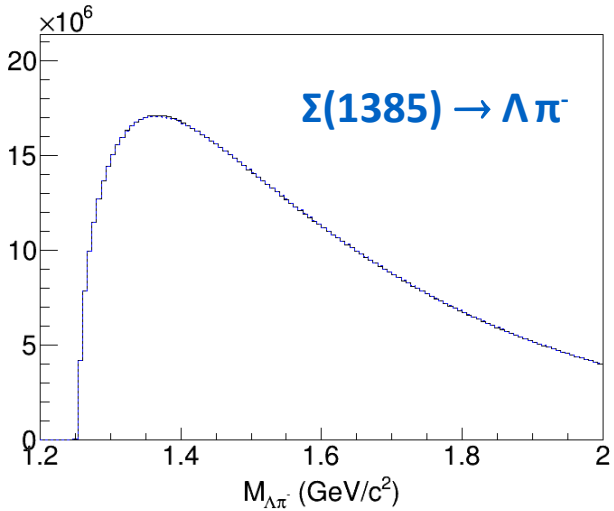
- For Σ(1385) children ($\Lambda\pi^-$) ,
  only the Process ID info,
  No Parent ID.

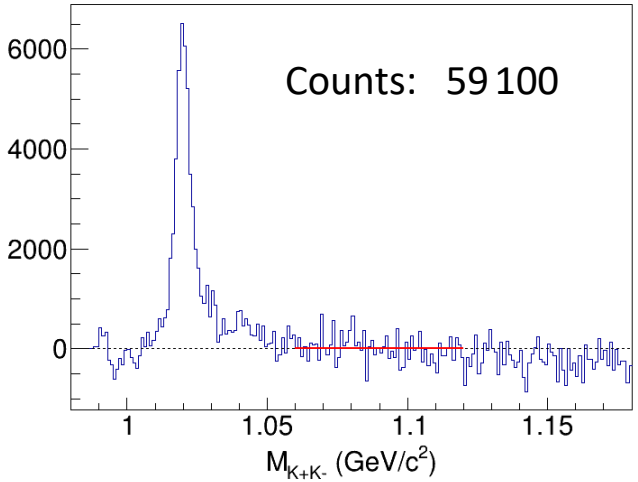
ϕ, K⁰(892) and Σ(1385) from PHQMD

- PHQMD 5.2: M_{Inv} spectrum (true pairs and event-mixed) for ϕ, K^0(892) and Σ^-(1385) without prior knowledge on Parent ID + Process ID.





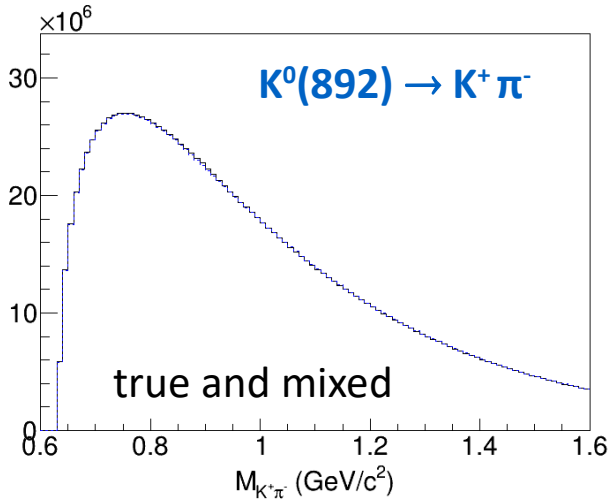


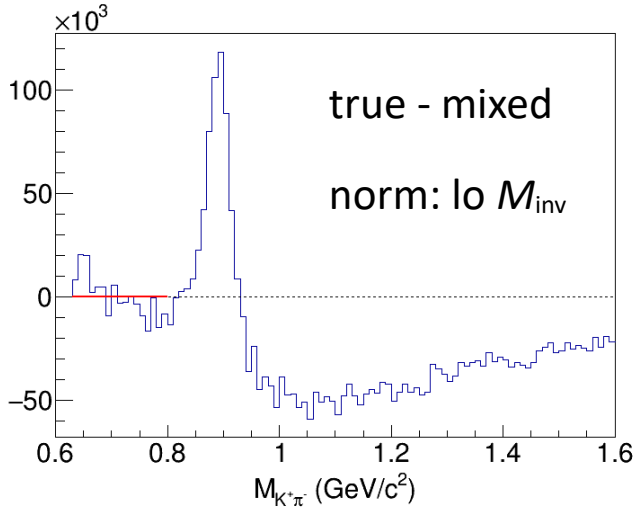


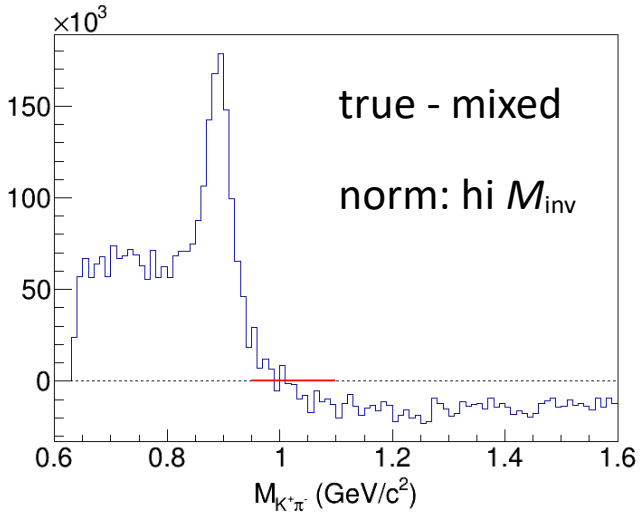
For ϕ, extraction of signal after subtraction of background is rather straightforward.

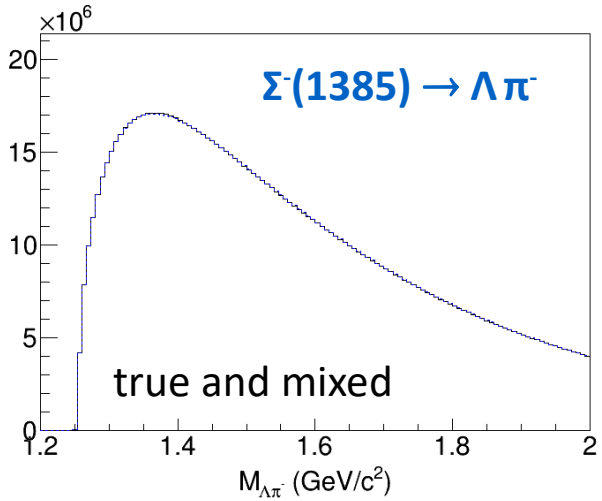
$K^0(892)$ and $\Sigma^-(1385)$ from PHQMD

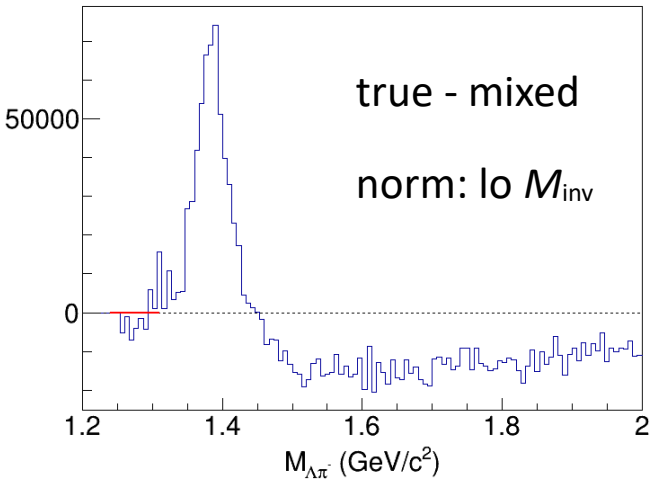
- $K^0(892)$ and $\Sigma^-(1385)$ signals from PHQMD @ Unigen level, after subtraction of event-mixed background

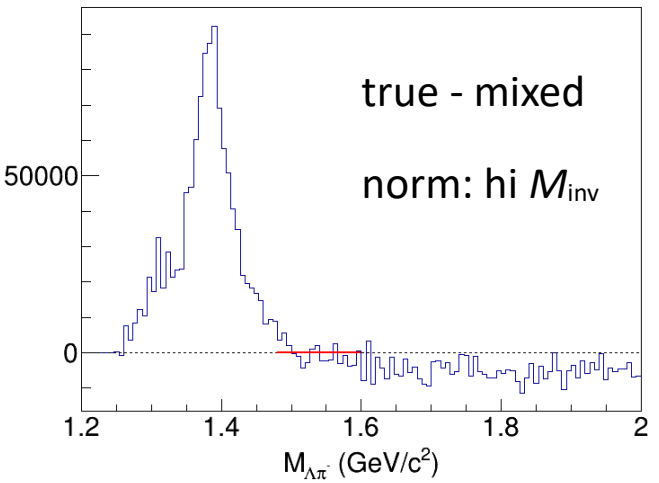






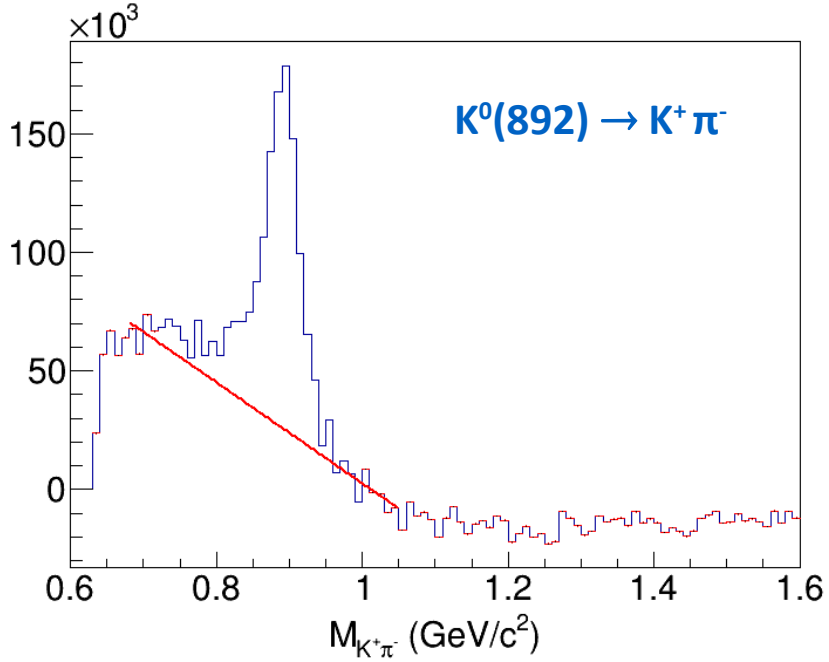






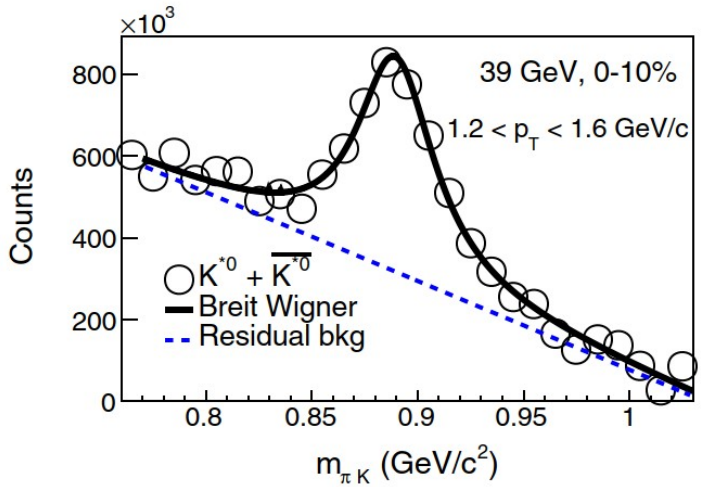
$K^0(892)$ and $\Sigma^-(1385)$ from PHQMD

- Seems possible to extract the (raw) yield by subtracting the residual background.



- Linear background fitted within side bands
- After subtraction of linear background:
  K* signal = 1 073 000 counts

- Btw. STAR proved it's publishable:

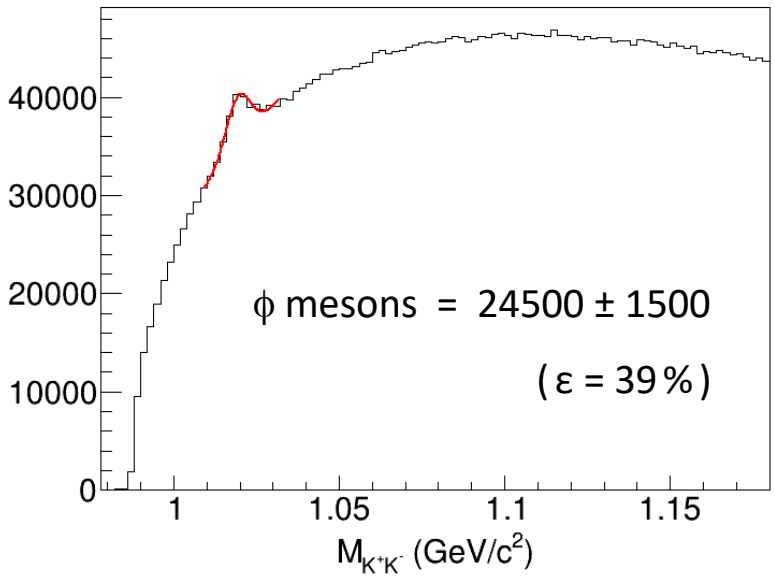


M.S. Abdallah, PRC 107, 034907 (2023)

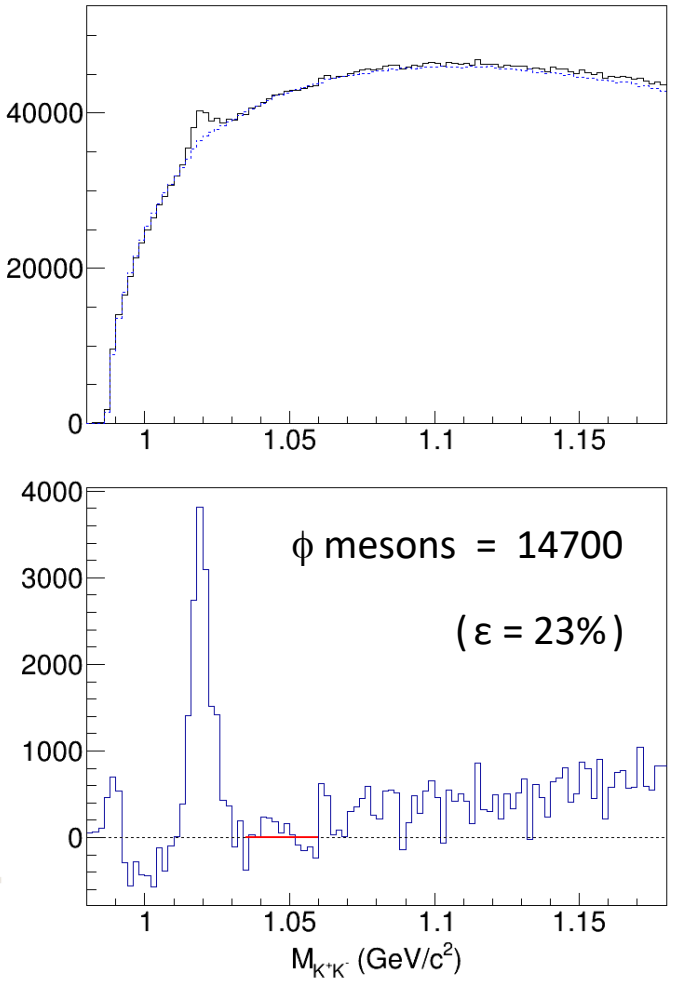
ϕ meson from KFParticleFinder

- Open track cuts. PID by MC (not experimentally-available)

▷ Signal extraction by **fit of Poly1 + Gauss**



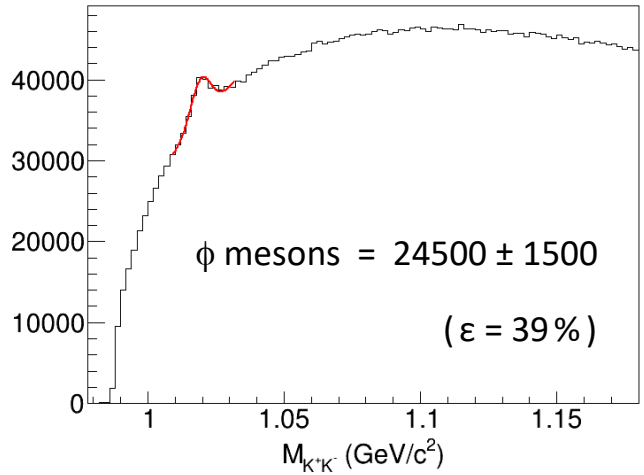
▷ … by **event mixing + subtraction + counting**



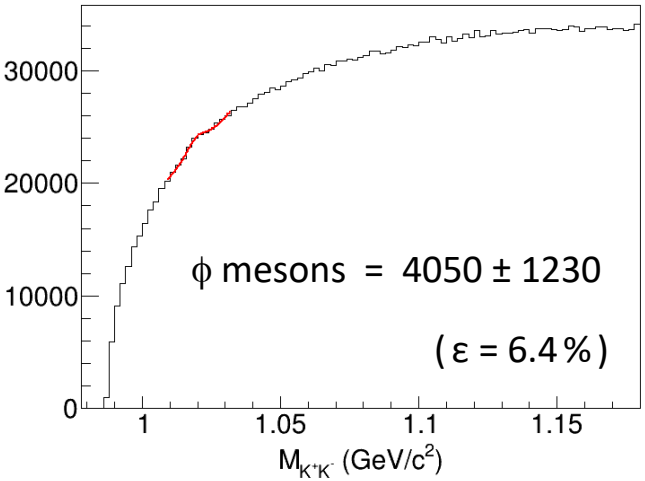
Deviation between profiles of backgrounds

ϕ meson from KFParticleFinder

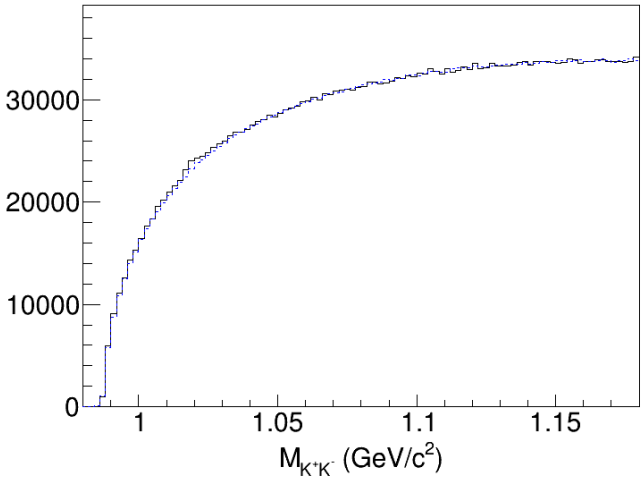
- **PID by MC** (not exp-available)

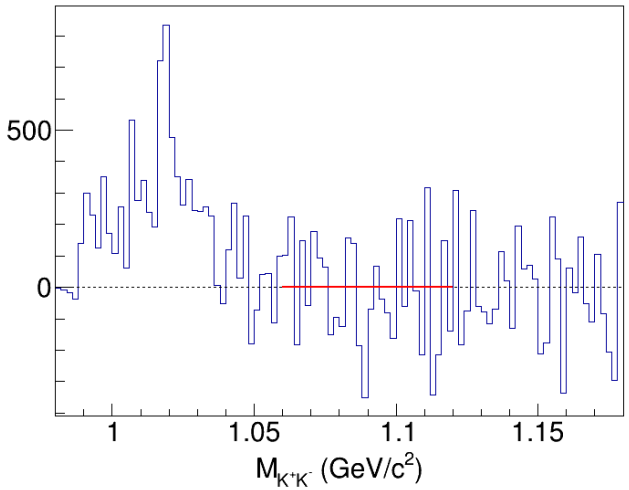


- **PID by curves on m^2 – ToF** (exp-available)



- PID by curves on m^2 – ToF:
  - ▷ by event mixing + subtraction + counting

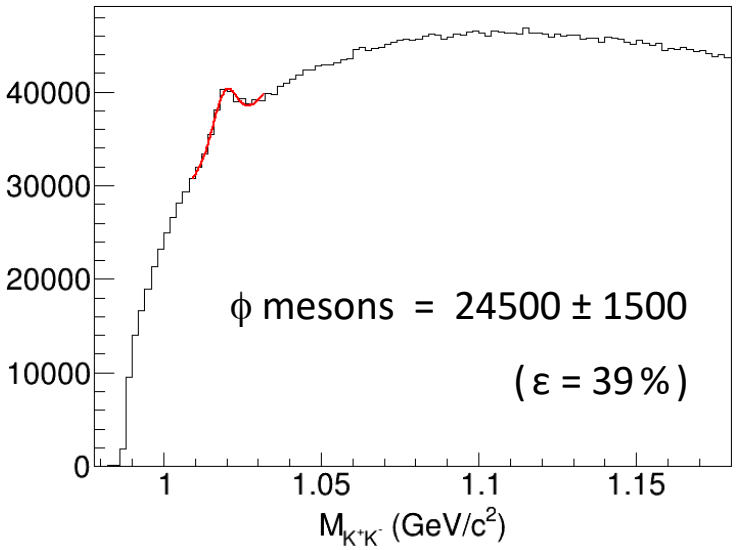




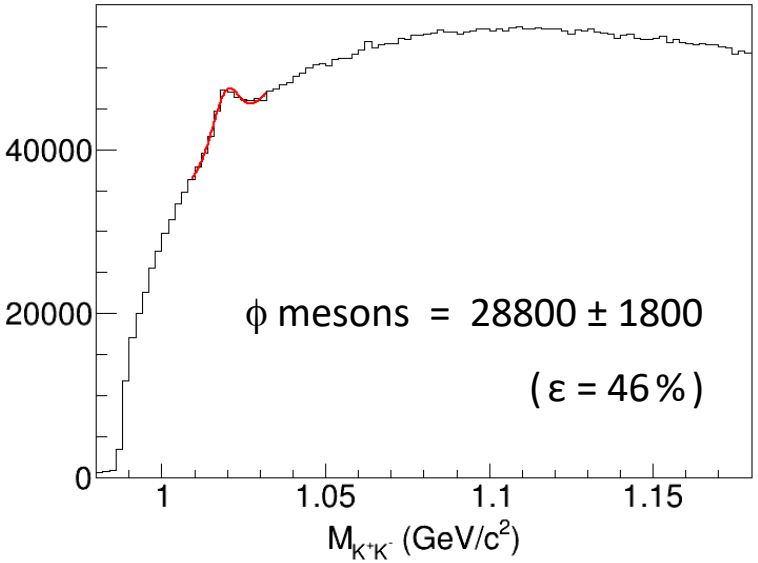
- Hardly a signal
- Small deviation between profiles

KFParticleFinder vs PFSimple

- KFParticleFinder: PID by MC



- PFSimple: PID by MC



▷ Apparently, the No. of counts within histogram differs:

ϕ KFPF case: 3 977 505 counts PFSimple case: 4 704 676 counts

K* KFPF case: 447 145 162 counts PFSimple case: 617 109 106 counts

Q: does the KFPF path have any precuts applied to the Reco data?

Summary of findings

- First-chance reconstruction of ϕ and K^0 (892) mesons, as well as Σ^- (1385) baryons
  - Source: PHQMD simulation of Au+Au collisions @ $\sqrt{s_{NN}}$ = 4.93A GeV
- Findings:
  - For raw PHQMD, the M_{Inv} profiles of background from event-mixing don't fully follow the 'true backgrounds' . This was observed and is publishable.
  - For ϕ via CbmKFParticleFinder:
    - PID via contour in m^2-ToF reduces the efficiency by an order of magnitude. This lets in a lot of p and π "as kaons" .
    - Peak + Linear bkgnd still allows for some signal extraction, Mixed events: 3M stat insufficient.
  - For ϕ via PFSimple:
    - Comparison w/ CbmKFPF at MC level: similar but clear yield differences

Thank You!