D_S reconstruction in ep and eAu

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D_s sample available now!

1) Ds filtered sample: PYTHIA ep @ 9X275 GeV, $Q^2 > 1$ ✅

epic:/RECO/26.07.1/epic_craterlake/SIDIS/Ds_ABCONV/HFsim-PYTHIA/pythia8.316-1.1/ep/9x275/q2_1

2) Ds filtered sample: BeAGLE eAu @ 9X100 GeV, $Q^2 > 1$ ✅

epic:/RECO/26.07.1/epic_craterlake/SIDIS/Ds_ABCONV/HFsim-BeAGLE/BeAGLE1.03.02-1.0/eAu/9x100/q2_1

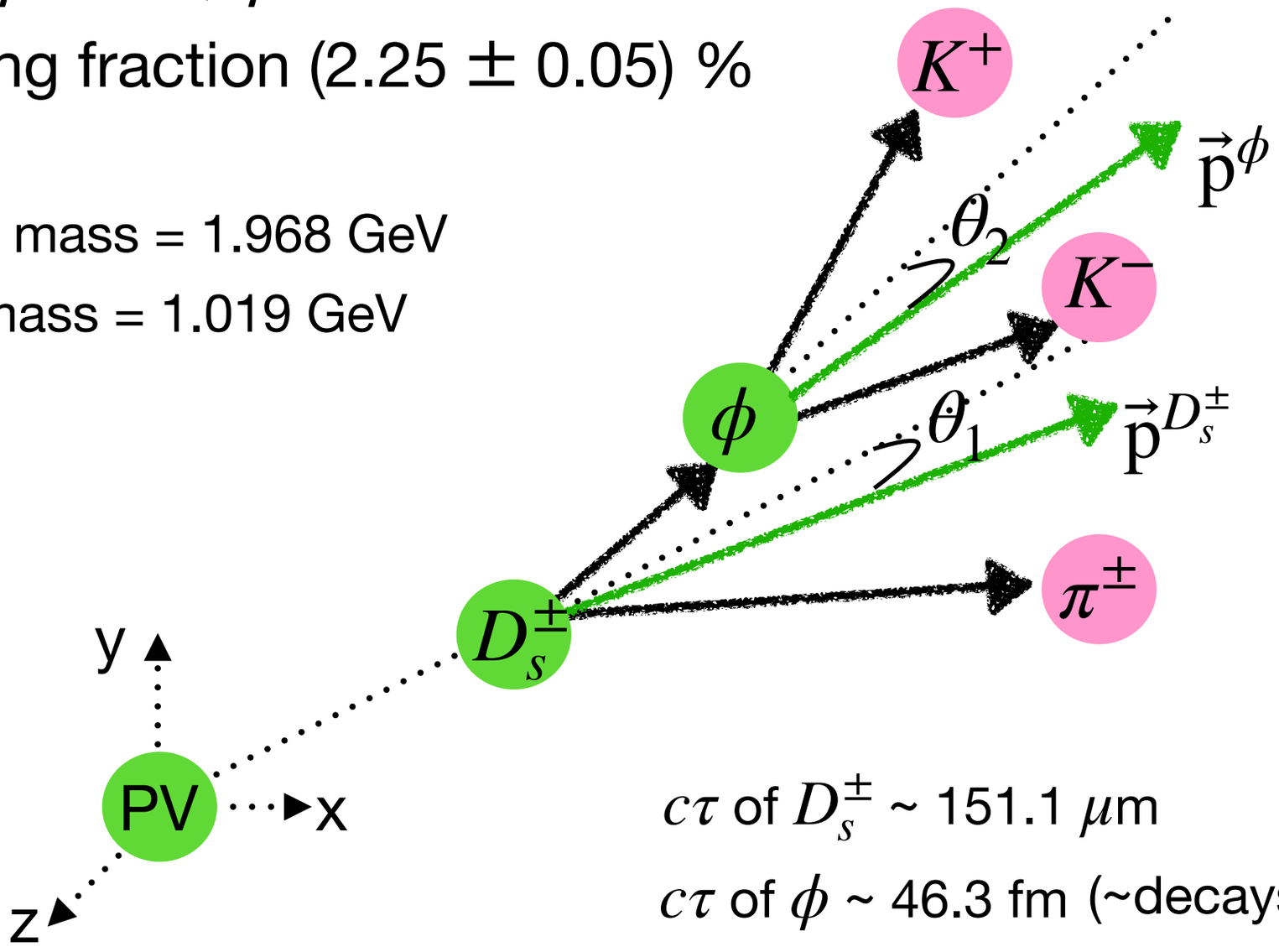
D_s decay channel

Decay channel of interest

- $D_s^{\pm} \rightarrow \phi + \pi^{\pm}, \phi \rightarrow K^+ + K^-$
  branching fraction (2.25 ± 0.05) %

$D_s^{\pm}$ rest mass = 1.968 GeV

ϕ rest mass = 1.019 GeV



$c\tau$ of $D_s^{\pm}$ ~ 151.1 μm

$c\tau$ of ϕ ~ 46.3 fm (~decays extremely quickly)

D_s decay channel

Decay channel of interest

Reconstruction is done using 3 decay tracks pointing to a single SV

(Thanks to Shyam's Λ_c reconstruction code!)

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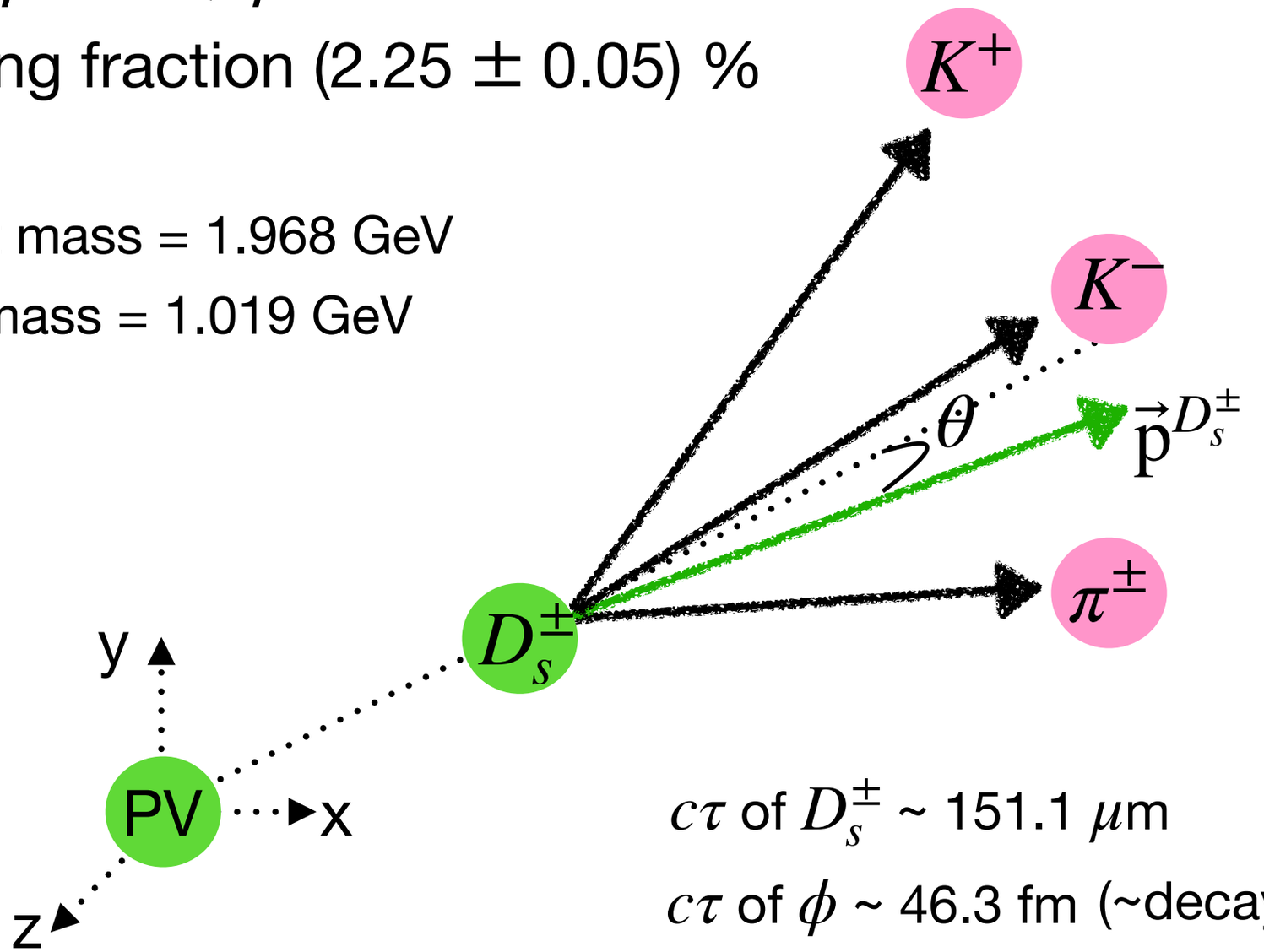


$c\tau$ of $D_s^{\pm}$ ~ 151.1 μm

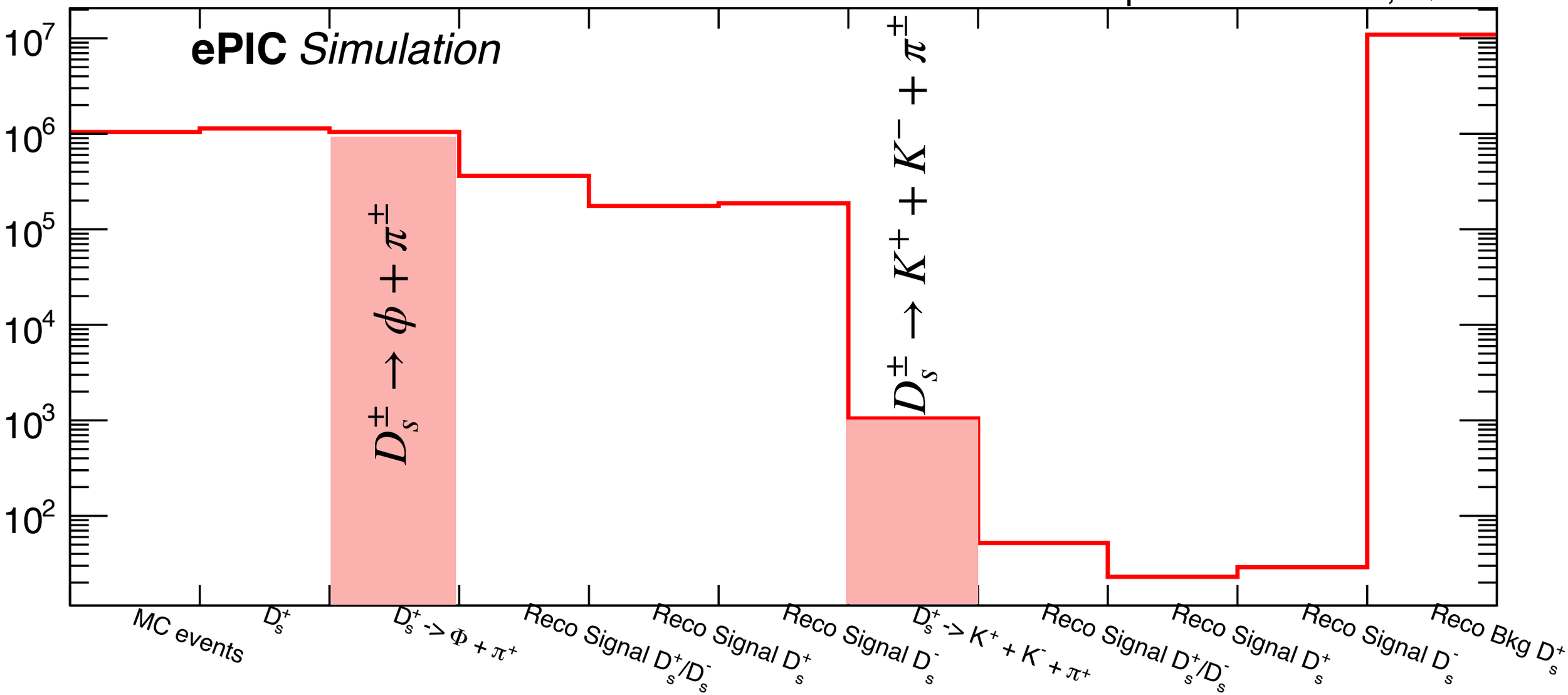
$c\tau$ of ϕ ~ 46.3 fm (~decays extremely quickly)

D_s event statistics in ep sample

Full sample processed

ep sample

Nevents: 1043898



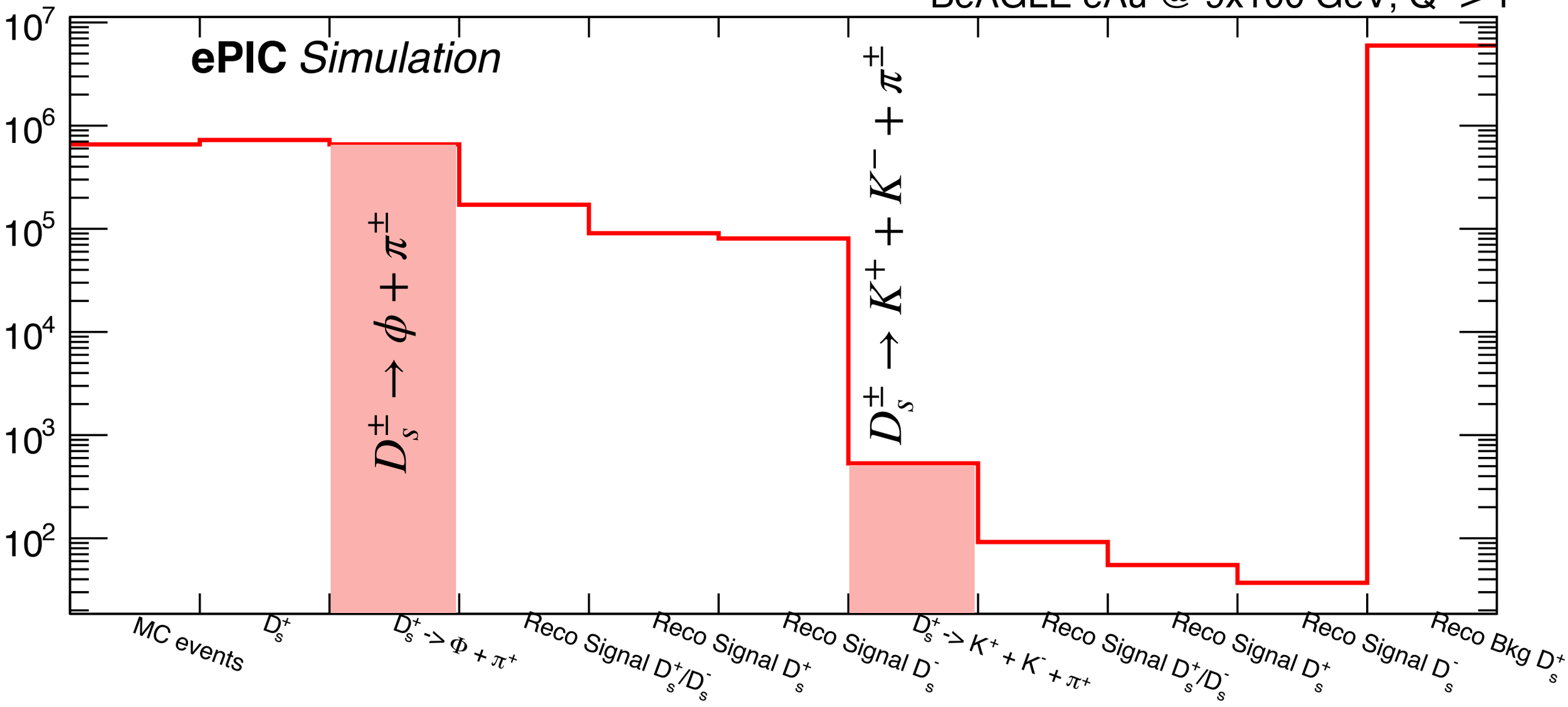
Negligible contribution of non-resonant decay channel in this sample

D_s event statistics in eAu sample

Full sample processed

eAu sample

Nevents: 657435

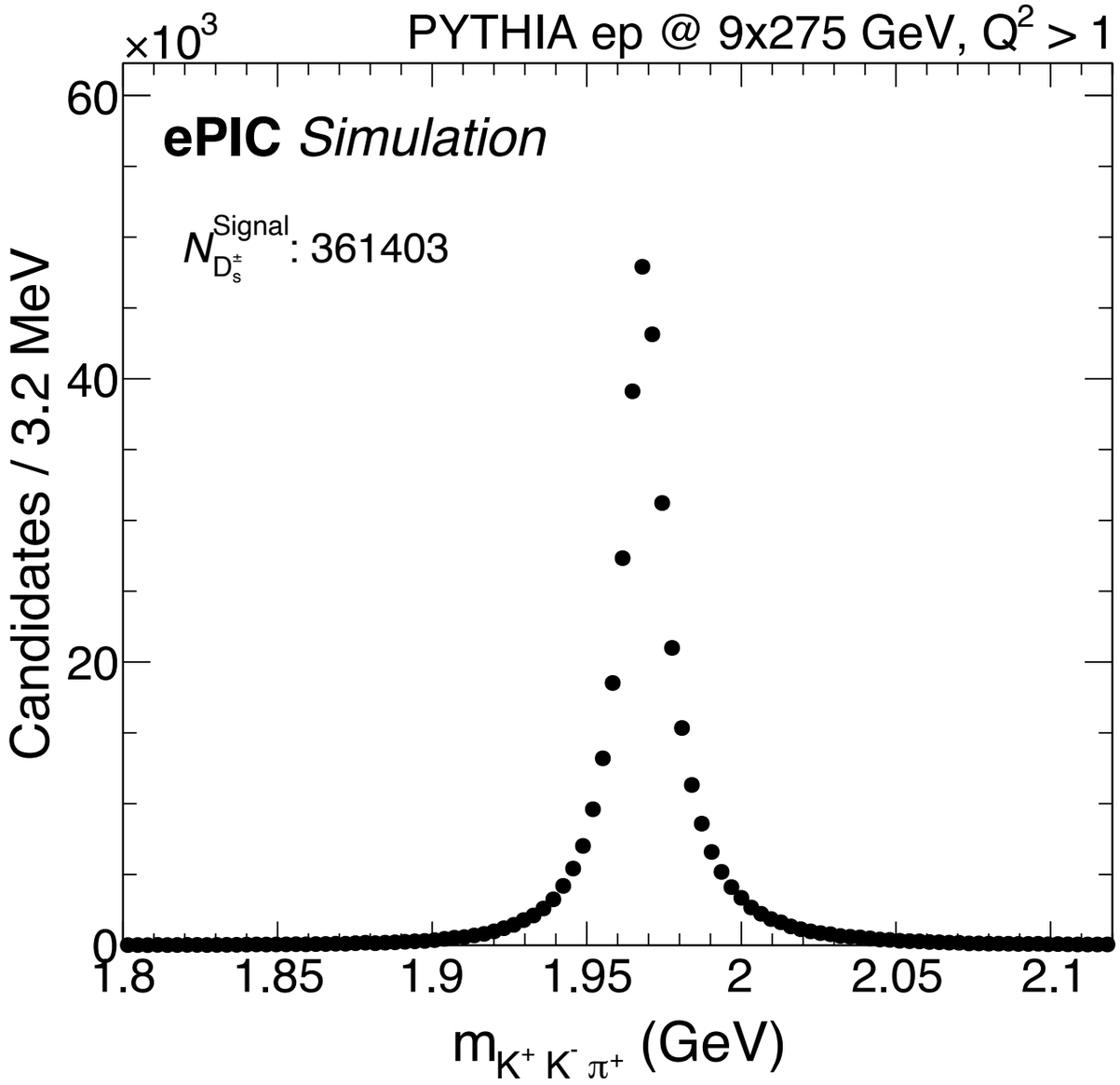


Negligible contribution of non-resonant decay channel in this sample

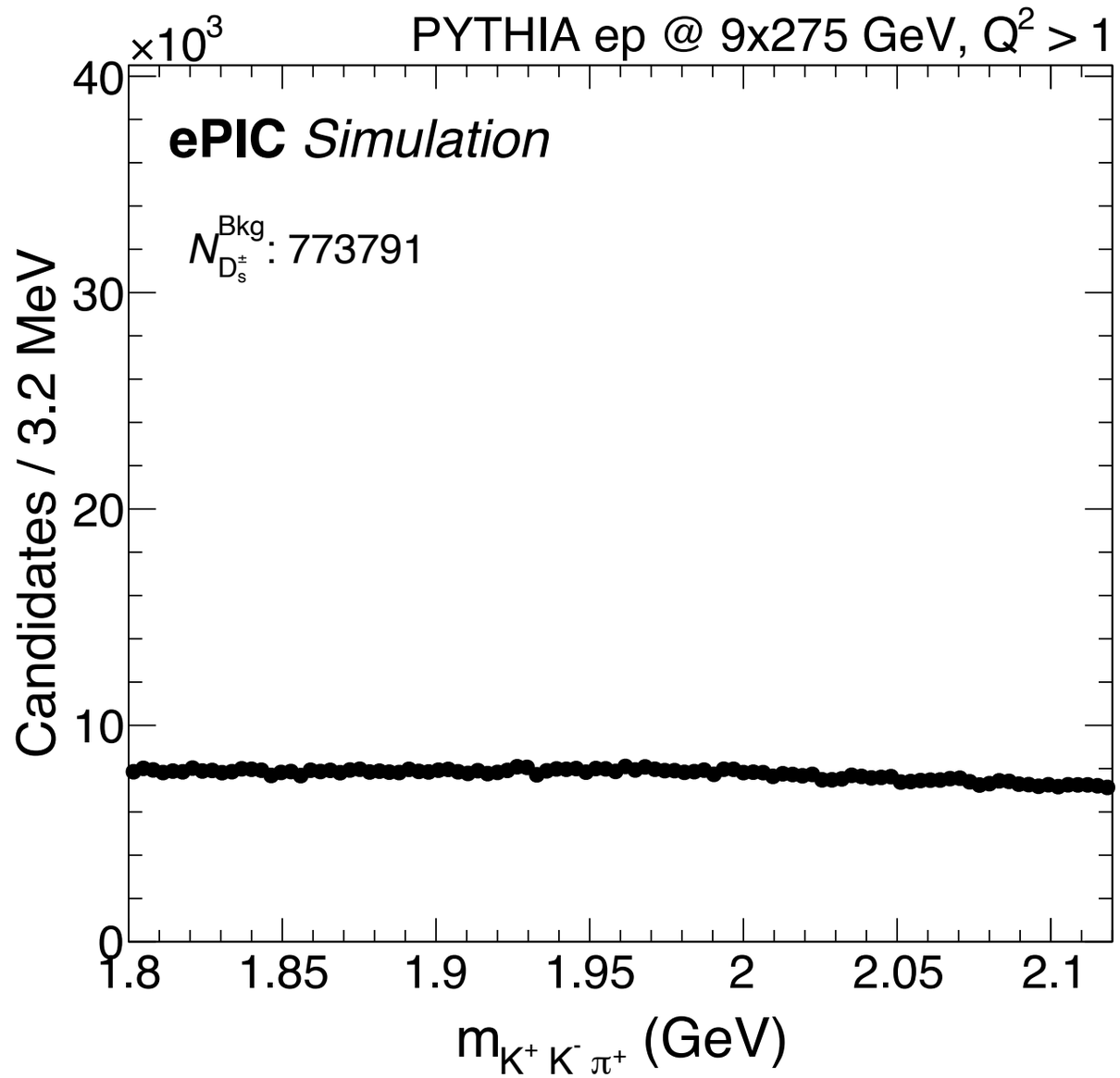
D_s mass peaks!

ep sample

Signal peak
(daughter tracks matched to genparticle)



Background

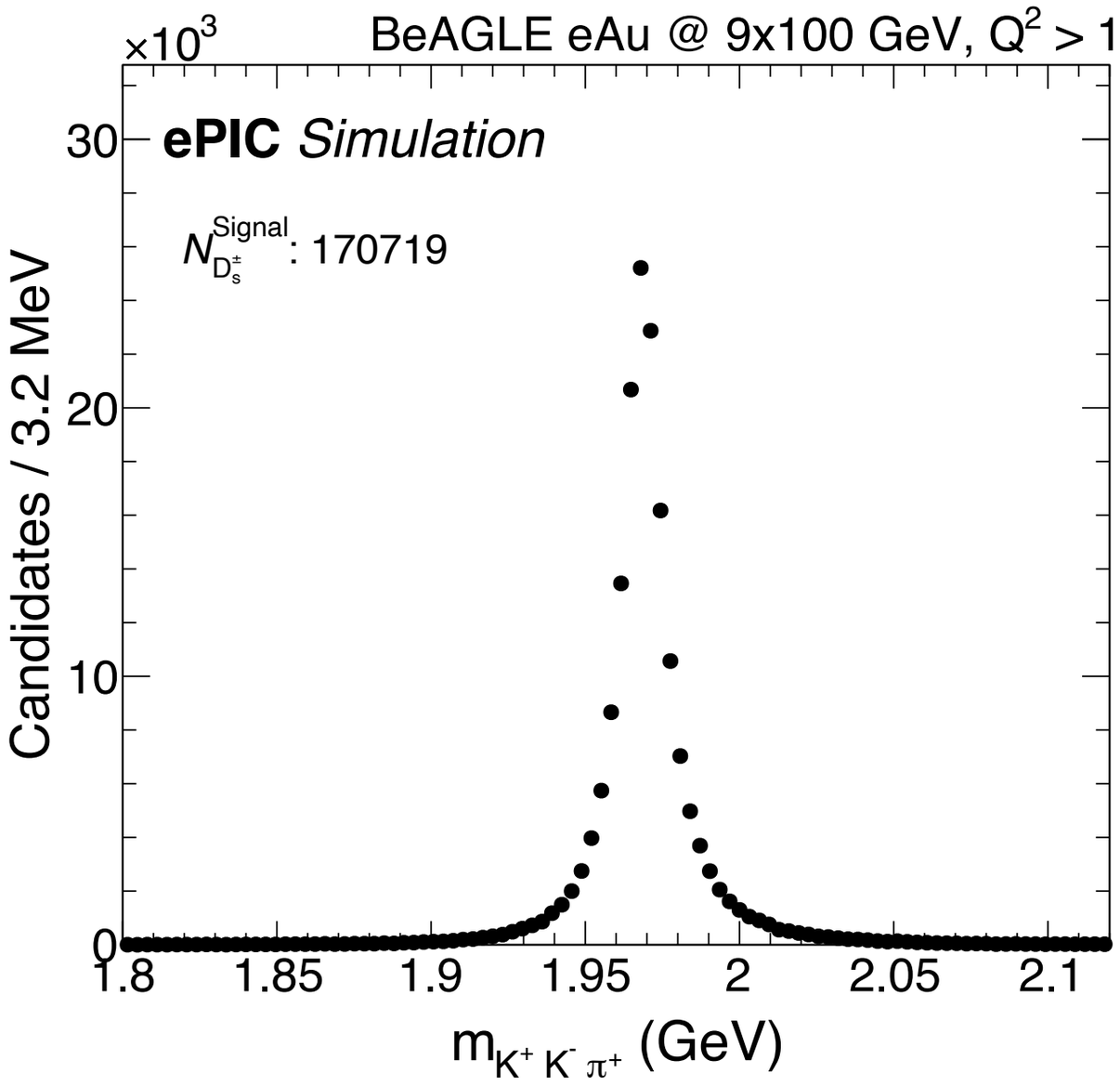


Note: No selection cuts applied

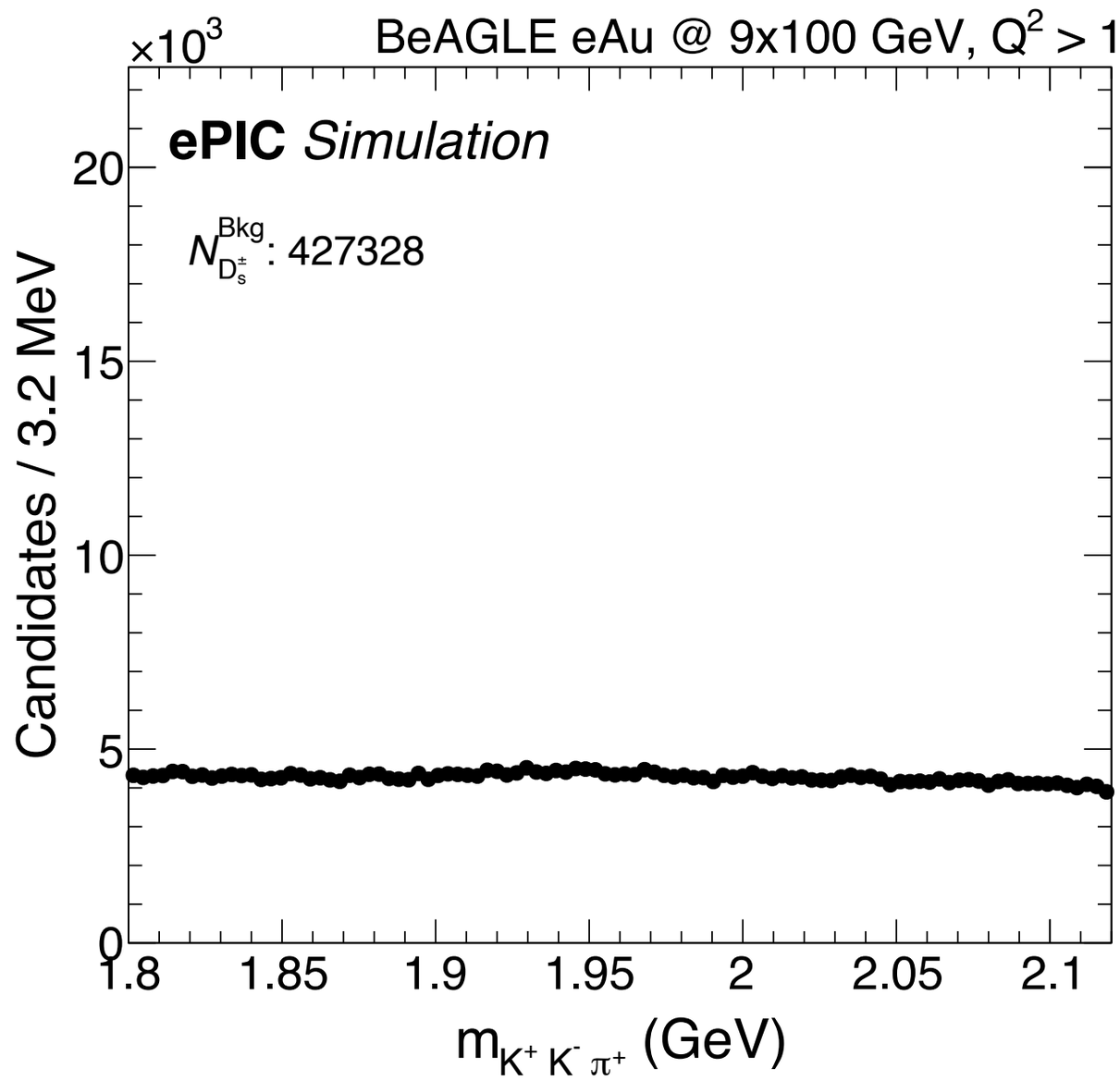
D_s mass peaks!

eAu sample

Signal peak
(daughter tracks matched to genparticle)



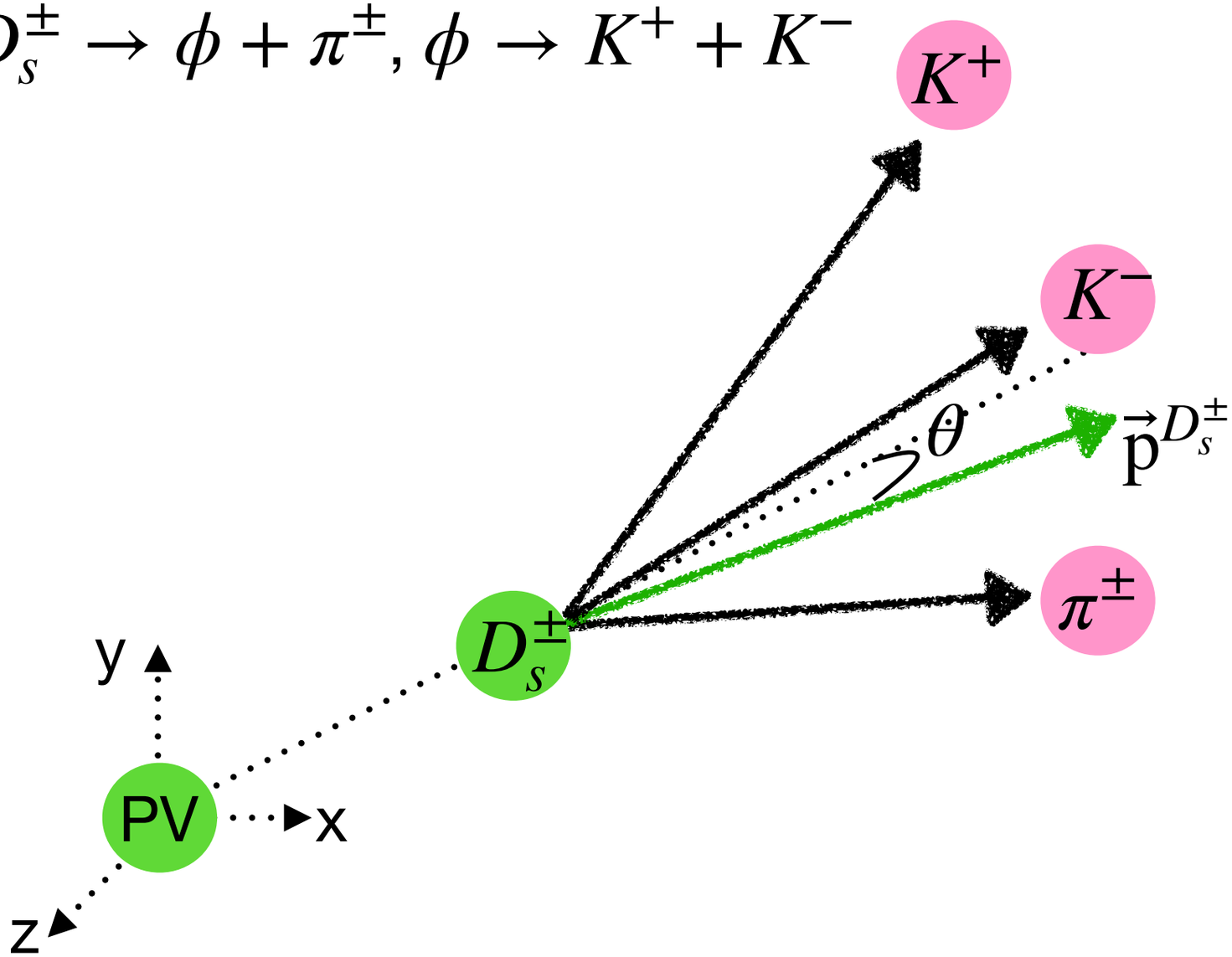
Background



Note: No selection cuts applied

And ϕ peaks too!

$D_s^{\pm} \rightarrow \phi + \pi^{\pm}, \phi \rightarrow K^+ + K^-$

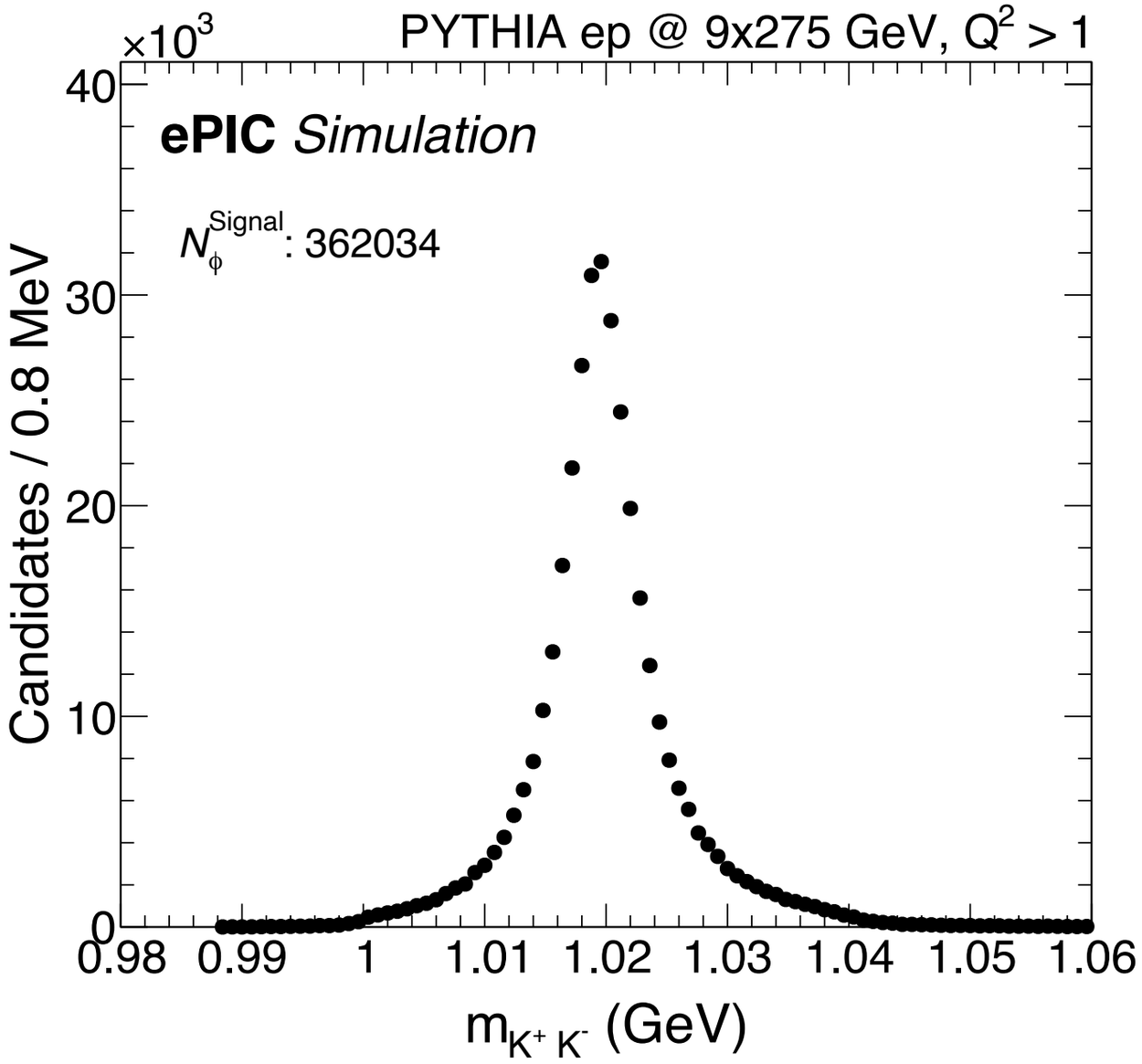


From the D_s decay vertex, we re-calculate the ϕ invariant mass

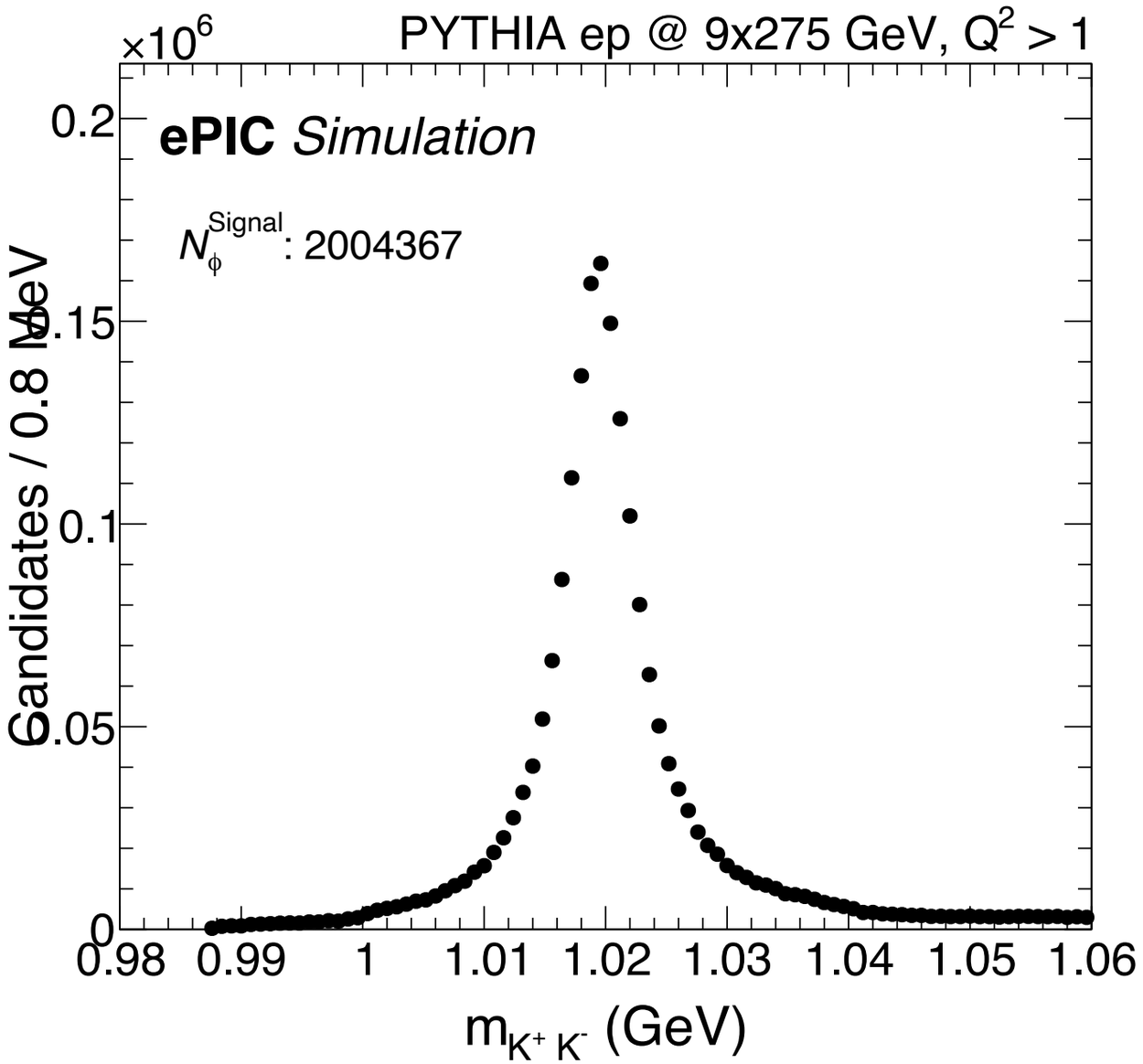
And ϕ peaks too!

ep sample

ϕ from D_s signal candidates



ϕ from D_s background candidates

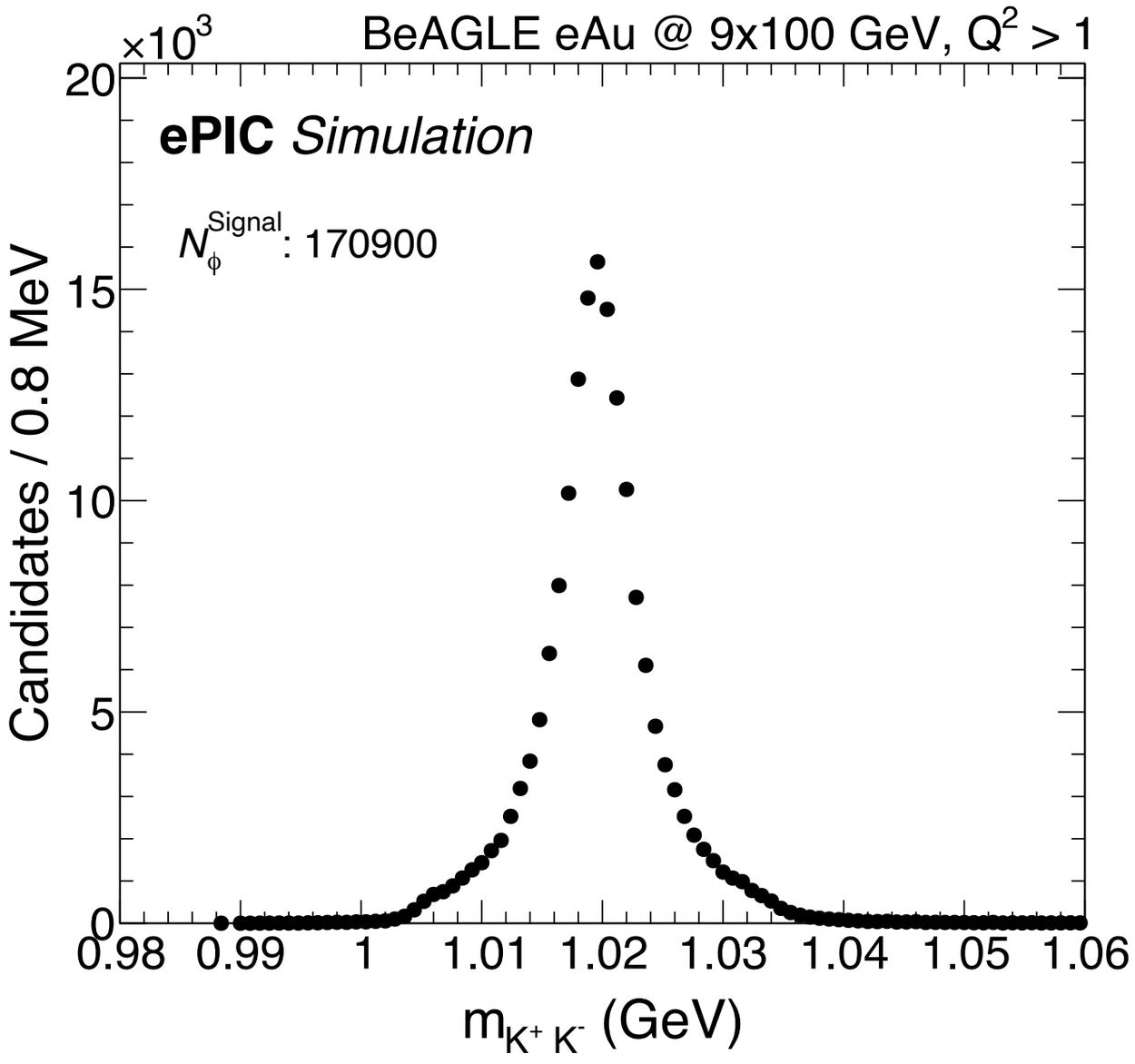


Note: No selection cuts applied

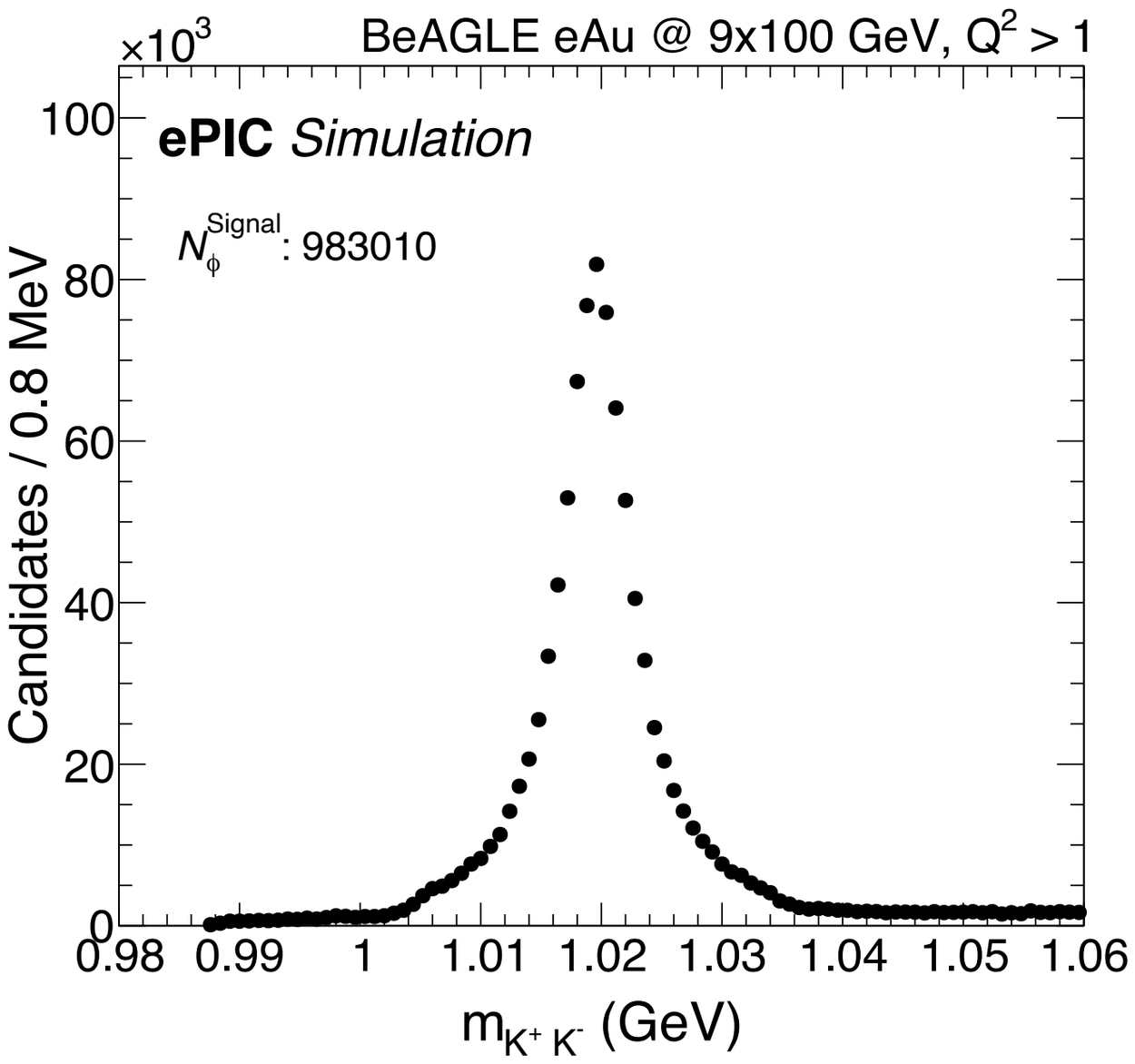
And ϕ peaks too!

eAu sample

ϕ from D_s signal candidates



ϕ from D_s background candidates



Note: No selection cuts applied

Next step

1) Study different cuts to optimize signal significance

2) Study p_T dependence of D_s/D^0 ratios

3) Projection for NIM-A paper

3.2.2. *Charm-strange mesons [Sruthy]*

$D_s^{\pm}$ is a charm–strange meson ($c\bar{s}$ or $\bar{c}s$). Charm quarks are produced very early in the collision through hard scattering processes because of their large mass scale. In contrast, strange quarks can be produced abundantly in the QGP medium. Therefore, studying the D_s/D^0 production ratio can provide insight into how charm quarks hadronize and, in particular, how the presence of strangeness affects charm hadronization.

Reconstructing $D_s^{\pm}$ in ePIC is a useful feasibility study toward future charm-hadron measurements. In particular, it allows us to evaluate the detector's capability to reconstruct short-lived charm hadrons through their displaced decay topology and to achieve sufficient signal-to-background separation. The $D_s^{\pm}$ can be reconstructed through the decay chain

$$D_s^+ \to \phi, \pi^+, \qquad \phi \to K^+K^-, \tag{3}$$

with a branching ratio of $(2.25 \pm 0.05)\%$.