Electroproduction of phi meson with CLAS12

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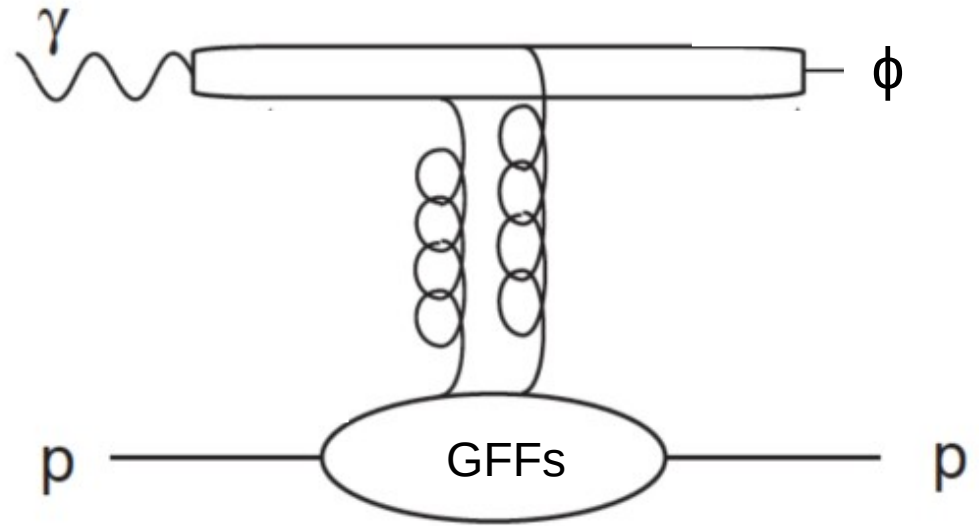
Thesis at CEA Saclay with Pierre Chatagnon

17 October 2025

Introduction and objectives

Analysis objective :

- Measurement of the cross section and diferential cross section of the electroproduction of ϕ in the $K_s\, K_L$ channel

- Interpretation with gluon Generalised Parton Distribution (GPDs) and gravitational form factors (GFFs)

Reaction :

$e\ p \to \phi\ e'\ p'$

Decay Channel :

$\phi \to K^0_s\ K^0_L$ \qquad (Br = 34.2 %)

$c\tau_{Ks} = 2.68$ cm and $c\tau_{KL} = 15.34$ cm

Detection :

$K^0_s \to \pi^+\ \pi^-$ \qquad (Br = 69.20 %)

$K^0_L \to$ cut on missing mass
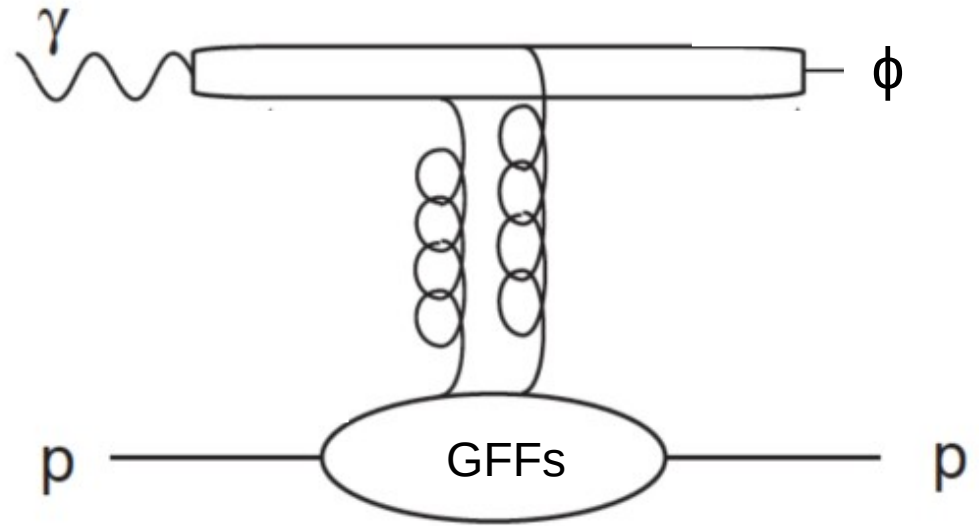
Introduction and objectives
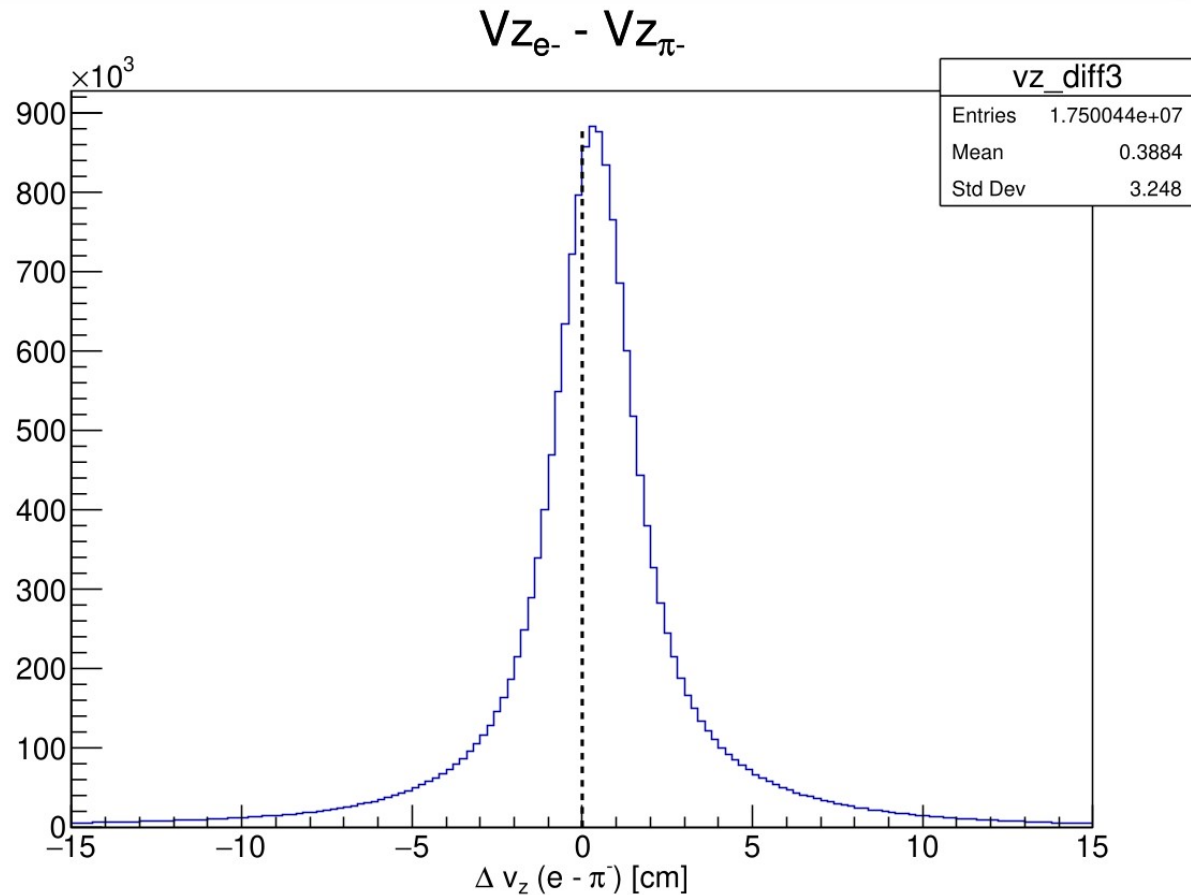
Reaction :

e p $\rightarrow \phi$ e' p'

Exclusivity Cuts :

- Selection of events with one e^- , p , π^+ and π^- in the final state.

- Cut on invariant mass of $\pi^+ \pi^-$ with $0.4 < M_{inv}(\pi^+ \pi^-) < 0.6$ GeV.

- Cut on Missing Mass in the reaction e p $\rightarrow$ e' p' K_s X with $0.4 < M_{issMass} < 0.6$ GeV.

- Cut on $Vz_{e-} - Vz_{\pi-} < 0$ && $-5 < Vz_{\pi+} - Vz_{\pi-} < 5$ cm

Datas :

Rg-A datas : fall2018 inbending

$Vz_{e^-} - Vz_{\pi^-}$

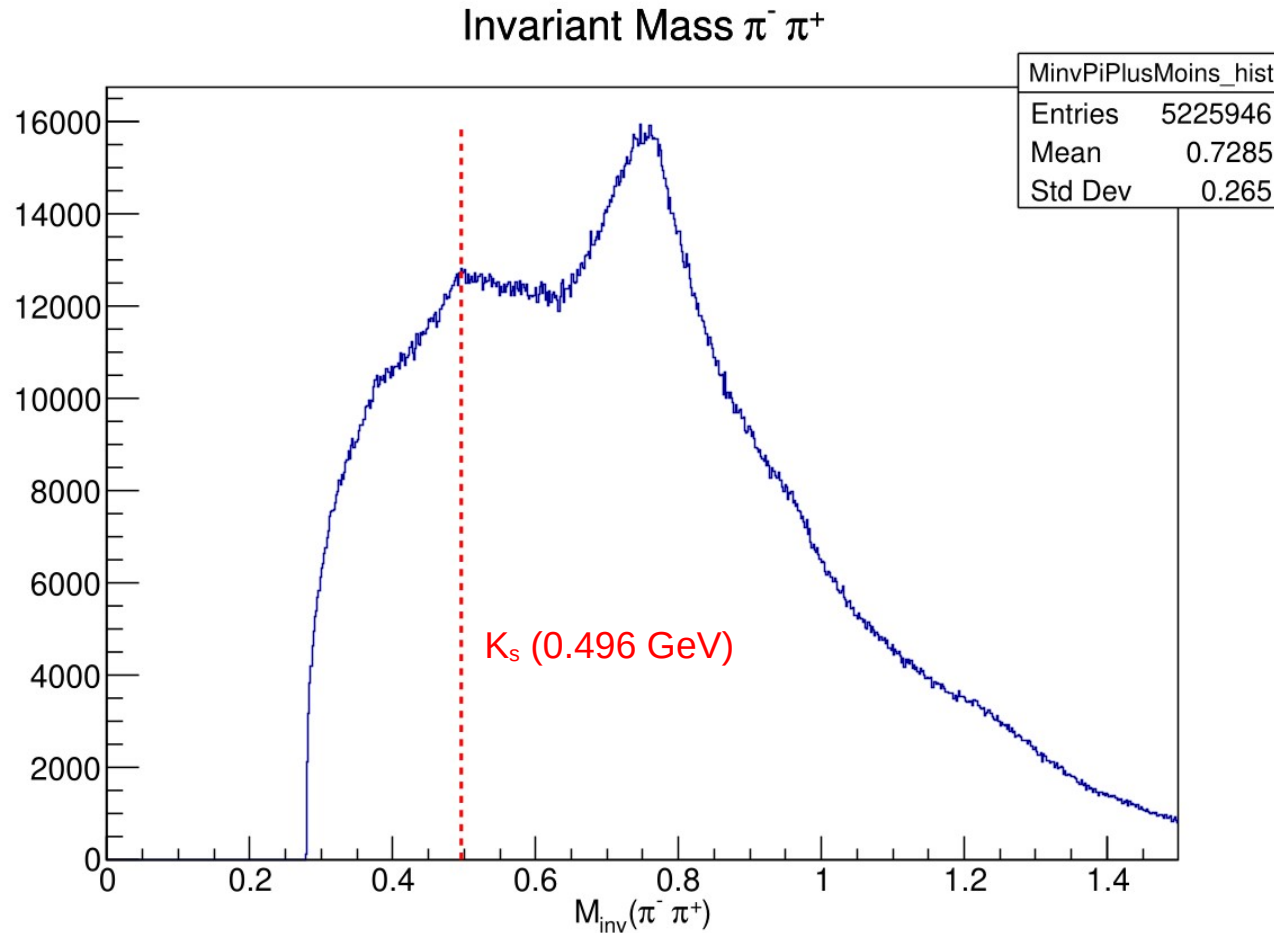| vz_diff3	
Entries	1.750044e+07
Mean	0.3884
Std Dev	3.248

Cut on $Vz_{e^-} - Vz_{\pi^-} < 0$ to ensure that the vertex of $Ks \rightarrow \pi^+ \pi^-$ is located further than the vertex of $\phi \rightarrow K_s K_L$

Introduction and objectives
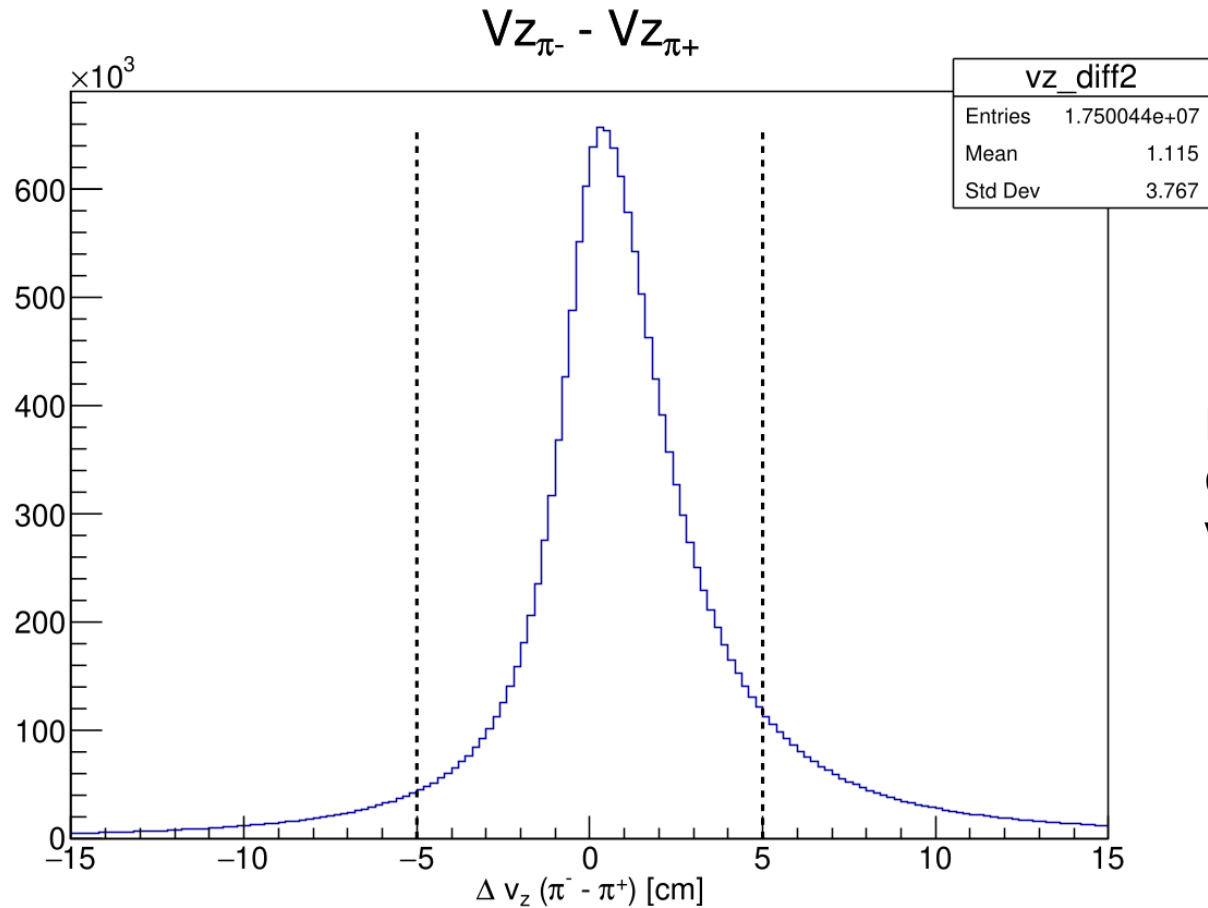
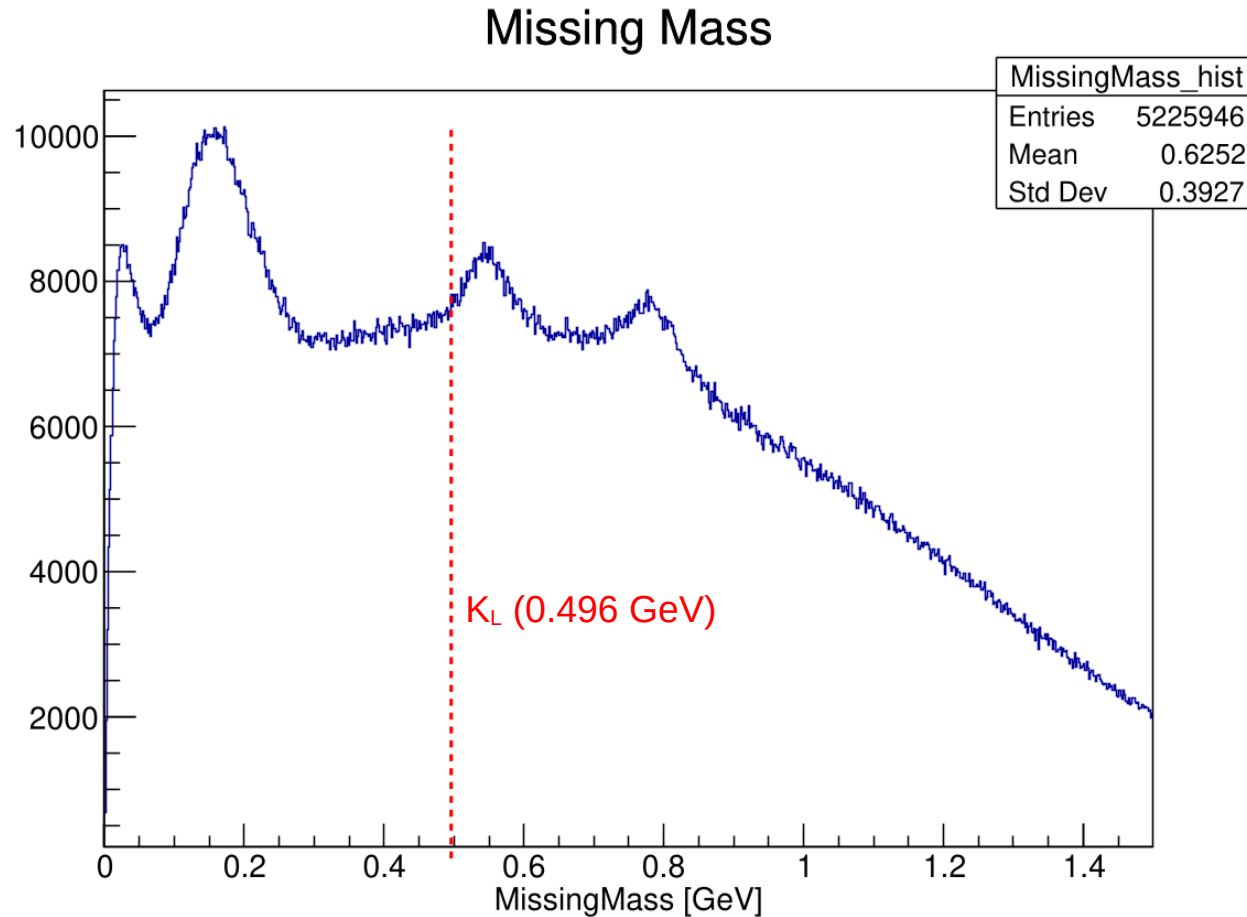Large cut on $-5 < Vz_{\pi-} - Vz_{\pi+} < 5$ cm to ensure that $\pi+$ and $\pi-$ have the same vertex

Invariant Mass π⁻ π⁺

Cuts :

* Particle final state
* $Vz_{e^-} - Vz_{\pi^-} < 0$
* $-5 < Vz_{\pi^+} - Vz_{\pi^-} < 5$ cm

Cuts :

* Particle final state
* $Vz_{e-} - Vz_{\pi-} < 0$
* $-5 < Vz_{\pi+} - Vz_{\pi-} < 5$ cm

Invariant Mass $\pi^-\pi^+$ with cut on MM

MinvPiPlusMoins_hist2	
Entries	825127
Mean	0.7312
Std Dev	0.2727

K_s (0.496 GeV)
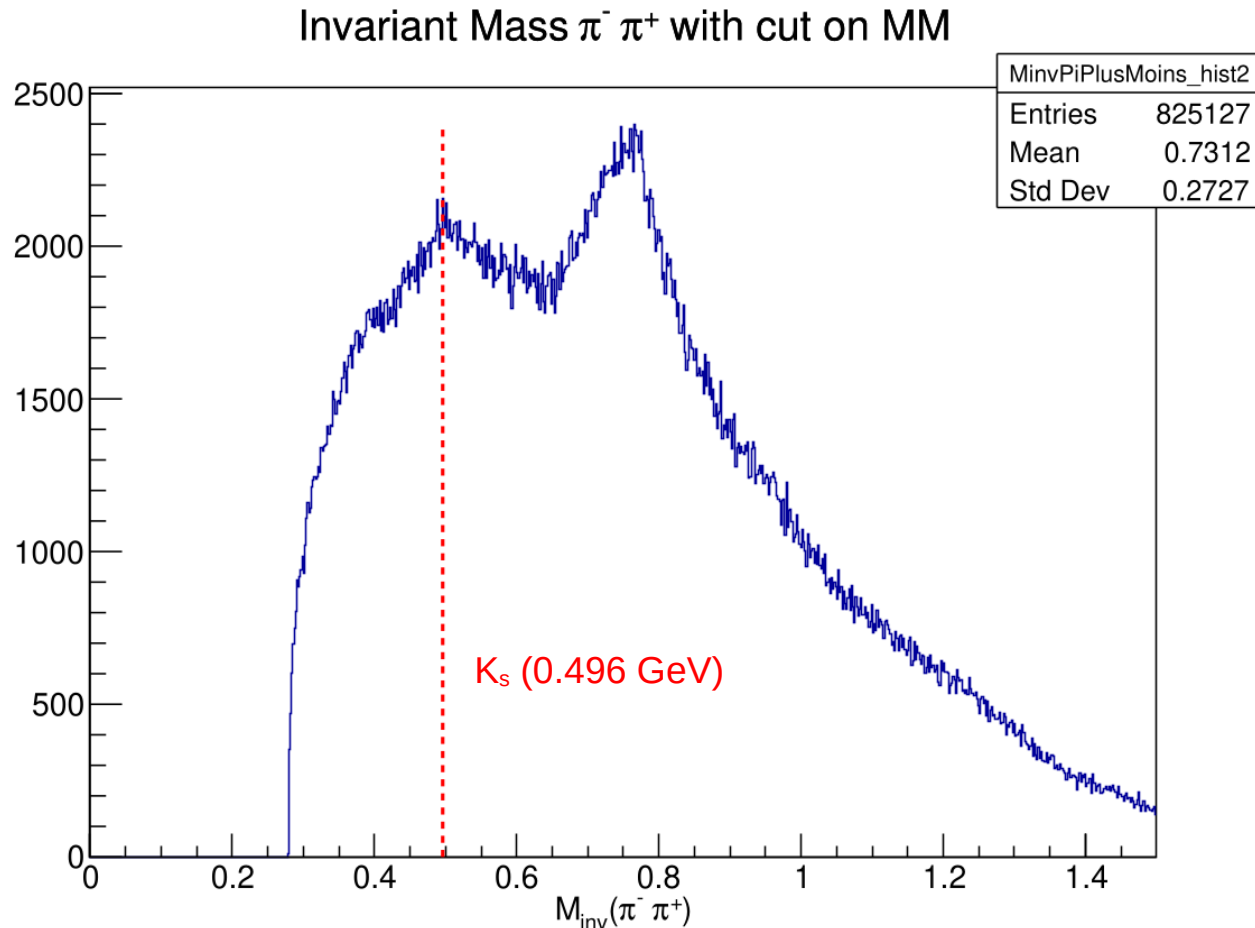
$M_{inv}(\pi^-\pi^+)$

Cuts :

* Particle final state
* $Vz_{e-} - Vz_{\pi-} < 0$
* $-5 < Vz_{\pi+} - Vz_{\pi-} < 5$ cm
* $0.4 <$ MissingMass < 0.6 Gev

Missing Mass with cut on M_{inv} of $\pi^+\pi^-$

MissingMass_hist2	
Entries	1283224
Mean	0.6643
Std Dev	0.3862

K_L (0.496 GeV)
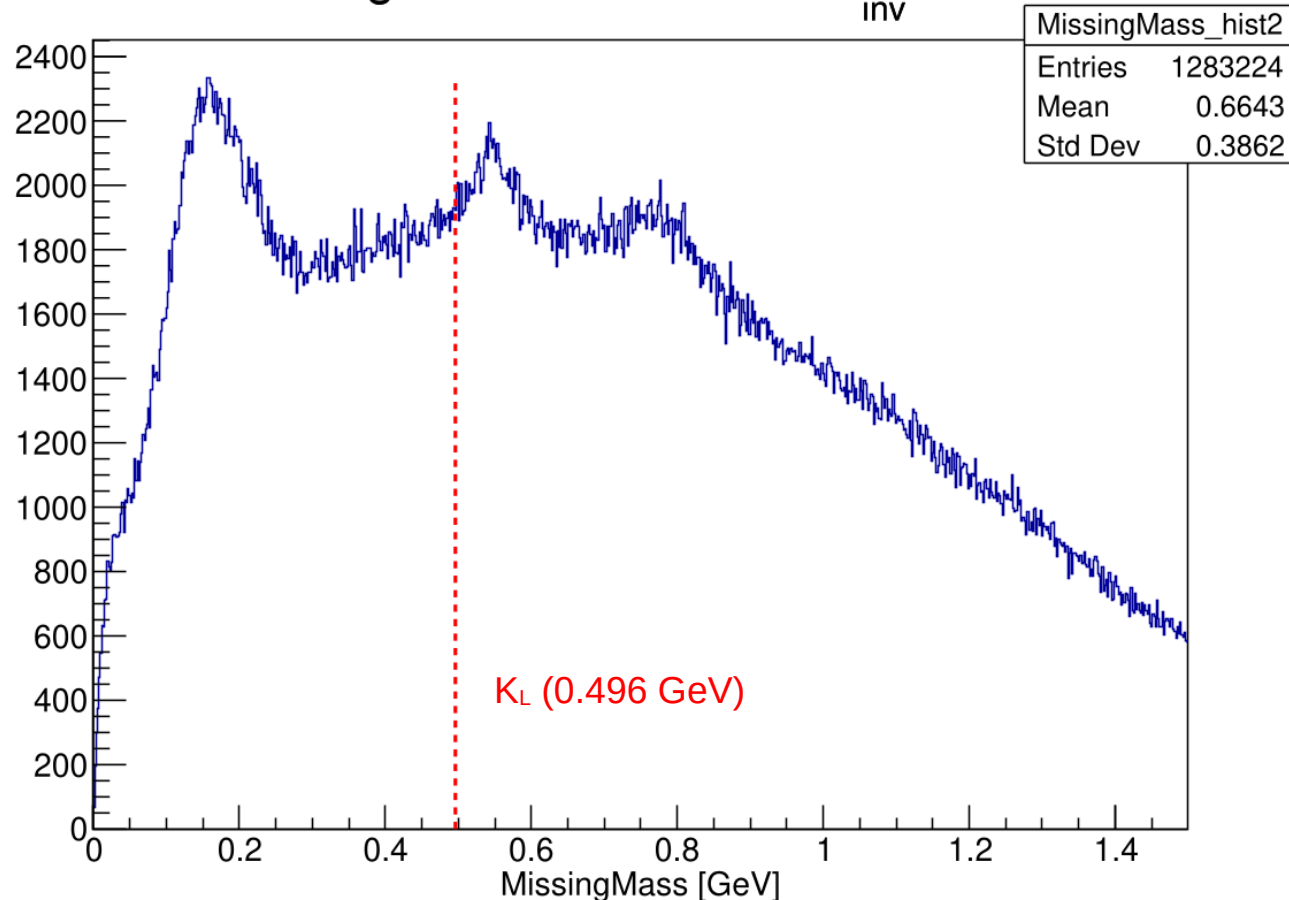
Cuts :

* Particle final state
* $Vz_{e^-} - Vz_{\pi^-} < 0$
* $-5 < Vz_{\pi^+} - Vz_{\pi^-} < 5$ cm
* $0.4 < Minv\,(\pi^+\pi^-) < 0.6$ GeV

First Plots

Invariant Mass $K_s K_L$

MinvKsKl_hist

Entries	206905
Mean	1.261
Std Dev	0.1352

ϕ (1.019 GeV)

$M_{inv}(K_s K_L)$ [GeV]
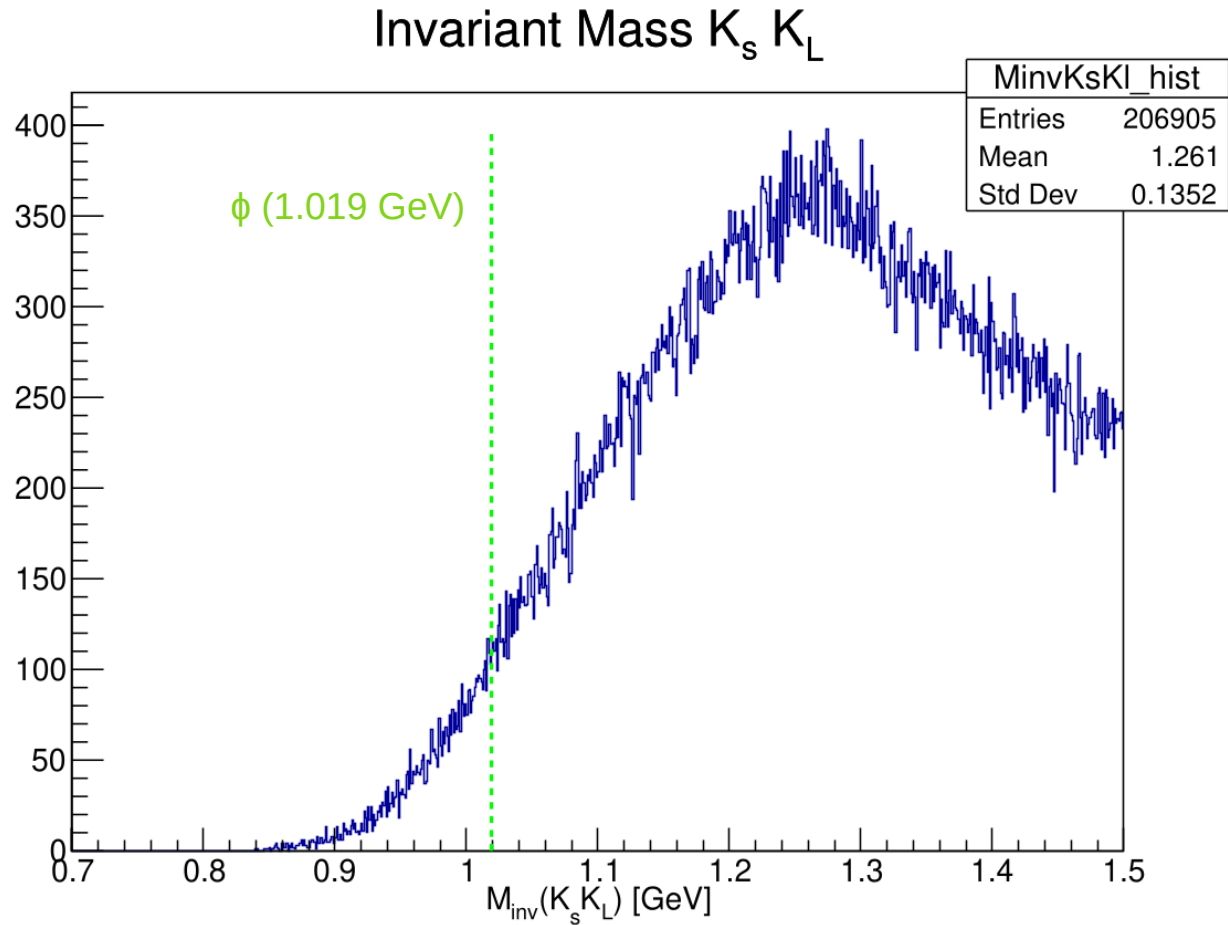
Cuts :

Particle final state
$Vz_{e^-} - Vz_{\pi^-} < 0$
$-5 < Vz_{\pi^+} - Vz_{\pi^-} < 5$ cm
$0.4 < Minv\,(\pi^+ \pi^-) < 0.6$ GeV
$0.4 < MissingMass < 0.6$ GeV

Outlook

Test already done :

* Move the missing mass cut between 0.5 – 0.7 GeV if the peack of K_L is shifted

* Same cut with rg-K datas

Further cuts :

* Improve the cut on ΔVz with the code of Veronique Ziegler

* Cut on Vt

Thanks !