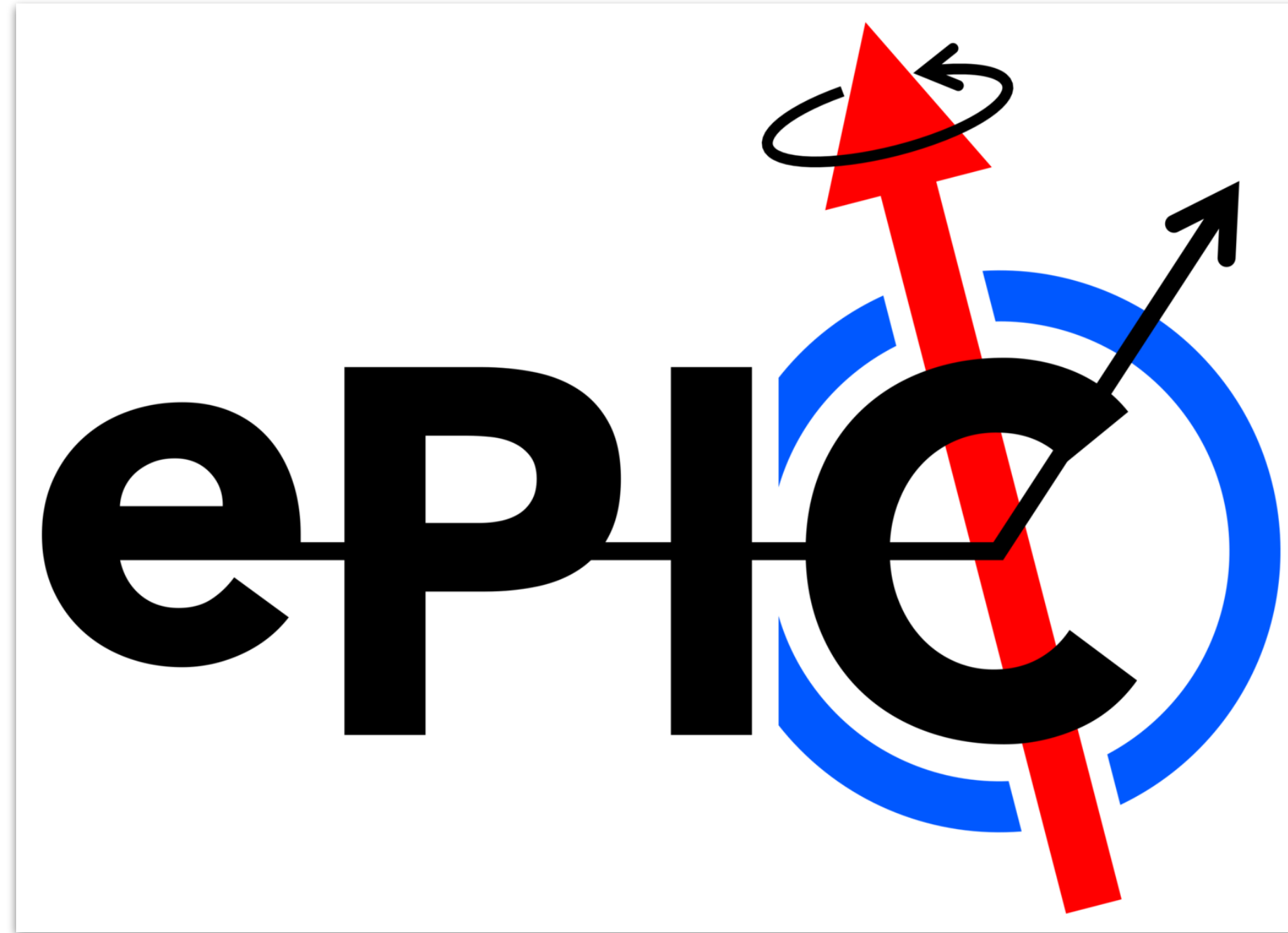
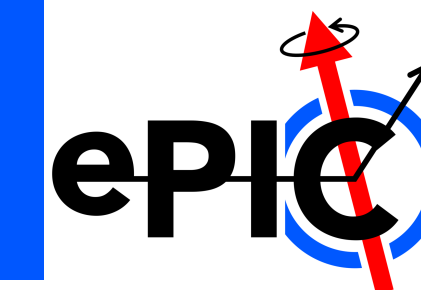




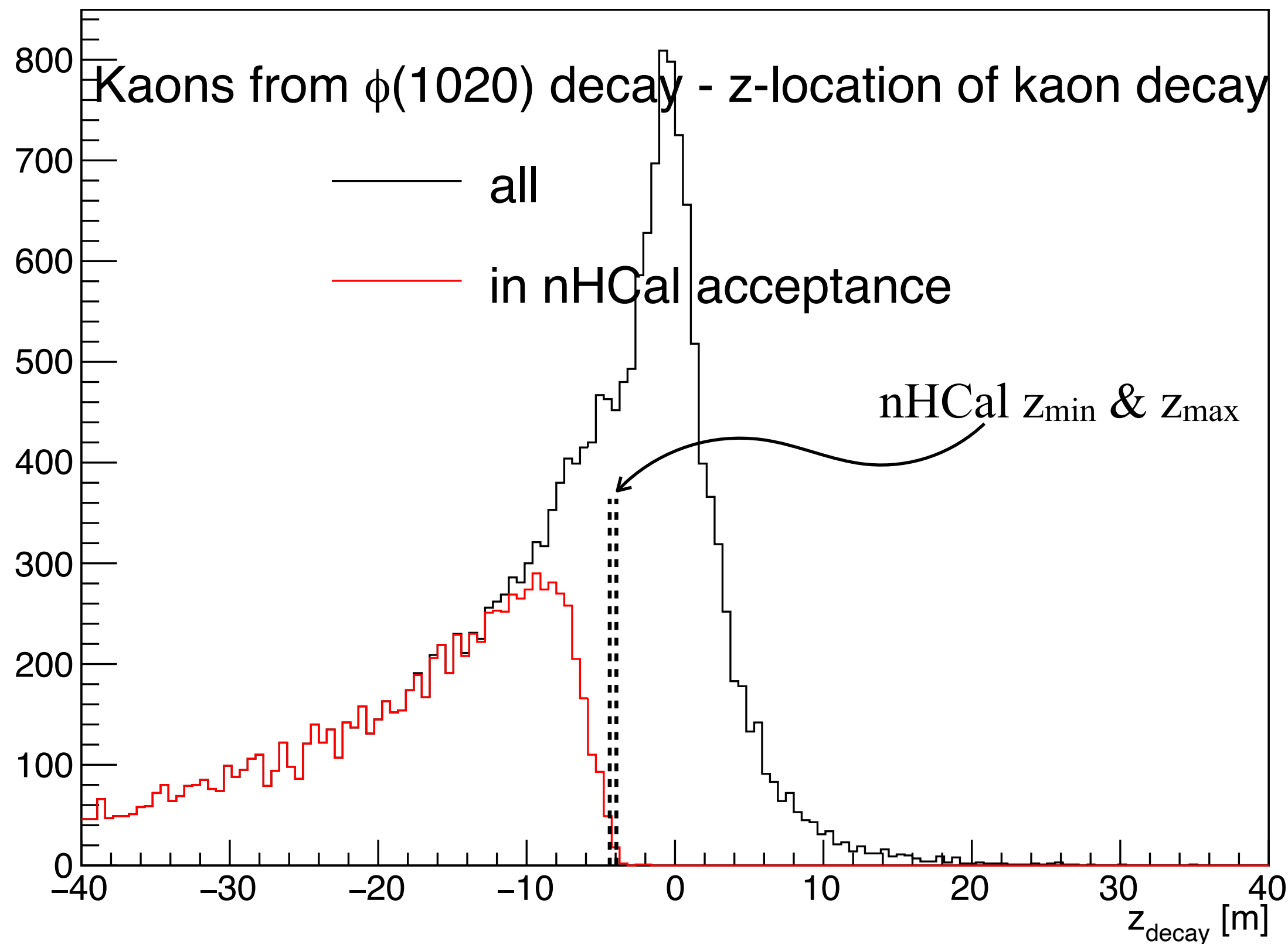
Update - exclusive VMs in the nHCal

Caroline Riedl (UIUC)
December 18, 2024

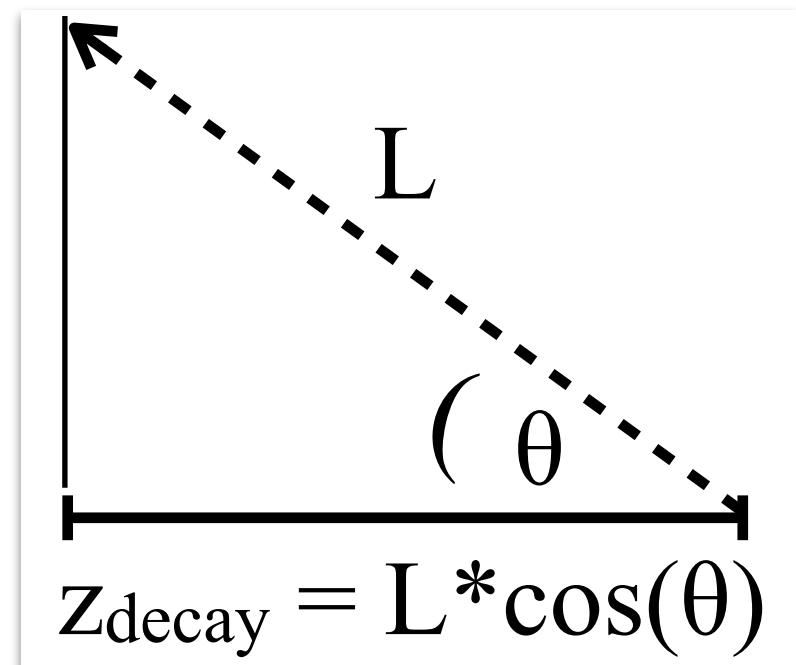
Decay length: Sartre 18x110 vs. Pythia 18x275



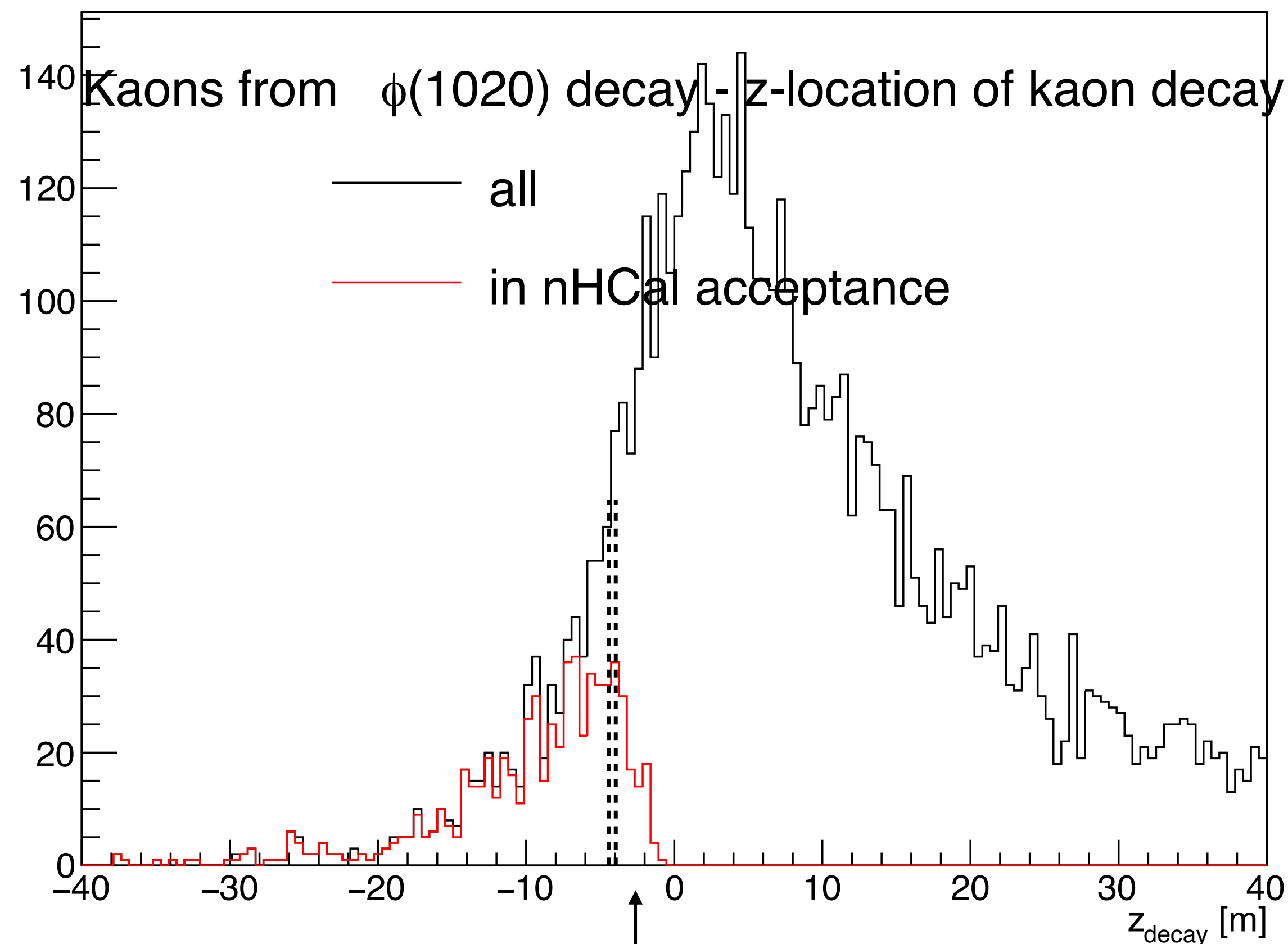
Sartre_Au_phi_10runs



$$L = (p/m) \cdot \tau \cdot c$$

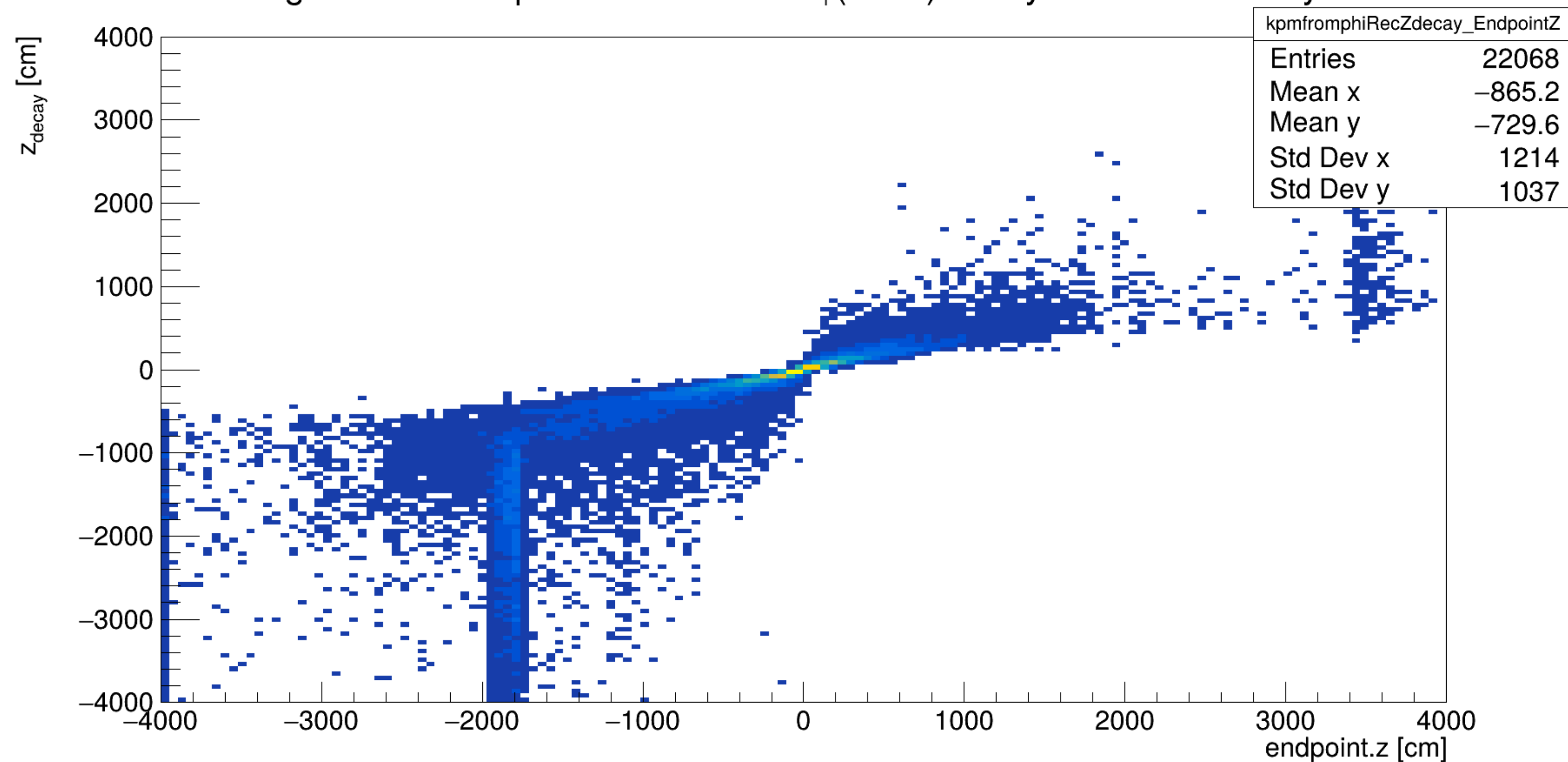


pythia8NCDIS_18x275_minQ2=1_beamEffects_xAngle=-0.025_hiDiv_1_1000runs

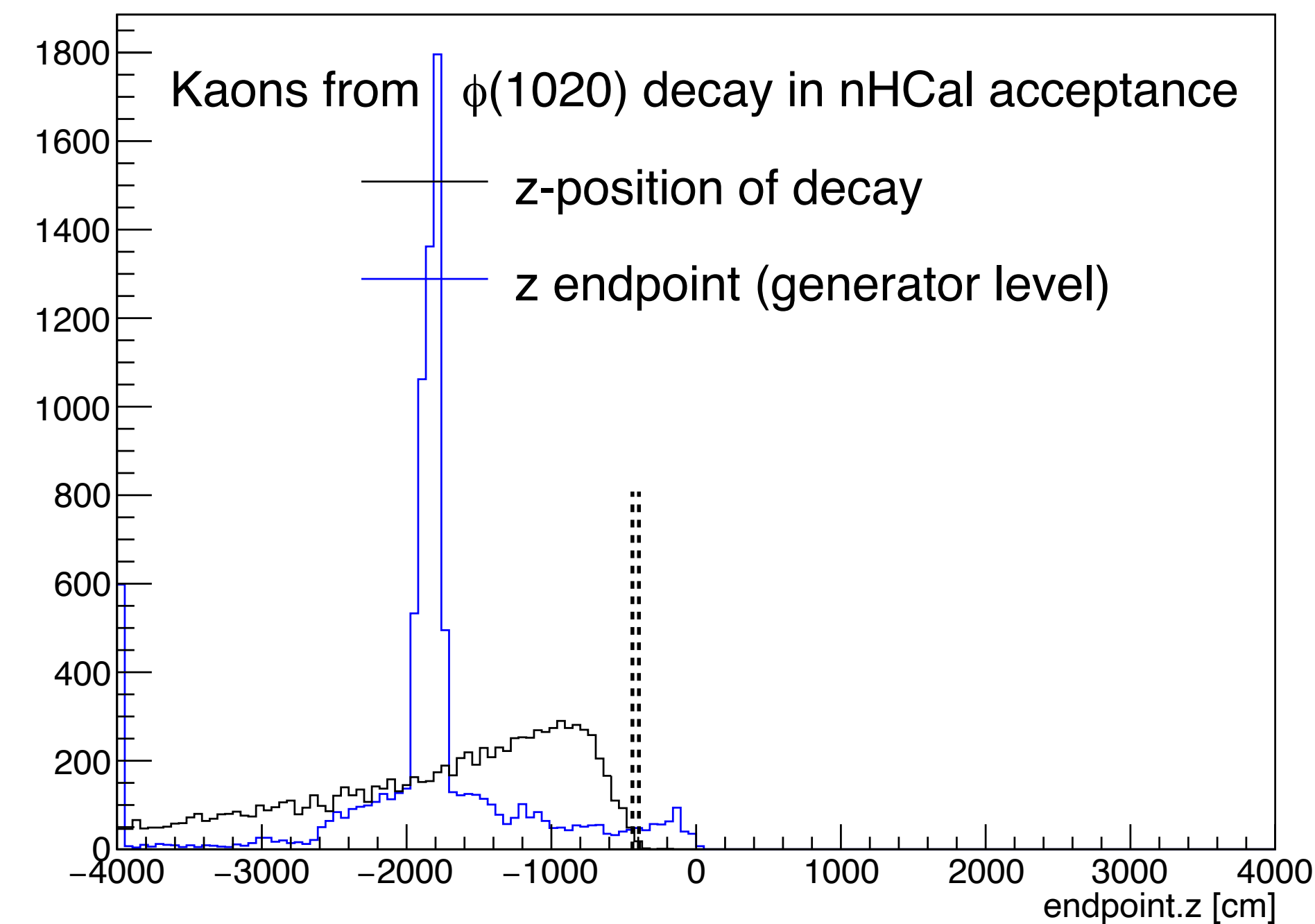


depending on the kinematics and process, it can easily happen that more kaons decay before they reach the nHCal

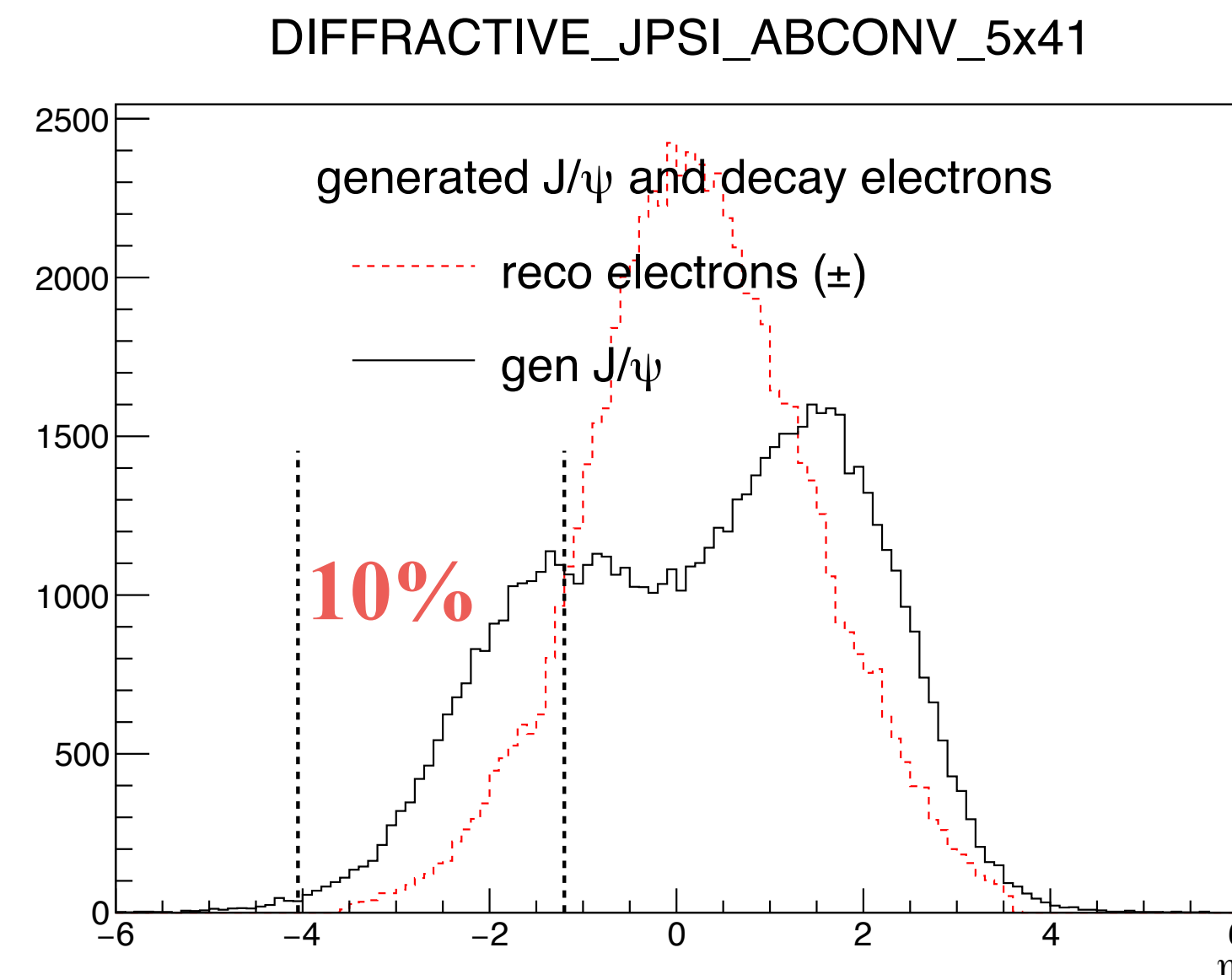
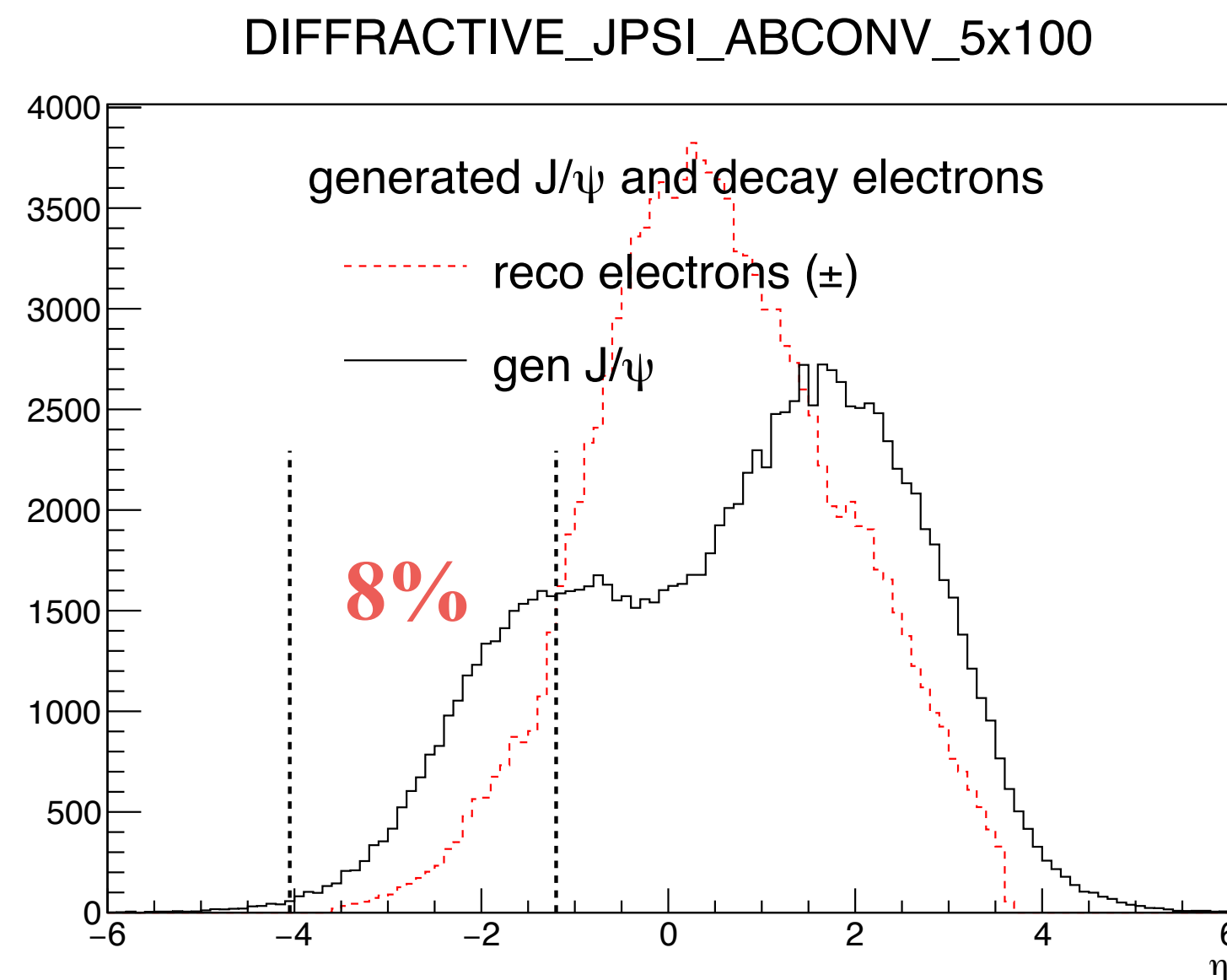
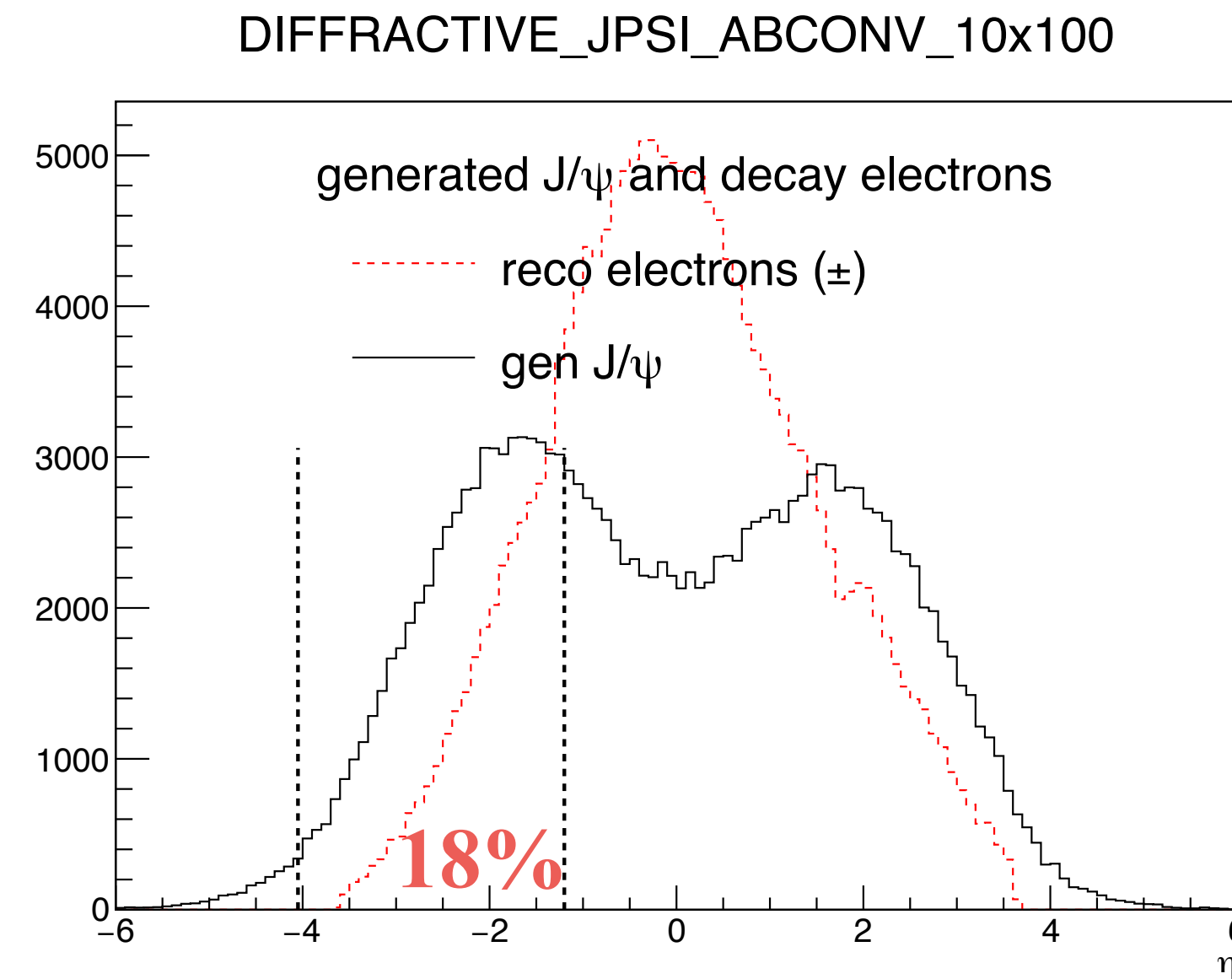
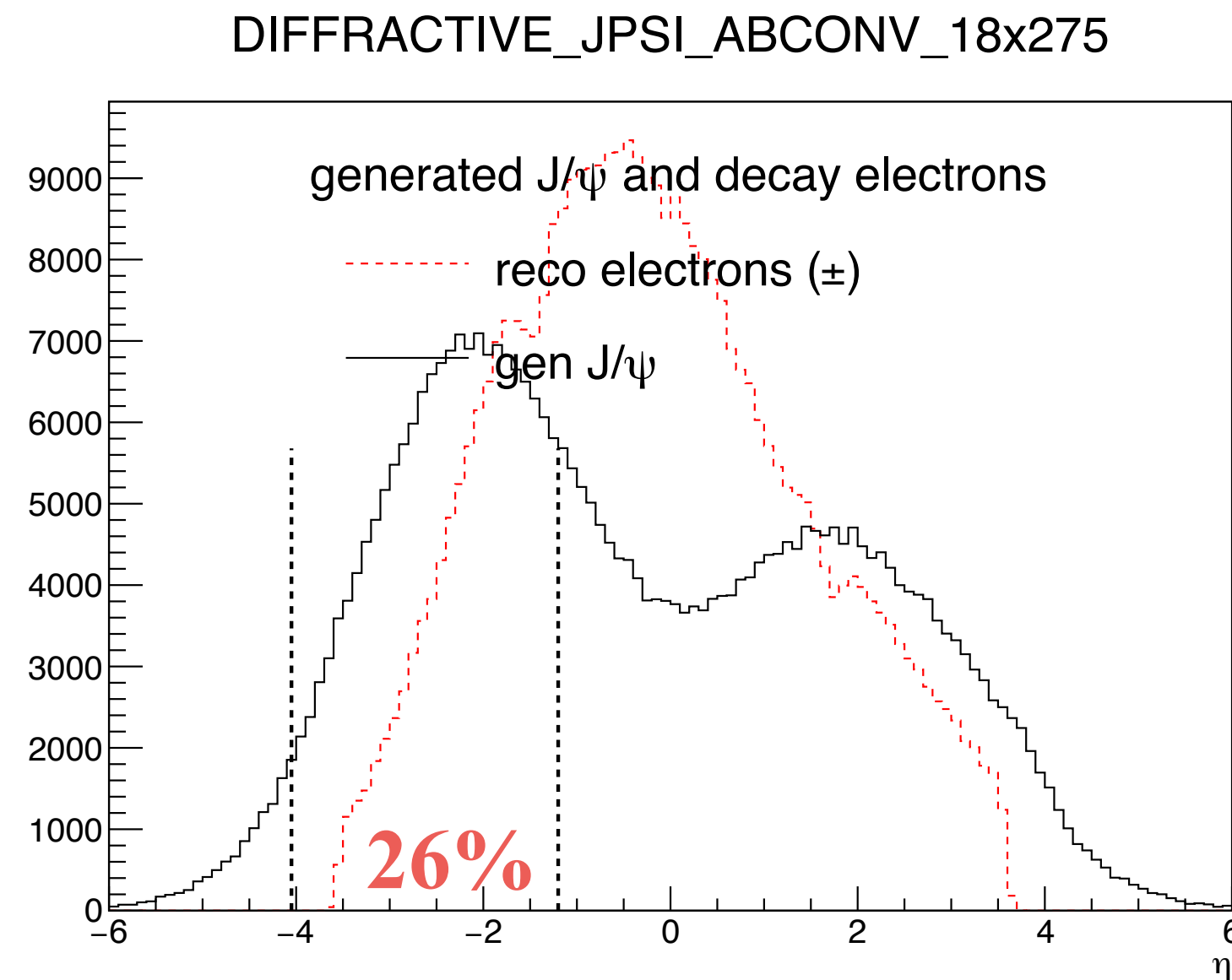
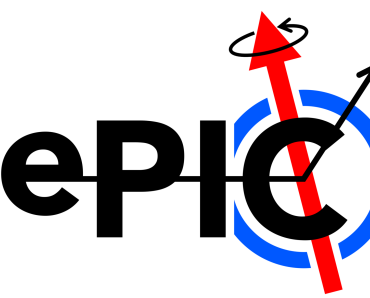
generated endpoint.z of $K^\pm$ from $\phi(1020)$ decay vs. its Z of decay



generated endpoint.z of $K^\pm$ from $\phi(1020)$ decay in the nHCal acceptance

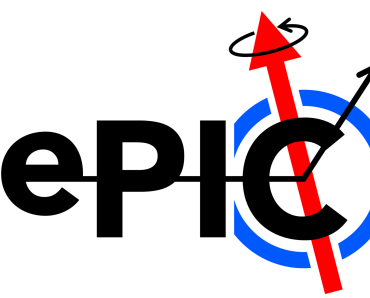


New: central diffractive J/Psi production (different beam energies)



- ▶ Argonne generic l/A-event generator (**lAger**), a flexible MC generator system to simulate electro- and photo-production off nucleons and nuclei.
https://eicweb.phy.anl.gov/monte_carlo/lager
- ▶ Diffractive $J/\psi \rightarrow ee$
- ▶ Fraction of decay electrons that are reconstructed and are in the η -acceptance

New: central exclusive J/Psi production



18x275:

Number of generated J/Psi: 379188 , of which decay into $e^+ e^-$: 207741, into $\mu^+ \mu^-$: 0
108559 reconstructed $e^+ e^-$ make it into the nHCal acceptance, with corresponds to a fraction 0.261284

10x100:

Number of generated J/Psi: 174020 , of which decay into $e^+ e^-$: 95281, into $\mu^+ \mu^-$: 0
34208 reconstructed $e^+ e^-$ make it into the nHCal acceptance, with corresponds to a fraction 0.179511

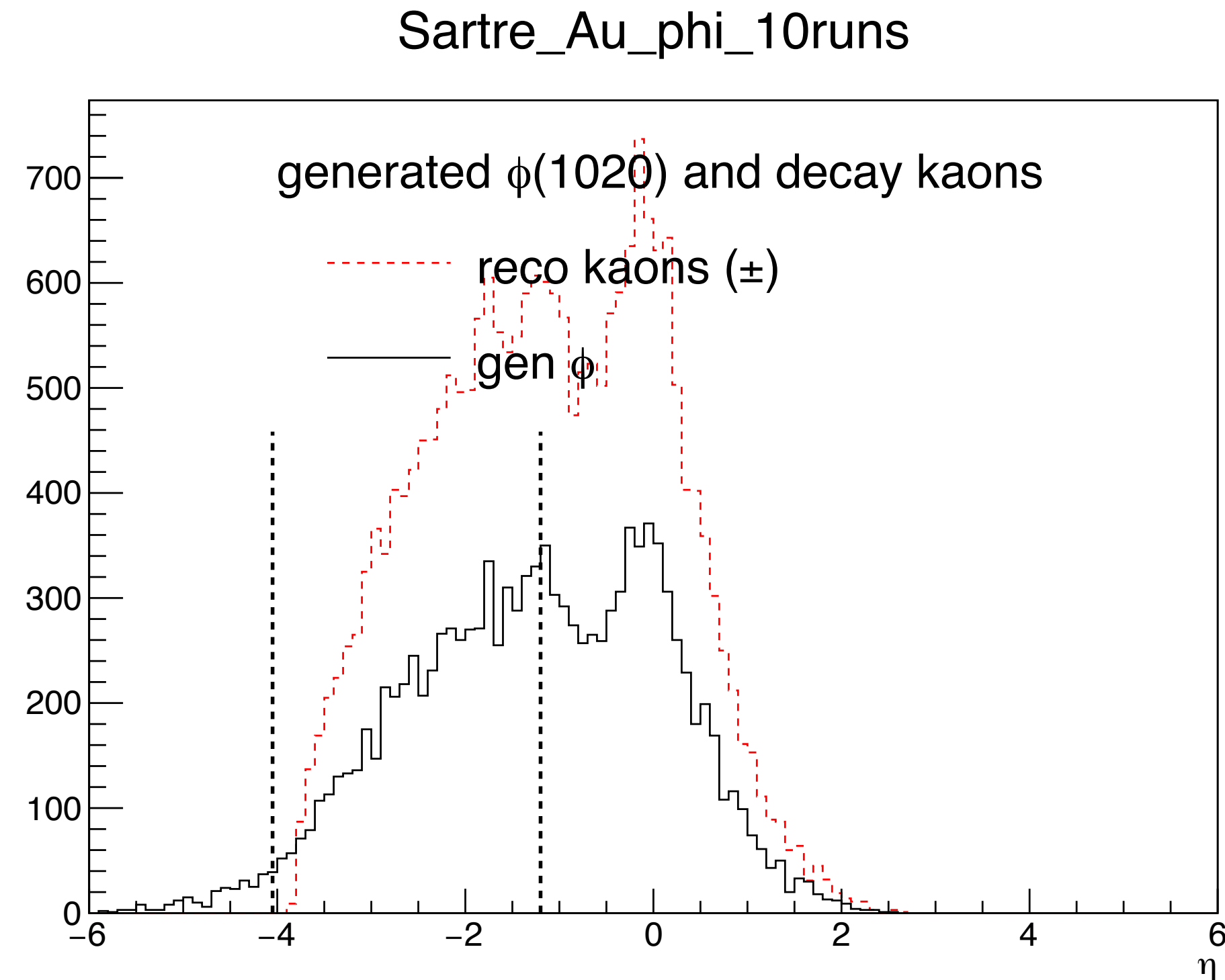
5x100:

Number of generated J/Psi: 117663 , of which decay into $e^+ e^-$: 64560, into $\mu^+ \mu^-$: 0
10051 reconstructed $e^+ e^-$ make it into the nHCal acceptance, with corresponds to a fraction 0.0778423

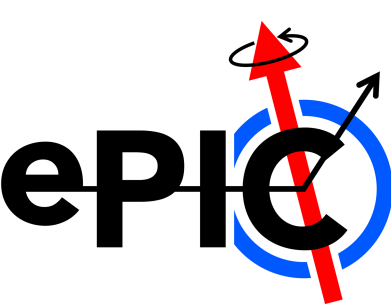
5x41:

Number of generated J/Psi: 66304 , of which decay into $e^+ e^-$: 36374, into $\mu^+ \mu^-$: 0
7072 reconstructed $e^+ e^-$ make it into the nHCal acceptance, with corresponds to a fraction 0.0972123

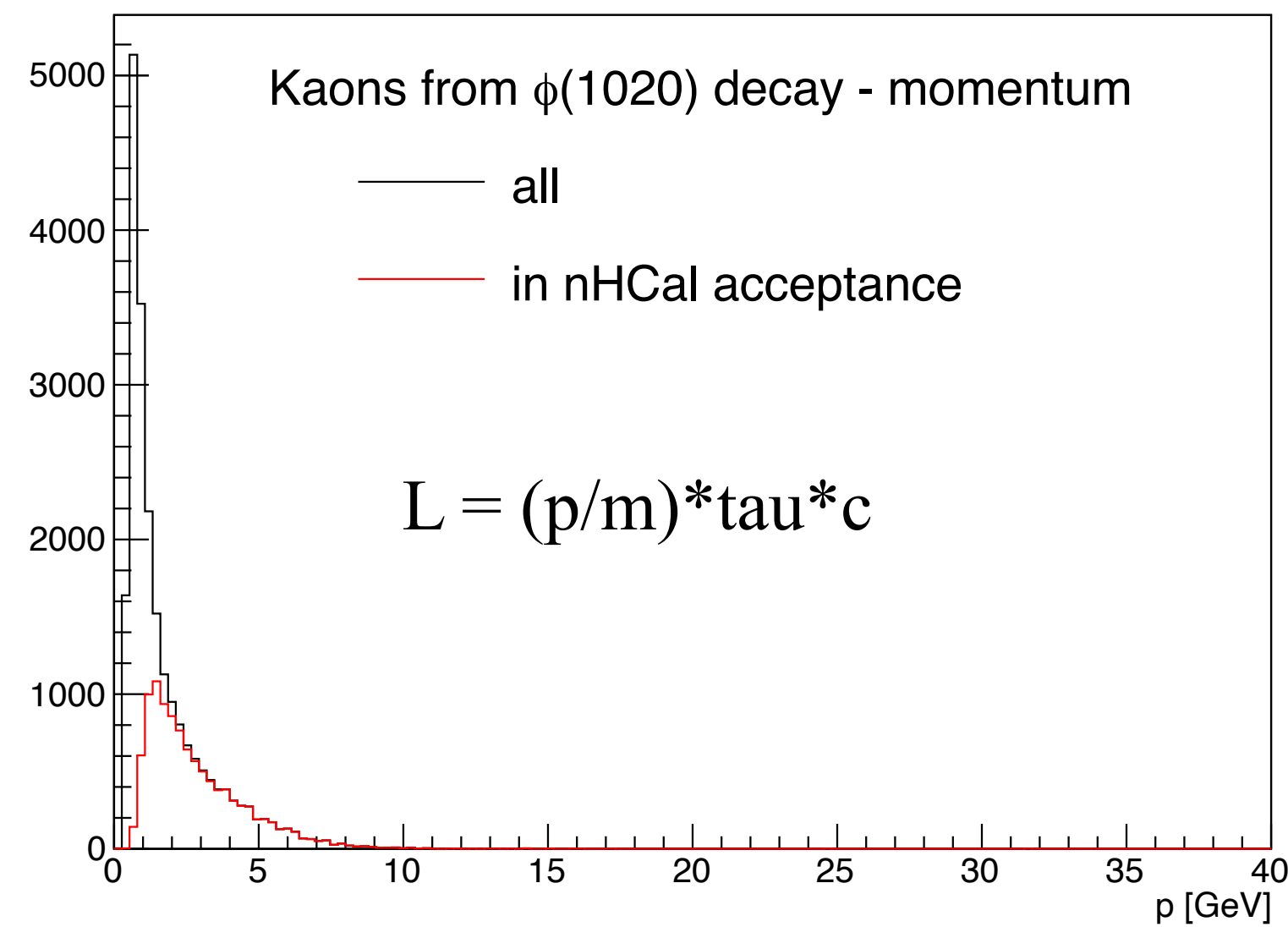
event generators tailored for this purpose. Diffractively produced VMs were studied as generated by the **sartre** event generator in coherent production: $e\text{Au} \rightarrow e\text{Au}\phi (\rightarrow K^+ K^-)$ from EPIC/REC0/24.07.0/epic_craterlake/EXCLUSIVE/DIFFRACTIVE_PHI_ABCONV/Sartre/Coherent. The beam energies are (18x110), the used dipole model is **bNonSat**, the dipole model parameter set KMW, the kinematic limits are $t = [0.5, \sim 0]$; $Q^2 = [1, 20]$; $W = [1.95772, 88.9985]$, and the **sartre** release is 1.39. The sample consists of one generated and decaying ϕ -meson



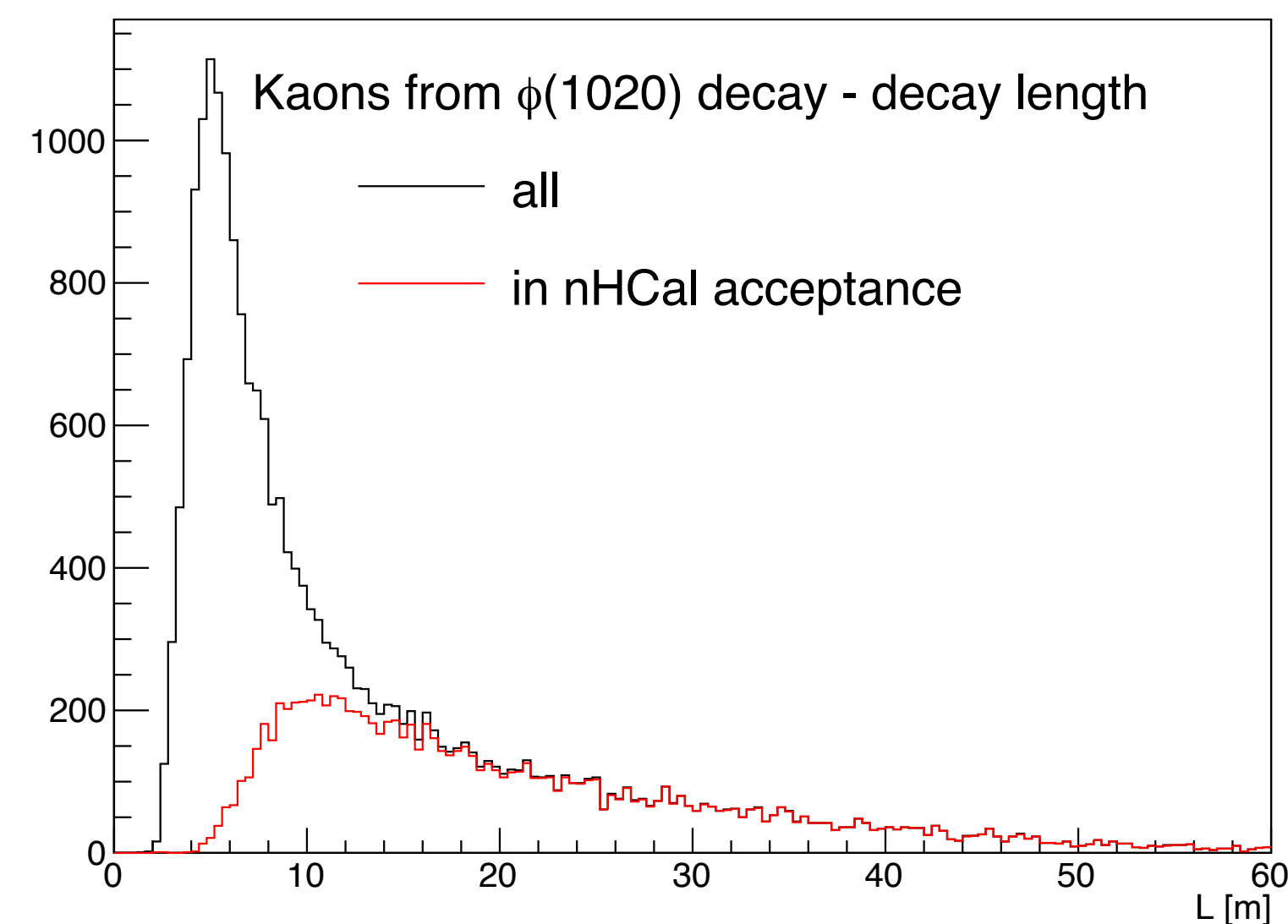
Does the nHCal see kaons ($K^{\pm}$) or muons? Sartre 18x110



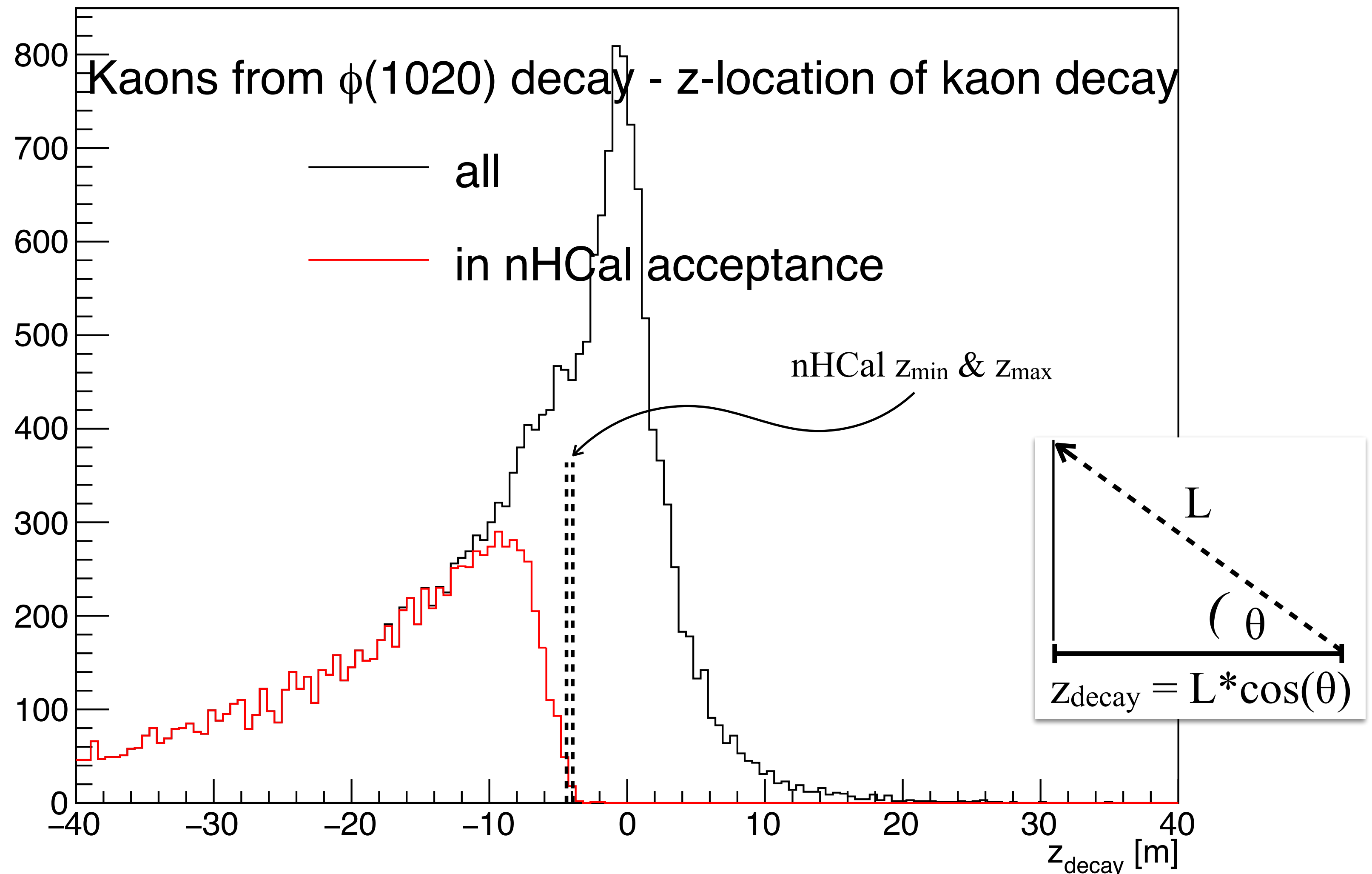
Sartre_Au_phi_10runs



Sartre_Au_phi_10runs



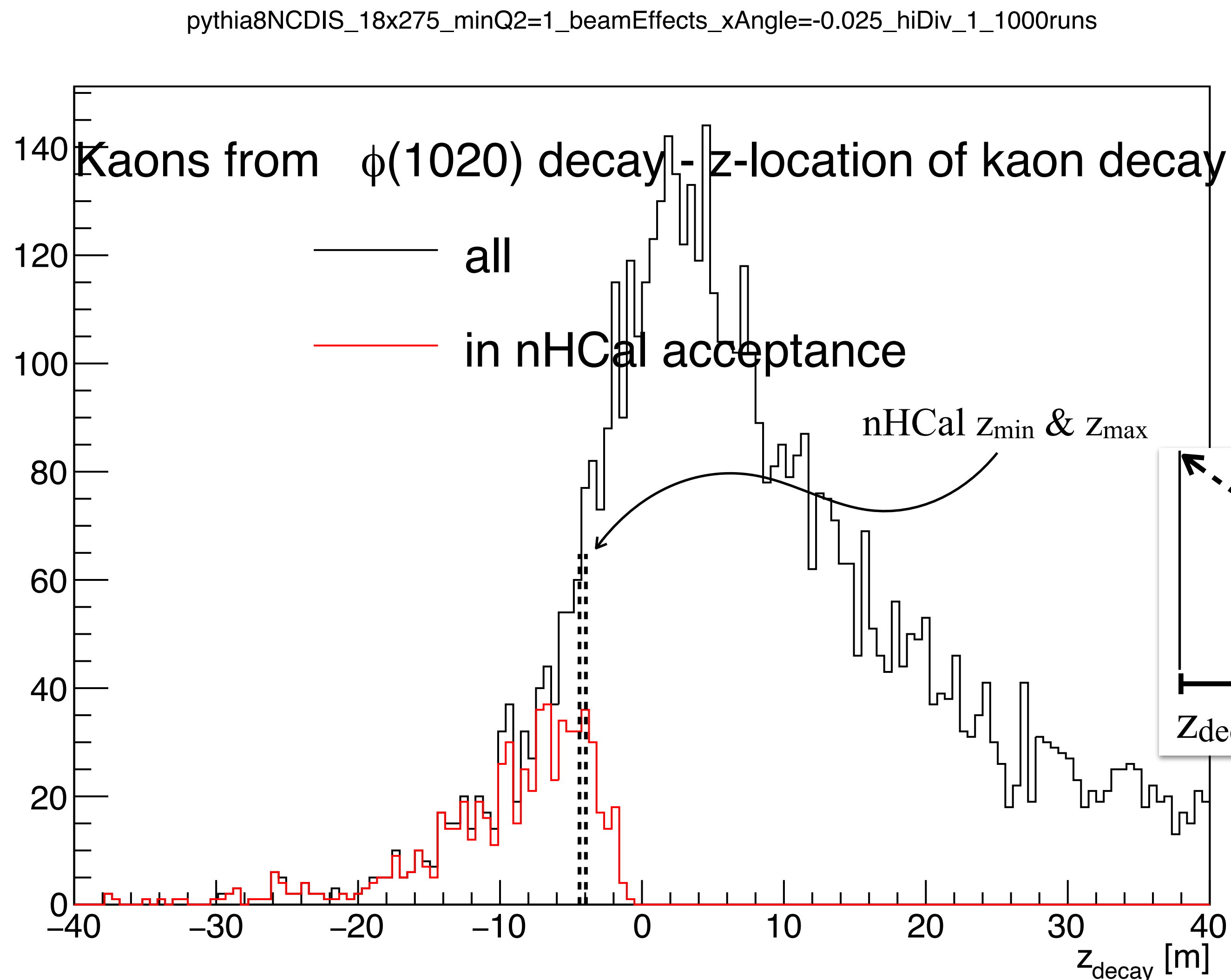
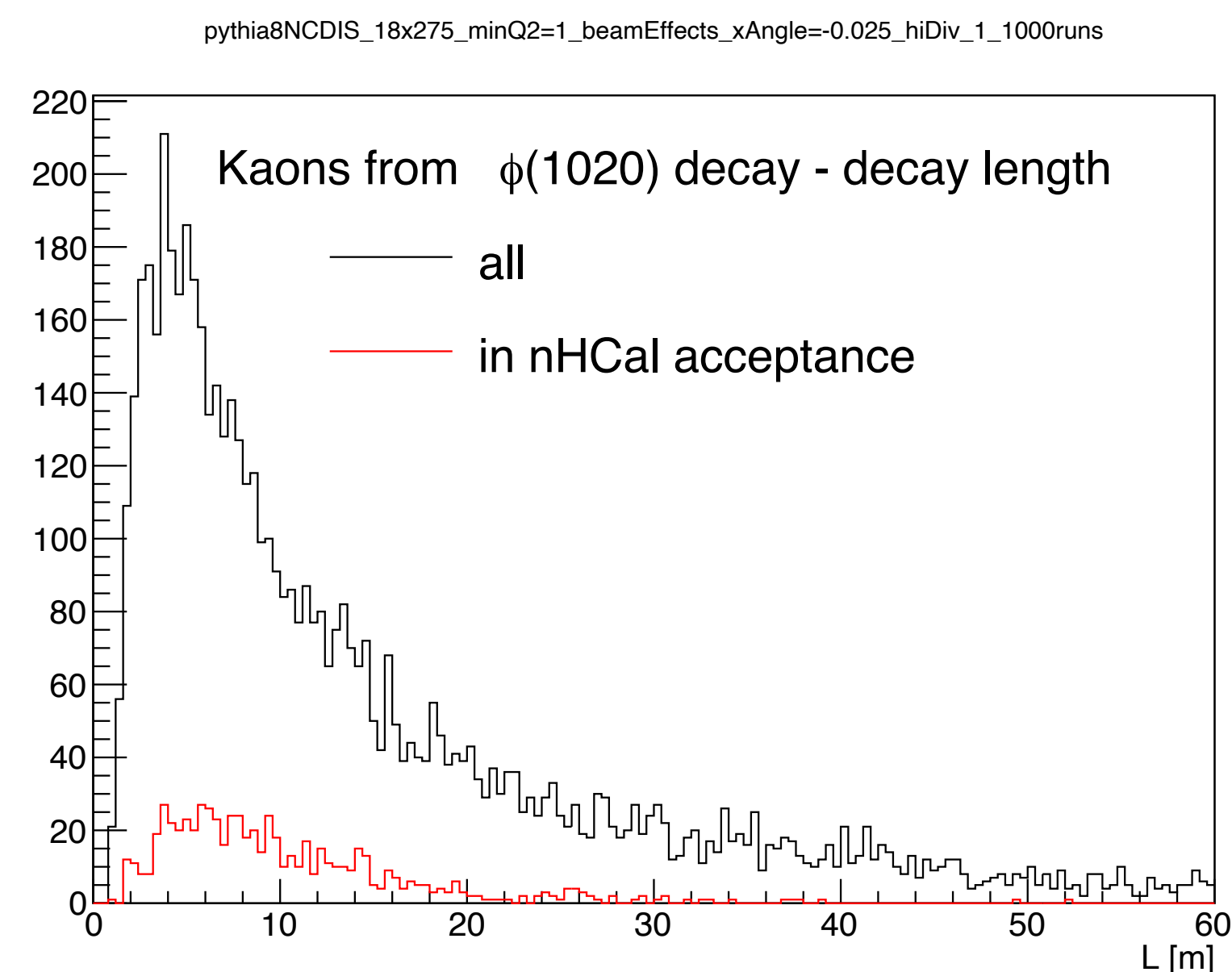
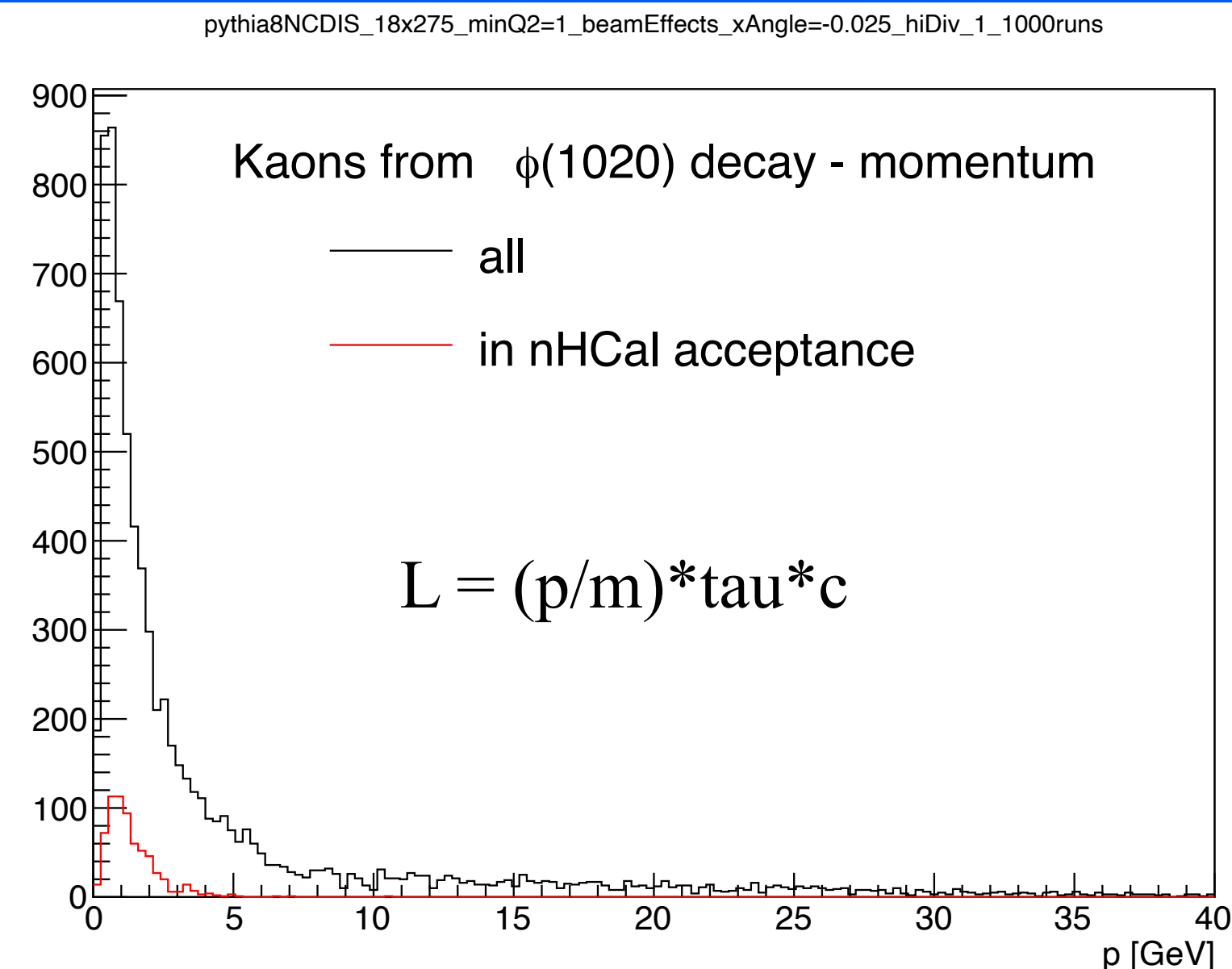
- Answer: mostly kaons. A few kaons start decaying right at the front face of the nHCal, but most (would) decay well downstream of the nHCal.



Does the nHCal see kaons ($K^{\pm}$) or muons? Pythia 18x275



- Answer: in pythia, some kaons decay upstream of the nHCal.

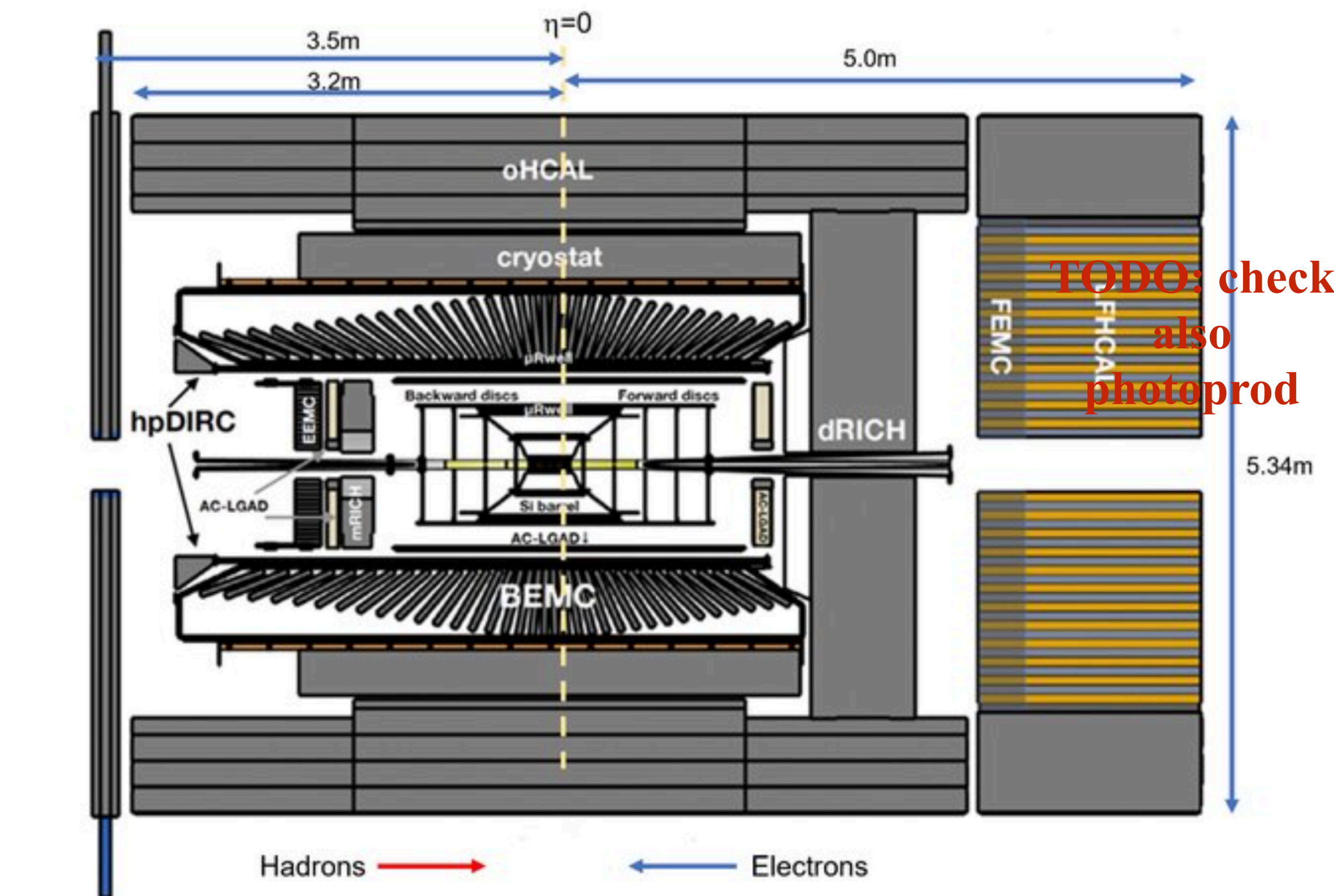


**TODO: check
also
photoprod**

- ▶ Is it correct / realistic that the kaons are not decayed in the simulation?
- ▶ $\phi \rightarrow K^+ K^-$ via strong interaction
(life time $\sim 10^{-22}$ sec) $\sim$ instant
- ▶ $K^\pm \rightarrow \mu^\pm \nu$ via weak interaction
(mean life time $1.238 \cdot 10^{-8}$ s)
 $\Rightarrow$ 3.7m travel before decay
- ▶ Will most kaons have decayed before reaching the nHCal??
- ▶ But: relativistic corrections (gamma factor)
- ▶ Decay length $L = \underbrace{\gamma * \tau * v}_{\text{time dilation}}$

time dilation

Calculate decay length for kaons from phi-meson decay. The decay length goes linearly with the momentum p (in GeV), as $(p/m) * \tau * c$, where m is the kaon+- rest mass (in GeV), τ its lifetime (in s), and c the speed of light (in m/s).



- ▶ Internal note <https://doi.org/10.5281/zenodo.14200155>
- ▶ Reference for preTDR etc.
- ▶ Work in progress

