Time of Flight (ToF) simulation status

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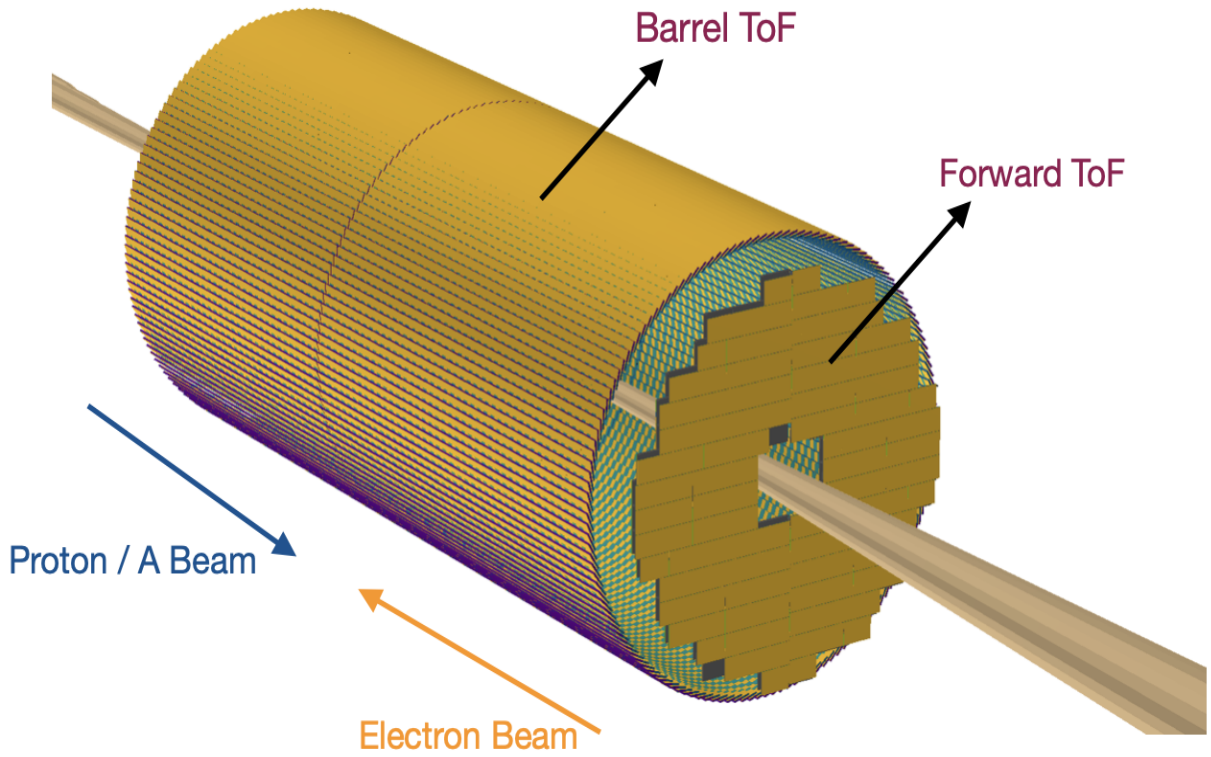
DD4HEP Simulations ToF



Aim

- Goal : quantify how TOF configurations affect $D^0 \to K^-\pi^+$ tagging/reconstruction efficiency.
- Study : PID separation of K and π.

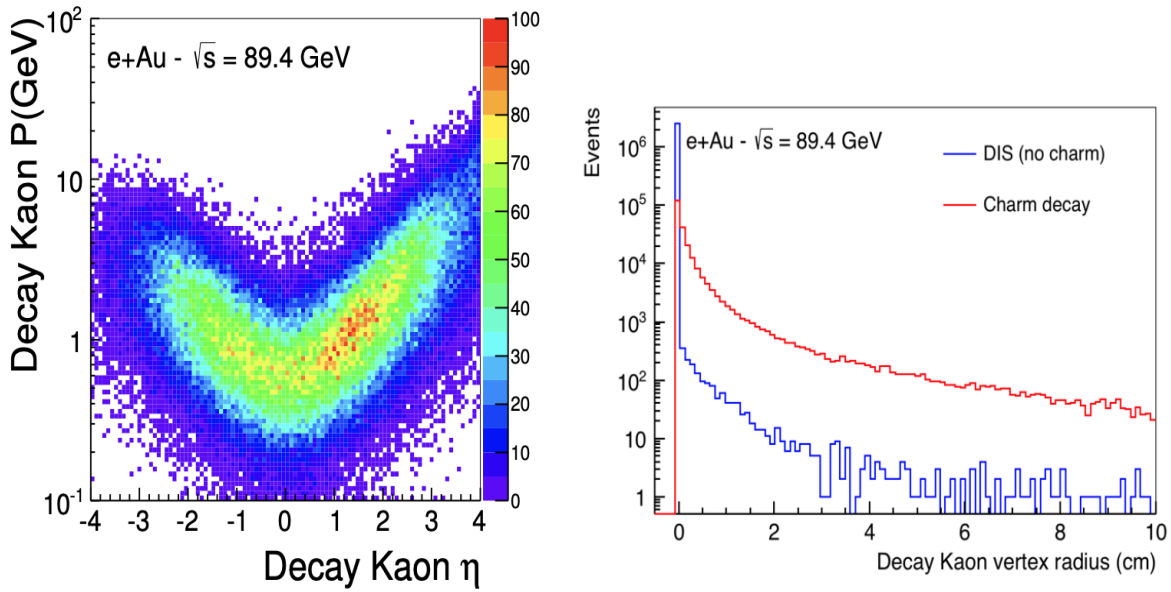


FIG. 5. Left: The distribution of the momentum of a decay K from $c\bar{c}$ production events versus pseudo-rapidity. Right: The vertex position of K in inclusive DIS (*blue line*) compared to $c\bar{c}$ production events (*red line*).

Ref:1708.05654v1.pdf

DD4HEP Simulations (FToF)

- Sample - epic:/RECO/26.04.1/epic_craterlake_without_zdc/SIDIS/D0_ABCONV/HFsim-BeAGLE/BeAGLE1.03.01-2.0/eAu/10x100/q2_1to10000
- No. of files : 10
- All the 10 files : 3687 $D^0 \rightarrow K^- \pi^+$ events ,

$D^0 \to K^-\pi^+$

- Two charged daughters
- Kaon + pion identification
- Invariant mass:

$$M_{K\pi} = \sqrt{(E_K + E_\pi)^2 - |\vec{p}_K + \vec{p}_\pi|^2} \tag{1}$$

Monte carlo $D^0 \to K^-\pi^+$

- MC truth information is used to validate the $D^0 \to K\pi$ decay topology. Mass of $D^0 = 1.865$ GeV/c^2.
- D^0 and $\overline{D}^0$ candidates are identified using the PDG codes:

$$D^0 : \ 421, \qquad \overline{D}^0 : \ -421$$

- Require exactly two daughters corresponding to:

$$D^0 \to K^-\pi^+, \qquad \overline{D}^0 \to K^+\pi^-$$

- Daughter momenta are obtained from the MC particle momentum branches.
- The $K\pi$ invariant mass is calculated as

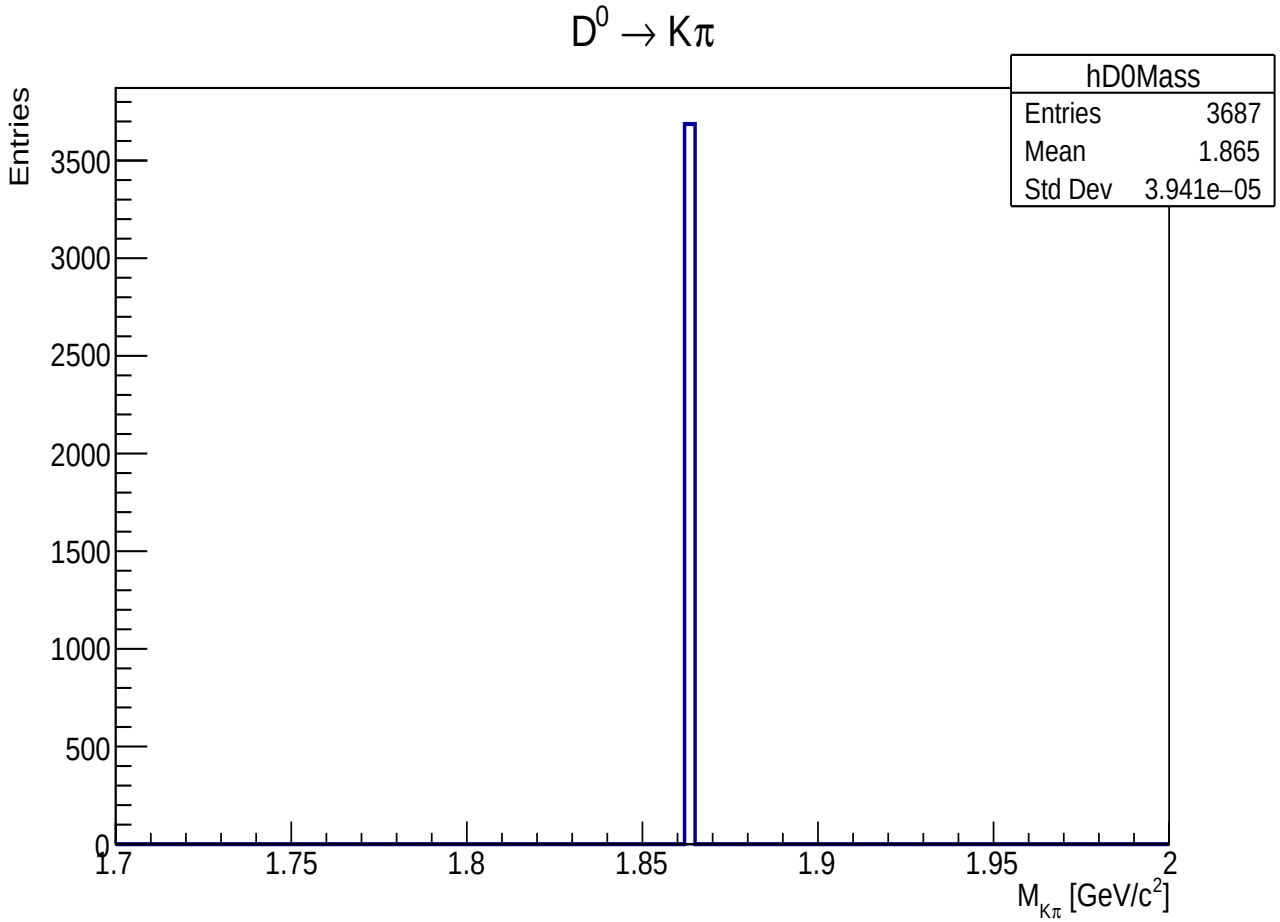
$$M_{K\pi} = \sqrt{(E_K + E_\pi)^2 - |\vec{p}_K + \vec{p}_\pi|^2}.$$

Monte carlo $D^0 \to K^-\pi^+$

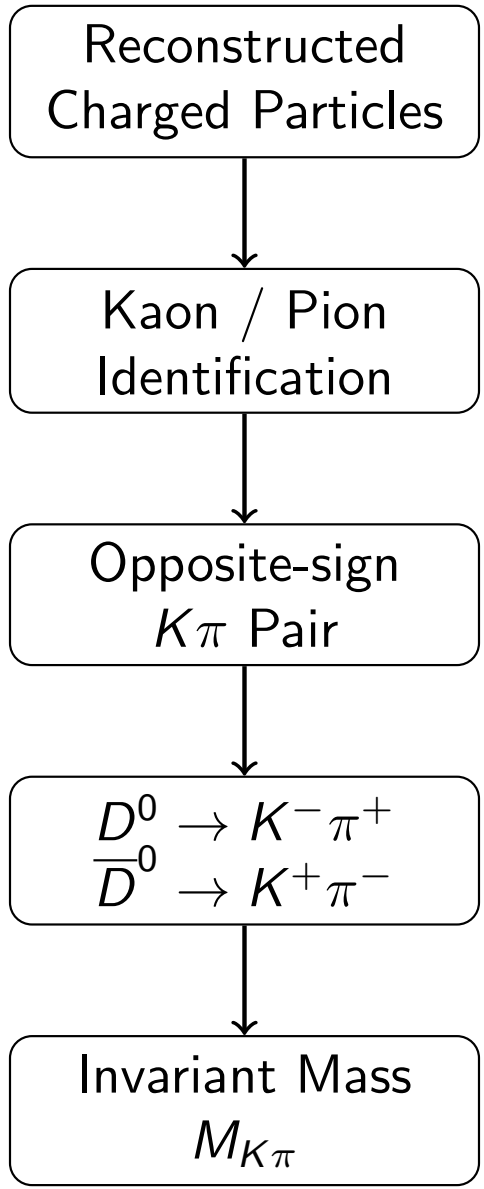
Branches used:-

- MCParticles.PDG
- MCParticles.momentum.x
- MCParticles.momentum.y
- MCParticles.momentum.z
- MCParticles.daughters_begin

Monte carlo $D^0 \to K^- \pi^+$



Reconstruction $D^0 \to K^-\pi^+$



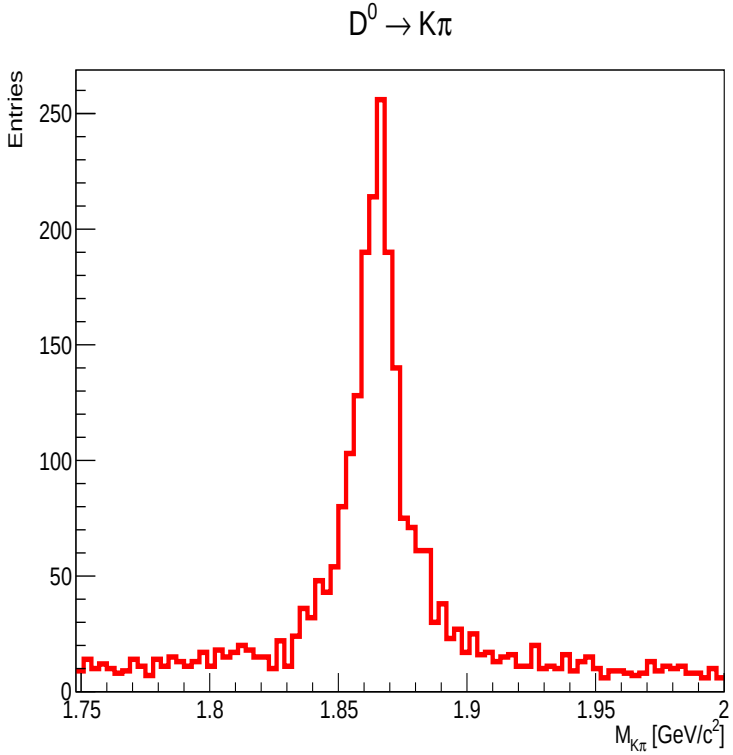
Reconstruction $D^0 \to K^-\pi^+$

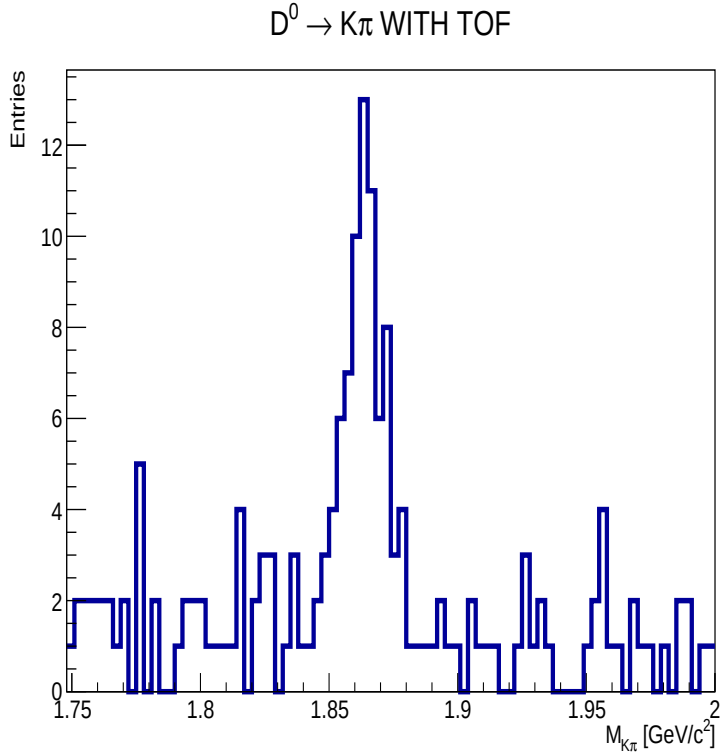
- Select reconstructed charged-particle candidates from ReconstructedChargedParticles
- Identify kaon and pion candidates using particle-identification information.
- Combine opposite-sign $K\pi$ pairs to form D^0 candidates.
- Calculate the invariant mass:

$$M_{K\pi} = \sqrt{(E_K + E_\pi)^2 - |\vec{p}_K + \vec{p}_\pi|^2}.$$

- Study the D^0 mass peak and compare reconstruction with and without ToF PID.

Reconstructed $D^0 \to K^-\pi^+$



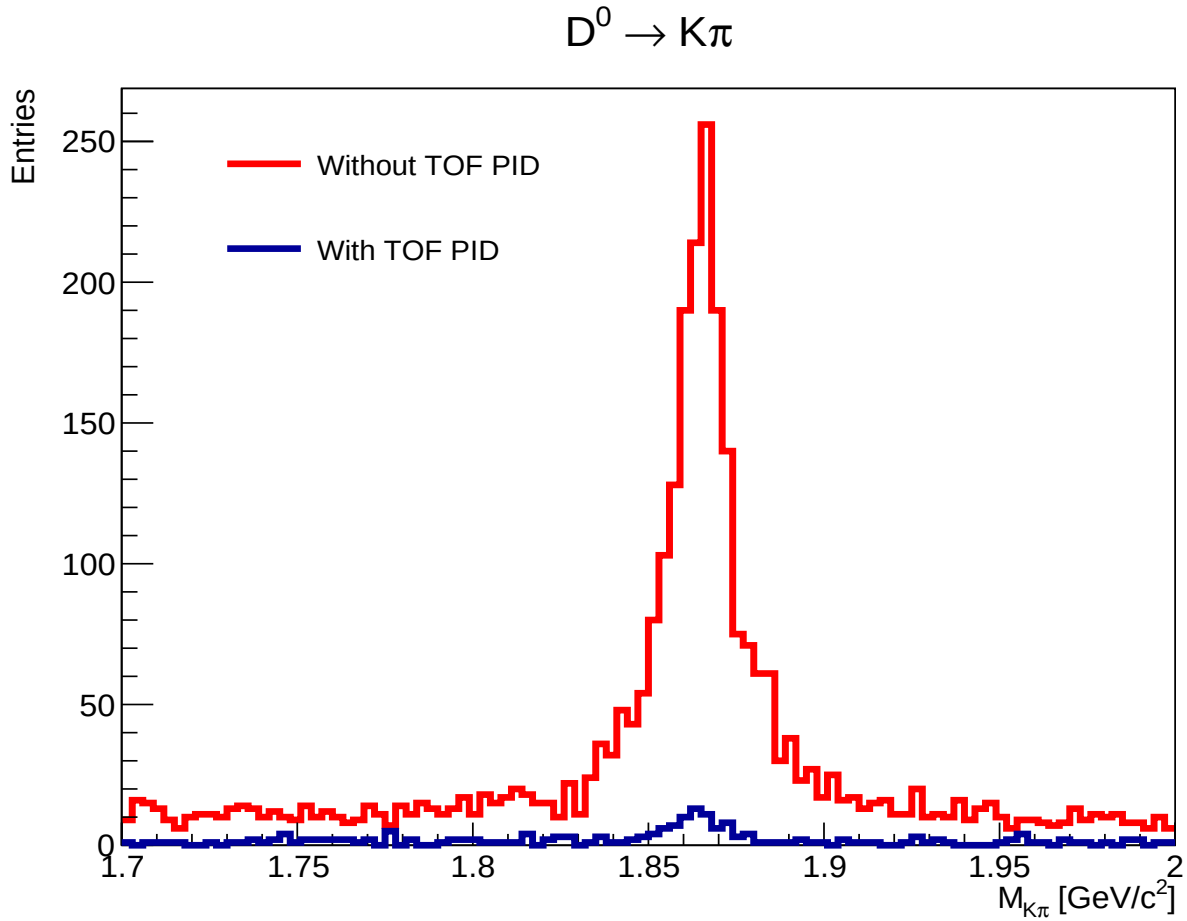


Reconstruction $D^0 \rightarrow K^-\pi^+$

Branches used:-

- ReconstructedChargedParticles.momentum.x , y and z.
- ReconstructedChargedParticles.charge
- ReconstructedChargedParticles.PDG
- ReconstructedChargedParticles.particleIDs_begin, end.
- CombinedTOFParticleIDs.PDG, CombinedTOFParticleIDs.likelihood

With and without ToF information



- Is it because of efficiency?