Physics & MC meeting,
28 April 2021

Example for short-lived particles reconstruction in SPD experiment

V. Andreev

General schema

1. generation some sample (for example, Minimum Bias events with Pythia8),
   => you can use macro XSimuQsl.C for this purpose

2. reconstruction – run track fit and vertex reconstruction tasks,
   => use standard macro for this case RecoEventFull.C

3. find decay particle (example of macro for K_s^0 ->pi+pi- decay on the base of KFParticle package),
   use macro findDecayK0.C

Standard selection criterias

1. select tracks on the base of chi2 of track and primary primary vertex

$$\chi^2_{prim} = \Delta\mathbf{r}^T (C_{track} + C_{PV})^{-1} \Delta\mathbf{r},$$

where Δr – distance between track and the primary vertex position, C_{track} is covariance matrix of a track and C_{PV} is a covariance matrix of primary vertex

2. distance (or chi2) between 2 daughter particles

3. decay length normalized on the it's error L / dL

4. chi2 of reconstructed V0 particle to PV

V0 finder (some more detail)

1. example is done on the base of standard Artur's example ReadRecoData.C

2. some input parameters:

   a) fMinItsHists = 3 - minimum Its hits for track selection

   b) fDaughters[2] = {-211, 211} – decay mode for K_s^0 ($c\tau \sim 2.68$ cm, 497.6 MeV/c^2)
   or {2212, -211} - decay mode for Λ^0 ($c\tau \sim 7.89$ cm, 1.115 GeV/c^2)
   or (-321, 211} - decay mode for D^0 ($c\tau \sim 122.9$ μm, 1.864 GeV/c^2)

   c) hardTrackCut = true(false) - hard track selection (tpars->GetIsGood() or all TrackPoints have been used in the fit, and the fit has converged)

   d) fMinChi2PV = 0.5 - minimum chi2 track to PV (primary selection)
   e) fMinChi2Part = 2.0 - minimum chi2 between 2 tracks (primary selection)

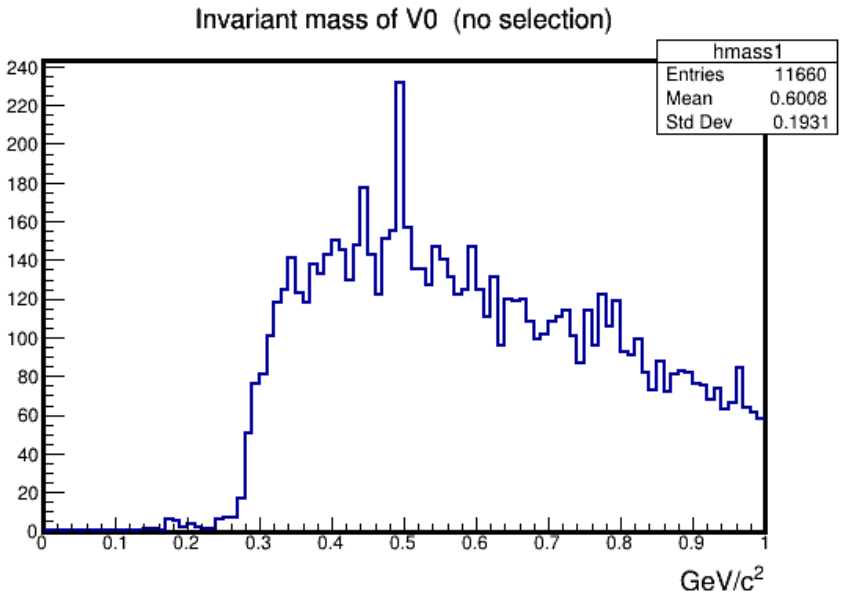
   f) fMinChi2PVadd = 30.0 - chi2 track to PV (additional cut)
   g) fMinL/dLcut = 15.0 - L/dL cut (additional cut), L – decay length, dL – error of L

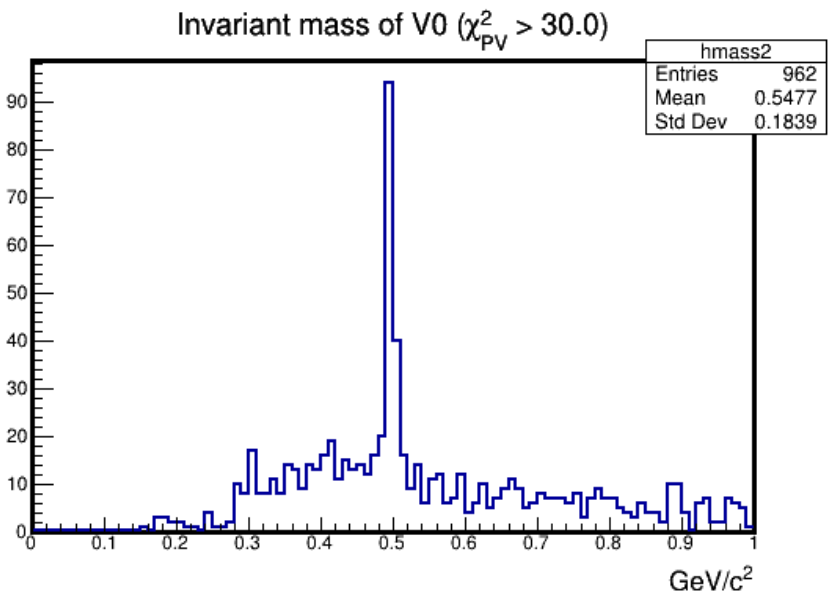
3. primary track selection is done on the base of track selection parameters a), b), c) and after KFparticle array is produced

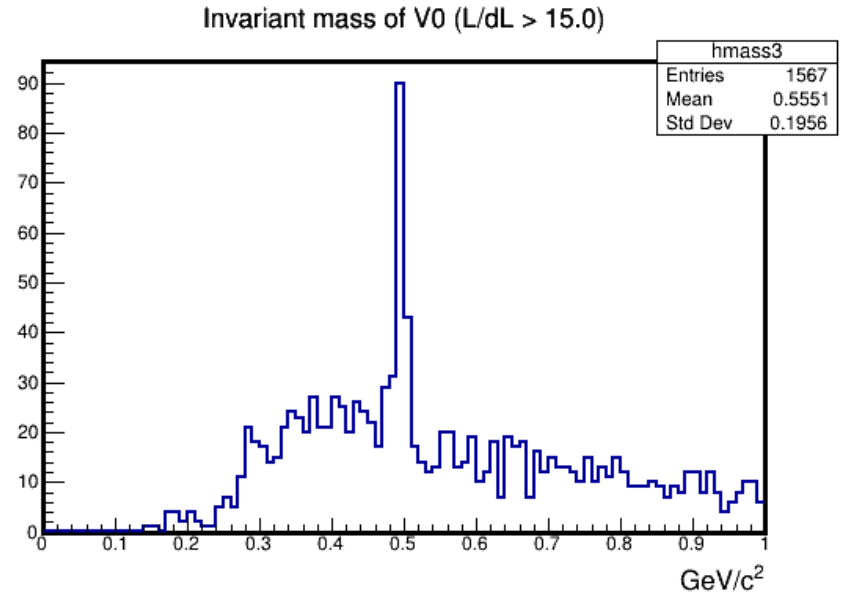
4. loop inside KFparticle array and determine V0 candidate (pi+pi- pair for K^0) parameters (invariant mass, decay length and so on) using PV and track fit parameters

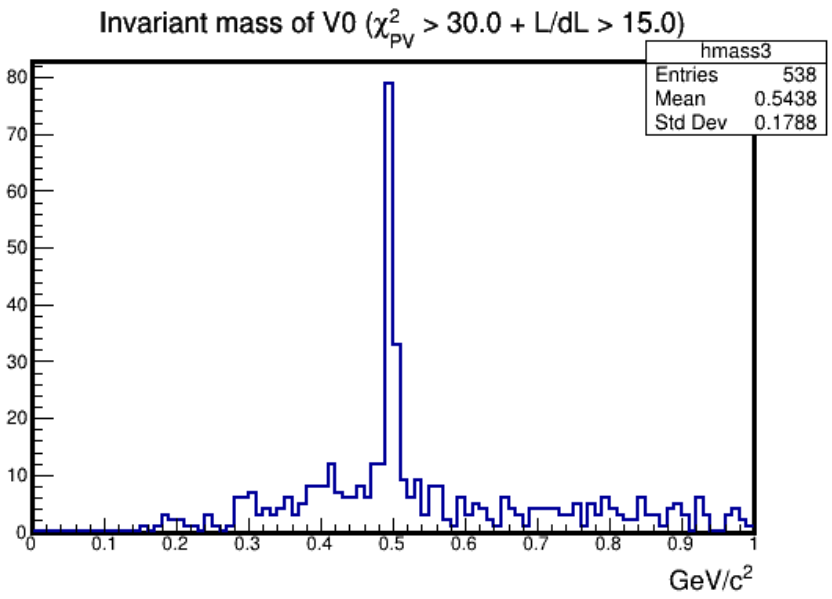
5. Minimum Bias (MB) and Open charm (D0) samples are generated with Pythia8 generator

K^0 -> pi+pi- (MB and PID)

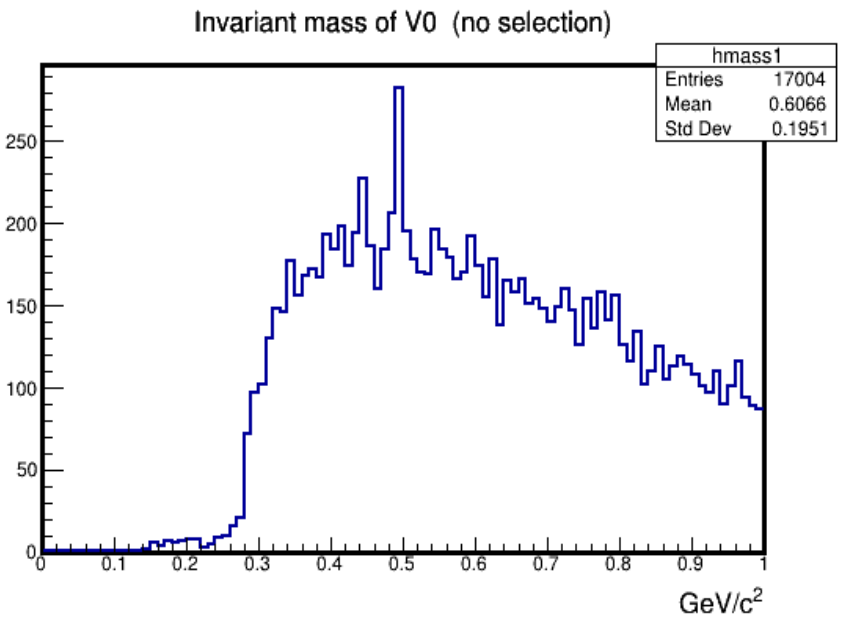


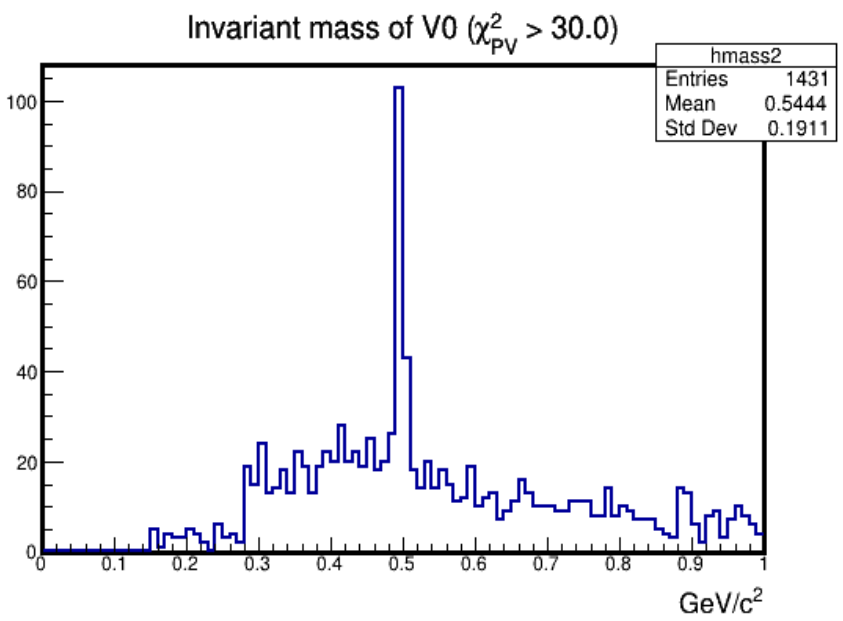


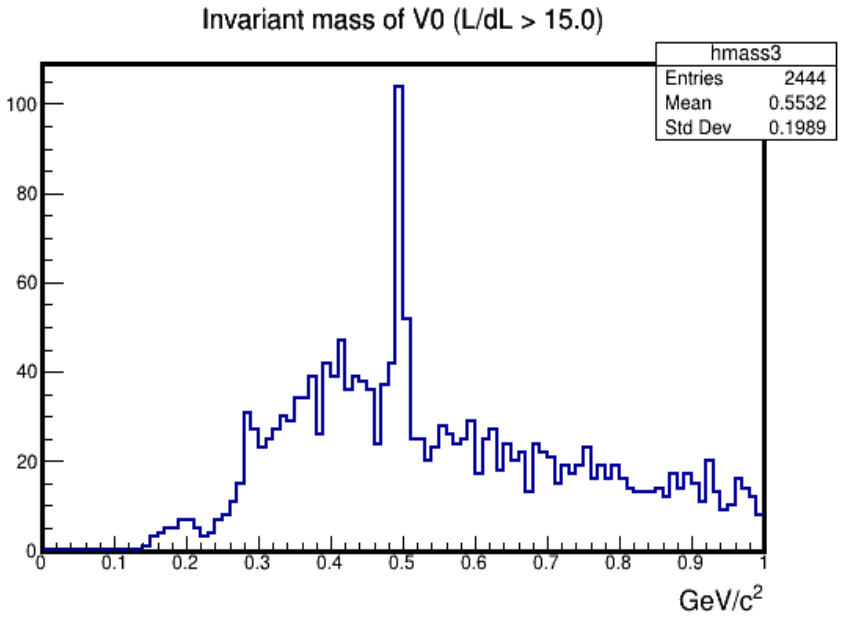


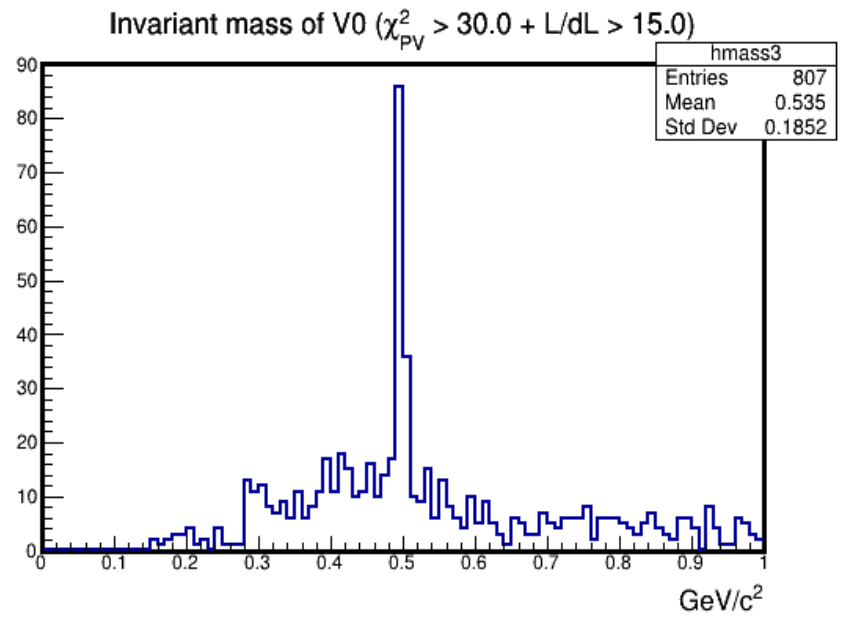


K^0 -> pi+pi- (MB and no PID)



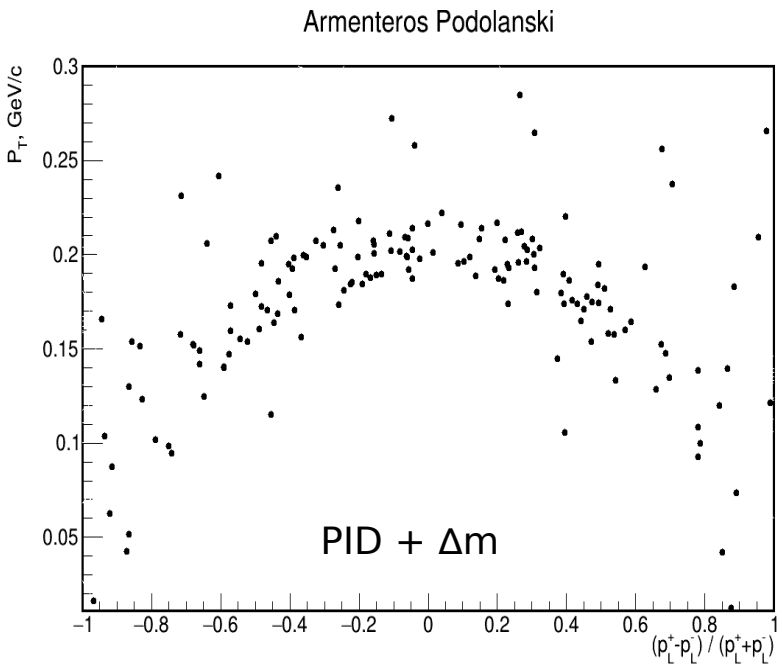


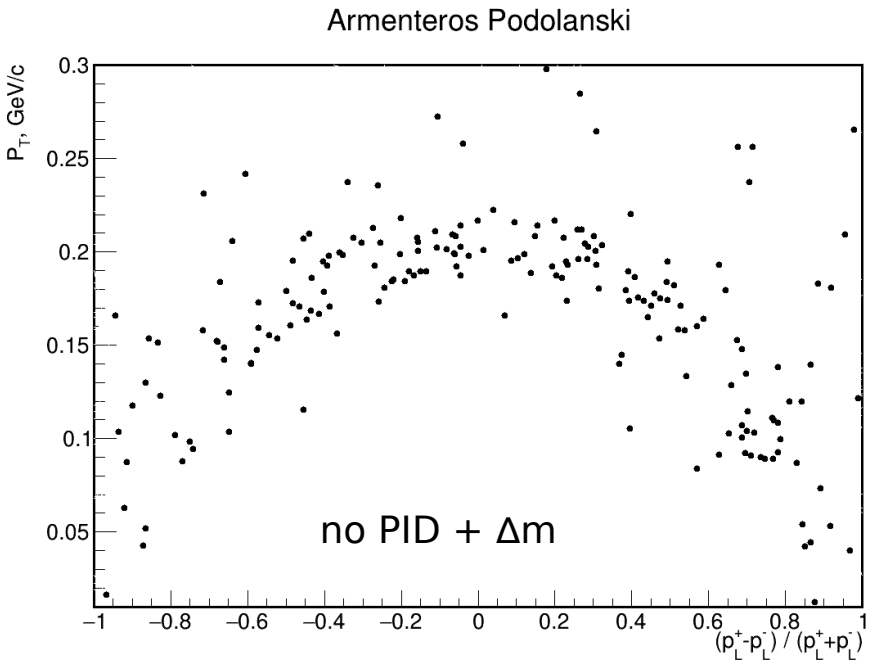




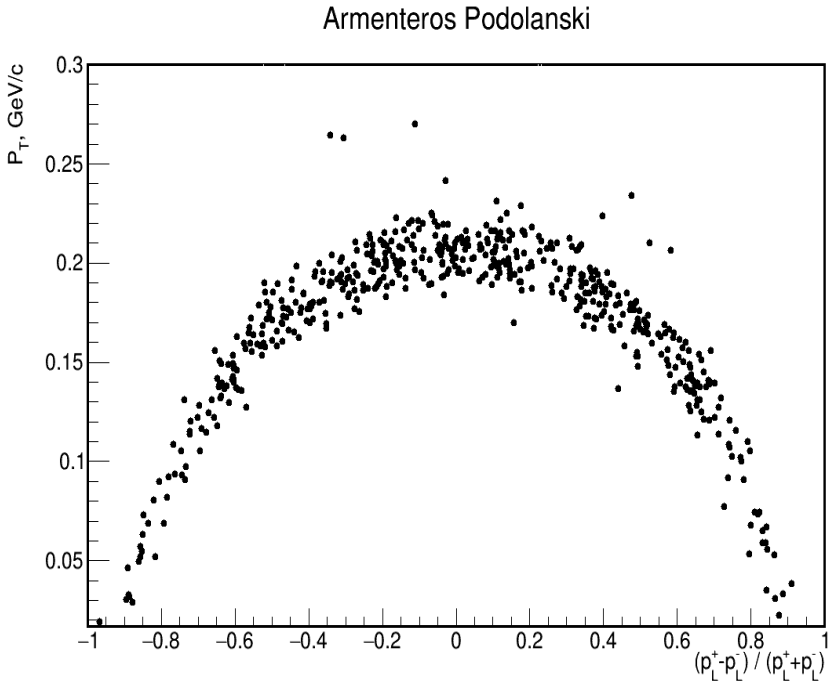
no PID => all positive particles are considered as pi+ and negative – as pi-

K^0 -> pi+pi-

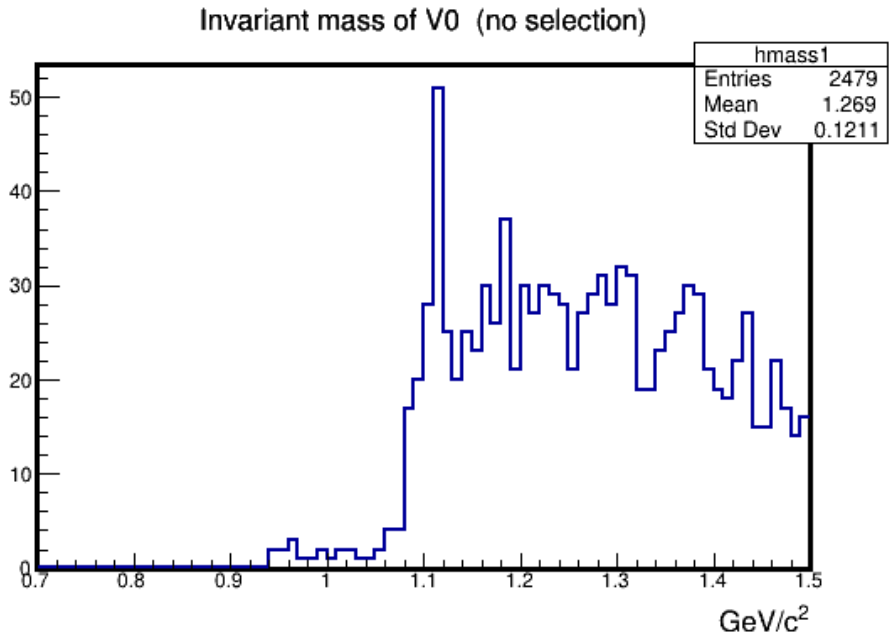


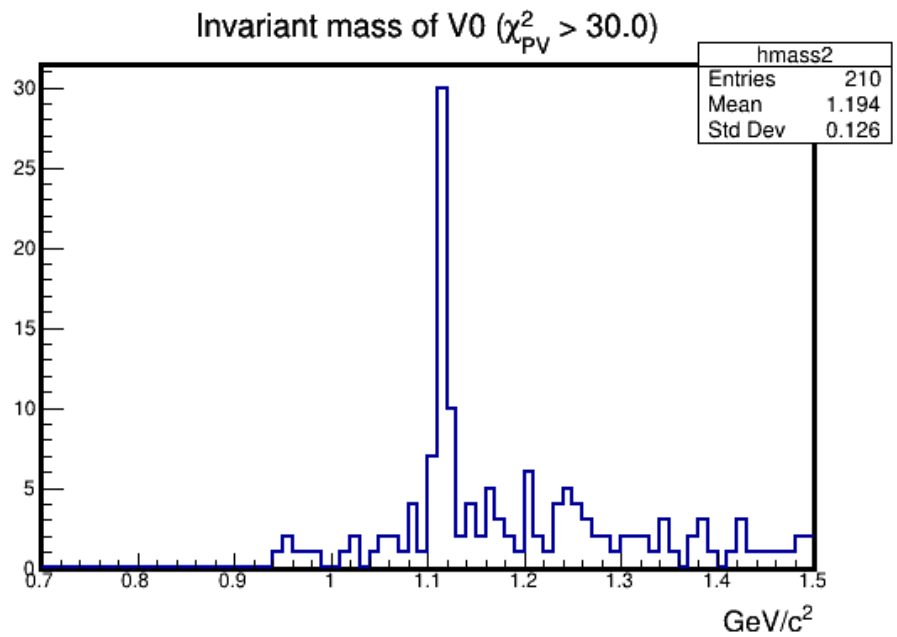


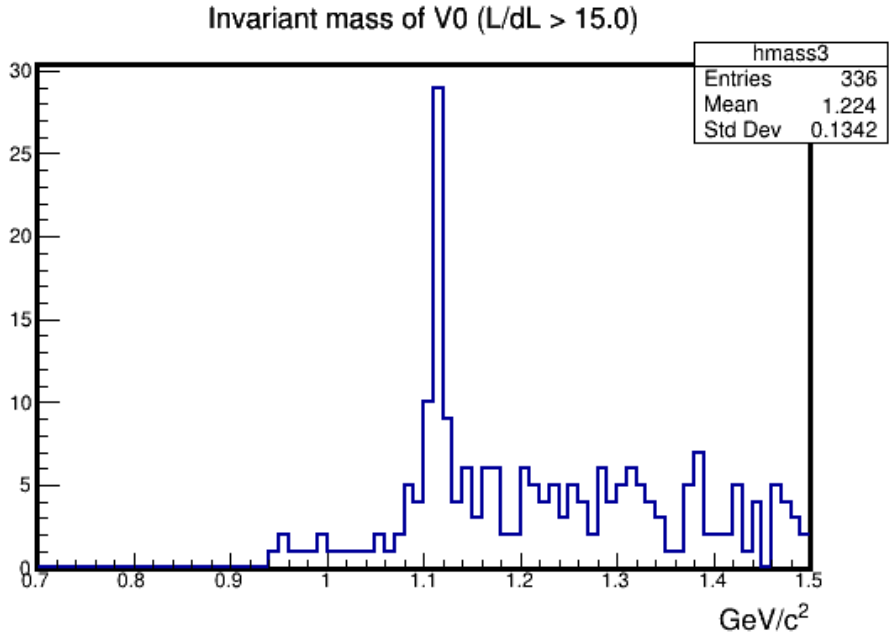
1000 events with 8 muons + K^0

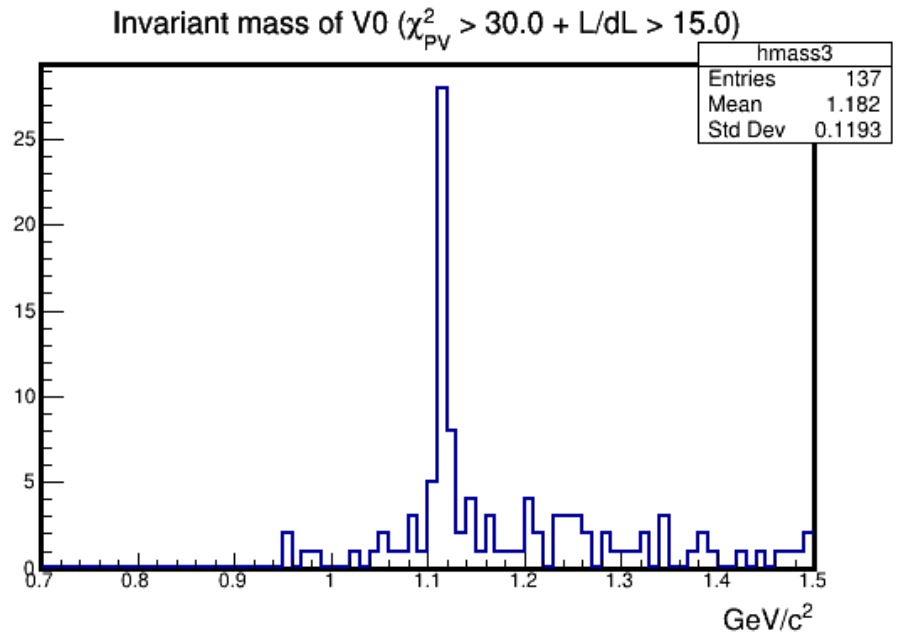


Λ^0 -> p+pi- (MB and PID)

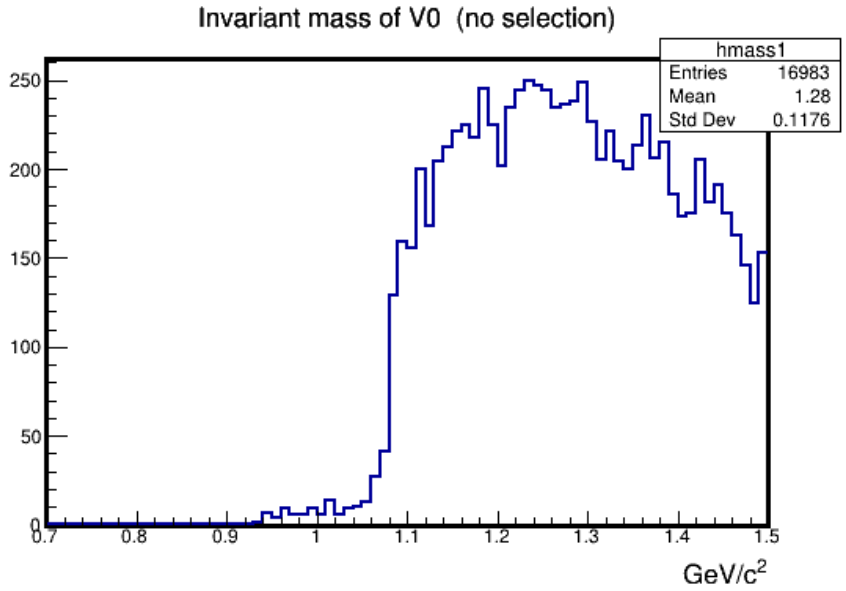


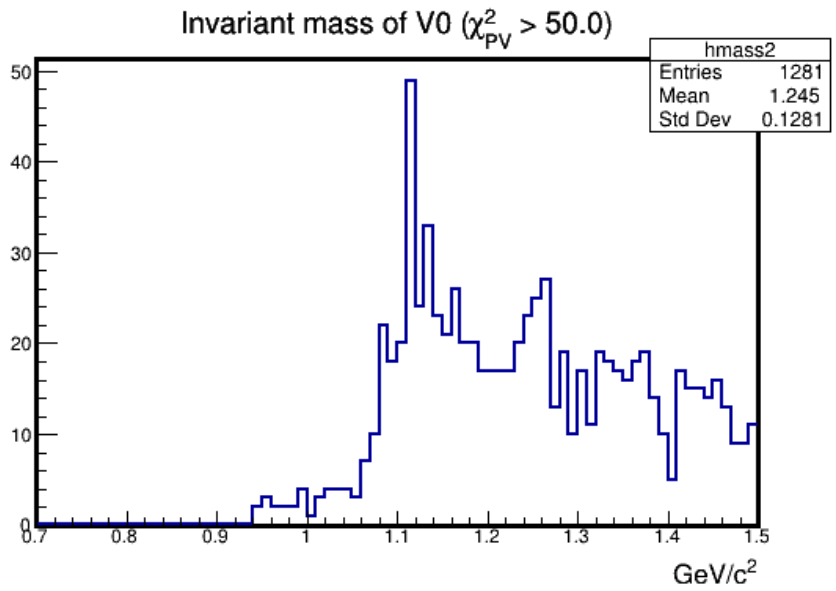


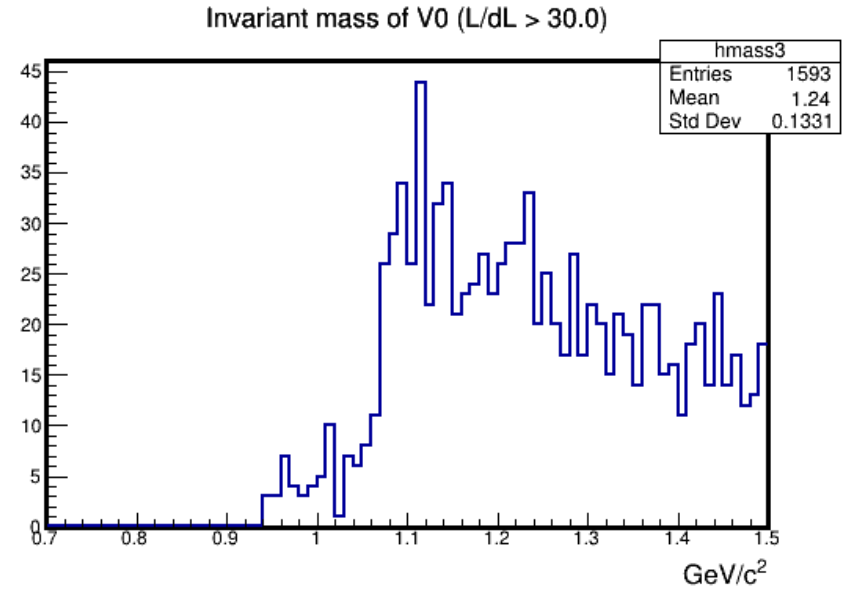


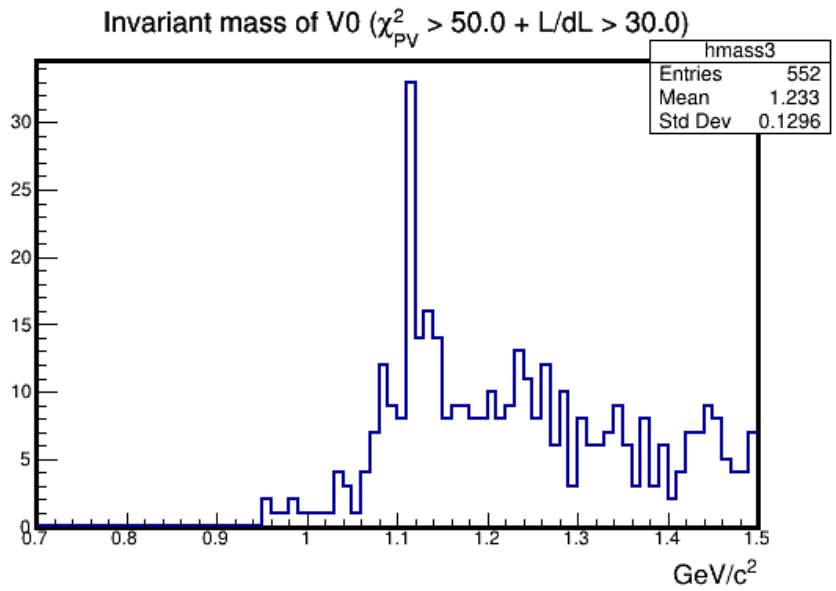


Λ^0 -> p+pi- (MB and no PID)



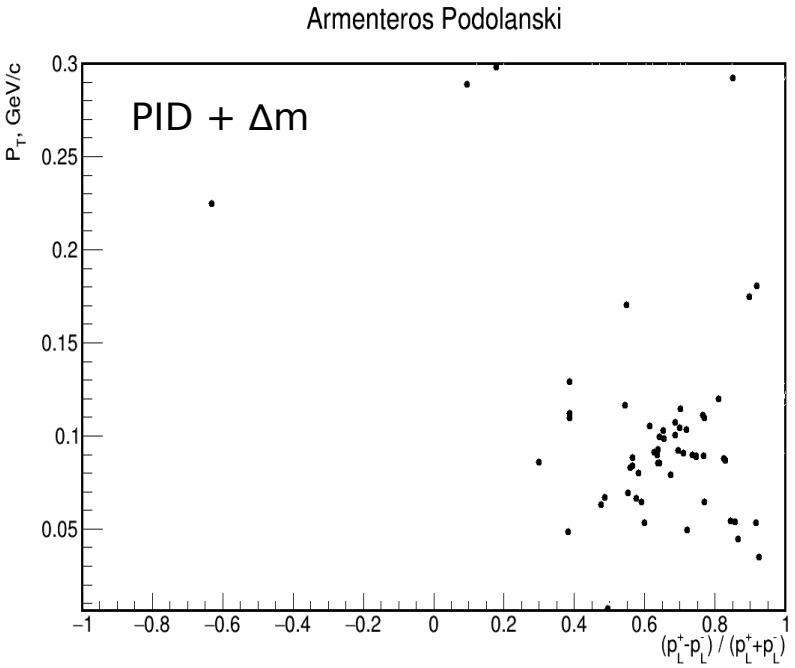


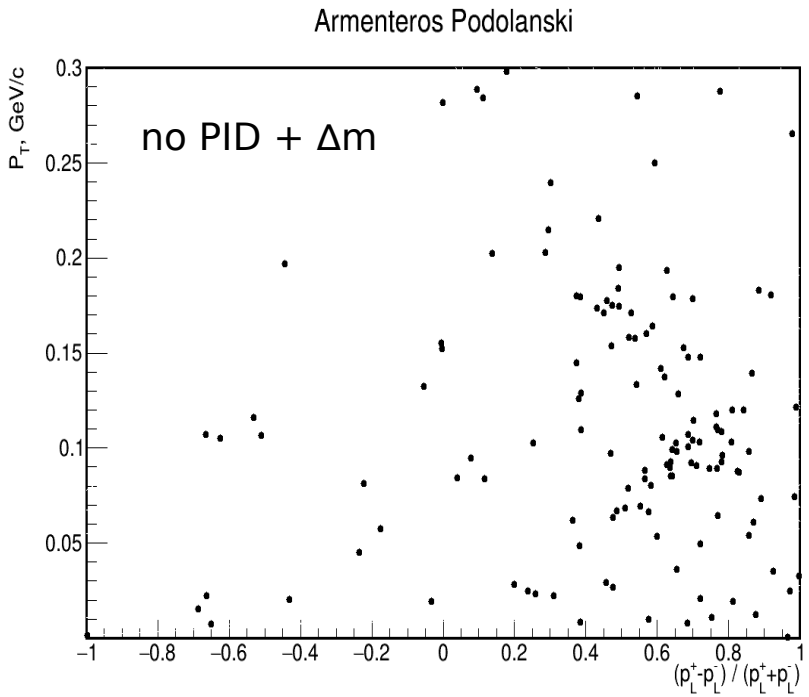


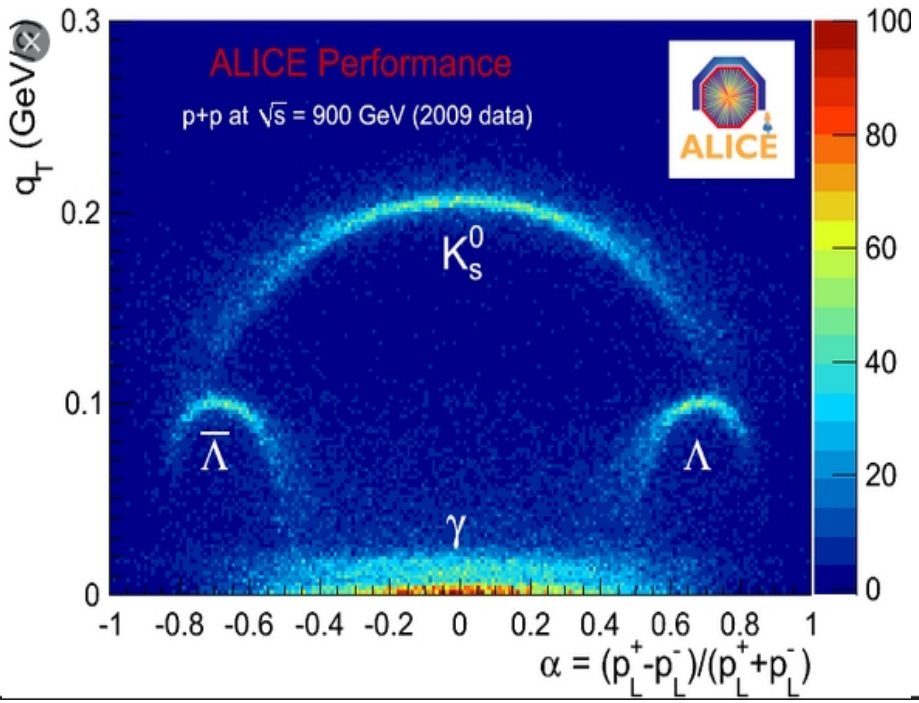


no PID => all positive particles are considered as proton and negative – as pi-

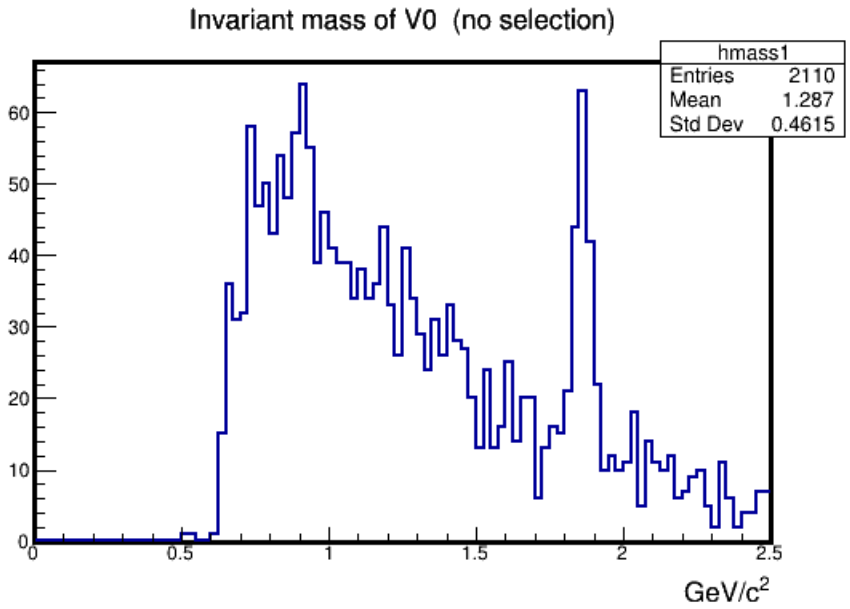
Λ^0-> p+pi-

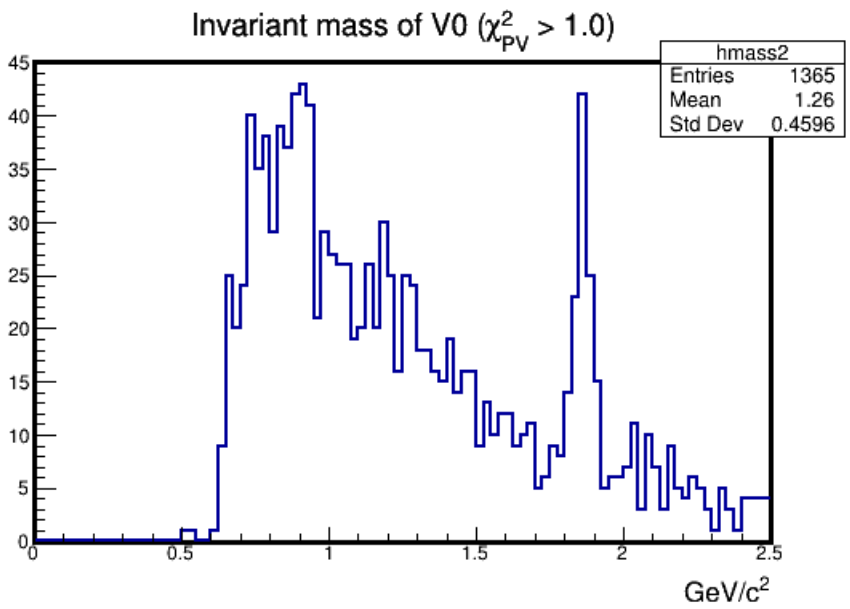

Armenteros Podolanski
PID + Δm
P_T, GeV/c
$(p_L^+-p_L^-) / (p_L^++p_L^-)$

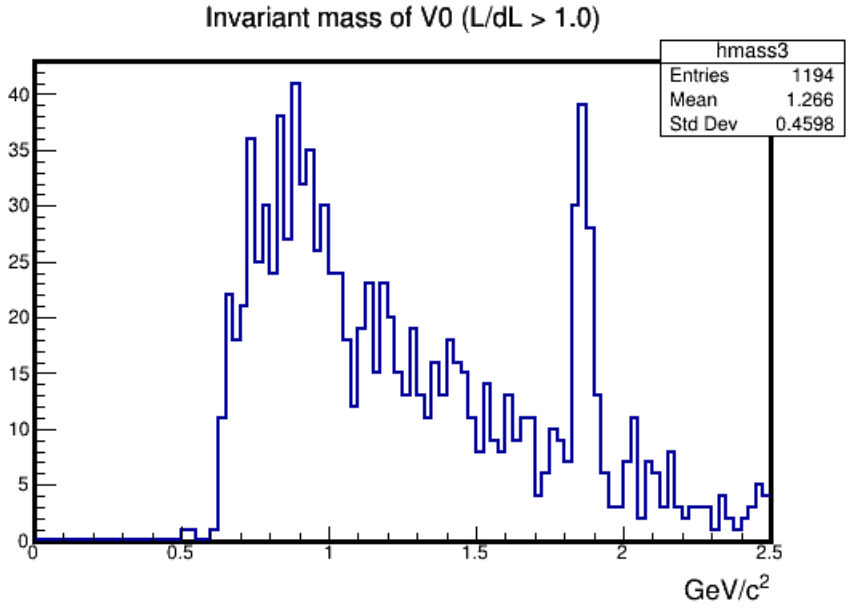

Armenteros Podolanski
no PID + Δm
P_T, GeV/c
$(p_L^+-p_L^-) / (p_L^++p_L^-)$

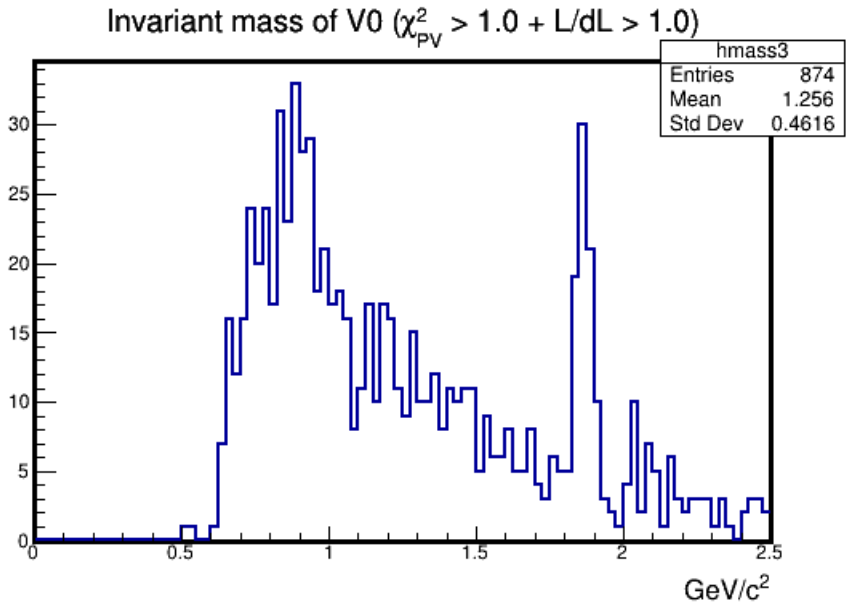

ALICE Performance
p+p at √s = 900 GeV (2009 data)
ALICE
K_s^0
$\bar{\Lambda}$
Λ
γ
q_T (GeV/c)
$\alpha = (p_L^+-p_L^-)/(p_L^++p_L^-)$

D^0 -> K-pi+ (open charm and PID)

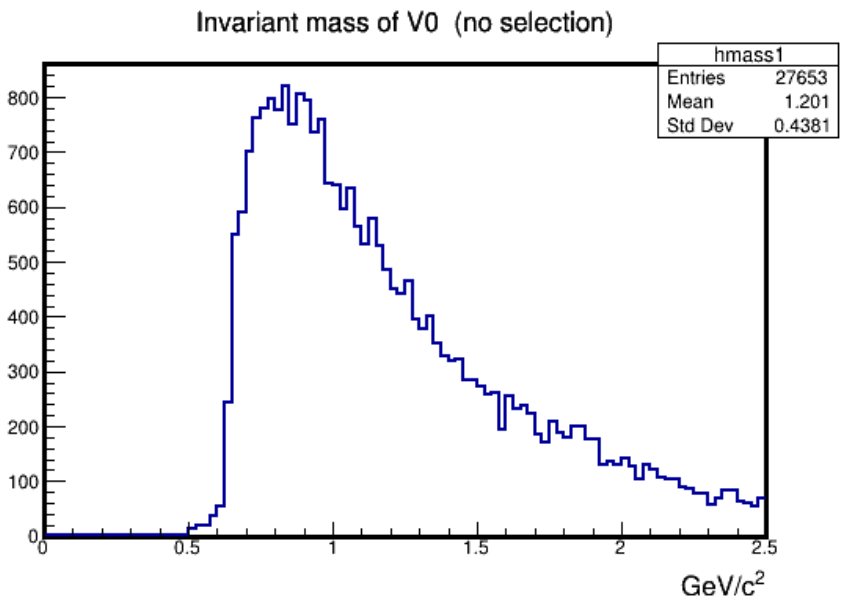


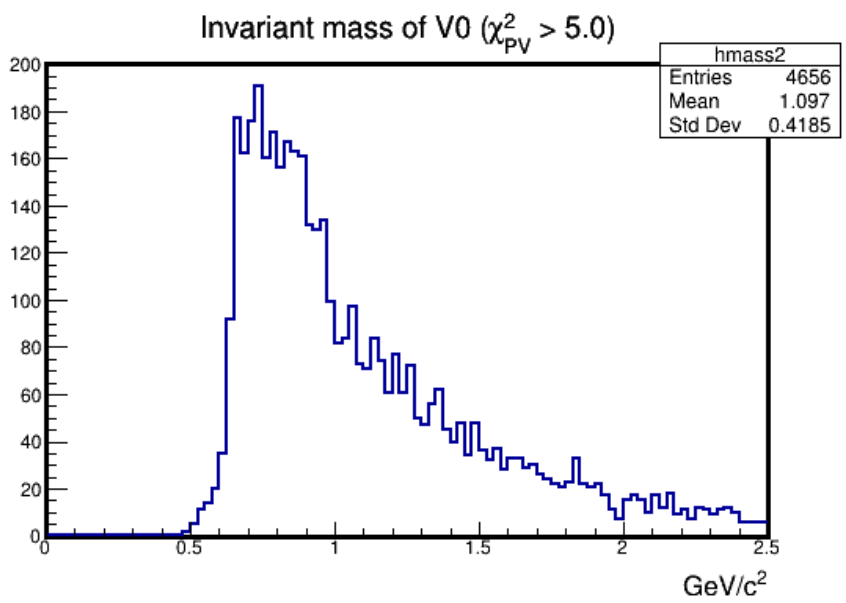


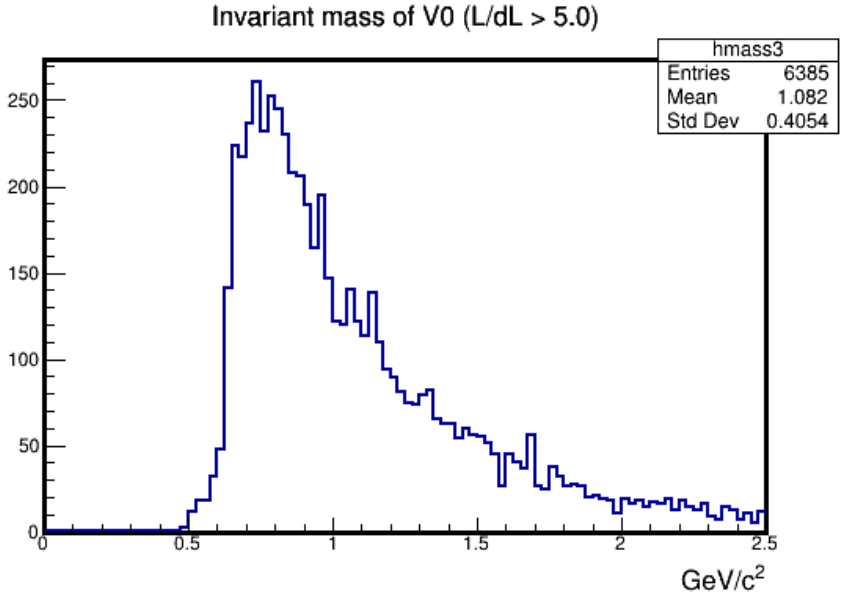


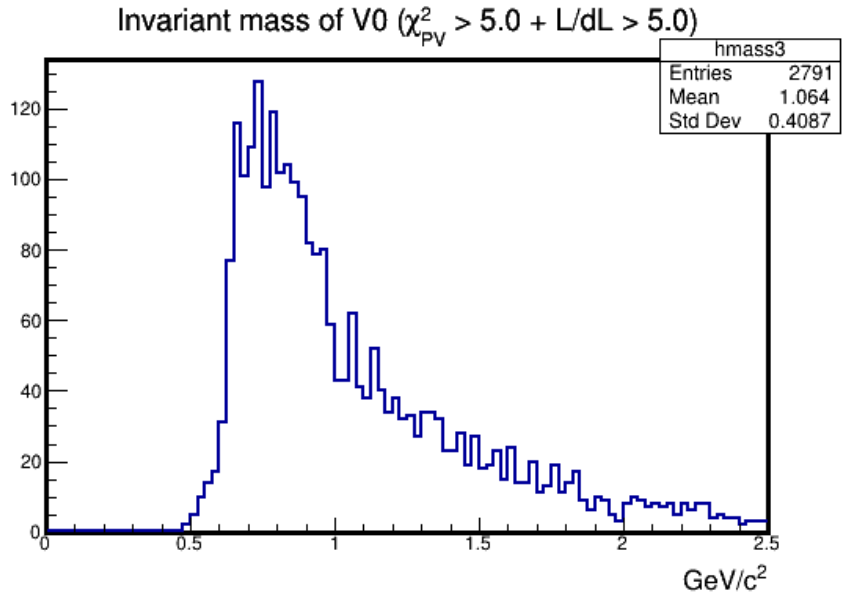


D^0 -> K-pi+ (open charm and no PID)



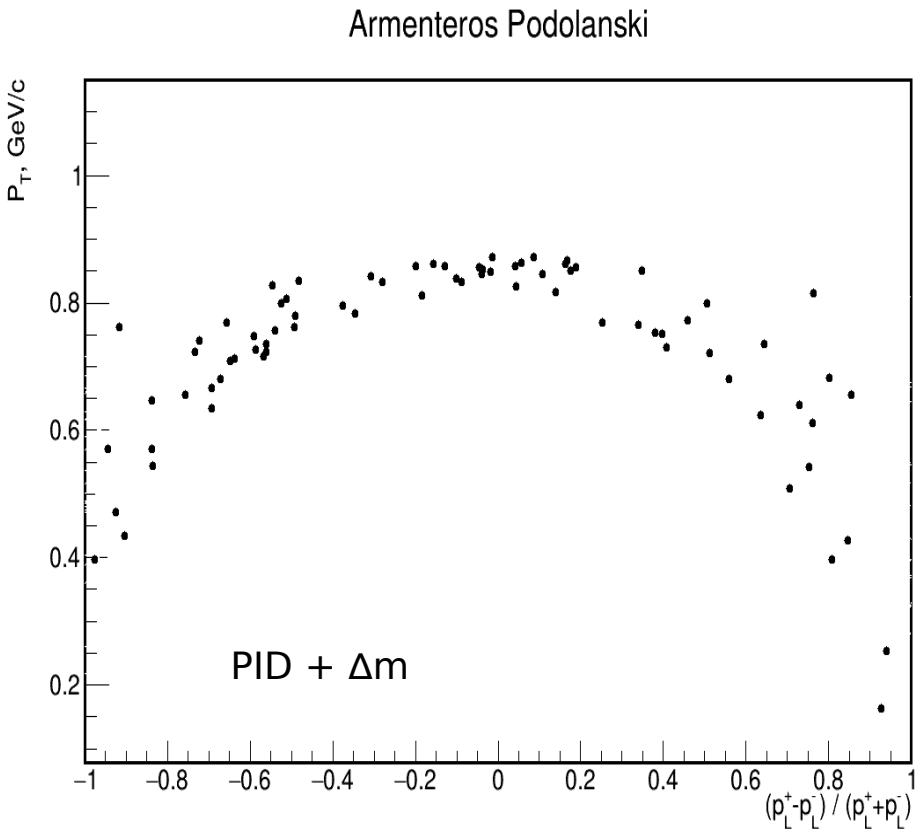


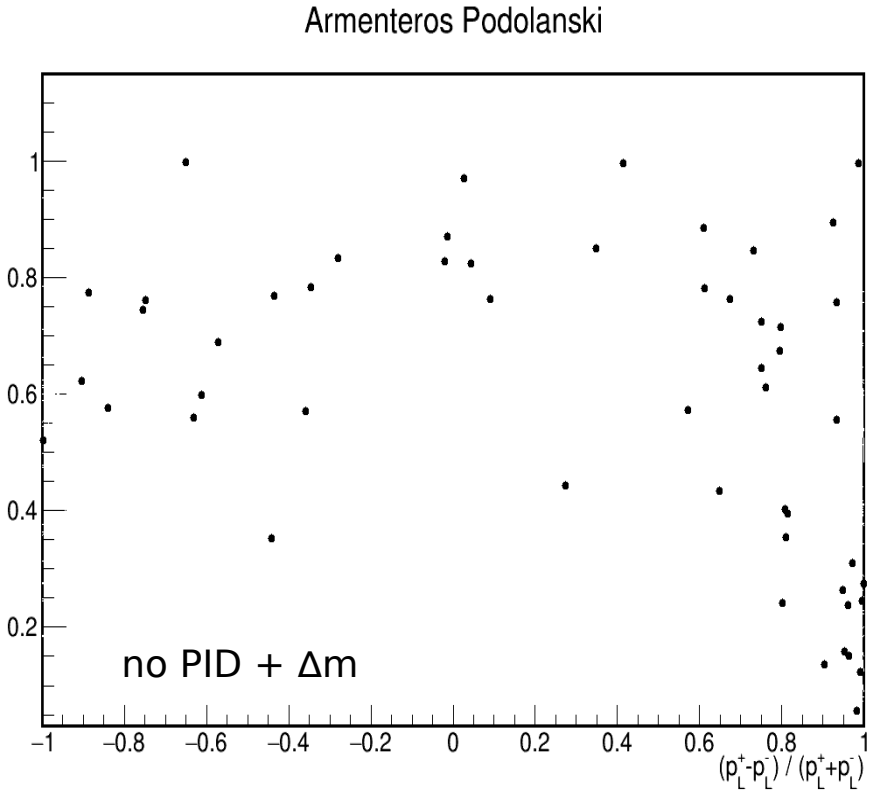




no PID => all positive particles are considered as pi+ and negative – as K-

D^0-> K-pi+


Armenteros Podolanski
P_T, GeV/c
PID + Δm
$(p_L^+-p_L^-) / (p_L^++p_L^-)$


Armenteros Podolanski
no PID + Δm
$(p_L^+-p_L^-) / (p_L^++p_L^-)$

Summary

1. there is example for finding short-lived particles using KFParticle package

2. you can use this example as base for your special finding