η_c analysis for Central Tracking selection

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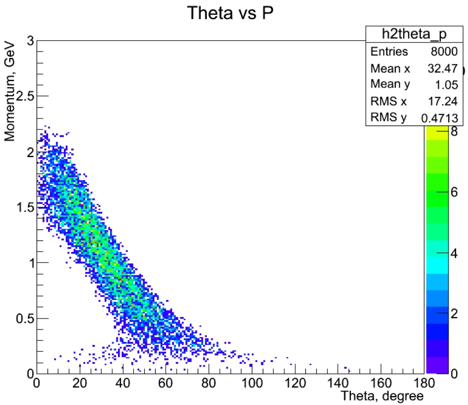
Kinematics of the reaction

Relevance for CT study: reaction is a decay of ground state of charmonium η_c with charged tracks in the whole acceptance range of CT in wide range of momenta. Reconstruction of η_c via narrow ϕ resonances provide good perspectives for background suppression.

$$p\overline{p} \rightarrow \eta_c \rightarrow \phi\phi \rightarrow K^+K^-K^+K^-,$$

$BR(\eta_c \rightarrow \phi\phi)$=$2.7 \cdot 10^{-3}$
$BR(\phi \rightarrow K^+K^-)$=48.9%

E_{CM}=2980 MeV,
p_z=3677 MeV



Data simulation

- Event generation is performed with EvtGen event generator using SVV_HELAMP decay model
- Monte Carlo simulation, digitization and reconstruction is performed within pandaroot framework
- PID is based on MonteCarlo Truth information
- 100000 events were produced on the grid with STT and TPC (no event mixing)

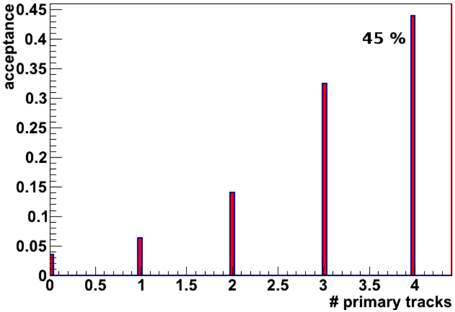
Analyzis

- Analyzis is performed with rho package
- No background suppression is studied
- Charged candidates with opposite charge are combined to ϕ candidate with ϕ mass preselection $1.02 \pm 0.1 GeV$
- Vertex fit is performed and best η_c candidate in each event is selected by minimal χ^2.
- Events with ϕ candidate within mass window: $1.00 GeV < m(K+K-) < 1.04 GeV$ are selected
- η_c is considered as reconstructed if it falls into mass window [2.90;3.06] GeV

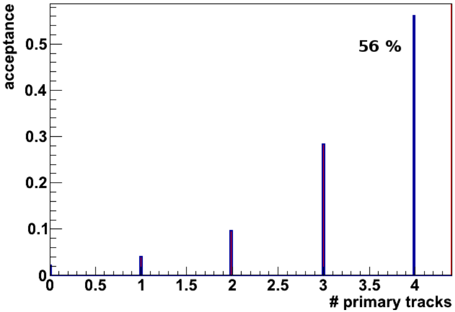
Geometrical acceptance

Estimation is done based on Monte Carlo simulation. Track is considered to be within acceptance of detector if it creates at least one Monte Carlo hit.

STT

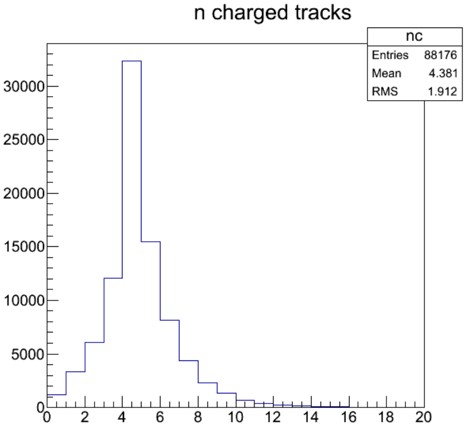


TPC



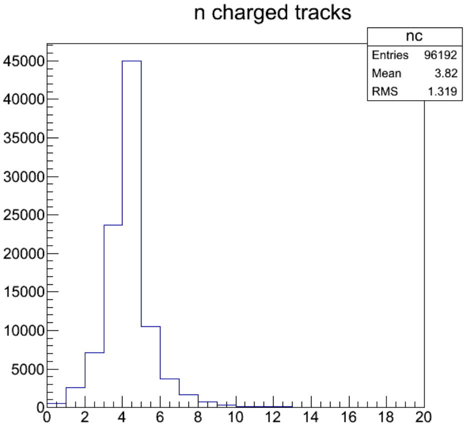
Number of reconstructed charged tracks

STT



84% >=4 tracks

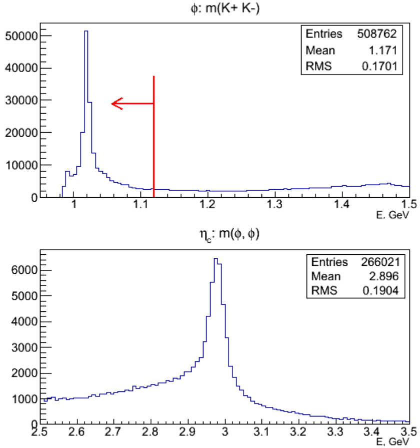
TPC



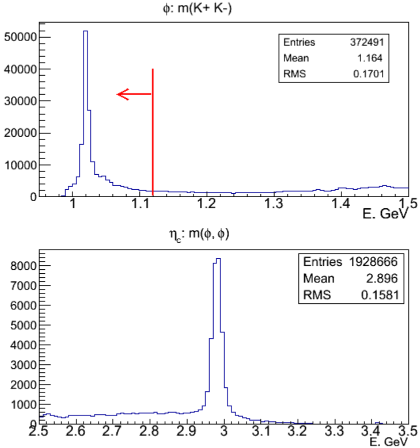
65% >=4 tracks

Invaraint mass (Preselection on ϕ mass in a wide window)

STT

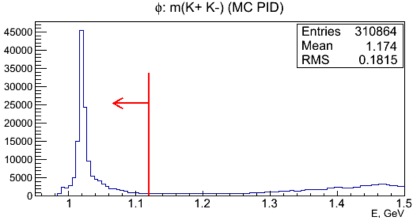


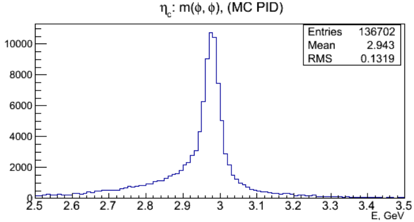
TPC



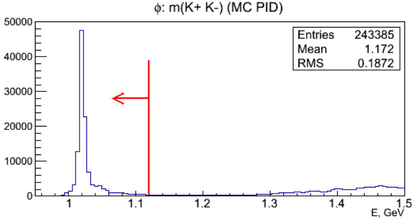
Monte Carlo based PID

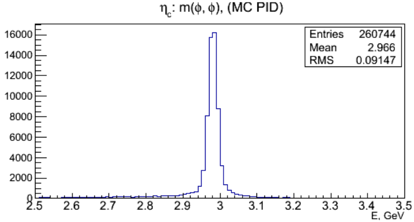
STT





TPC

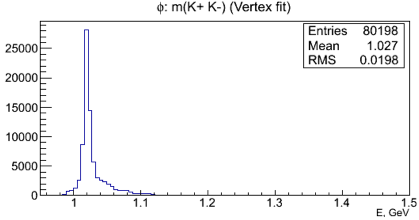


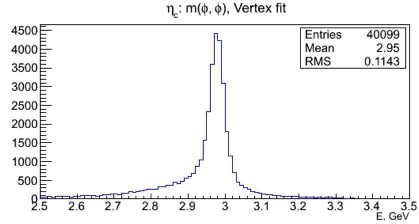


Combinatorial backgroud is significantly reduced for both cases

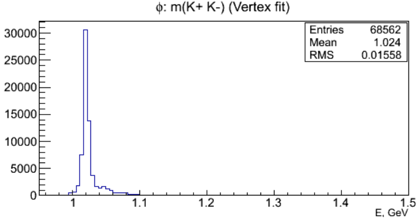
Best candidate from vertex fit

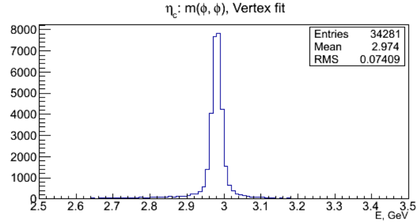
STT





TPC





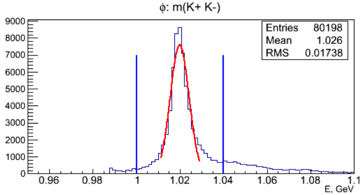
Peak fit procedure

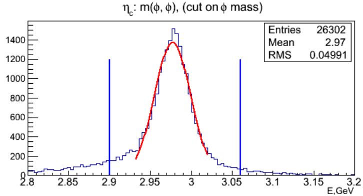
Two step peak fit:

- First fit with a gaus and extraction of μ, σ
- Second fit with a gaus in the range [μ-1.6*σ,μ+1.6*σ] to extract peak width σ_2

Cut on invariant mass

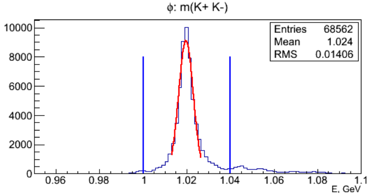
STT

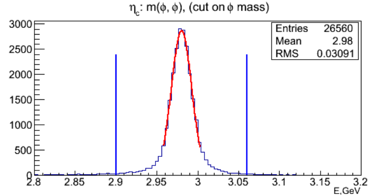




- $\sigma(\phi)$= 4.28 $\pm$ 0.02 MeV
- $\sigma(\eta_c)$= 22.1 $\pm$ 0.2 MeV
- ε_{ff}=21.3 $\pm$ 0.2% or 47.3 $\pm$ 0.3 % withind detector acceptance

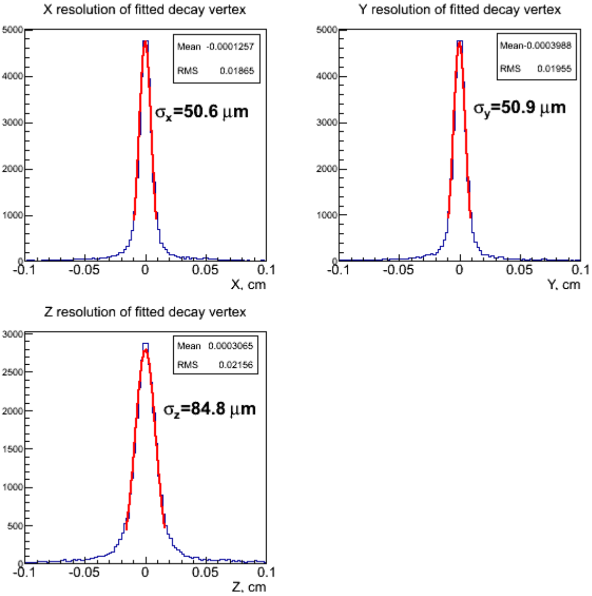
TPC



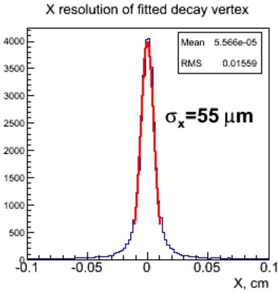


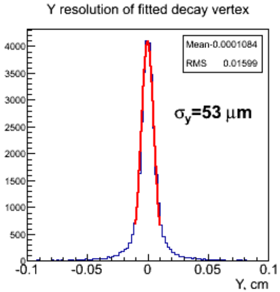
- $\sigma(\phi)$= 3.35 $\pm$ 0.02 MeV
- $\sigma(\eta_c)$= 12.5 $\pm$ 0.1 MeV
- ε_{ff}=25.8 $\pm$ 0.2% or 46.1 $\pm$ 0.3 % withind detector acceptance

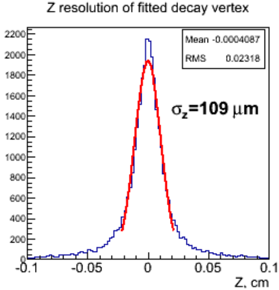
Vertex resolution (STT)



Vertex resolution (TPC)







Summary

- Efficiencies of η_c reconstruction within detector acceptance are comparable for both options and slightly better for STT case $47.3 \pm 0.3\%$ vs $46.1 \pm 0.3\%$, however TPC detector acceptance (56 % vs 45 %) and overall efficiency ($25.8 \pm 0.2\%$ vs $21.3 \pm 0.2\%$) is higher for this channel.
- Resolution of reconstructed η_c state and intermediate ϕ meson is better for TPC detector.