

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

$$E_{CM}=2980 \text{ MeV}, p_z=3677 \text{ MeV}$$

- Monte Carlo simulation, digitization and reconstruction is performed within pandaroot framework
- PID is based on MonteCarlo Truth information, however effect of PID is also studied
- 100000 events were produced on the grid with and without event mixing

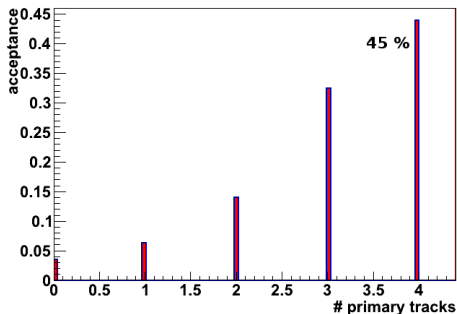
Figures of merit

- Efficiency of η_c reconstruction
- Resolution of the reconstructed invariant mass for both η_c and ϕ .

- Analysis is performed with rho package
- No background suppression is studied
- Charged candidates with opposite charge are combined to ϕ candidate with ϕ mass preselection $1.02 \pm 0.1 \text{ GeV}$
- 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:
 $1.00 \text{ GeV} < m(K + K^-) < 1.04 \text{ GeV}$ are selected
- η_c is considered as reconstructed if it falls into mass window $[2.90; 3.06] \text{ GeV}$

Geometrical acceptance

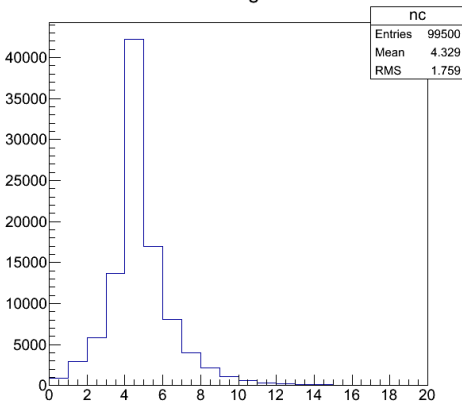
Estimation is done based on Monte Carlo simulation. Track is considered to be within acceptance of detector if it creates at least one Monte Carlo hit.



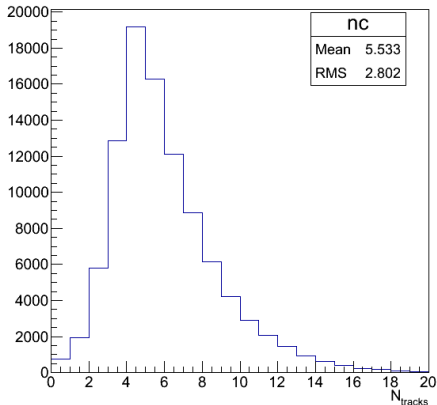
Defines upper limit for η_C reconstruction efficiency

Number of reconstructed charged tracks

Pure signal
n charged



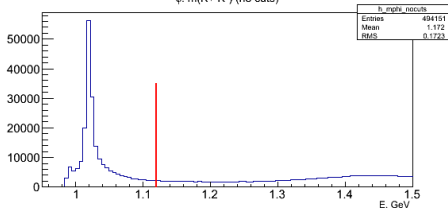
Background mixing
Number of tracks



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

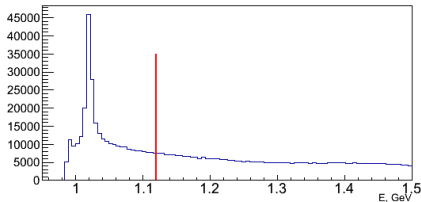
Pure signal

ϕ : $m(K^+ K^-)$ (no cuts)

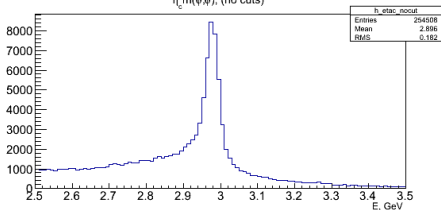


Background mixing

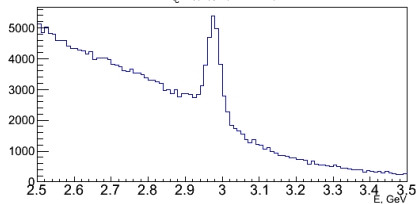
ϕ : $m(K^+ K^-)$ (no cuts)



η_c $m(\phi, \phi)$ (no cuts)

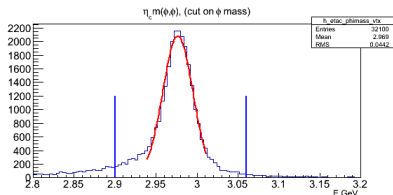
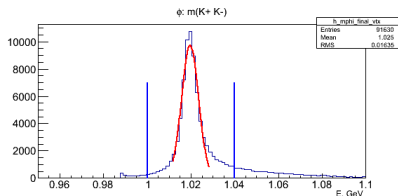


η_c $m(\phi, \phi)$ (no cuts)



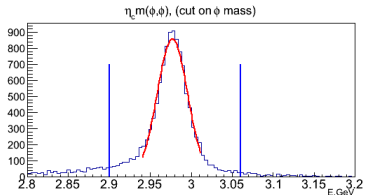
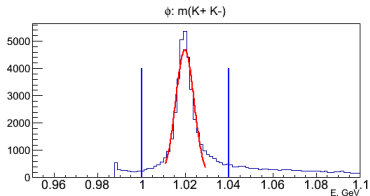
Final invariant mass

Pure signal



- $\sigma(\phi) = 3.87 \pm 0.02$ MeV
- $\sigma(\eta_c) = 18.4 \pm 0.2$ MeV
- $\varepsilon_{ff} = 27.3 \pm 0.2\%$

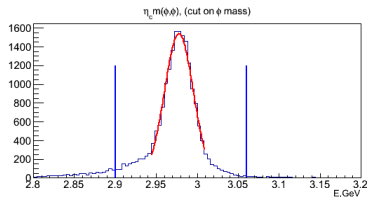
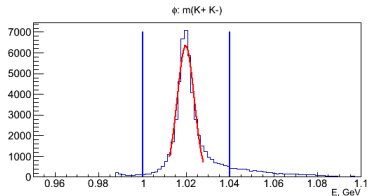
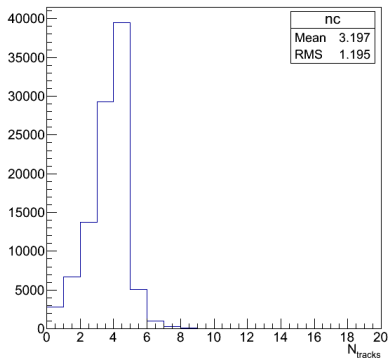
Background mixing



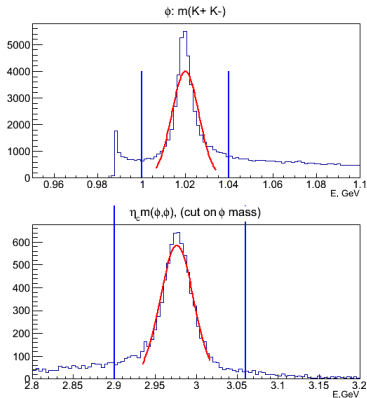
- $\sigma(\phi) = 4.20 \pm 0.02$ MeV
- $\sigma(\eta_c) = 18.6 \pm 0.1$ MeV
- $\varepsilon_{ff} = 11.6 \pm 0.2\%$

Effect of cleanup (pure signal)

Number of tracks



- $\sigma(\phi) = 3.85 \pm 0.02$ MeV
- $\sigma(\eta_c) = 17.5 \pm 0.2$ MeV
- $\varepsilon_{ff} = 19.1 \pm 0.2\%$

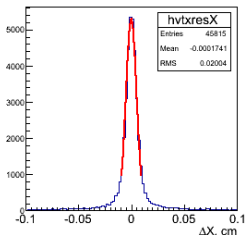


$$\varepsilon_{\text{eff}} = 9.6 \pm 0.1\%$$

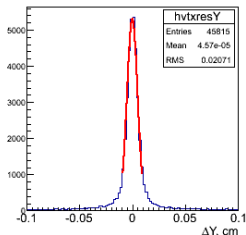
Efficiency reduction in comparison with ideal PID is not significant

Vertex resolution (Pure signal)

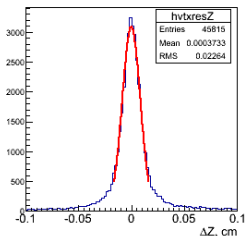
X resolution of fitted decay vertex



Y resolution of fitted decay vertex

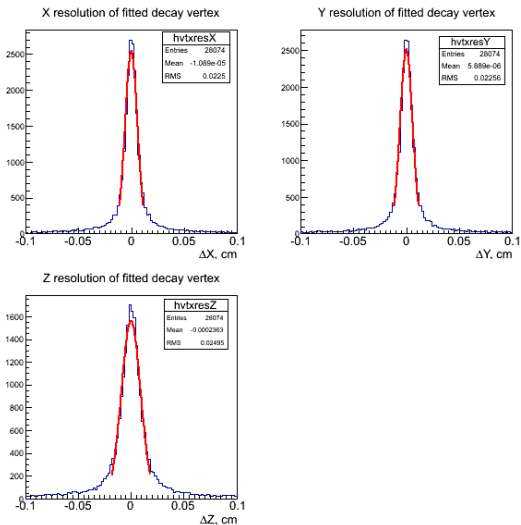


Z resolution of fitted decay vertex



$$\sigma_X = 50.8 \mu m, \sigma_Y = 50.7 \mu m, \sigma_Z = 85.8 \mu m$$

Vertex resolution (Background mixing)



$$\sigma_X = 58.3\mu m, \sigma_Y = 59.7\mu m, \sigma_Z = 90.9\mu m$$