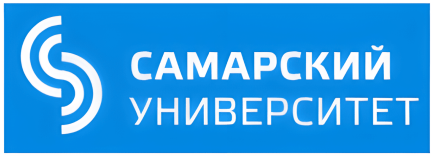
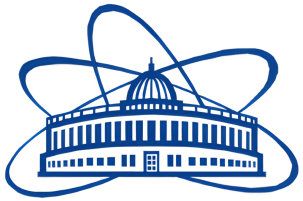




Study of K_S^0 meson recontruction efficiency at SPD.

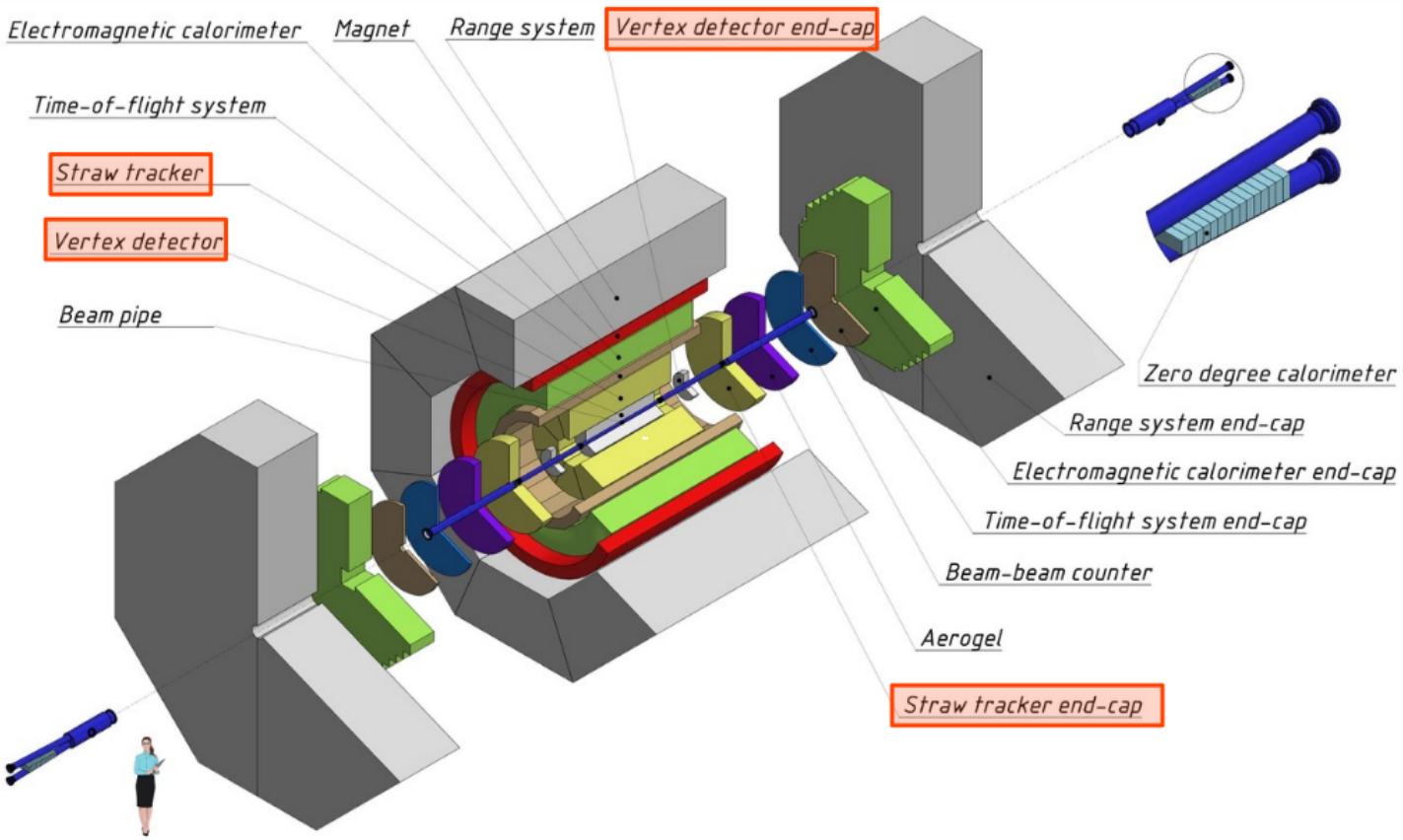
Natalia Rogacheva

LHEP, JINR, Dubna

SPD collaboration meeting
23-27 October 2023

Spin Physics Detector and event sample for the K^0_S analysis

Secondary vertex (V^0) are reconstructed in the detectors: Vertex detector and Straw tracker.



Event sample

SpdRoot(March 2023)

Generation: Pythia 8, (p+p) at $\sqrt{S}$=27 GeV, SoftQCD(MB)

4 000 000 events (1 sec of data taking)

Selection criteria

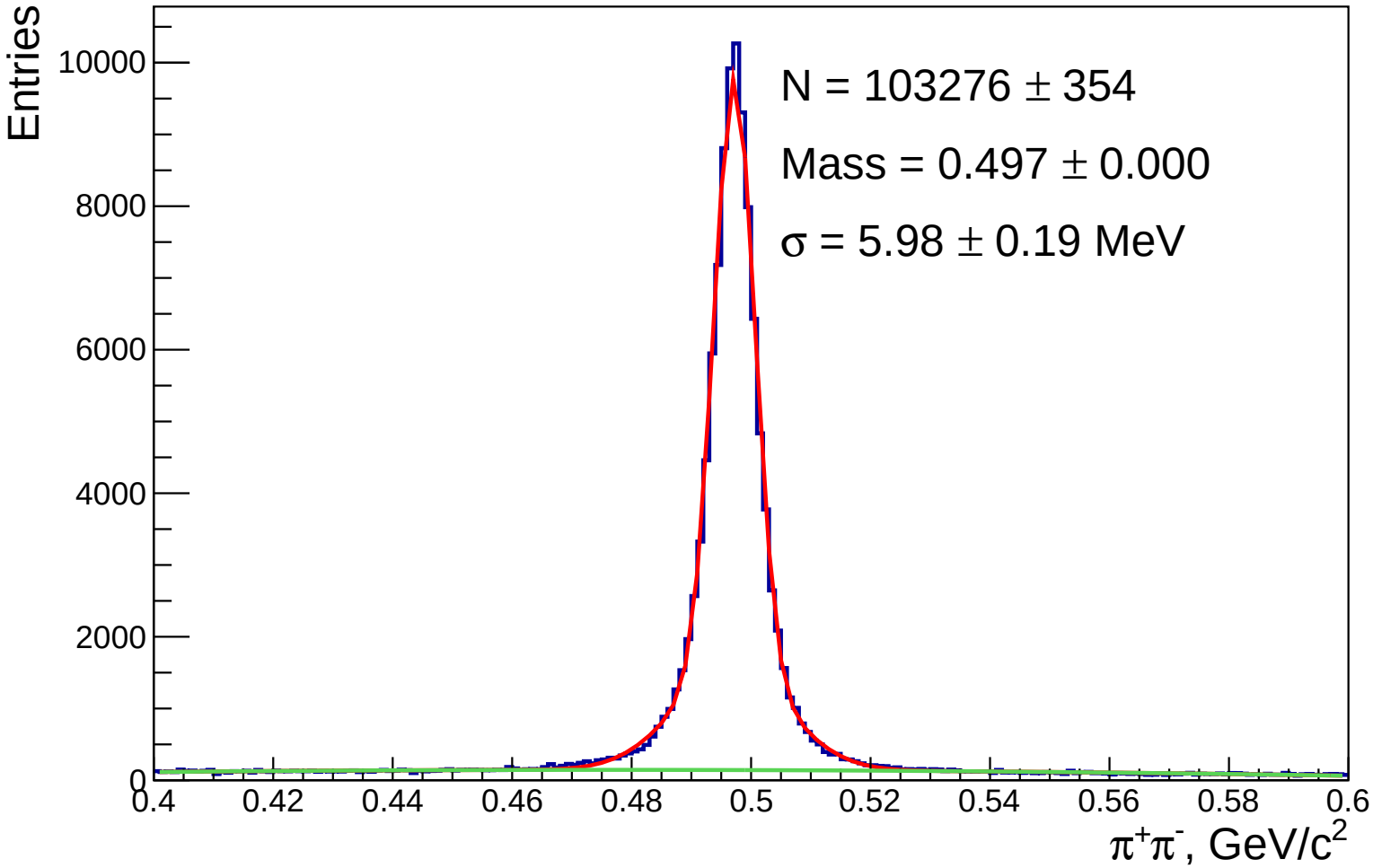
PV and V0 selection:

1. The primary vertex coordinates has a gaussian smearing with $\sigma_z = 30$ cm, $\sigma_x = \sigma_y = 0.1$ cm,
2. Daughters = K^0(-211, 211),Λ(2212,-211),$\bar{\Lambda}$(-2212, 211);
   Bg = (321,-321), (-321,211), (321,-211).
3. For track selection: minimum Its hits = 0;
   total minimum hits = 3.
4. The track candidates were required to be well-fitted and to have a track fit χ^2 over the number of degrees of freedom less than 6 ($\chi^2/NDF < 6$).
5. Minimum χ^2_{V0} track to PV is less than 2.
6. Track extrapolation χ^2 is more than 10.
7. Track fit is converged.

Kinematical cuts:

1. $\theta_{coll} < 0.03$ rad for K^0. This cut selects V^0 events the momentum looking at the PV.
2. $Dist = \sqrt{(x_{SV} - x_{PV})^2 + (y_{SV} - y_{PV})^2 + (z_{SV} - z_{PV})^2}$.
   This cut selects V^0 which decay close to PV. $Dist > 0.7$ cm for K^0_S.

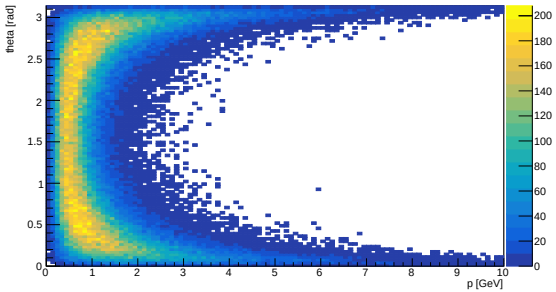
Invariant mass of K^0_S after all cuts

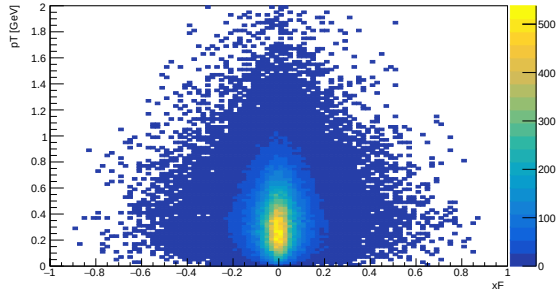


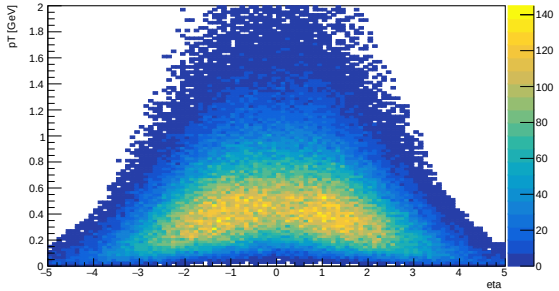
The shape of the K^0_S signal was parametrized by double Gaussian and background was parametrized by the second order polynomial.

The selected V^0 candidates are plated in (p,θ), (x_F, p_T) and (η, p_T) phase space

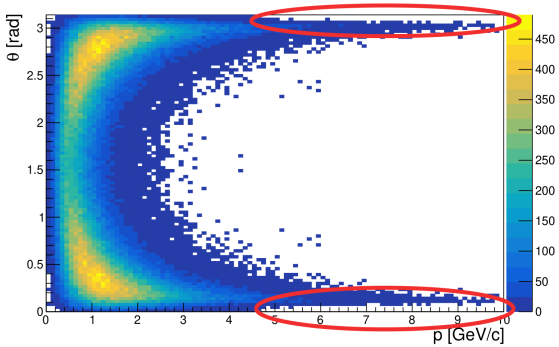
Pure Pythia 8 (true), K^0_S:



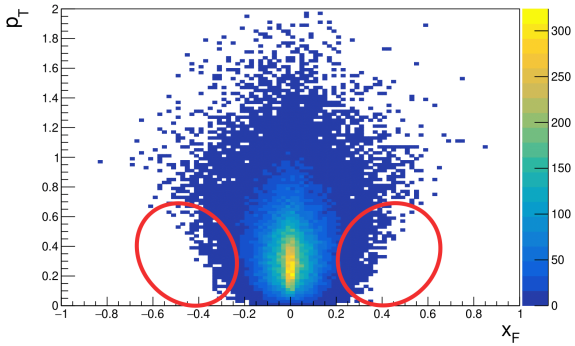




Reconstruction data (RD):

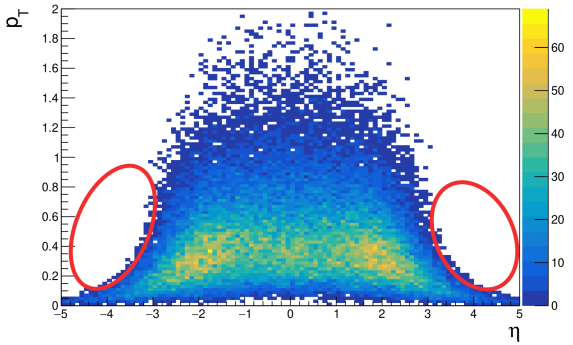


θ - polar angle
p - total momentum



p_T - transverse momentum
x_F - Feynman variable

$$x_F = \frac{2p_T}{\sqrt{S}}$$

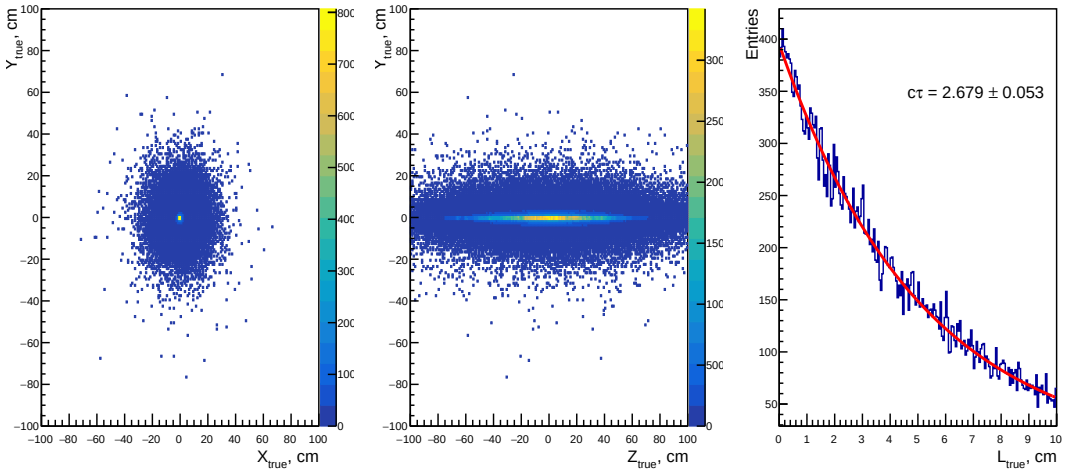


p_T - transverse momentum
η - pseudorapidity

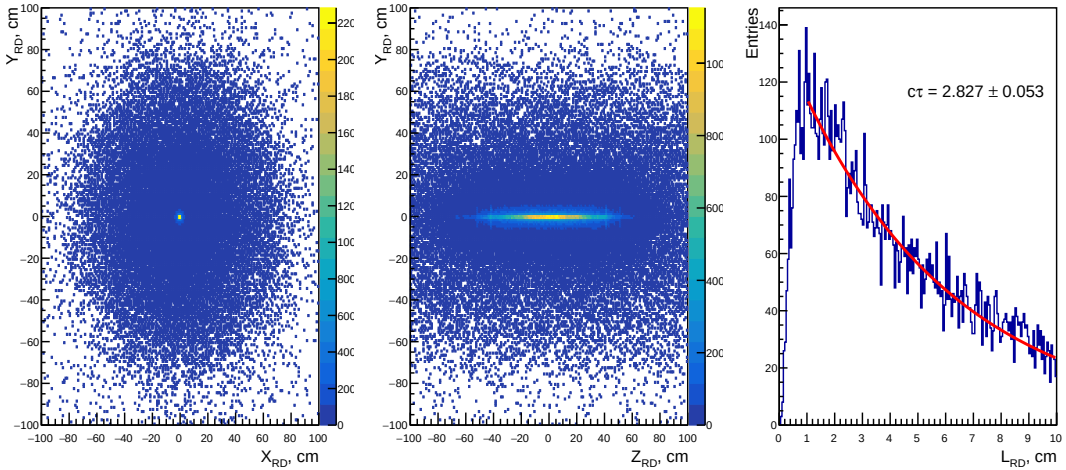
$$\eta = -\ln\left[\tan\left(\frac{\theta}{2}\right)\right]$$

Distribution of K^0_S decay vertex position and decay length.

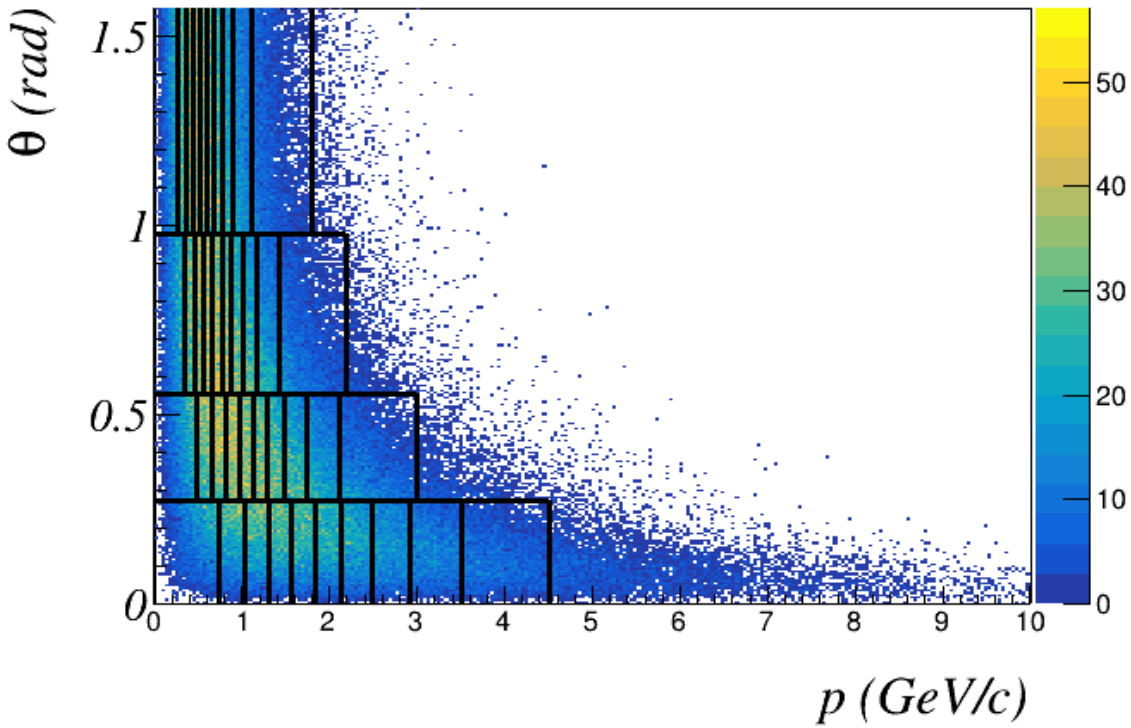
$$\text{Length} = \sqrt{(x_{decay} - x_{PV})^2 + (y_{decay} - y_{PV})^2 + (z_{decay} - z_{PV})^2}.$$



PDG:
$c\tau$=2.6844 cm

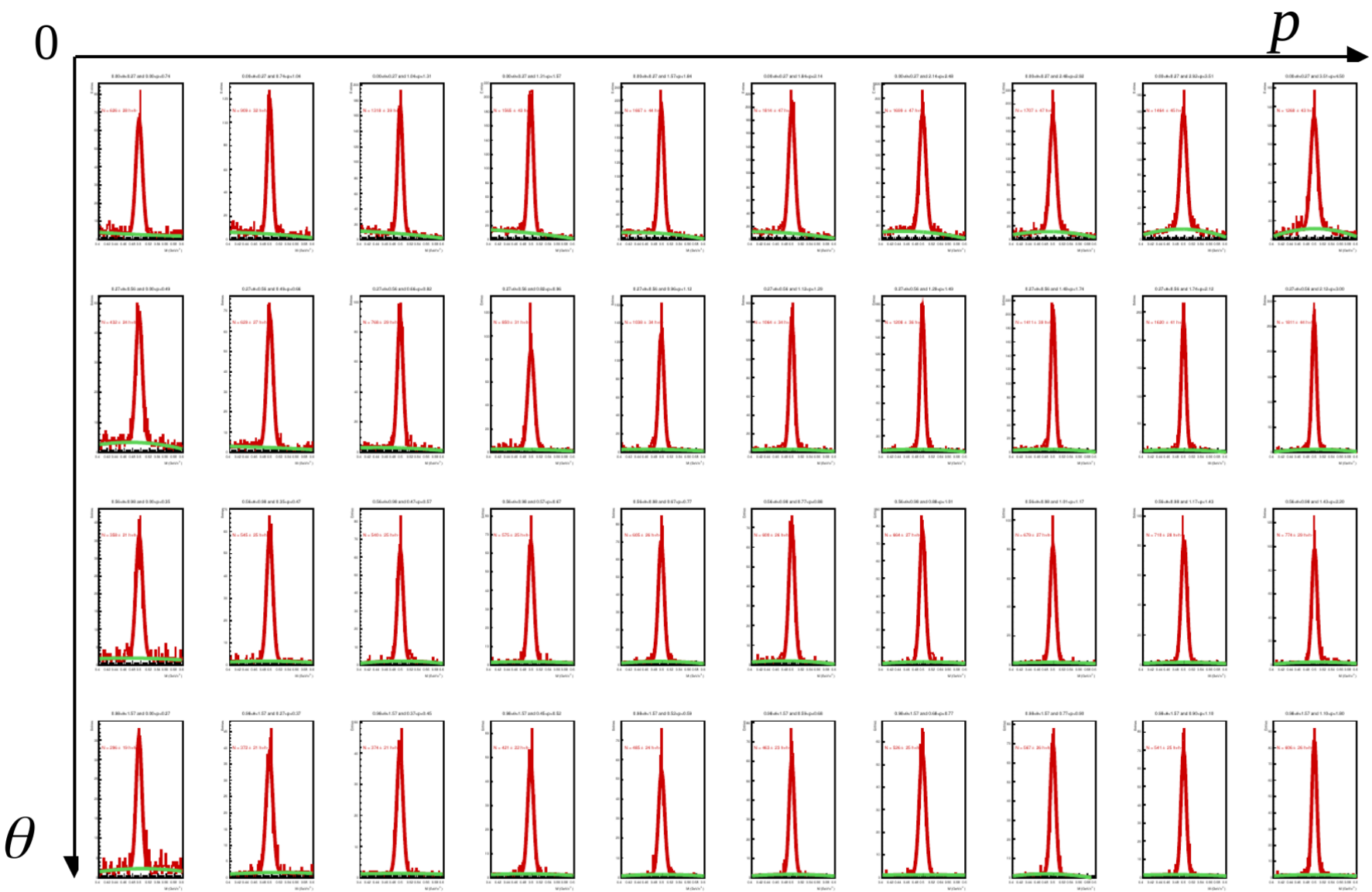


Binning

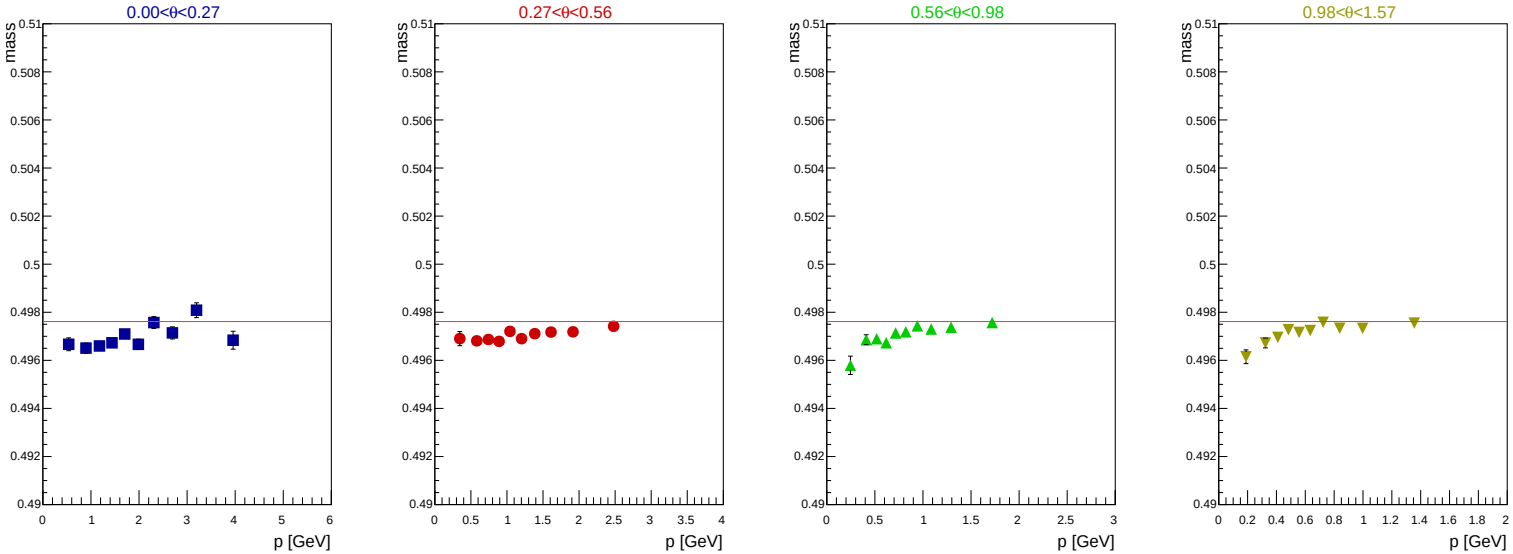


The choice of the binning scheme is obtained from distribution of K^0 simulated in Pythia 8. It was done to have the similar number of K^0_S in bins ($n^{\theta}_{bin} = 4, n^{p}_{bin} = 10$).

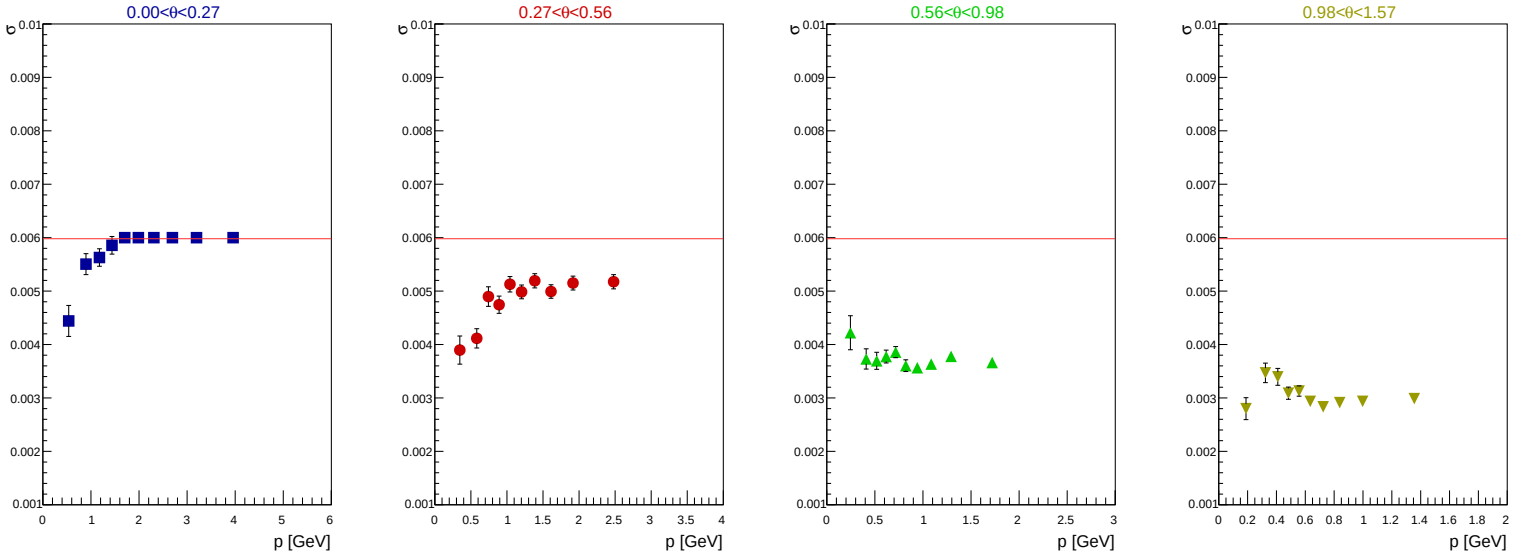
Distributions of the K^0_S candidates with all cuts



Mass and sigma of K^0_S (in p for fixed θ interval)

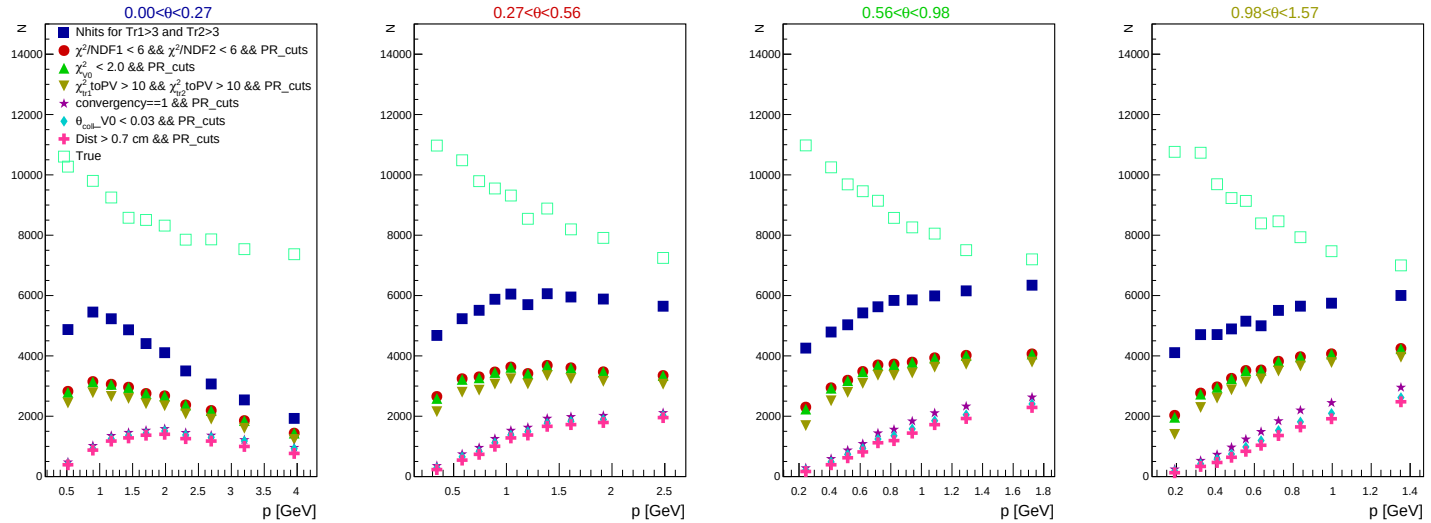


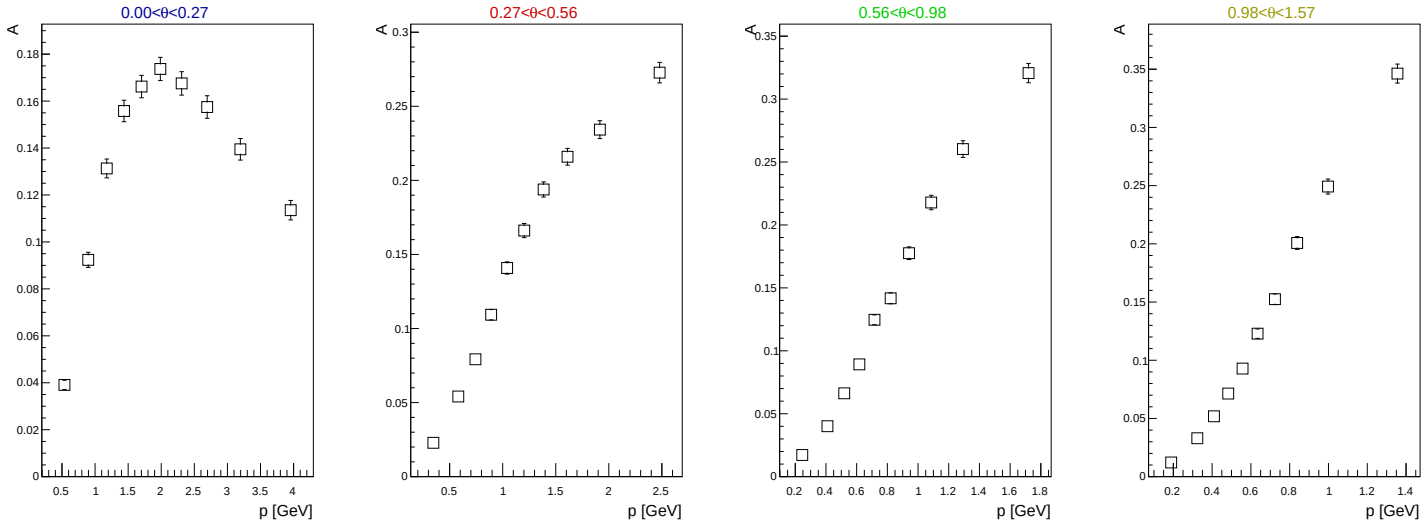
red line shows m(PDG) = 0.497 GeV



red line shows the sigma of the K^0_S fit using full data sample

Number of K^0_S after different cuts and K^0_S reconstruction efficiency with all corrections included





$C = N^{MC}_{Rec} / N^{MC}_{true}$

Total correction factor includes: geometrical acceptance, track and vertex reconstructed efficiency.

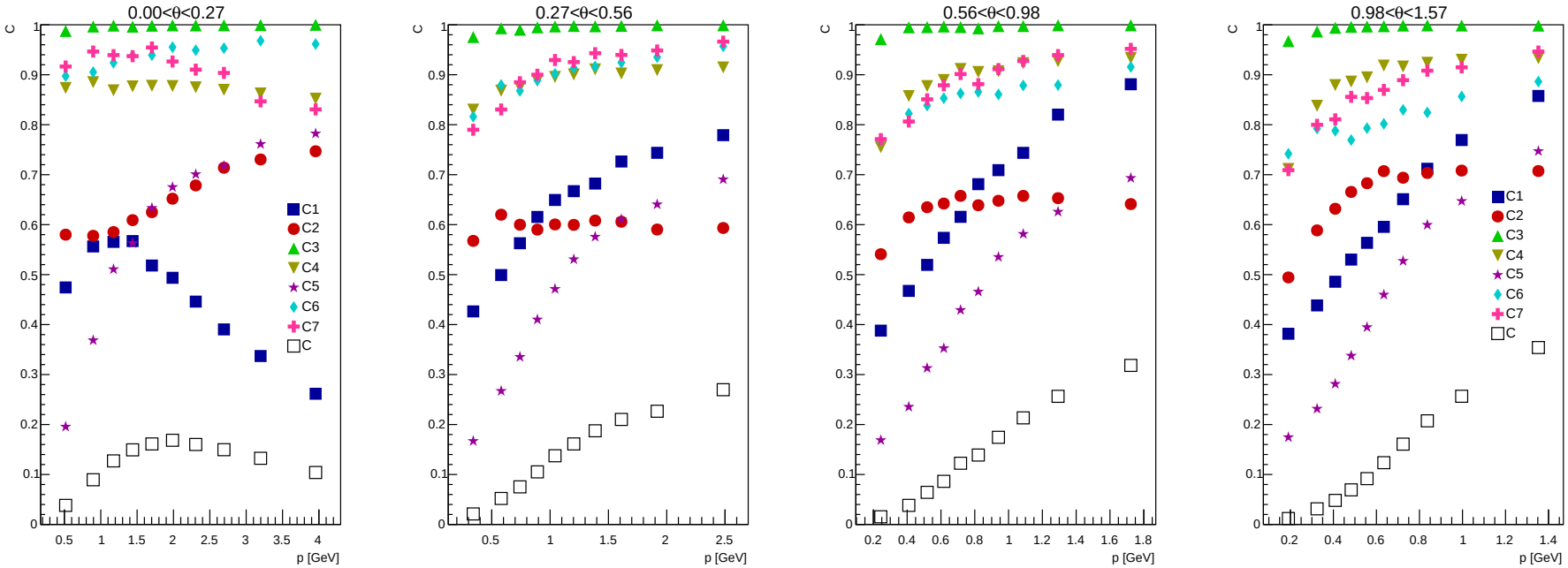
Factorization of the MC correction

$$C = \frac{N(RD)}{N(true)} = C1*C2*C3*C4*C5*C6*C7$$

$$C1 = \frac{N(3hits)}{N(true)} \qquad C2 = \frac{N(\chi^2/NDF_{tr1,2}<6)}{N(3hits)} \qquad C3 = \frac{N(\chi^2_{V0}<2.0)}{N(\chi^2/NDF_{tr1,2}<6)}$$

$$C4 = \frac{N(\chi^2_{tr1,2}toPV>10)}{N(\chi^2_{V0}<2.0)} \qquad C5 = \frac{N(convergency==1)}{N(\chi^2_{tr1,2}toPV>10)} \qquad C6 = \frac{N(\theta_{coll}<0.03)}{N(convergency==1)}$$

$$C7 = \frac{N(Dist>0.7)}{N(\theta_{coll}<0.03)}$$



Conclusion and TODO

1. Analysis of the K_S^0 reconstruction efficiency was performed.
2. MC correction was factorized.
3. Next step is to include feed down correction.

Thank you for your attention.