

# $K_S^0$ analysis

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# Event and track selection for the $V^0$ analysis

## Event sample

SpdRoot 4.1.4

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

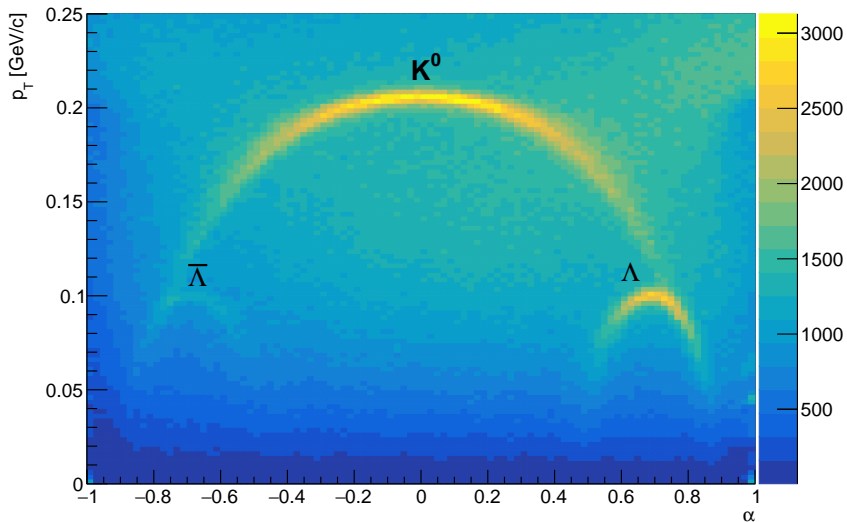
4 000 000 events (1 sec of data taking)

## $V^0$ selection:

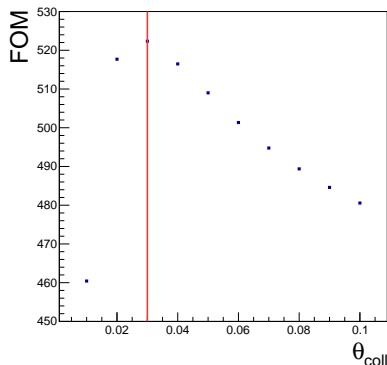
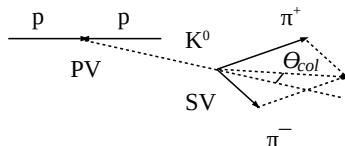
input parameters for SpdMCKFpartRCV0Finder:

- 1 fMinItsHists = 3 - minimum Its hits for track selection
- 2 fDaughters =  $K^0(-211, 211), \Lambda(2212, -211), \bar{\Lambda}(-2212, 211)$ ;  
Bg = (321, -321), (-321, 211), (321, -211).
- 3 fMinChi2PV = 2.0 - minimum chi2 track to PV (primary selection)
- 4 fMinChi2Part = 2.0 - minimum chi2 between 2 tracks (primary selection)

# Distributions of the $V^0$ candidates in the Podolanski-Armenteros without selection cuts



# The collinearity cut

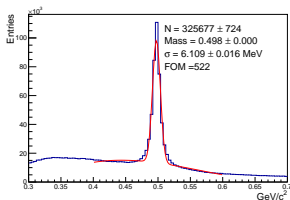
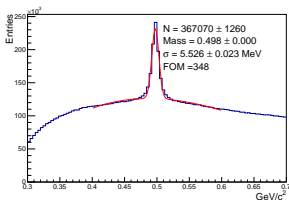


① 
$$FOM = \frac{N_{sig}}{\sqrt{N_{sig} + N_{bg}}};$$

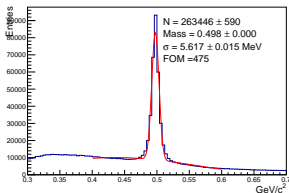
- ② This cut selects  $V^0$  events the momentum looking at the PV.  
 $\theta_{coll} < 0.03$  rad for  $K^0$ .

# Invariant mass of $K^0$ for different cuts

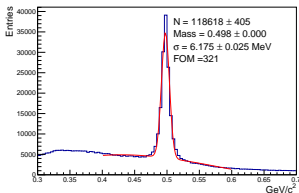
$\theta_{coll} < 0.03$



$\theta_{coll} < 0.03 + \chi^2/ndf < 10$



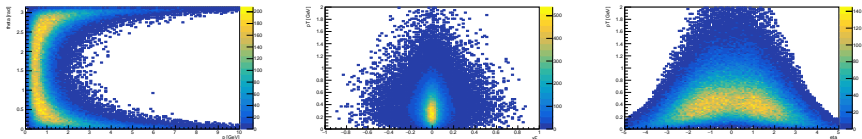
$\theta_{coll} < 0.03 + \chi^2/ndf < 10 + \text{isgood}$



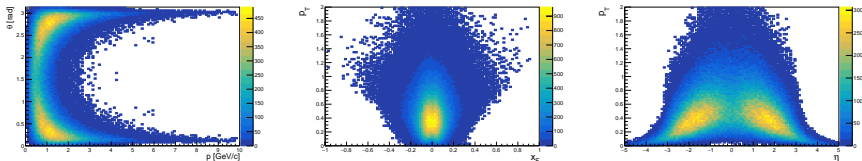
	all	$\theta_{coll} < 0.03$	$\theta_{coll} < 0.03 + \chi^2/ndf < 10$	$\theta_{coll} < 0.03 + \chi^2/ndf < 10 + \text{isgood}$
FOM ( $\pm 2\sigma$ ):	348	522	475	321
$N(K^0)$ :	367 070	325 677	263 446	118 618

The selected  $V^0$  candidates are plotted in  $(p, \theta)$ ,  $(p_T, x_F)$  and  $(p_T, \eta)$  phase space

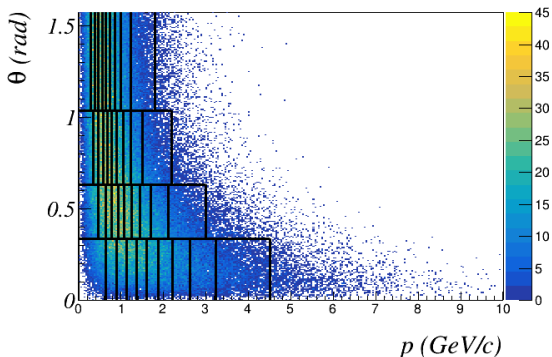
Pure Pythia 8,  $K^0$



Reconstruction data, cuts:  $K^0 \pm 2\sigma$  and  $\theta_{coll} < 0.03$  rad.

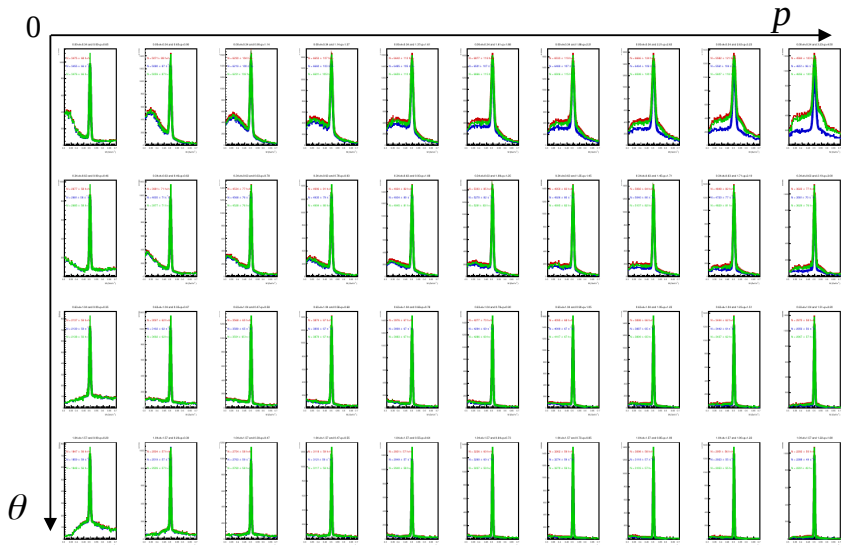


## Binning



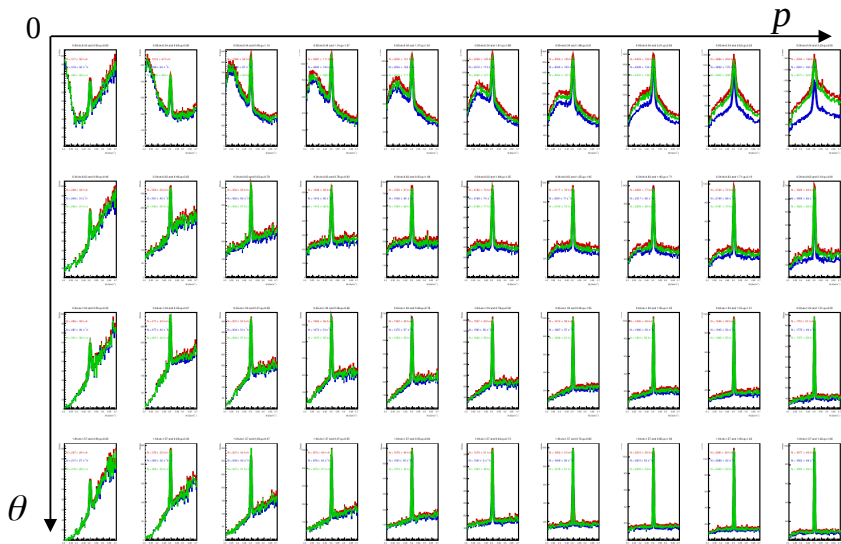
The choice of the binning scheme is obtained from distribution of  $K^0$  simulated in Pythia 8. It was done to have the similar number of  $K^0$  in bins ( $n_{bin}^\theta = 4, n_{bin}^p = 10$ ).

# Distributions of the $K^0$ candidates with only cut $\theta_{coll} < 0.03$



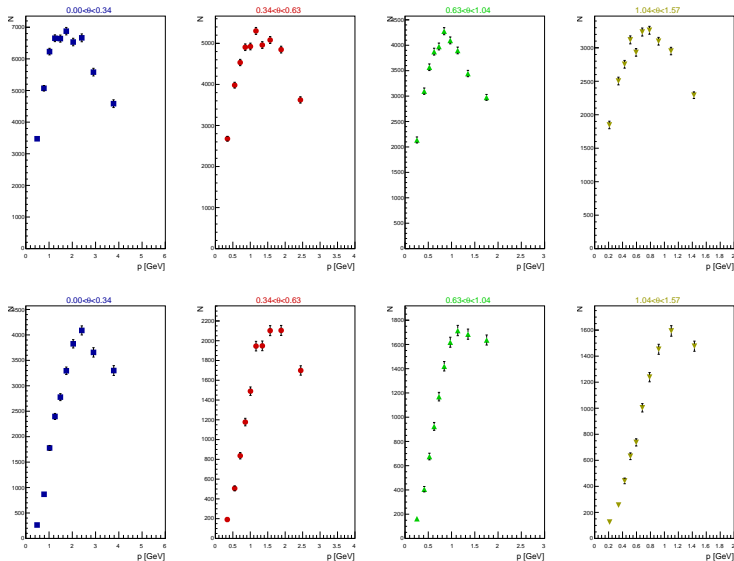


# Distributions of the $K^0$ candidates with cuts $\chi^2/ndf < 10$ and isgood



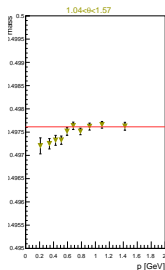
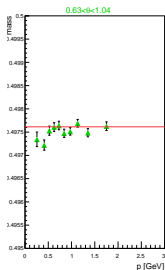
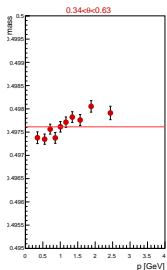
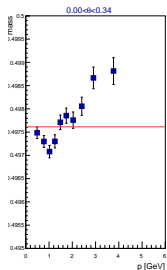
# Result of the fit (number of $K^0$ in $p$ for fixed $\theta$ interval)

$\theta_{coll} < 0.03\text{rad.}$

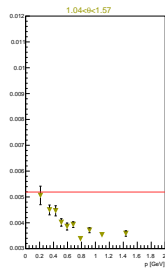
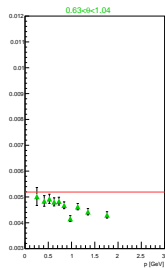
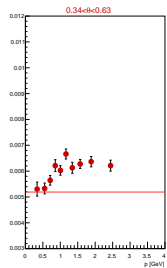
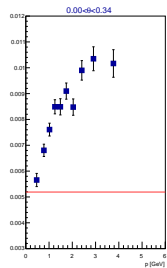


$\chi^2 / ndf < 10$   
isgood

# Mean mass and sigma of $K^0$ (in $p$ for fixed $\theta$ interval)

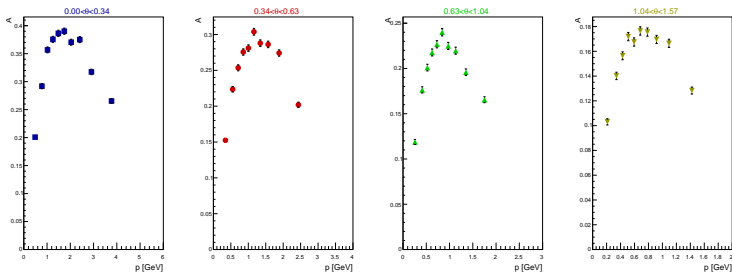


red line shows  
 $m(\text{PDG}) =$   
 0.497 GeV

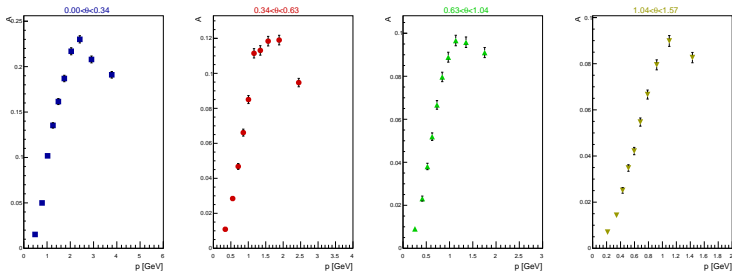


red line shows  
 the sigma of  
 the  $K^0$  fit  
 using full  
 data sample

# $K^0$ reconstruction efficiency with all corrections included ( $A = N_{Rec}^{MC} / N_{pythia}^{MC}$ )



$\theta_{coll} < 0.03 \text{ rad.}$



$\chi^2 / \text{ndf} < 10$   
isgood

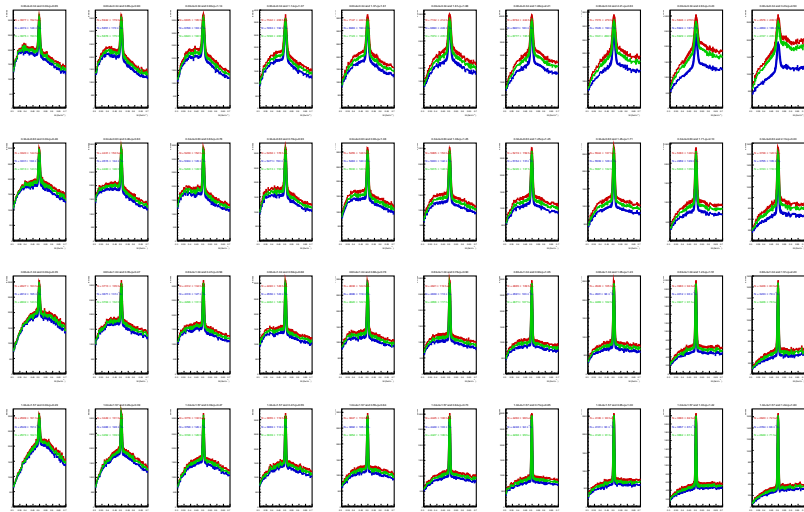
# Conclusion and TODO

- 1 Analysis of various factors affecting the  $K_S^0$  reconstruction efficiency was performed.
- 2  $K_S^0$  reconstruction efficiency depends on  $p$  and  $\theta$  and in general is not larger than 40%.
- 3 Criterion is good rejects many signal events. Particularly for low momentum ( $p=0-1.5$  GeV).
- 4 Further apply this procedure for  $\Lambda$  and  $\bar{\Lambda}$ .

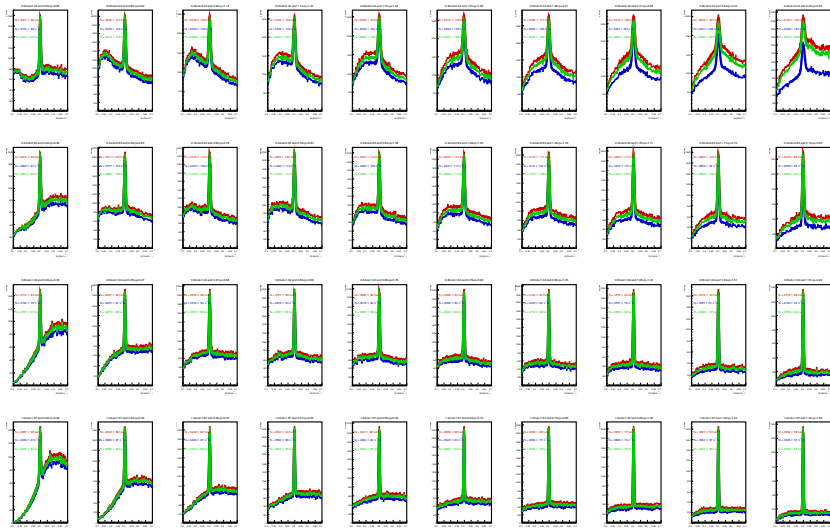
## Backup slides

$\theta$	$\theta$	$\theta$	$\theta$
0 - 0.33	0.33 - 0.63	0.63-1.03	1.03 - 1.57
p	p	p	p
0-0.6	0-0.4615	0-0.35	0-0.29
0.64-0.90	0.46-0.63	0.35-0.47	0.29-0.38
0.90-1.13	0.63-0.78	0.47-0.57	0.38-0.47
1.13-1.36	0.78-0.92	0.57-0.67	0.47-0.55
1.36-1.60	0.92-1.08	0.67-0.78	0.55-0.63
1.60-1.88	1.08-1.24	0.78-0.90	0.63-0.73
1.88-2.20	1.24-1.44	0.90-1.04	0.73-0.84
2.20-2.62	1.44-1.70	1.04-1.23	0.84-0.99
2.62-3.23	1.70-2.10	1.23-1.50	0.99-1.21
3.23-4.5	2.10-3	1.50-2.2	1.21-1.8

# Distributions of the $K^0$ candidates

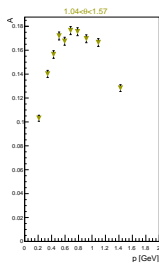
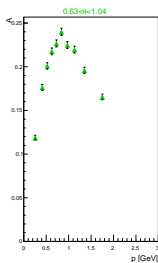
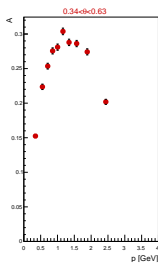
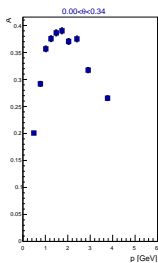


## Distributions of the $K^0$ candidates with only cut $\chi^2/ndf < 10$



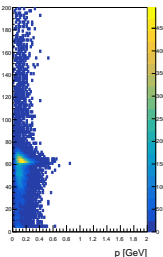
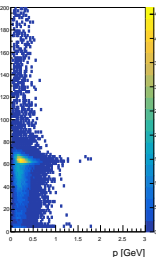
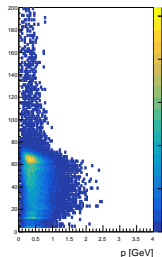
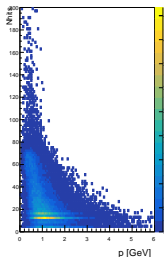


# Nhits distributions of the $K^0$ in $p$ for fixed $\theta$ interval



$$\theta_{coll} < 0.03 \text{ rad.}$$

$$A = N_{Rec}^{MC} / N_{pythia}^{MC}$$



Nhits( $\pi$ ) vs  $p(K^0)$

# Problem!!!

Pythia 8 (not decay  $K^0$ )

SpdRoot (decay  $K^0$ )

Change pdg  $K^0$  to  $K_S^0$  and  $K_L^0$

In analysis

When we ask mother pdg of tracks, we see

```
spdgenerators/SpdPrimaryGenerator.cxx
if (pdgid == 311 || pdgid == -311)
{
  Double_t test = fgen->Uniform(0.,1.);
  if (test >= 0.5) pdgid = 311; //  $K_S^0$ 
  else pdgid = 130; //  $K_L^0$ 
}
```

Bug in SpdRoot

