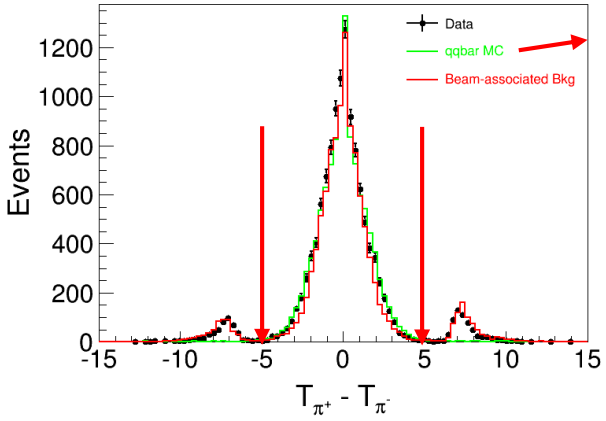
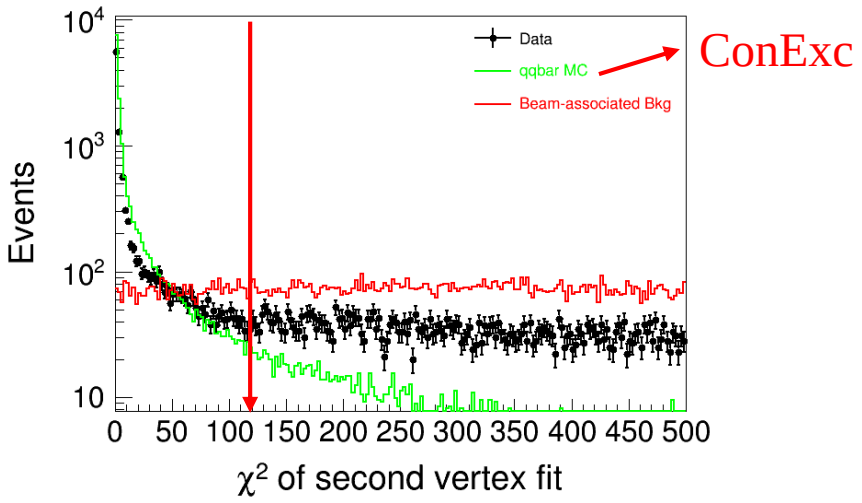
Ks cut criteria

- ✓ Track selection
  - ➢ |Vr|< 10cm, |Vz|<30cm
- ✓ PID: Prob π > Prob K and Prob π > Prob P

  $N_{\pi+}$ >=1 and $N_{\pi-}$ >=1
- ✓ Second vertex fitting: $L/\sigma_L > 2.0$



- ✓ Remove the cosmic rays: $|T(\pi^+) - T(\pi^-)| < 5$



- ✓ Remove the beam-associated backgrounds: χ^2(second vertex fit) < 120

1, Ks efficiency differences

Here, MSTJ(21) = 0

Table 18: K_S^0 efficiencies (%) vary with momentum in different MC models.

p(GeV)	$\varepsilon(K_S^0)$ from ConExc	$\varepsilon(K_S^0)$ from Lundalw	Uncertainty
0.0-0.1	30.3	31.9	-5.4
0.1-0.2	39.8	39.8	-0.1
0.2-0.3	44.3	44.8	-1.2
0.3-0.4	45.3	46.4	-2.4
0.4-0.5	48.2	48.7	-1.1
0.5-0.6	45.3	50.5	-11.5
0.6-0.7	43.4	49.4	-13.8
0.7-0.8	44.3	55.2	-24.5
0.8-0.9	49.6	57.7	-16.3
0.9-1.0	55.8	53.1	4.7
1.0-1.1	52.8	57.3	-8.6
1.1-1.2	47.8	45.3	5.3
1.2-1.3	62.6	12.3	80.4
1.3-1.4	81.8	0.6	99.3

Ks truth events using different MSTJ(21) parameters (1M MC)

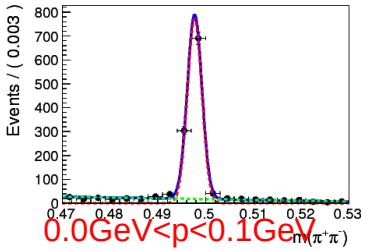
MSTJ(21) = 0

MSTJ(21) = 2

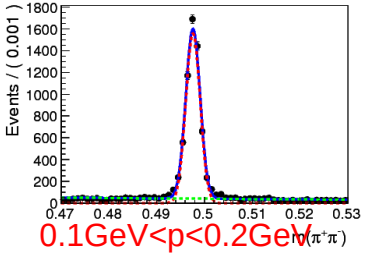
Table 20: K_S^0 truth events using different MSTJ(21) parameters.

p(GeV)	Events in Lundalw(0)	Events in Lundalw(2)
0.0-0.1	3098	0
0.1-0.2	14703	0
0.2-0.3	23387	134
0.3-0.4	26025	277
0.4-0.5	21816	1216
0.5-0.6	15705	1639
0.6-0.7	11183	1821
0.7-0.8	7979	1209
0.8-0.9	5099	778
0.9-1.0	2668	534
1.0-1.1	1657	61
1.1-1.2	1499	710
1.2-1.3	588	73
1.3-1.4	0	0

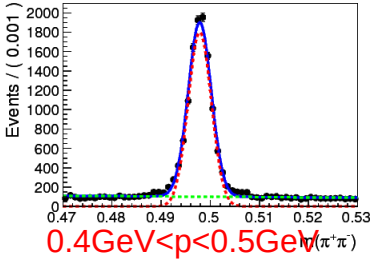
Ks mass distribution with MSTJ(21) = 0



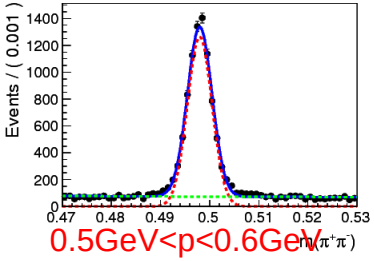
0.0GeV<p<0.1GeV



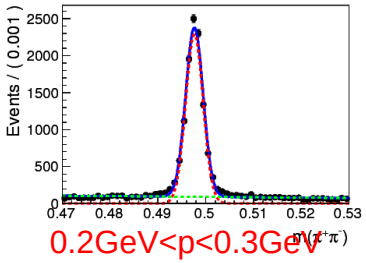
0.1GeV<p<0.2GeV



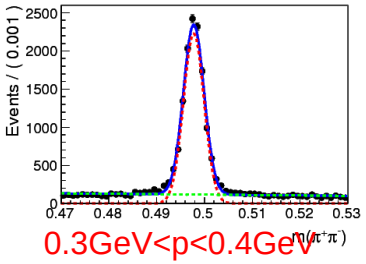
0.4GeV<p<0.5GeV



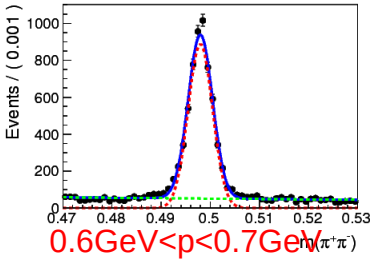
0.5GeV<p<0.6GeV



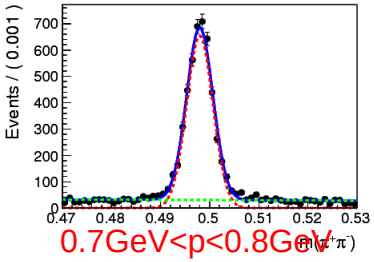
0.2GeV<p<0.3GeV



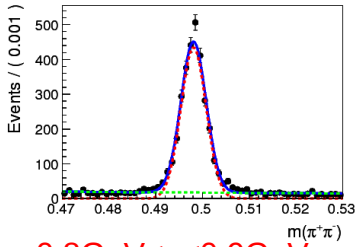
0.3GeV<p<0.4GeV



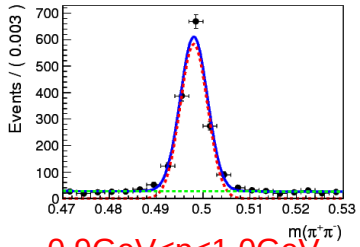
0.6GeV<p<0.7GeV



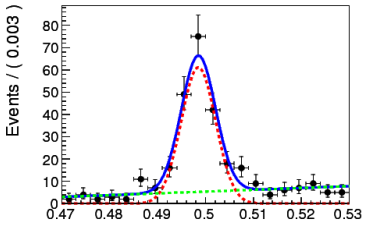
0.7GeV<p<0.8GeV



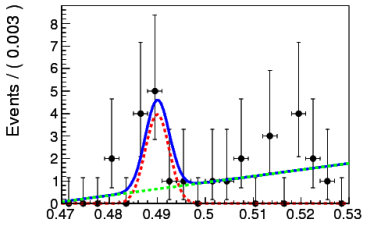
0.8GeV<p<0.9GeV



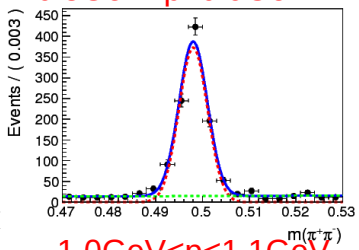
0.9GeV<p<1.0GeV



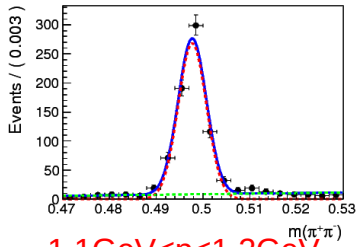
1.2GeV<p<1.3GeV



1.3GeV<p<1.4GeV

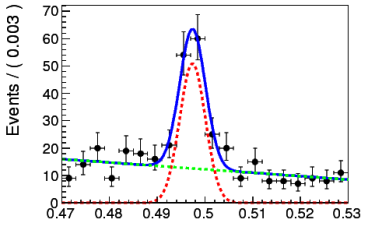


1.0GeV<p<1.1GeV

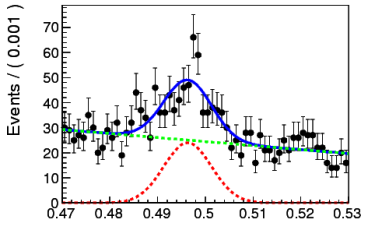


1.1GeV<p<1.2GeV

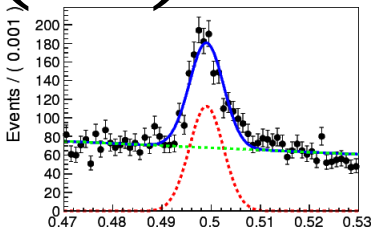
Ks mass distribution with MSTJ(21) = 2



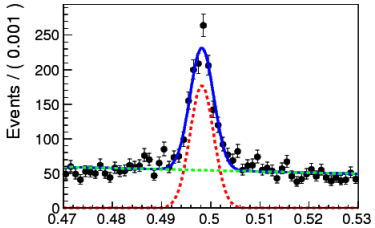
0.0GeV<p<0.1GeV



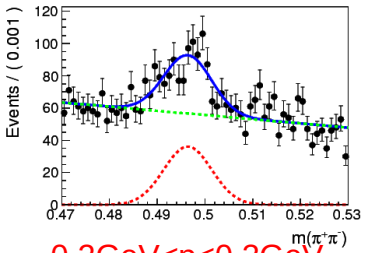
0.1GeV<p<0.2GeV



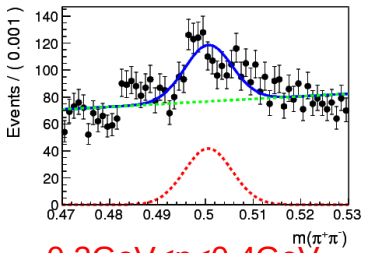
0.4GeV<p<0.5GeV



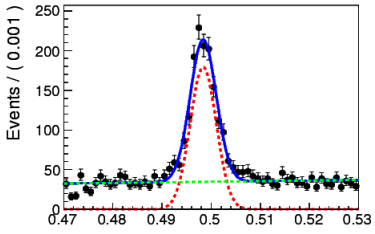
0.5GeV<p<0.6GeV



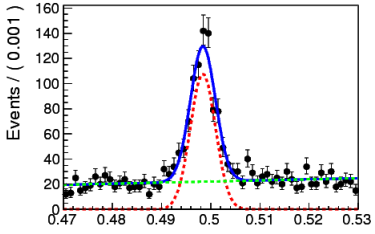
0.2GeV<p<0.3GeV



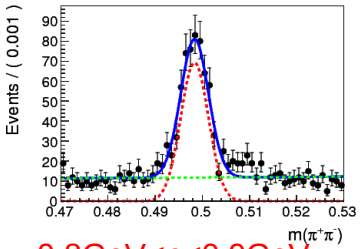
0.3GeV<p<0.4GeV



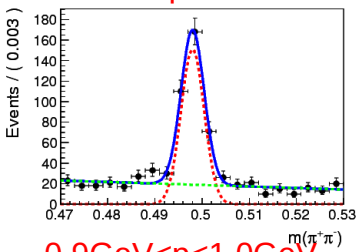
0.6GeV<p<0.7GeV



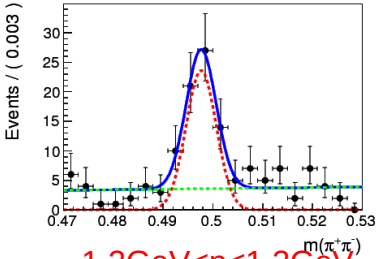
0.7GeV<p<0.8GeV



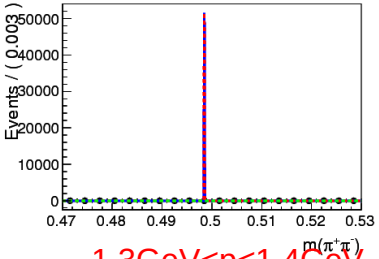
0.8GeV<p<0.9GeV



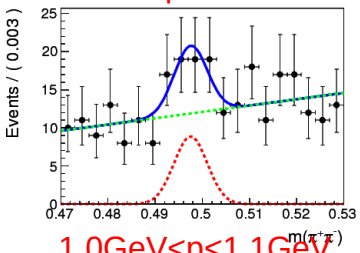
0.9GeV<p<1.0GeV



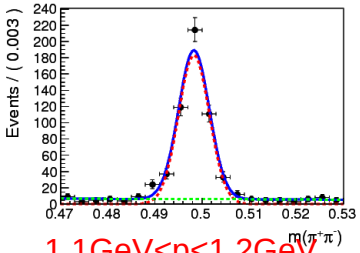
1.2GeV<p<1.3GeV



1.3GeV<p<1.4GeV



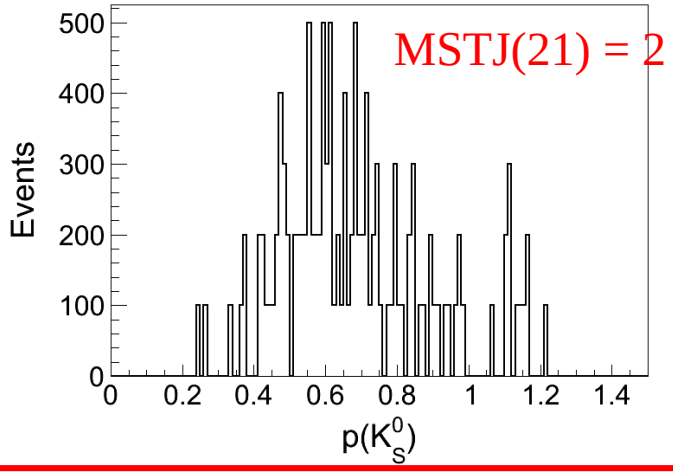
1.0GeV<p<1.1GeV

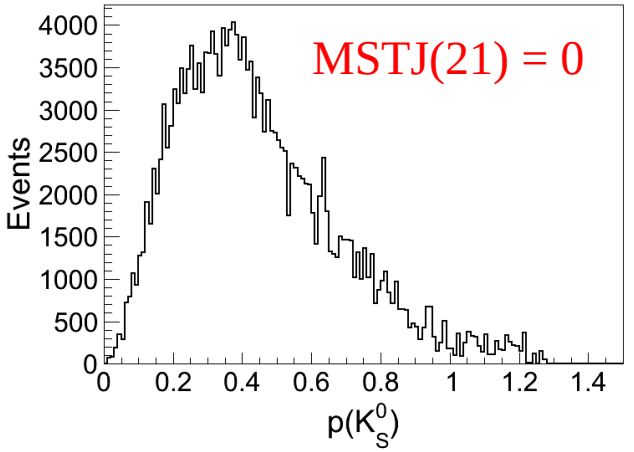


1.1GeV<p<1.2GeV

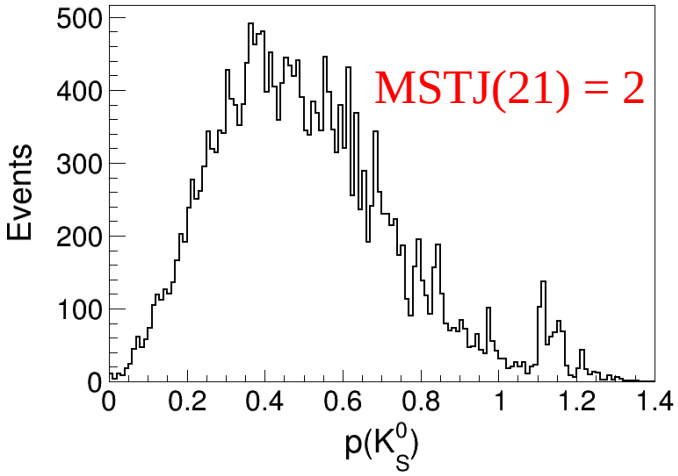
Ks momentum in truth level and detect level

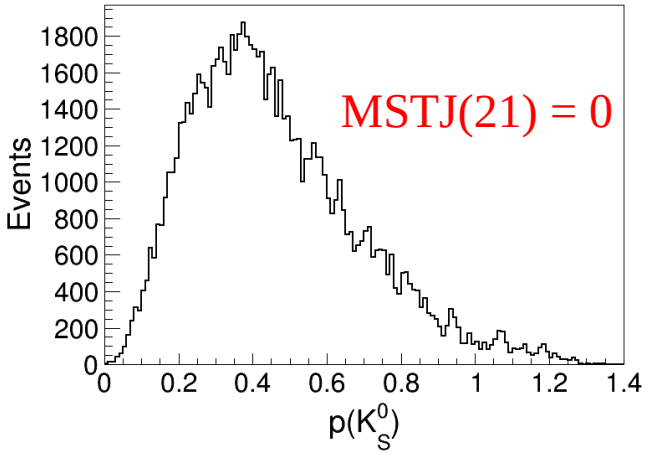
Ks momentum in truth level:





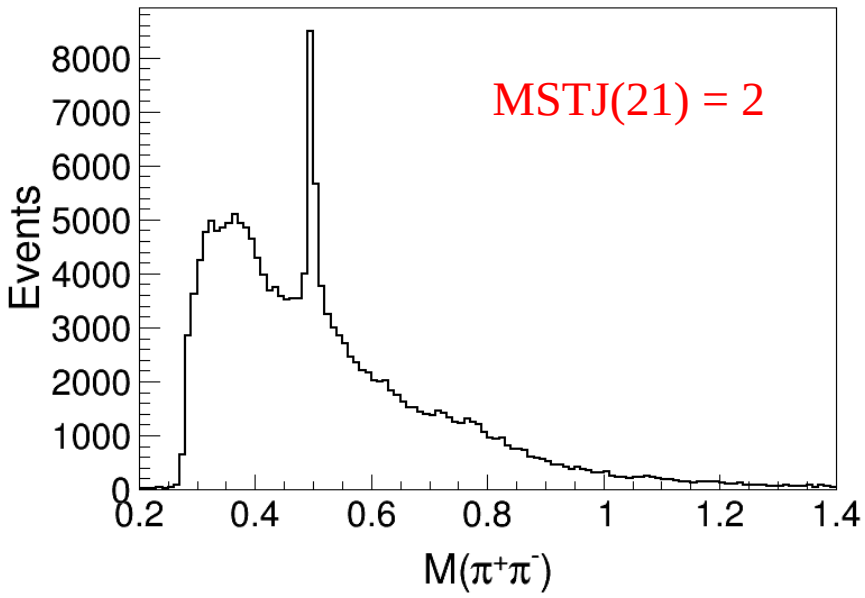
Ks momentum in detect level:

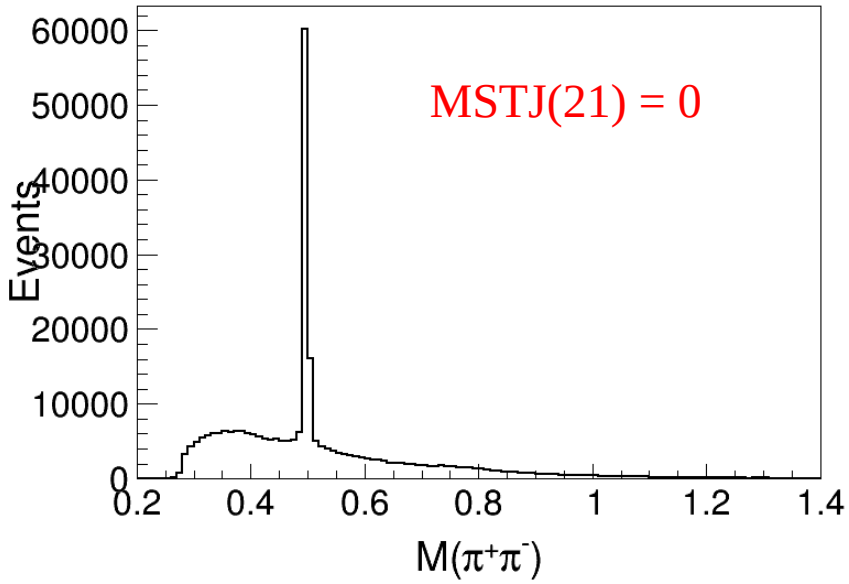




Ks mass in detect level

Ks mass in detect level:





2, Hadron efficiency differences

- Hadronic event selection efficiency:

  74.3% (Here, the generator is Lundalw, and MSTJ(21) = 2, Gao zhen's efficiency is 72.7%)

  82.9% (Here, the generator is Lundalw, and MSTJ(21) = 0, Gao zhen's efficiency is 72.7%)

  72.8% (Here, the generator is ConExc, and Gao Zhen's efficiency is 72.7%)

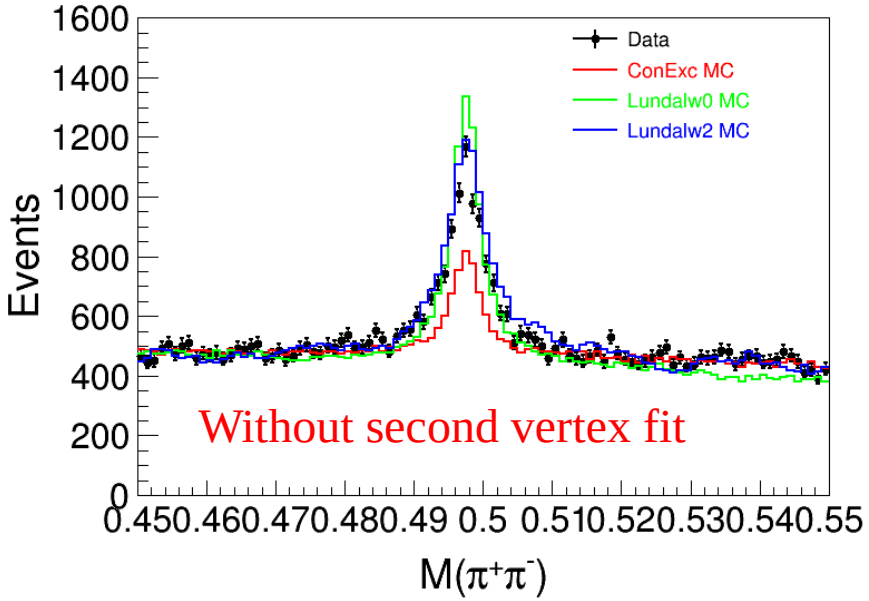
Cut flow for hadronic event selection:

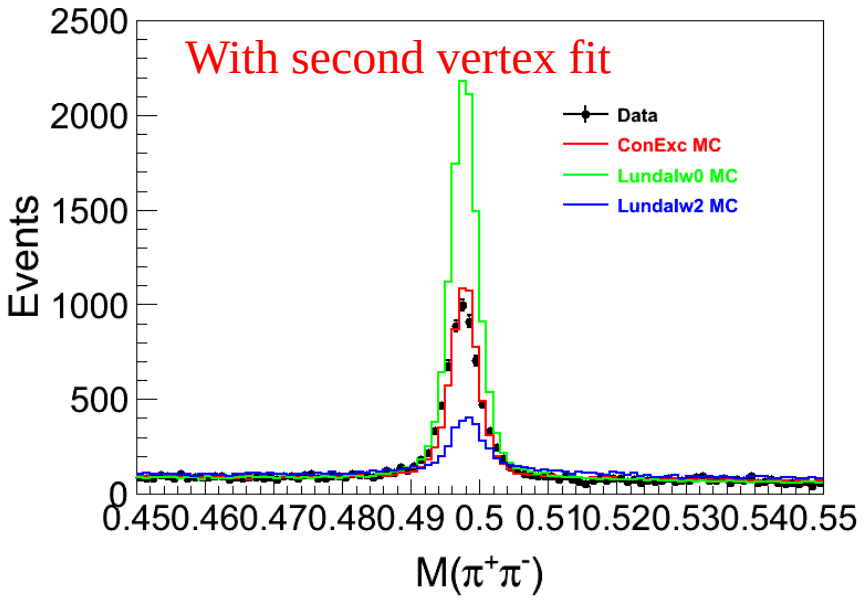
MSTJ(21) = 0 MSTJ(21) = 2

Table 19: Hadron efficiencies (%) using different Lundalw parameters.

Cut criteria	Lundalw(0)		Lundalw(2)		ε differences
	Events	$\varepsilon(hadron)$	Events	$\varepsilon(hadron)$	
Total events	200000	-	200000	-	-
$\lvert\theta_1 + \theta_2 - 180°\rvert < 10°$ and $E > 0.65 * E_{beam}$	199986	99.99	199960	99.98	0.01
$N_{good} >= 2$	179987	90.00	163270	81.65	8.35
$N_{good} = 2$	44845	-	40771	-	-
$\lvert\theta_1 + \theta_2 - 180°\rvert < 15°$ and $\lvert\lvert\phi_1 - \phi_2\rvert - 180°\rvert < 10°$	43104	96.11	39608	97.15	-1.04
$N_{Isolated} >= 2$	34086	79.08	28938	73.06	6.02
	169228	94.02	151437	92.75	1.27
$N_{good} = 3$	45524	-	38322	-	-
$\lvert\theta_1 + \theta_2 - 180°\rvert < 15°$ and $\lvert\lvert\phi_1 - \phi_2\rvert - 180°\rvert < 10°$	43692	95.98	36801	96.03	-0.05
$N_{eop} > 1$	42600	97.50	35952	97.69	-0.19
$N_{ProbE} > 1$	42223	99.11	35592	99.00	-0.11
	165927	98.05	148707	98.20	-0.15
Finally Efficiency	165927	82.96	148707	74.35	8.61

Ks mass distribution





For the invariant mass distribution of Ks, the left plot show the result without second vertex fit and the right one using the second vertex fit.

Lundalw0 means lundalw generator with MSTJ(21) = 0
and Lundalw2 means lundalw generator with MSTJ(21) = 2