

$$D_S^{*+} \rightarrow D_S^+ e^+ e^-$$

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Contents

DeltaM Sideband

| Mode | $\Delta M < 0.5 \text{ GeV}$ | | | | | $\Delta M < 0.3 \text{ GeV}$ | | | | |
|--------------------|------------------------------|-----------------|-----------------|----------------|---------------------------------|------------------------------|----------------|-----------------|---------------|---------------------------------|
| | ddmix MC | cont MC | tot MC | data | $\frac{\text{data}}{\text{MC}}$ | ddmix MC | cont MC | tot MC | data | $\frac{\text{data}}{\text{MC}}$ |
| $K^+K^-\pi^+$ | 43 ± 1.5 | 6.2 ± 1.1 | 49 ± 1.8 | 97 ± 9.8 | 2 ± 0.21 | 4.3 ± 0.46 | 0.4 ± 0.28 | 4.7 ± 0.54 | 9 ± 3 | 1.9 ± 0.68 |
| $K_S K^+$ | 13 ± 0.82 | 7.2 ± 1.2 | 21 ± 1.5 | 28 ± 5.3 | 1.4 ± 0.27 | 2.2 ± 0.33 | 0.8 ± 0.4 | 3 ± 0.52 | 4 ± 2 | 1.3 ± 0.71 |
| $\eta\pi^+$ | 3.1 ± 0.4 | 13 ± 1.6 | 16 ± 1.6 | 26 ± 5.1 | 1.6 ± 0.36 | 0.35 ± 0.13 | 2.2 ± 0.66 | 2.6 ± 0.68 | 4 ± 2 | 1.6 ± 0.89 |
| η/π^+ | 2.5 ± 0.35 | 0.2 ± 0.2 | 2.7 ± 0.4 | 3 ± 1.7 | 1.1 ± 0.68 | 0.2 ± 0.1 | 0 ± 0 | 0.2 ± 0.1 | 0 ± 0 | 0 |
| $K^+K^-\pi^+\pi^0$ | 150 ± 2.73 | 23.8 ± 2.2 | 173 ± 3.5 | 400 ± 20 | 2.31 ± 0.12 | 17.1 ± 0.9 | 3 ± 0.8 | 20.1 ± 1.2 | 41 ± 6.4 | 2.03 ± 0.34 |
| $\pi^+\pi^-\pi^+$ | 28.6 ± 1.19 | 72.4 ± 3.8 | 101 ± 4.0 | 225 ± 15 | 2.23 ± 0.17 | 2.6 ± 0.36 | 7.8 ± 1.25 | 10.4 ± 1.3 | 15 ± 3.87 | 1.44 ± 0.41 |
| $K^{*+}K^{*0}$ | 42.8 ± 1.46 | 4.4 ± 0.94 | 47.2 ± 1.7 | 144 ± 12 | 3.05 ± 0.28 | 7.1 ± 0.6 | 0.8 ± 0.4 | 7.9 ± 0.72 | 10 ± 3.16 | 1.27 ± 0.42 |
| $\eta\rho^+$ | 35.4 ± 1.33 | 57.6 ± 3.39 | 93 ± 3.65 | 128 ± 11.3 | 1.38 ± 0.133 | 4.05 ± 0.45 | 8.2 ± 1.28 | 12.2 ± 1.36 | 16 ± 4 | 1.31 ± 0.357 |
| η/π^+ | 24.1 ± 1.1 | 45.6 ± 3.02 | 69.7 ± 3.21 | 136 ± 11.7 | 1.95 ± 0.19 | 3.05 ± 0.391 | 6.2 ± 1.11 | 9.25 ± 1.18 | 9 ± 3 | 0.973 ± 0.347 |

Dataset 47

Increase
statistics

| Mode | $\Delta M < 0.5 \text{ GeV}$ | | | | | $\Delta M < 0.3 \text{ GeV}$ | | | | |
|--------------------|------------------------------|----------------|----------------|----------------|---------------------------------|------------------------------|----------------|----------------|--------------|---------------------------------|
| | ddmix MC | cont MC | tot MC | data | $\frac{\text{data}}{\text{MC}}$ | ddmix MC | cont MC | tot MC | data | $\frac{\text{data}}{\text{MC}}$ |
| $K^+K^-\pi^+$ | 116 ± 2.4 | 20.6 ± 2.0 | 136 ± 3.2 | 270 ± 16.4 | 1.98 ± 0.13 | 12.9 ± 0.8 | 2.6 ± 0.7 | 15.5 ± 1.1 | 28 ± 5.3 | 1.81 ± 0.36 |
| $K_S K^+$ | 35.8 ± 1.3 | 15 ± 1.7 | 50.8 ± 2.2 | 89 ± 9.4 | 1.75 ± 0.2 | 5.4 ± 0.5 | 1.6 ± 0.6 | 7.0 ± 0.8 | 11 ± 3.3 | 1.58 ± 0.51 |
| $\eta\pi^+$ | 10 ± 0.7 | 31.6 ± 2.5 | 41.6 ± 2.6 | 55 ± 7.4 | 1.32 ± 0.20 | 1.6 ± 0.3 | 4.4 ± 0.9 | 6.0 ± 1.0 | 13 ± 3.6 | 2.18 ± 0.70 |
| η/π^+ | 6 ± 0.6 | 2 ± 0.6 | 8 ± 0.9 | 10 ± 3.1 | 1.25 ± 0.42 | 0.8 ± 0.2 | 0 ± 0 | 0.8 ± 0.2 | 0 ± 0 | $0 \pm \text{nan}$ |
| $K^+K^-\pi^+\pi^0$ | 406 ± 4.5 | 72 ± 3.8 | 478 ± 5.9 | 1003 ± 32 | 2.16 ± 0.07 | 45.1 ± 1.5 | 10.6 ± 1.5 | 55.8 ± 2.1 | 95 ± 9.8 | 1.7 ± 0.19 |
| $\pi^+\pi^-\pi^+$ | 78.8 ± 2.0 | 204 ± 6.4 | 283 ± 6.7 | 548 ± 23.4 | 1.94 ± 0.10 | 7.1 ± 0.60 | 22.2 ± 2.1 | 29.3 ± 2.2 | 33 ± 5.7 | 1.13 ± 0.21 |
| $K^{*+}K^{*0}$ | 115 ± 2.4 | 10.4 ± 1.4 | 125 ± 2.8 | 374 ± 19.3 | 2.99 ± 0.17 | 17.6 ± 0.9 | 1.4 ± 0.5 | 19 ± 1.1 | 28 ± 5.3 | 1.47 ± 0.29 |
| $\eta\rho^+$ | 93.1 ± 2.2 | 154 ± 5.6 | 247 ± 6.0 | 357 ± 18.9 | 1.44 ± 0.08 | 11.2 ± 0.8 | 22 ± 2.1 | 33.2 ± 2.2 | 48 ± 6.9 | 1.45 ± 0.23 |
| η/π^+ | 68.1 ± 1.9 | 120 ± 4.9 | 188 ± 5.2 | 364 ± 19.1 | 1.93 ± 0.12 | 7.5 ± 0.6 | 16.4 ± 1.8 | 23.8 ± 1.9 | 27 ± 5.2 | 1.13 ± 0.24 |

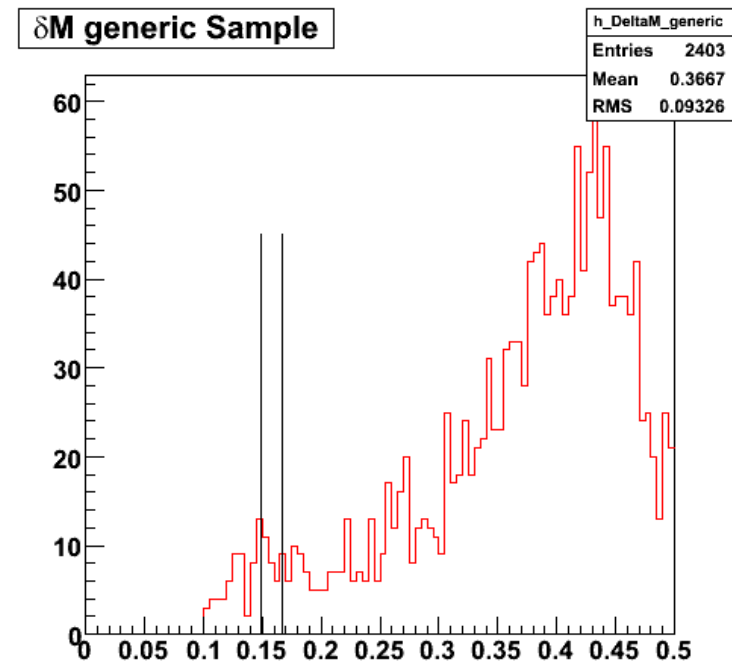
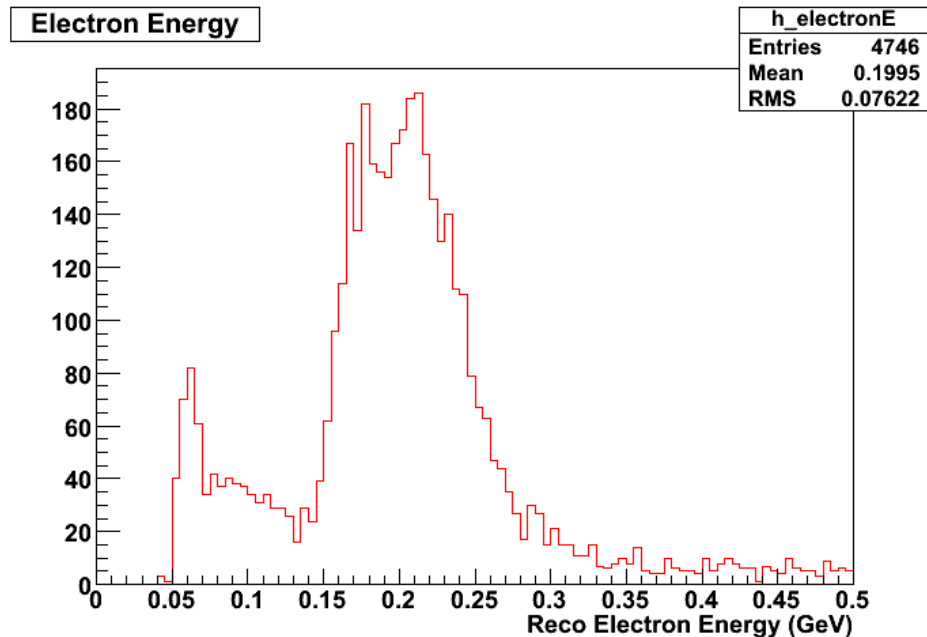
Dataset 47 + 48

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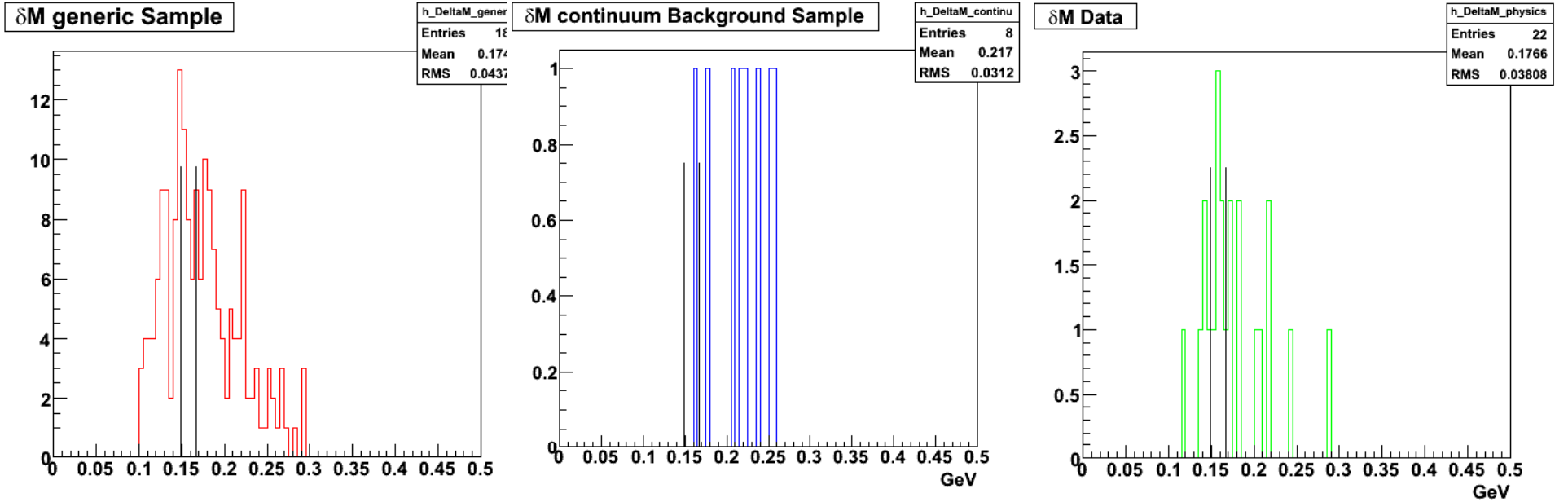
Reprocessing

Possible Reasons of Discrepancy

1. Electrons of events in the sidebands are very soft and the reconstruction efficiency is not modeled accurately in Generic MC
 1. So we plotted the energy (p^2+m^2) of the electrons to get a feel...
2. 3 sigma dE/dx is applied as a track quality criterion in my n-tuplizer. We should try taking this out and see if Generic MC matches data any closer. If so, then Generic MC isn't accurately modeling the dE/dx .



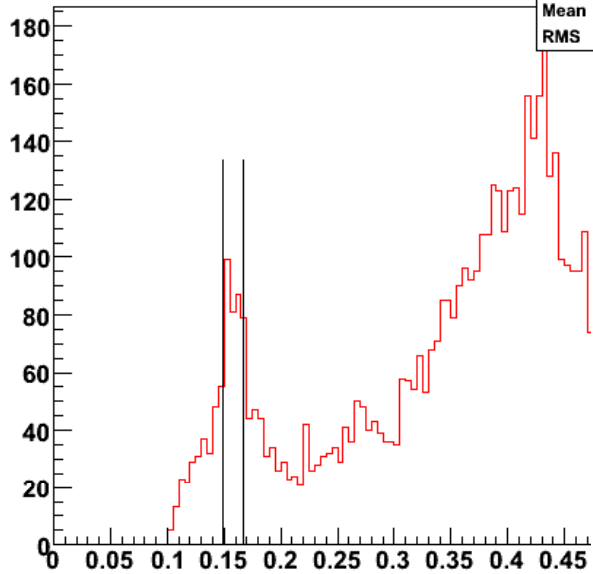
DeltaM after Energetic Constraints on e+e-



| Mode | ΔM before signal region | | | | | ΔM after signal region | | | | |
|--------------------|---------------------------------|---------------|---------------|----------------|---------------------------------|--------------------------------|----------------|----------------|----------------|---------------------------------|
| | ddmix MC | cont MC | tot MC | data | $\frac{\text{data}}{\text{MC}}$ | ddmix MC | cont MC | tot MC | data | $\frac{\text{data}}{\text{MC}}$ |
| $K^+K^-\pi^+$ | 3.1 ± 0.4 | 0.0 ± 0.0 | 3.1 ± 0.4 | 5.0 ± 2.2 | 1.61 ± 0.75 | 4.8 ± 0.5 | 1.4 ± 0.5 | 6.2 ± 0.7 | 11.0 ± 3.3 | 1.76 ± 0.57 |
| $K_S K^+$ | 1.1 ± 0.2 | 0.2 ± 0.2 | 1.3 ± 0.3 | 0.0 ± 0.0 | $0.00 \pm \text{nan}$ | 2.2 ± 0.3 | 0.6 ± 0.3 | 2.9 ± 0.5 | 2.0 ± 1.4 | 0.70 ± 0.51 |
| $\eta\pi^+$ | 0.1 ± 0.1 | 0.8 ± 0.4 | 1.0 ± 0.4 | 0.0 ± 0.0 | $0.00 \pm \text{nan}$ | 0.6 ± 0.2 | 1.4 ± 0.5 | 1.9 ± 0.6 | 3.0 ± 1.7 | 1.54 ± 0.99 |
| $\eta'\pi^+$ | 0.2 ± 0.1 | 0.0 ± 0.0 | 0.2 ± 0.1 | 1.0 ± 1.0 | 4.00 ± 4.38 | 0.3 ± 0.1 | 0.0 ± 0.0 | 0.3 ± 0.1 | 0.0 ± 0.0 | $0.00 \pm \text{nan}$ |
| $K^+K^-\pi^+\pi^0$ | 8.5 ± 0.7 | 1.2 ± 0.5 | 9.7 ± 0.8 | 11.0 ± 3.3 | 1.13 ± 0.35 | 19.4 ± 1.0 | 5.0 ± 1.0 | 24.4 ± 1.4 | 29.0 ± 5.4 | 1.19 ± 0.23 |
| $\pi^+\pi^-\pi^+$ | 1.2 ± 0.2 | 4.4 ± 0.9 | 5.6 ± 1.0 | 6.0 ± 2.4 | 1.07 ± 0.48 | 3.1 ± 0.4 | 10.2 ± 1.4 | 13.3 ± 1.5 | 16.0 ± 4.0 | 1.20 ± 0.33 |
| $K^{*+}K^{*0}$ | 2.8 ± 0.4 | 0.2 ± 0.2 | 3.0 ± 0.4 | 3.0 ± 1.7 | 1.00 ± 0.59 | 7.0 ± 0.6 | 0.4 ± 0.3 | 7.4 ± 0.7 | 15.0 ± 3.9 | 2.03 ± 0.55 |
| $\eta\rho^+$ | 2.6 ± 0.4 | 4.0 ± 0.9 | 6.6 ± 1.0 | 6.0 ± 2.4 | 0.91 ± 0.39 | 4.3 ± 0.5 | 10.2 ± 1.4 | 14.5 ± 1.5 | 22.0 ± 4.7 | 1.52 ± 0.36 |
| $\eta'\pi^+$ | 1.6 ± 0.3 | 2.4 ± 0.7 | 4.0 ± 0.7 | 6.0 ± 2.4 | 1.50 ± 0.67 | 2.8 ± 0.4 | 7.8 ± 1.2 | 10.6 ± 1.3 | 9.0 ± 3.0 | 0.85 ± 0.30 |

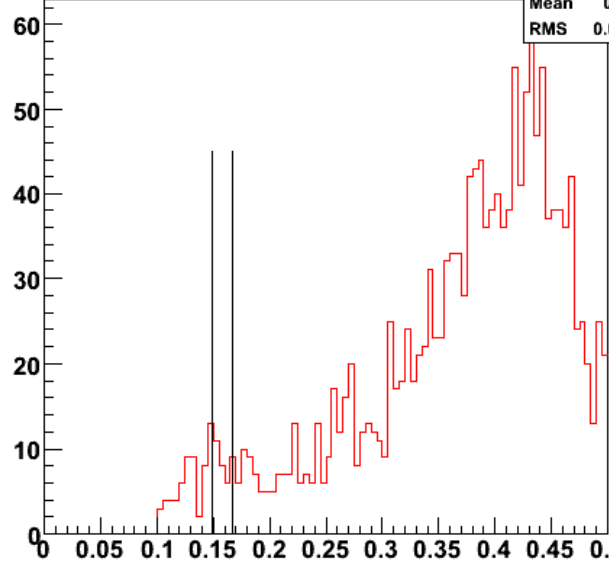
What is the bump in DeltaM?

δM generic Sample



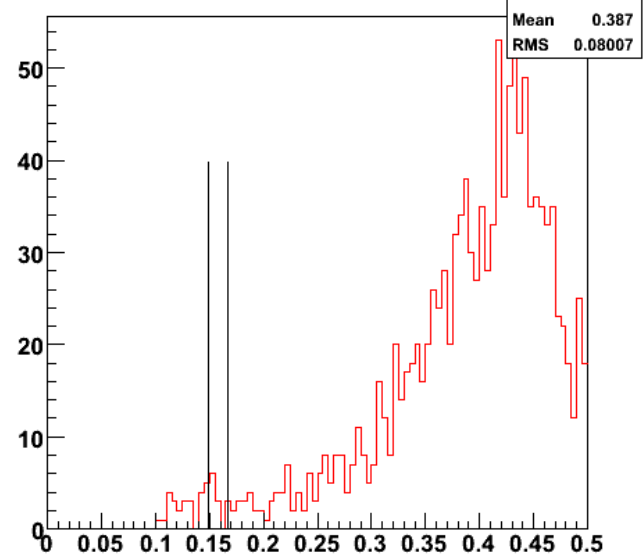
DeltaM before dPhi Cut

δM generic Sample



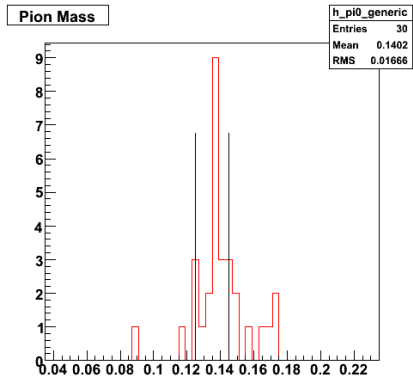
DeltaM after dPhi Cut

δM generic Sample



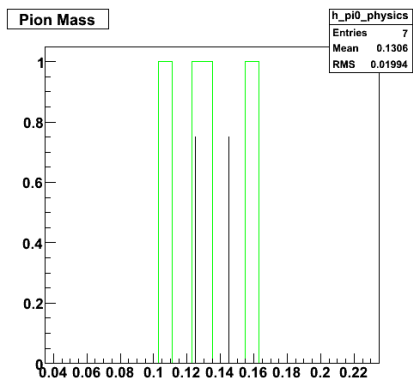
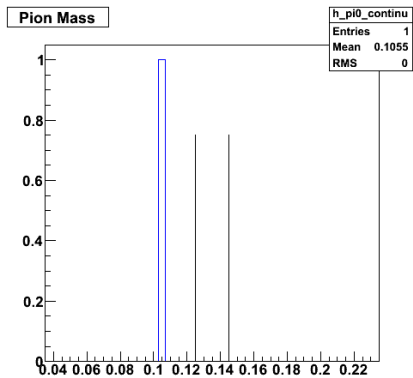
DeltaM after dPhi Cut and π^0 Veto

Pi0 Veto



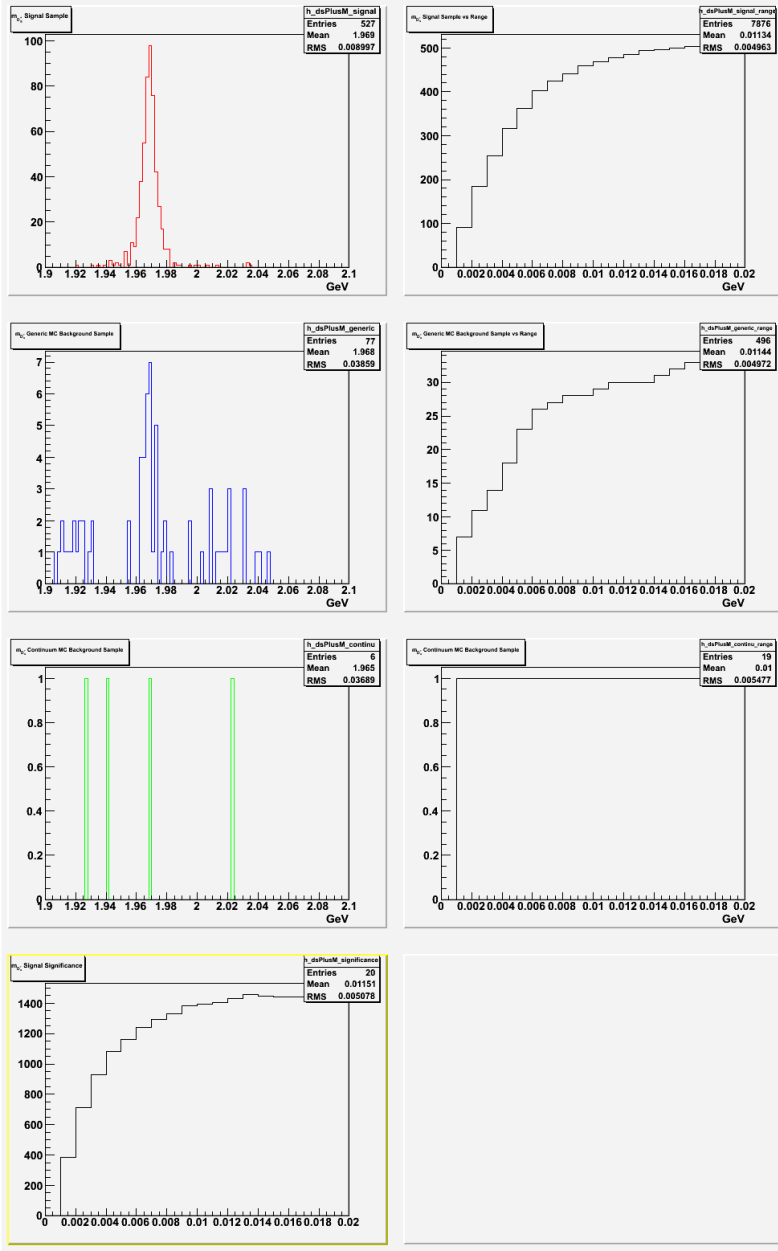
Pi0 veto of Dalitz Decays:

- We keep pi0 candidates built out of e+, e- and photon which reconstructs closest to the pi0 mass in the ntuplizer.
- Plots of signal MC (top), continuum MC (middle), generic MC (bottom) for pi0 mass after all cuts have been applied on KKpi mode in Dataset 47 + 48.



| Mode | Generic | Continuum | Total MC | Data | ~ Expected (yet to apply pi0 veto) |
|---------------|---------|-----------|----------|------|------------------------------------|
| KKpi | 11/20 | 1/5 | 0.75 | 5 | 10.5 |
| KsK | 5/20 | 2/5 | 0.65 | 1 | 2.8 |
| pieta | 0/20 | 0/5 | 0 | 2 | 1.3 |
| pietaprime | 1/20 | 0/5 | .05 | 0 | 0.8 |
| KKpipi0 | 30/20 | 1/5 | 1.7 | 6 | 4.5 |
| pipipi | 5/20 | 5/5 | 1.25 | 5 | 3.1 |
| KsKmpipi | 10/20 | 0/5 | .5 | 0 | 1.7 |
| pipi0eta | 8/20 | 2/5 | .8 | 2 | 4.2 |
| pietaprimerho | 5/20 | 4/5 | 1.05 | 2 | 1.6 |
| Total | 75/20 | 15/5 | 6.75 | 23 | 30.5 ⁶ |

DsMass Cut Optimizations



For KKpi channel, cut moved:
from 1.96849 ± 0.02 GeV
to 1.96849 ± 0.014 GeV

Reprocessing

Dataset 48 is pass2'ed and dtagged, except runs: 233087, 233088, 234056, 234058

Dataset47 has been staged out, skimming and now being pass2'ed.