Status of MC Reconstruction using GEANT

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Why Bother?

- Develop and test tools for RunII
  - the RunII analysis framework
  - Monte Carlo generation
  - Detector simulation
  - Reconstruction software
  - Two Track Trigger Filter
- Check resolutions
- Validate simulation
- Check efficiencies and acceptances
- Flavor tagging

Sample generation:

- Pythia generates $b\bar{b}$ pairs and does hadronization
- QQ decays
  - $B_s \to D_s \pi$
  - $D_s \to \phi\pi$
  - $\phi \to K\,K$
- BFilter selects events with at least one B_s with $p_t > 2.0$ GeV (eff. $\sim 10\%$)
- Events were then filtered with the generator level Two Track Filter, with loose cuts (eff $\sim 10\%$)
- GEANT simulation was run on the events that passed
- RunII reconstruction software was ran on the GEANT data ($\sim$ 1sec/event)
- A reconstruction level Two Track Filter with real cut values can be run on the reconstructed events (eff $\sim 10\%$)

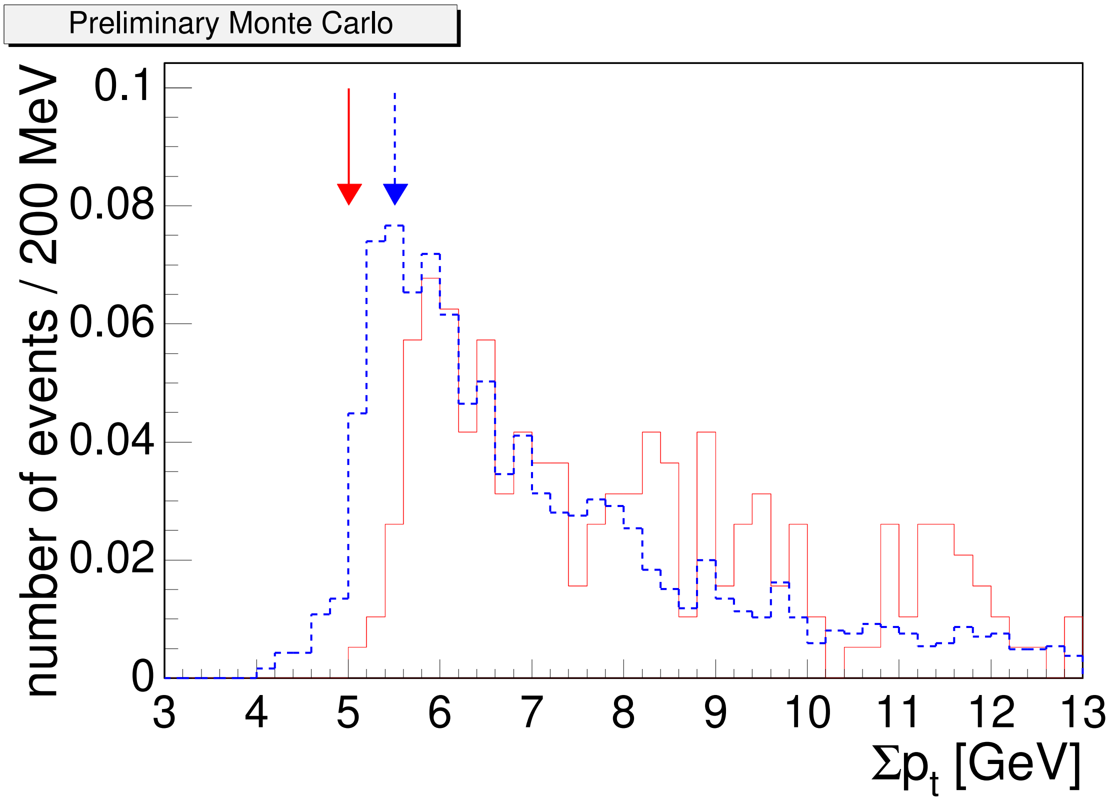
Two Track Trigger Filter:

- Apply XFT slices of 1.25^{o} in ϕ
- Select two outmost tracks in 15^{o} bin in ϕ
- Level1:

- Two tracks with $\mathrm{p_t} > 2\,\mathrm{GeV}$
- 7 or more tracks pass automatically
- Require opposite charge
- $\Delta\phi < 135^{o}$
- $\mathrm{P_{t1}} + \mathrm{P_{t2}} > 5.5\,\mathrm{GeV}$
- Level2:

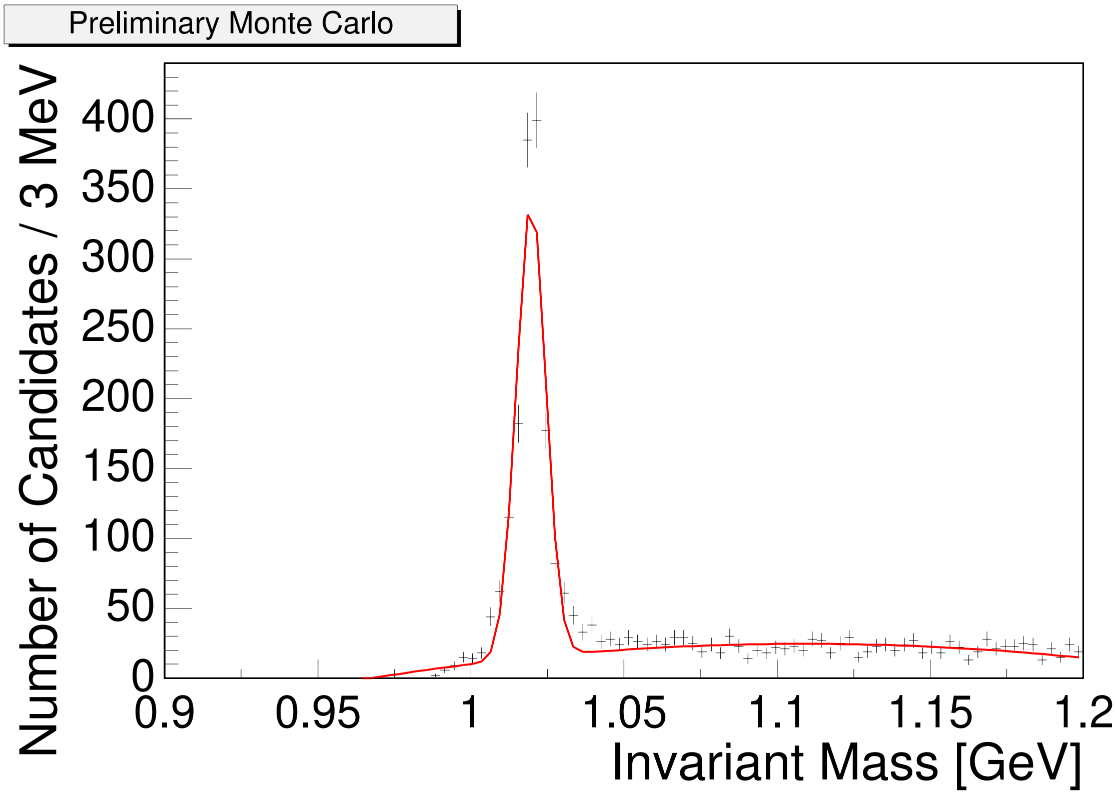
- Impact parameter cut $(120\mu\mathrm{m} < \mathrm{d_0} < 1\mathrm{mm})$
- Positive decay length
- $2^{\mathrm{o}} < \Delta\phi < 90^{\mathrm{o}}$

Level 1 Cut on Scalar $\mathrm{P_t}$ Sum:



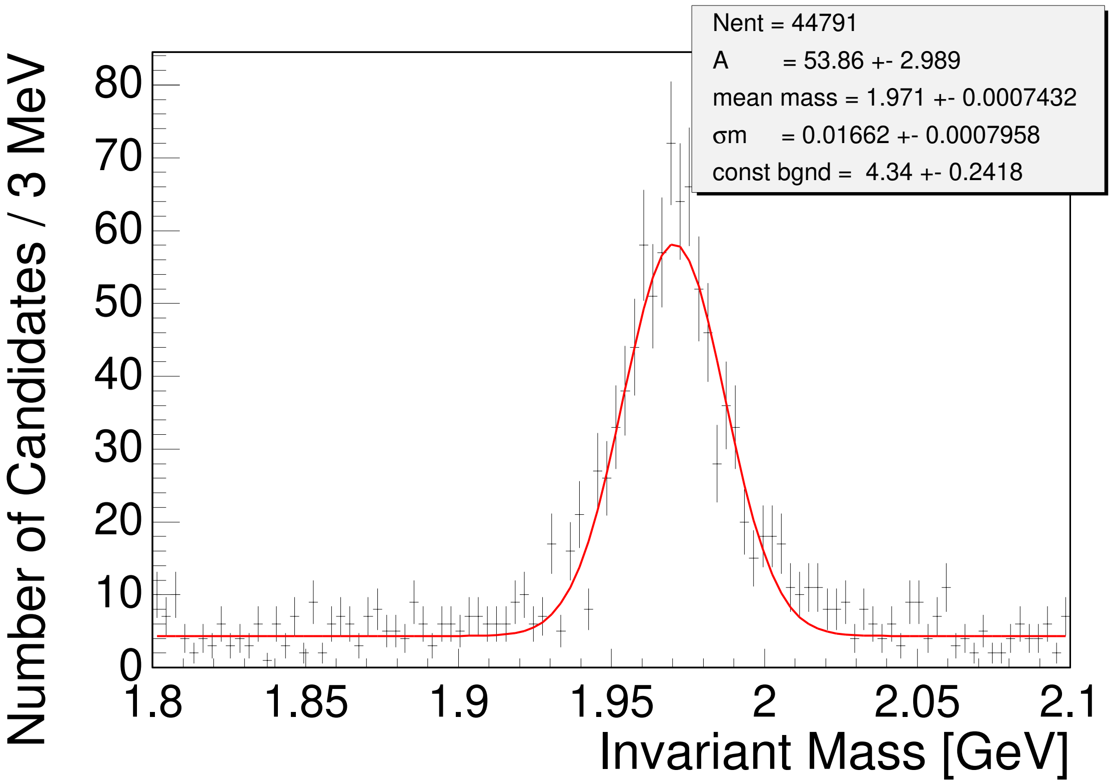
- Sample generated with loose cut, $\Sigma \mathrm{p_t} > 5.0$ GeV at generator level
- After GEANT simulation, cut $\Sigma \mathrm{p_t} > 5.5$ GeV on reconstructed $\mathrm{p_t}$ (dashed line)
- Verification at generator level (solid line)

Reconstructed ϕ invariant mass:



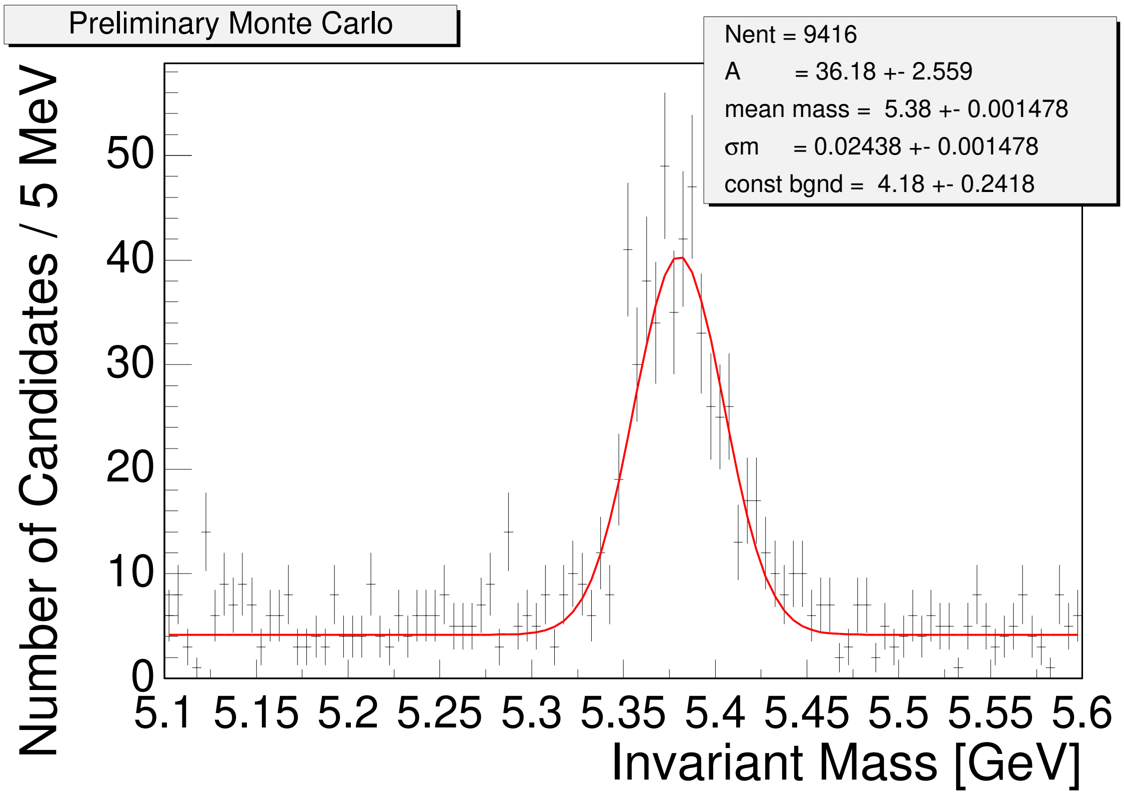
- Kaon candidates have $\mathrm{p_t} > 1.0\ \mathrm{GeV}$ and $\mathrm{d_0} < 10\mathrm{cm}$
- Pairs of candidates with opposite charge are fitted to a common vertex
- Fit of the invariant mass yields
  $\mathrm{mass}(\phi) = 1020.0 \pm 0.1\mathrm{MeV}$
  $\sigma(\mathrm{mass}) = 4.5 \pm 0.2\mathrm{MeV}$

Reconstructed D_s invariant mass:



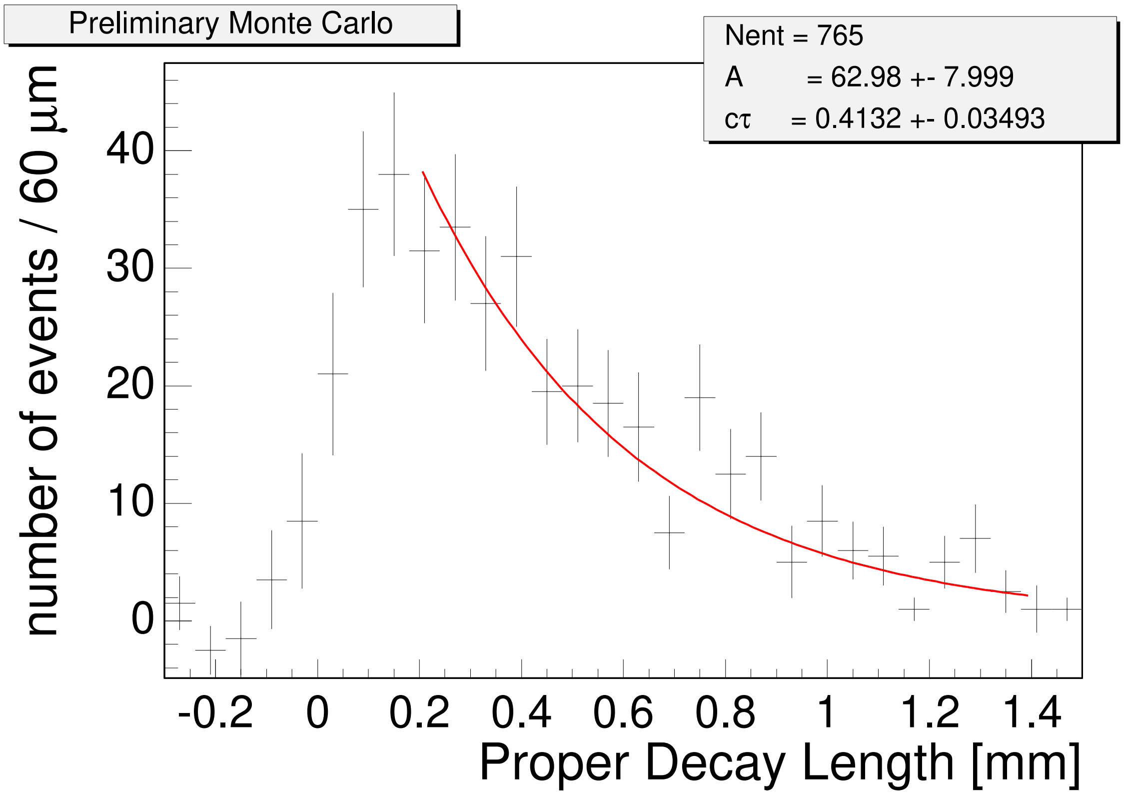
- Pion candidates have $pt > 0.8\text{GeV}$, $d_0 < 10\text{cm}$
- phi candidates have $1.0 \text{ GeV} < \text{mass} < 1.05 \text{ GeV}$
- χ^2fit of the invariant mass yields
  $m_{D_s} = 1971 \pm 0.7\text{MeV}$ $\sigma_m = 17 \pm 1\text{MeV}$
  (MC true mass = 1968.8 MeV)

Reconstructed $\mathrm{B_s}$ invariant mass:



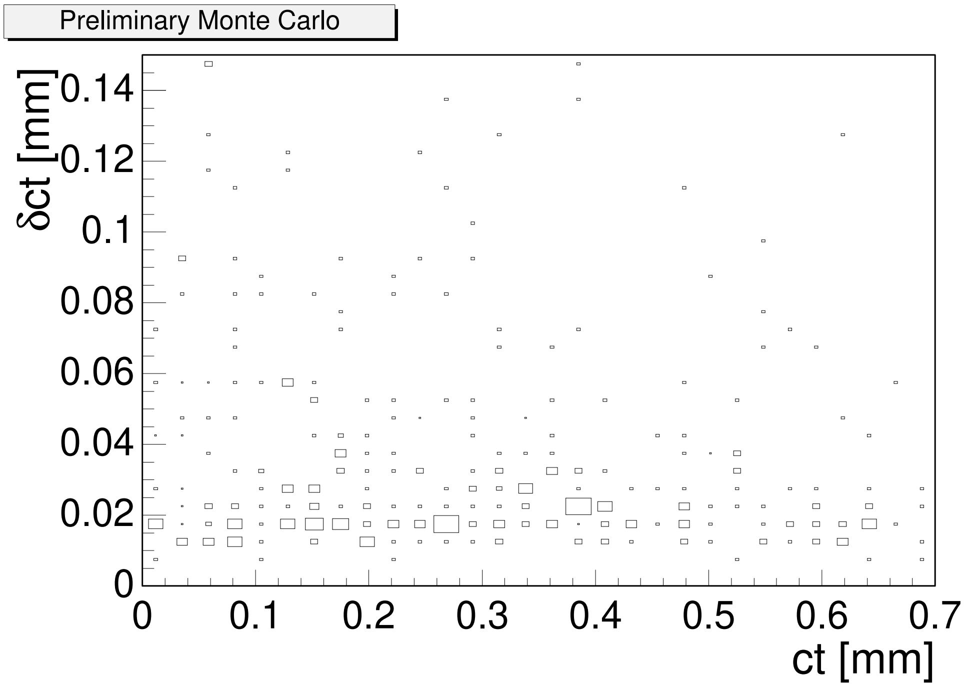
- Pion candidates are unused tracks with $\mathrm{d_0} < 10\mathrm{cm}$ and charge opposite to that of the $\mathrm{D_s}$ candidate
- $\mathrm{D_s}$ and π candidates are fitted to a common vertex
- Corrected momenta are used to calculate the invariant mass
- $\mathrm{m_{Bs}} = 5380 \pm 1$ MeV; $\sigma_\mathrm{m} = 24 \pm 1$ MeV
  MC true mass = 5380 MeV

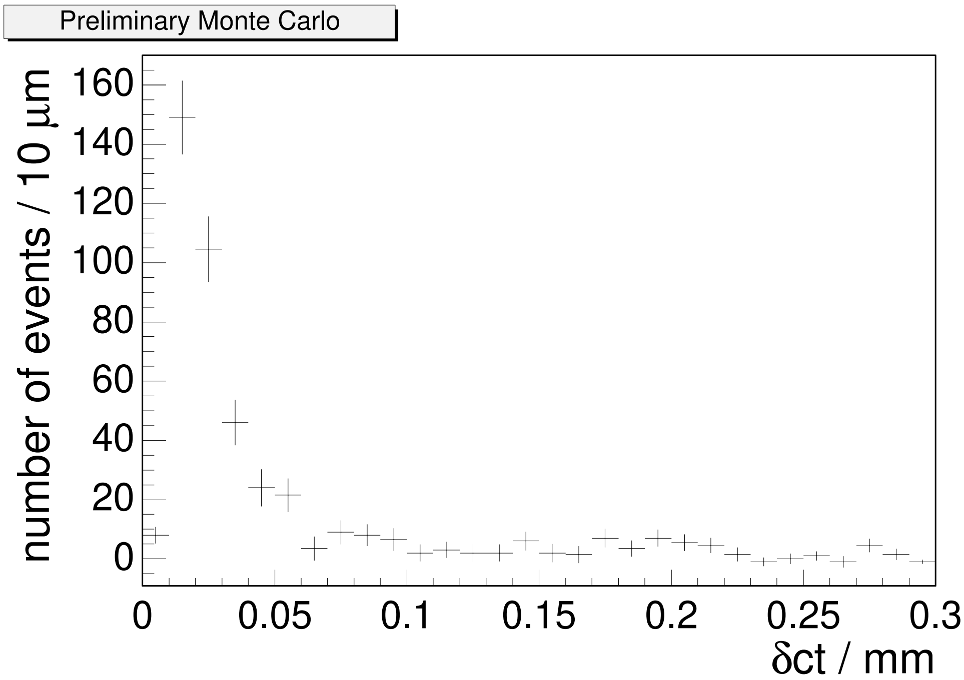
Reconstructed $\mathrm{B_s}$ proper decay length:



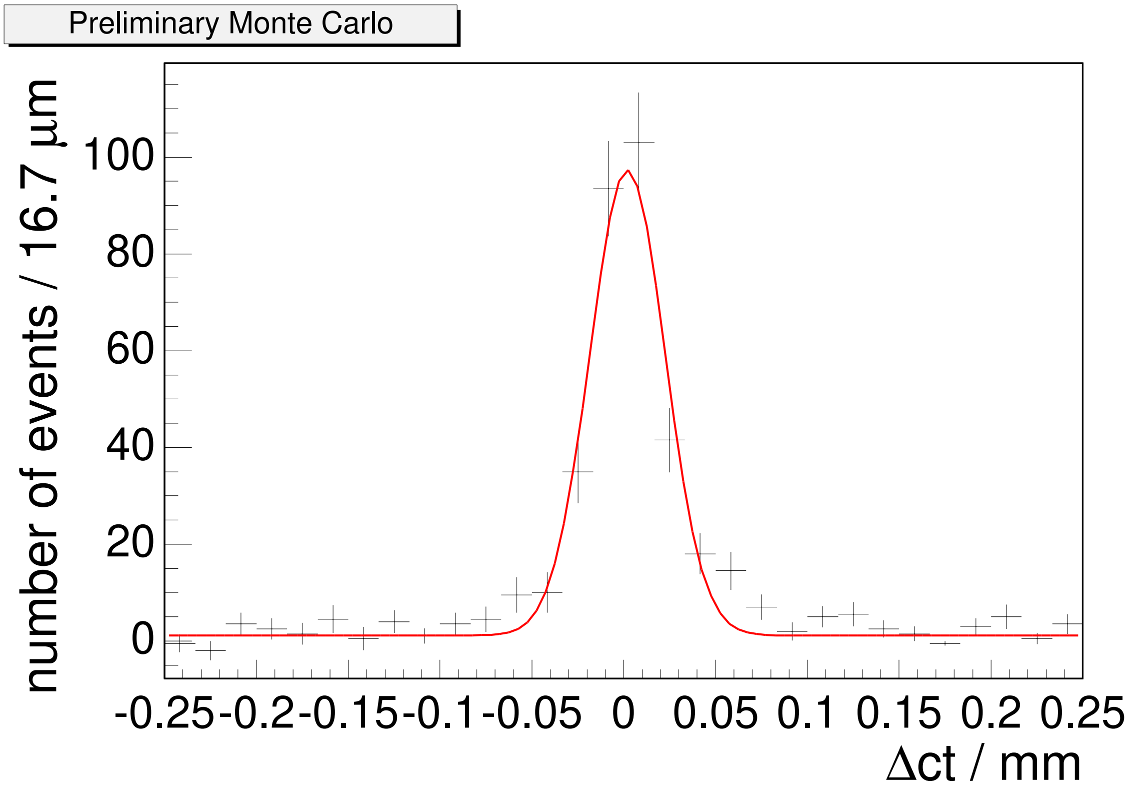
- Reconstructed $\mathrm{B_s}$ candidates with $5.3\ \mathrm{GeV} < \mathrm{mass} < 5.45\ \mathrm{GeV}$ are analyzed
- χ^2 fit to an exponential yields $c\tau = 400 \pm 30\mu\mathrm{m}$ (QQ $c\tau = 465\mu\mathrm{m}$)

Vertex Fit Proper Time Resolution:



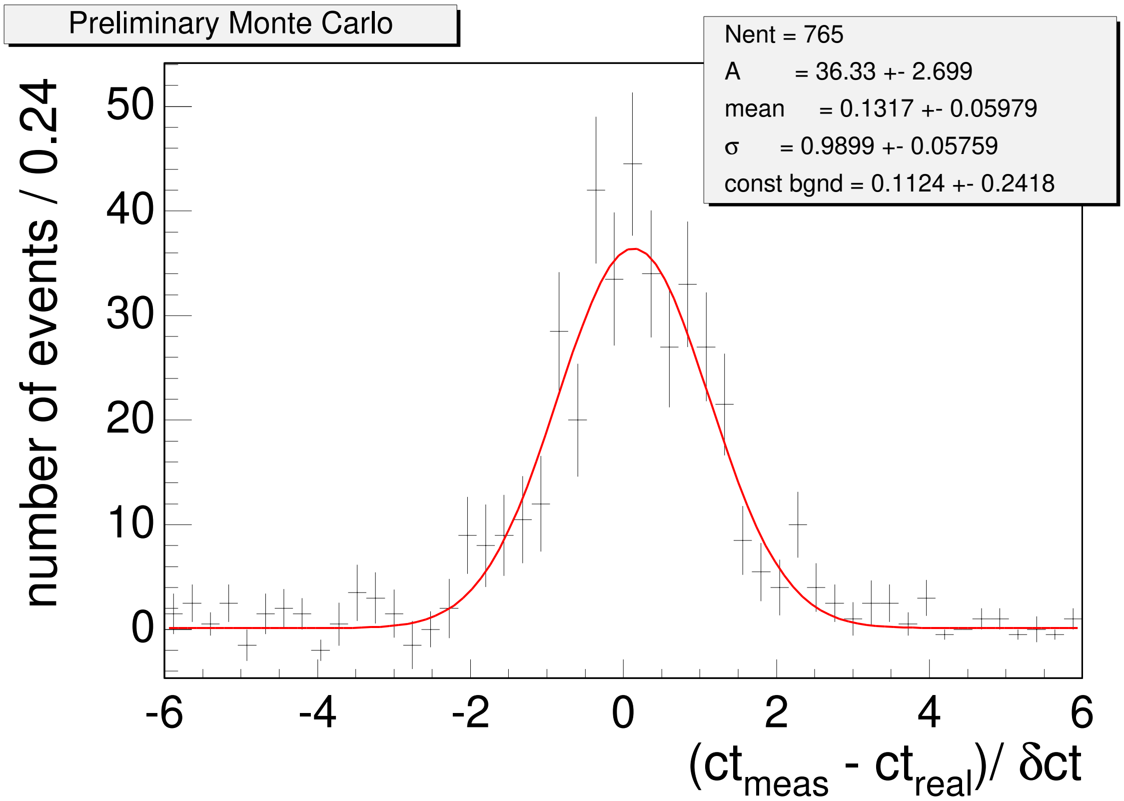


$c\tau$ Resolution:



- Distribution after subtraction of the sideband contributions
- χ^2 fit yields a σ of $20 \pm 1\mu\mathrm{m}$
- Previous estimate of the $c\tau$ resolution was $18\mu\mathrm{m}$ (60 fs, PAC report)

$(ct_{\mathrm{measured}} - ct_{\mathrm{real}}/\delta(ct))$:



- Invariant mass window: $5.3\ \mathrm{GeV} < \mathrm{mass} < 5.45\ \mathrm{GeV}$
- Combinatoric background subtracted by sampling in sidebands
- χ^2 fit to a Gaussian yields $\sigma = 0.99 \pm 0.05$

Conclusion:

- The following tools have been tested:
  - the RunII analysis framework
  - Monte Carlo generation
  - Detector simulation
  - Pattern recognition software
  - Reconstruction software
- First results are not discouraging
  - $\delta c\tau$ vs $c\tau$ distribution is flat
  - $c\tau$ resolution in agreement with previous studies

- Future steps:
  - Generation of larger samples
  - Inclusion of TOF particle ID
  - Flavor tagging studies