SuperB Backward EMC Resolution in FastSim and Potential for PID

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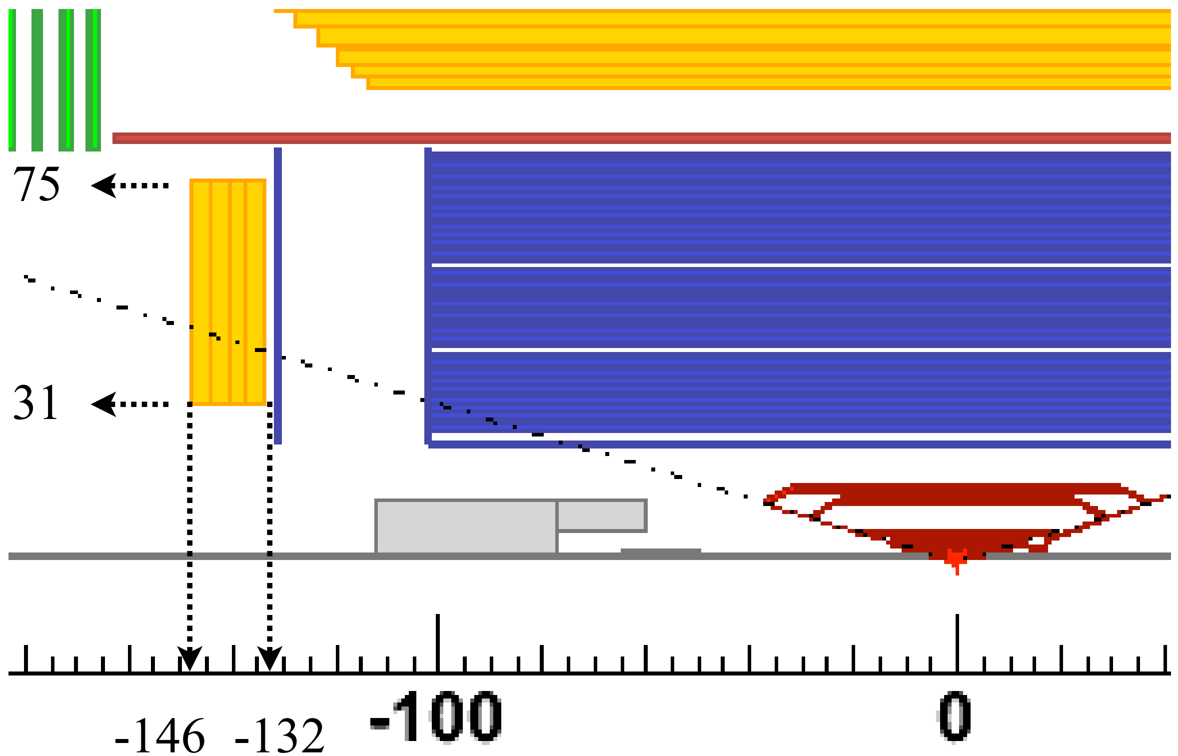
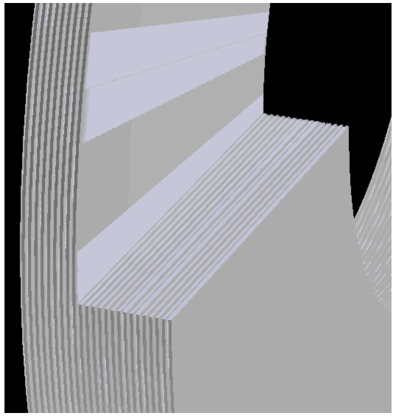
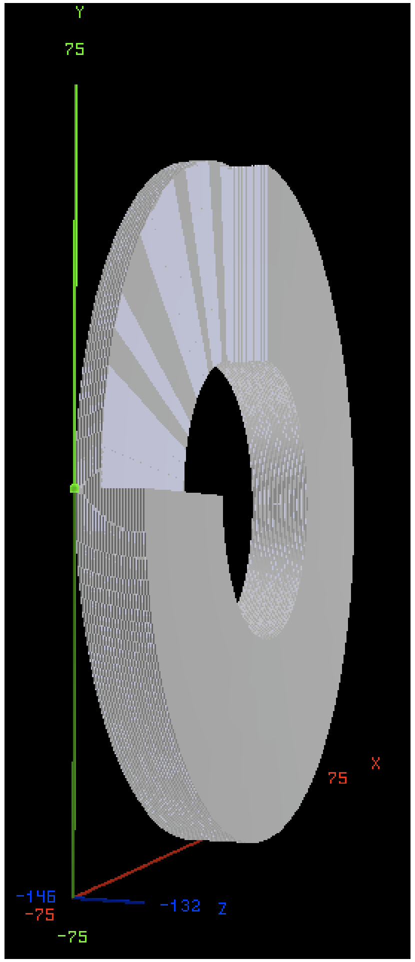
Backward EMC geometry



- Current design: 24 layers of Pb and scintillators. Only scintillators are active, of course.

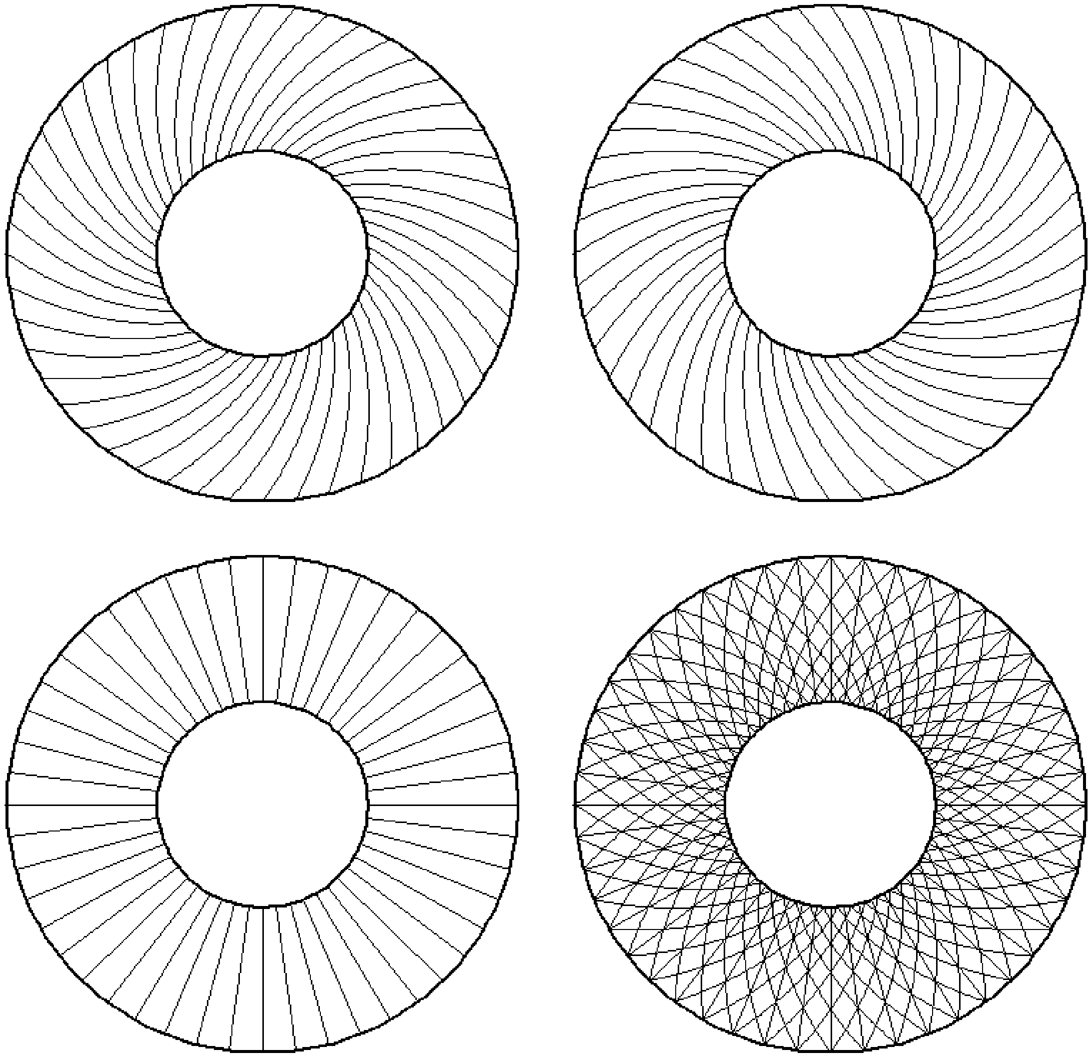




G4 model

Segmentation

- No segmentation in theta.
- Three types of phi segmentations (left-handed logarithmic spiral, right-handed, straight) to resolve theta ambigouity. 48 sectors in each layer.

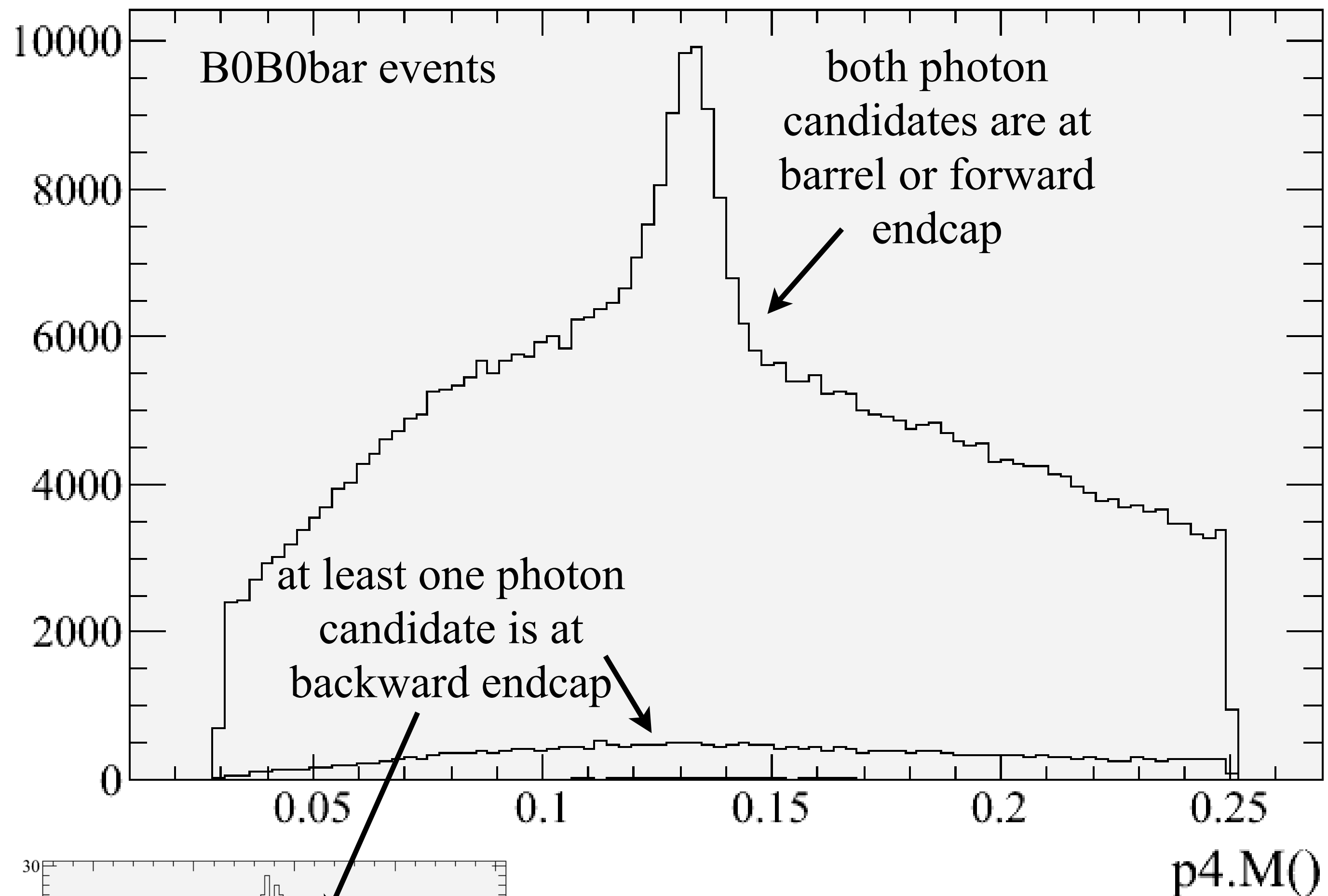


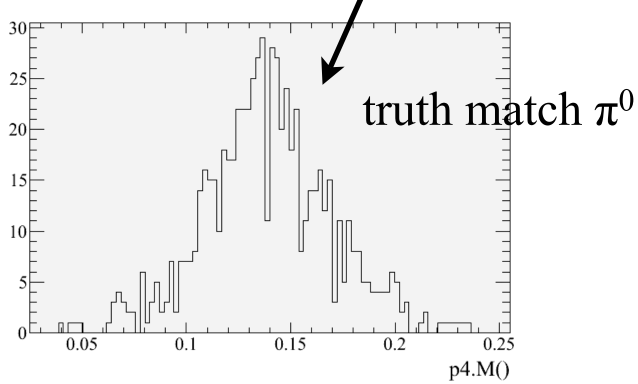
FastSim does not have those details

- Use four thick layers to model geometry.
- Mix Pb and scintillator as its material.
- Assume there are 8 rings, each with 60 “crystals”.
  - avoid the complication from reconstruction.
- Assume the entire body is active.
  - avoid the energy calibration from sampled energy deposition to the entire shower energy.
- Effective Moliere radius: 3.3 cm.
- Model energy resolution:

$$\frac{\sigma_E}{E} = \frac{14\%}{\sqrt{E(\mathrm{GeV})}} \oplus 3\%$$

γγ invariant mass resolution

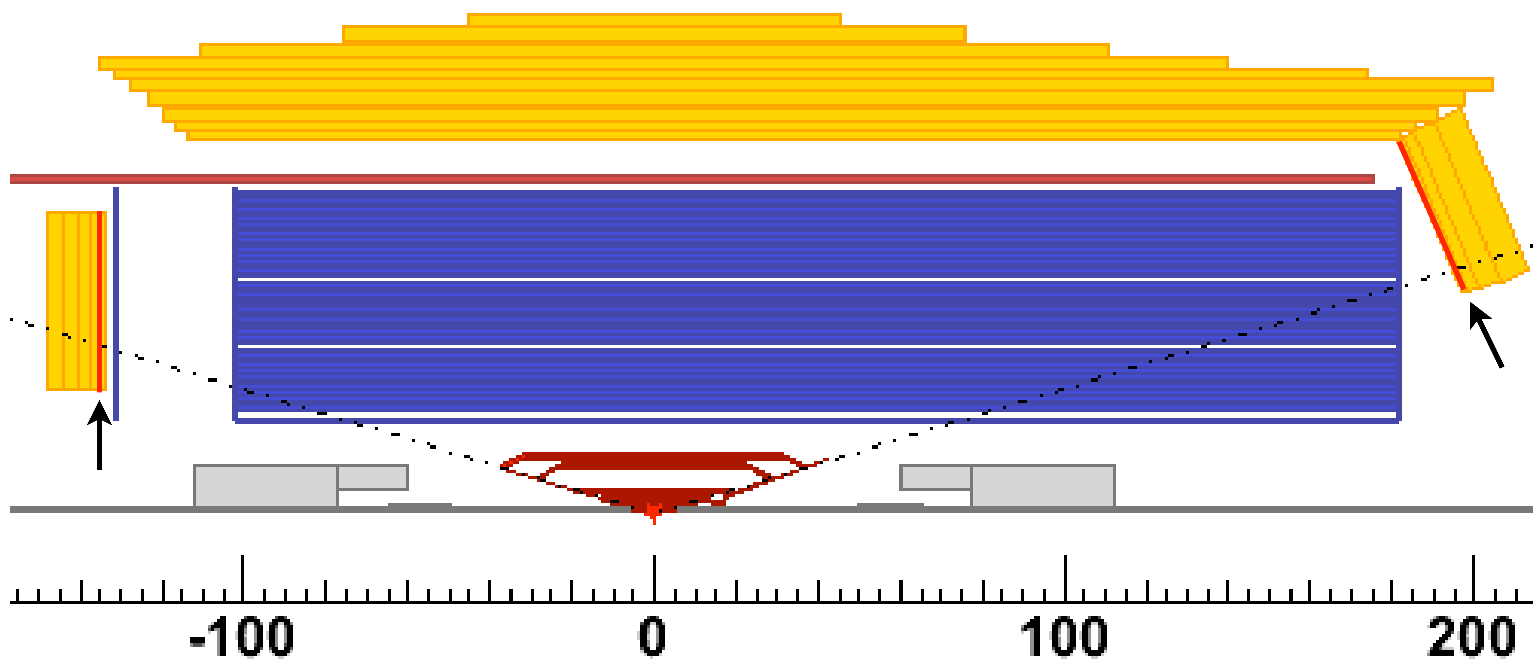




- Backward EMC resolution is too bad to reconstruct π^0.

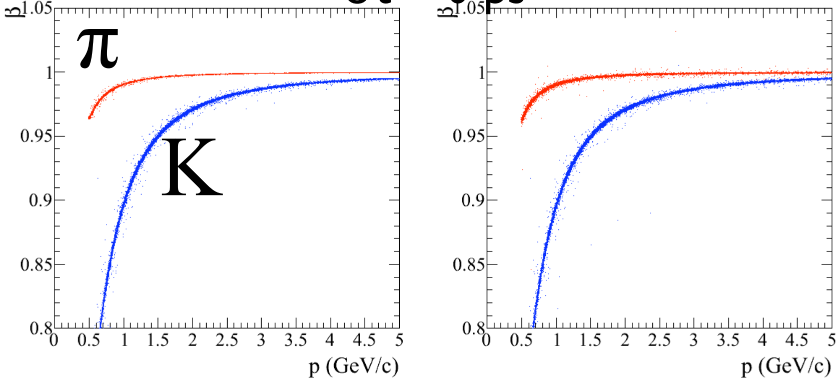
Timing device at or in front of EMC

- Test K/π separation using fastsim:
  - store track timing at the first layer of EMC fastsim model at sim-track level (i.e., true time)
  - smear timing with a Gaussian at given resolution.
  - use reconstructed path length to calculate velocity.

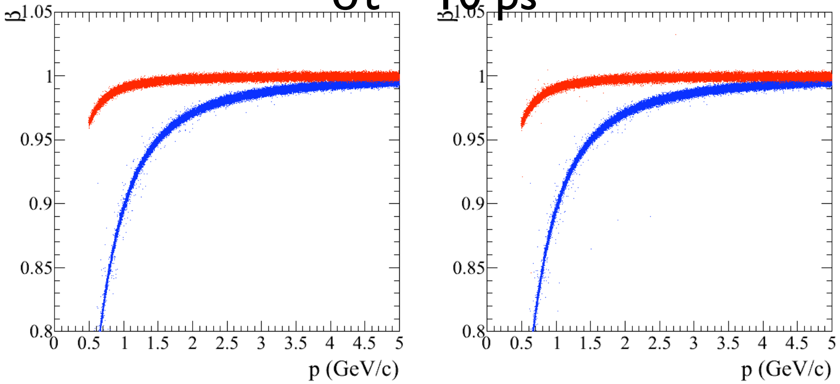


Forward

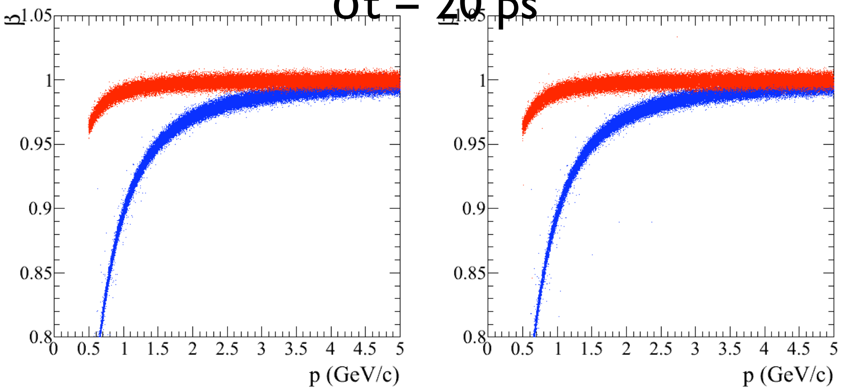
σt = 0 ps



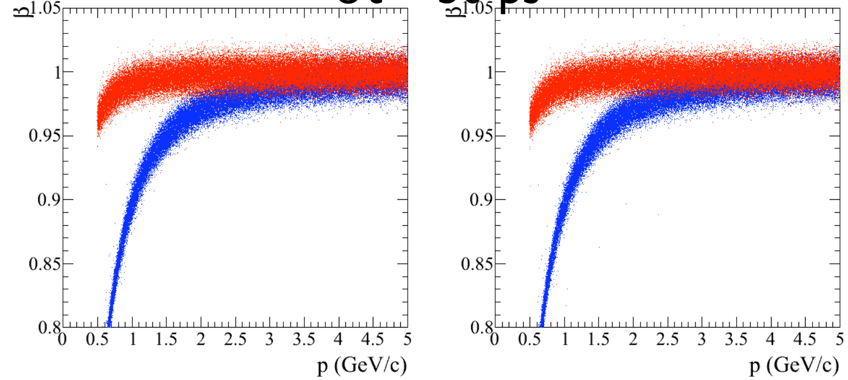
σt = 10 ps



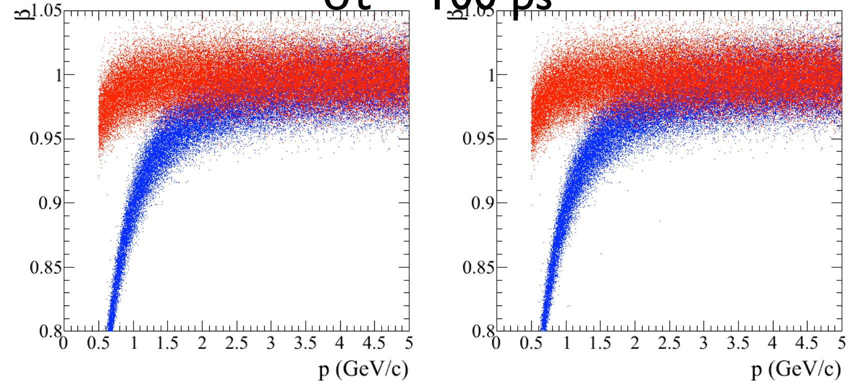
σt = 20 ps



σt = 50 ps



σt = 100 ps

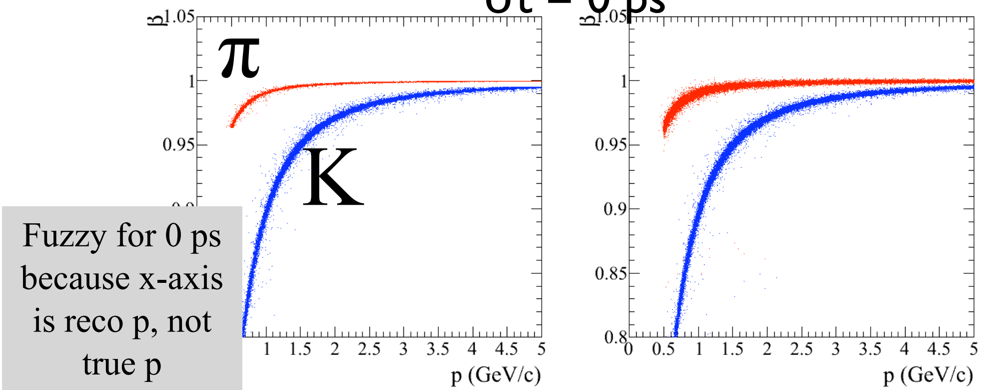


velocity versus reco momentum

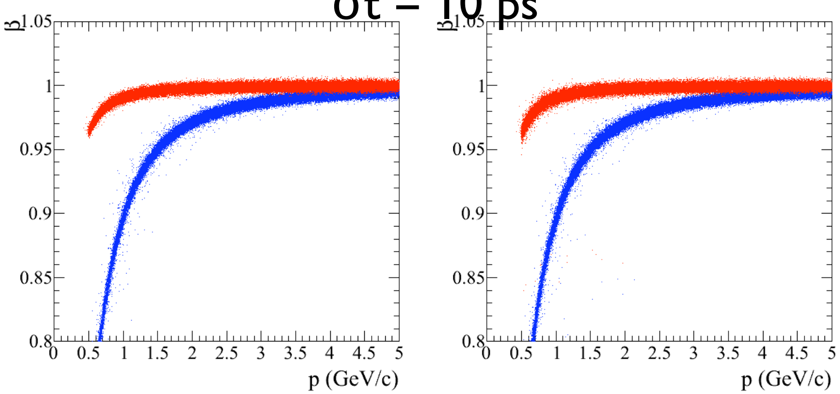
- In each pair, left plot just smears true velocity, ignoring uncertainty from reco path length, right plot is using reco path length.

Backward

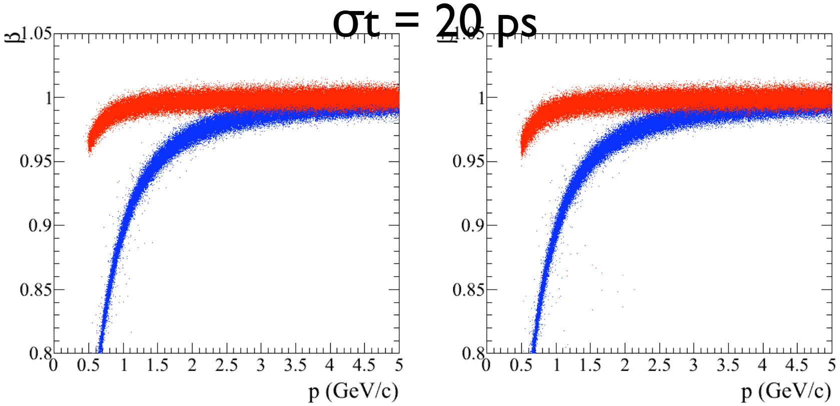
σt = 0 ps



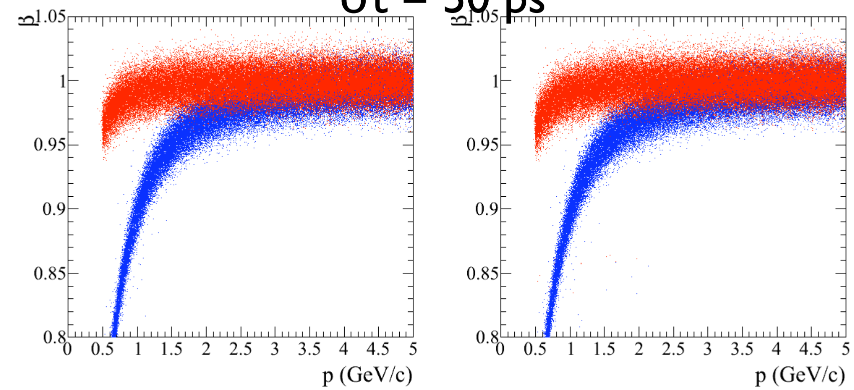
σt = 10 ps



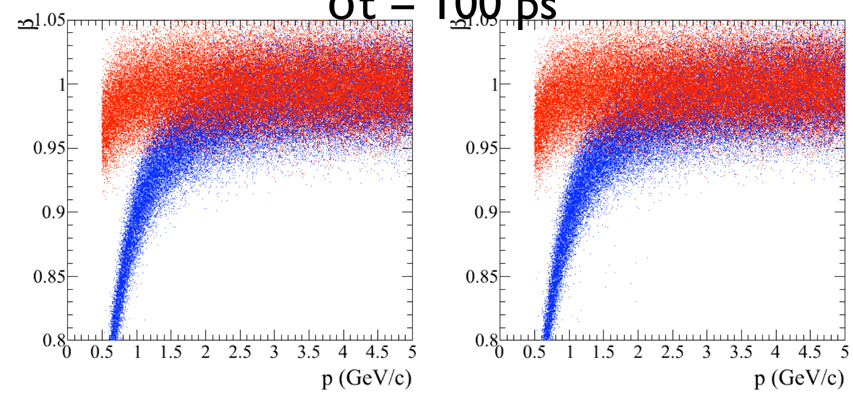
σt = 20 ps



σt = 50 ps



σt = 100 ps



velocity versus reco momentum

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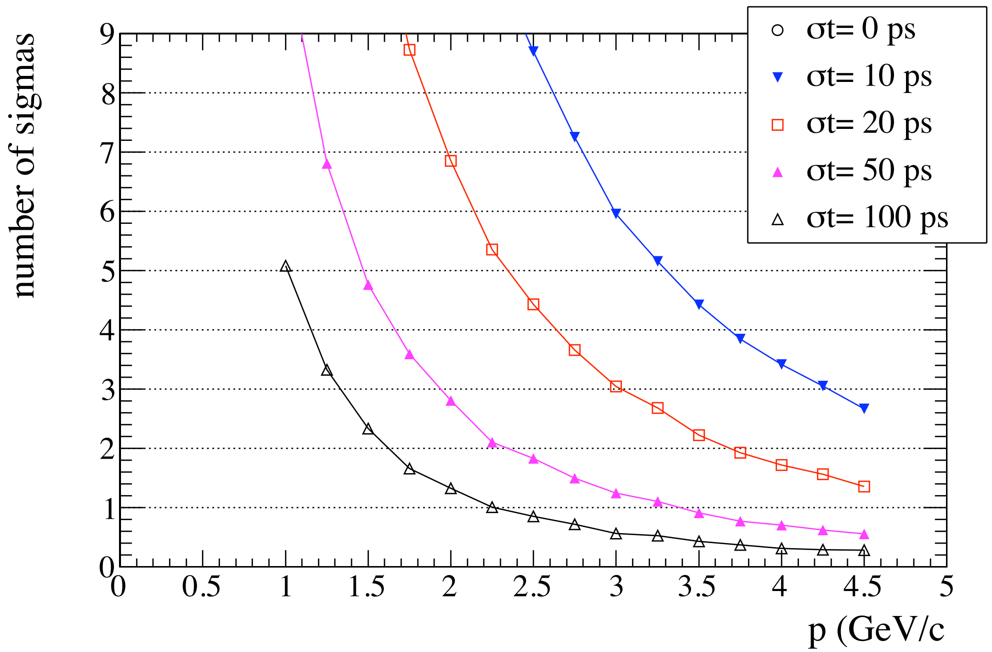
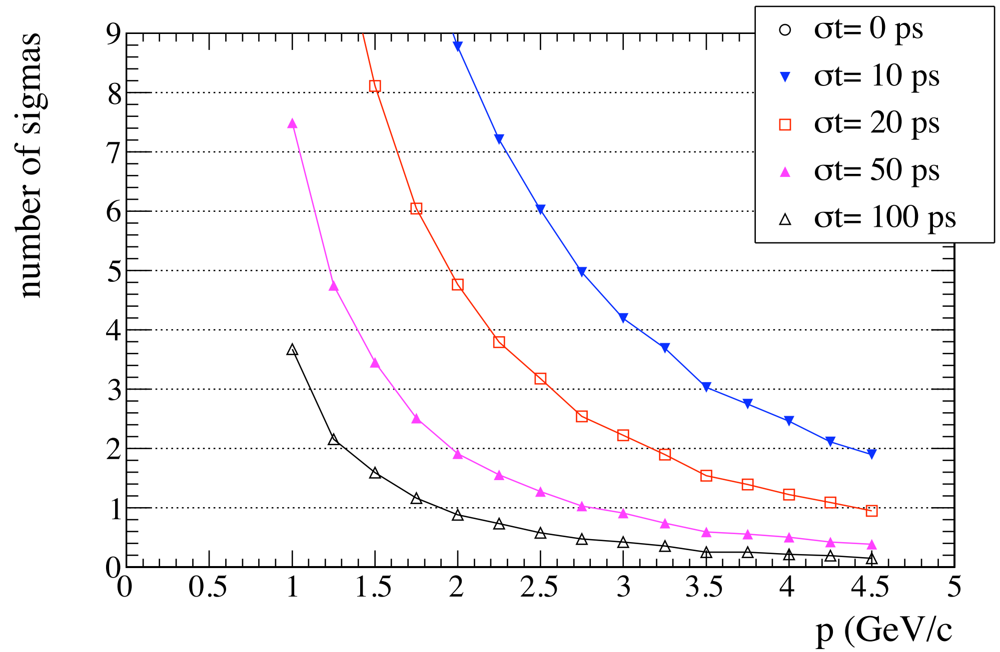
K/π separation

Forward



Backward



- To obtain a 2σ separation at 2GeV/c at the backward region requires timing resolution no worse than 50 ps.