BigBite Geant3 Model and Analysis for E06-010

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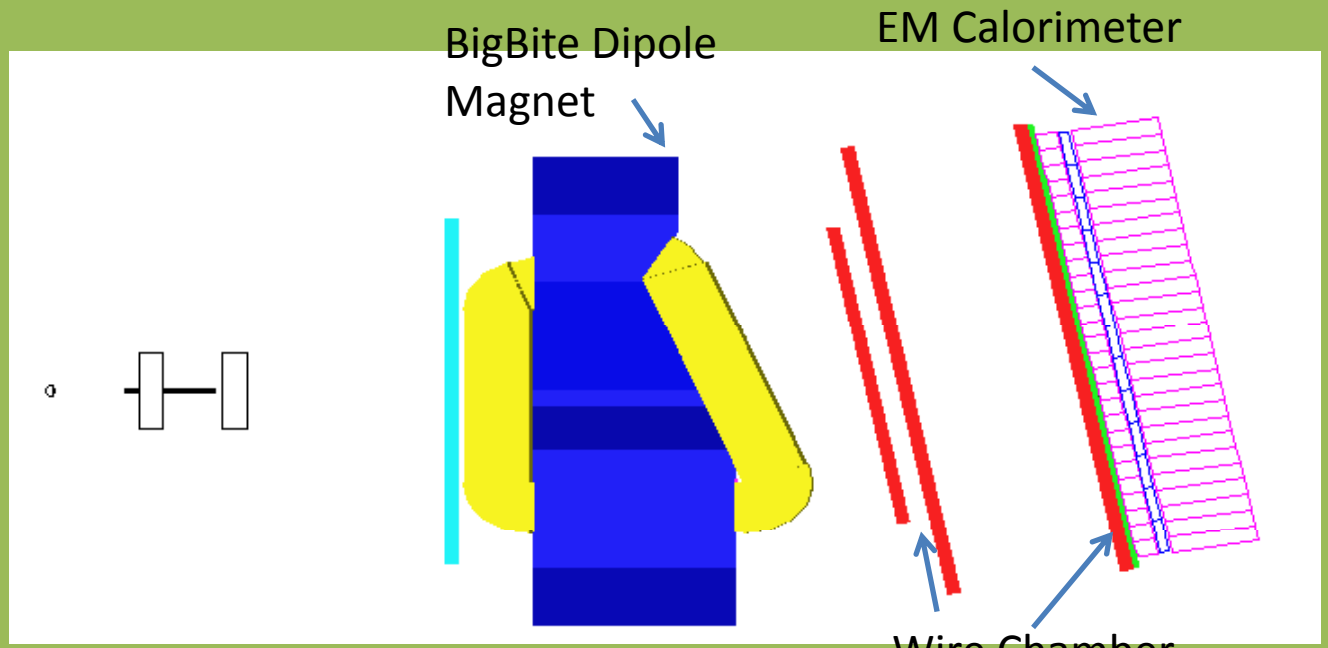


Outline

- Motivation
- BigBite Geant3 model
  - Interface with Analyzer
  - BigBite Optics model
  - BigBite Collimator/BigBite Acceptance
- Some results from the BigBite Geant3 analysis
- Summary

Motivation

- The BigBite Geant3 model is developed
  - Understand the background rates on chamber.
  - Serve as tracking Monte-Carlo.
  - Negative pion contaminations in electron sample in the single analysis.
  - Understand the photon background.
  - Prepare for the development of physics simulation
    - Understand the acceptance
    - Understand the collimator
    - Forward optics transportation

The BigBite GEANT3 Model

- Constructed by E. Chudakov
- Magnetic field model
  - Snake emulation from MAFIA, by V. Nelyubin
- The model has been used to estimate the background rates on wire chamber.
- The model has been used to estimate the acceptance coverage of BigBite for transversity experiment.
- More information about COMGEANT:
  - http://www.jlab.org/~gen/simul/comgeant/

Detector Digitization

- BigBite Wire Chamber (MWDC):
  - Which wire is fired?
  - The drift time, assuming a linear drift time to drift distance conversion.
- BigBite Calorimeter:
  - Which block is fired?
  - The energy deposited in this block.
- Scintillator can be added also.

Event Generator

- Default GEANT3 interaction
  - Include all forward angle reactions.
  - 1 MeV EM cut-off.
  - To simulate background.
- Customize event generators
  - Uniformly distributed within the target length.
  - Cross-section can be weighed.
- In addition, the different reaction processes can be turned on/off.
- Absorbers can be added to speed up.

Interface to Analyzer

- Output from COMGEANT:
  - CERNLIB: Ntuples (The data are packed)
- Fortran code to decode from COMGEANT Ntuples to standard Ntuples
  - Save the initial track information
  - Save the digitizations
- Then use "h2root" to transform it to normal rootfiles
- Another C-based program to add in
  - Background
  - Resolution/efficiency etc
  - Other features like pile-up, etc

Interface to Analyzer

- The interface follows the idea of “VDCsim”
  - Made by K. Rossato under Ole’s guidance
- Structure:
  - THaBBDCSimTrack to store track information, such as direction, position, momentum etc
  - THaBBDCSimWireHit to store wire chamber hit information, such as wire number and drift time
  - THaBBSHSimHit to store shower hit information, such as block number and signal size
  - THaBBPSSimHit to store preshower hit information
  - THaBBSCSimHit to store scintillator hit information
  - THaBBSimEvent to store all the detector responsing information (not the THaBBDCSimTrack)
    - Use TList to store all the hit information .

Interface to Analyzer

- THaBBSimRun:
  - Init: Set the date for choosing each database (Still need a database to decode)
  - Open:
    - Open the rootfile which contain the simulated data
    - Use SetBranchAddress method to connect the variables in the rootfiles with the variables in the THaBBSimRun
  - ReadEvent:
    - Read the information from the rootfiles using GetEntry and fill the information in the THaBBDCSimTrack and THaBBSimEvent *event
  - Close: Close the rootfile.
  - GetEvBuffer: return the event pointer for decoding purpose.

Interface to Analyzer

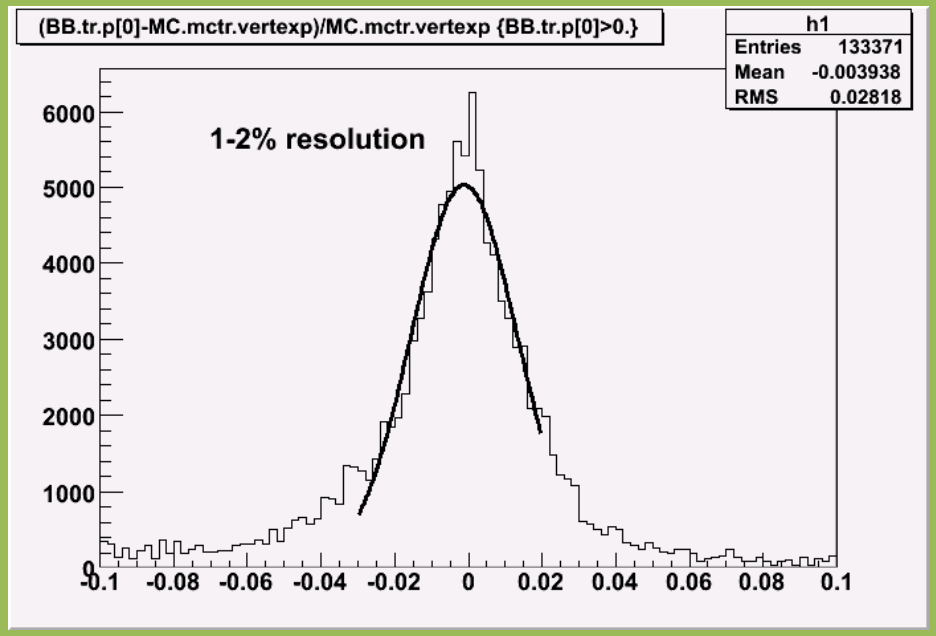
- THaBBSimDecoder:
  - DefineVariables: Save the initial track information stored in THaBBDcSimTrack into the output rootfile.
  - LoadEvent:
    - Mimic the roc, slot and channel
    - Fill the crateslot with crateslot(idx[roc,slot]) -> loadData("tdc",chan, raw,raw)
    - Inside the detector decoder, information will be decoded directly from the crateslot.
  - The database files need to match the roc, slot and channel we faked here.

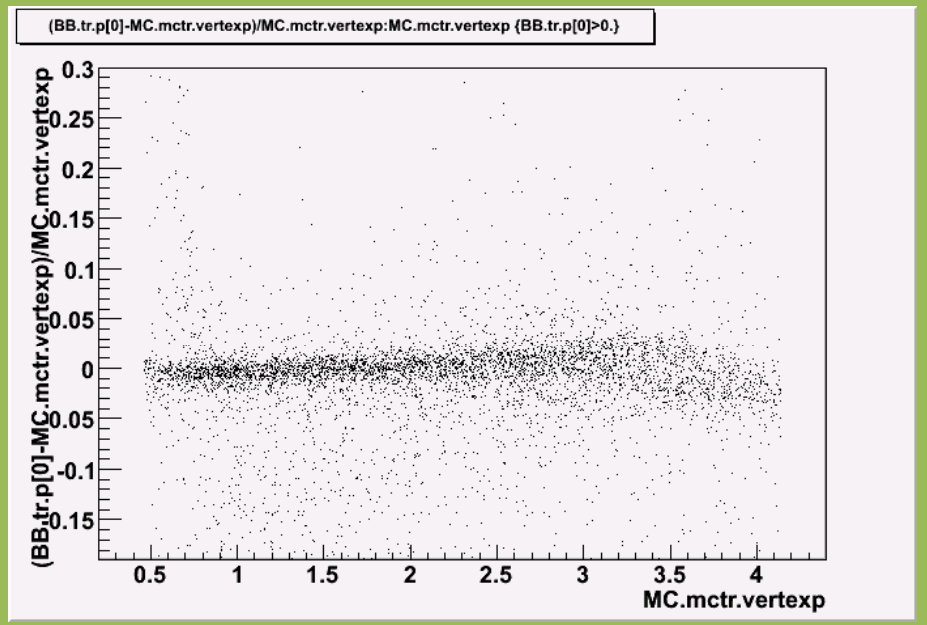
Interface to Analyzer

- With the new decoder, we can use the standard analysis software, including Tree Search Pattern Match tracking code, Optics software, Shower Clustering, to analyze the Monte-Carlo data.
- Things to check:
  - Magnetic field Model
  - Collimator
  - Acceptance

Magnetic Field Model in GEANT3

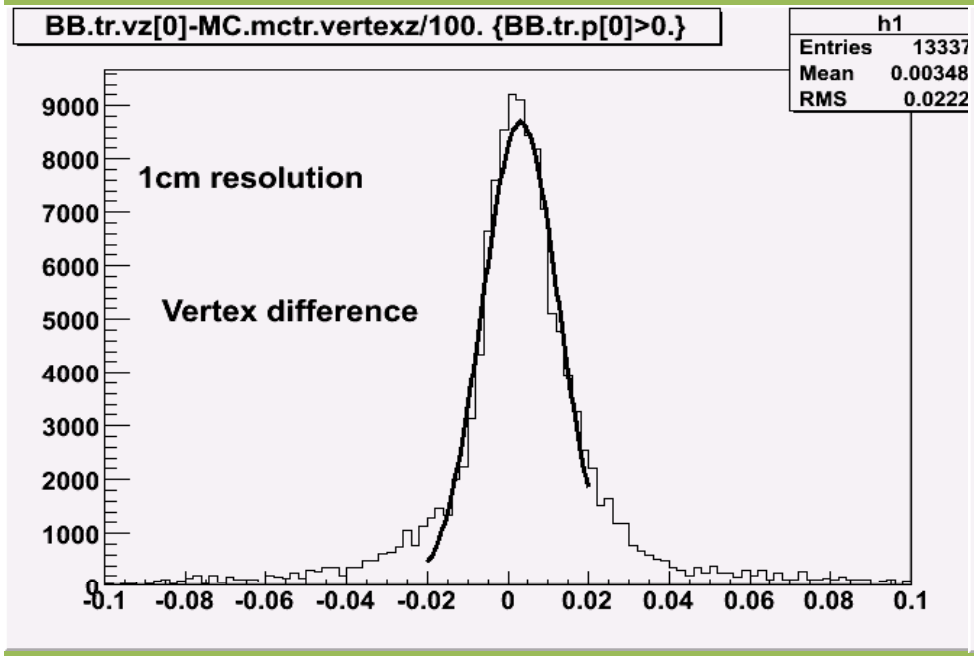
- We tuned the position of detector package slightly to match the optics model.
- Fringe field are not easy to be modelled.
- Reach about 1-2% momentum resolution.

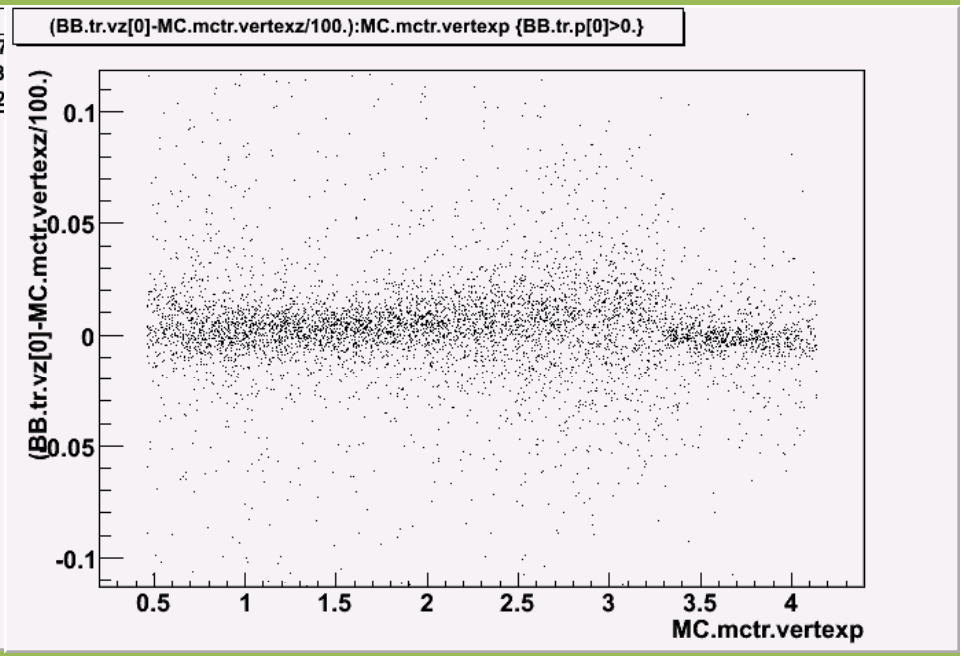




Magnetic Field Model in GEANT3

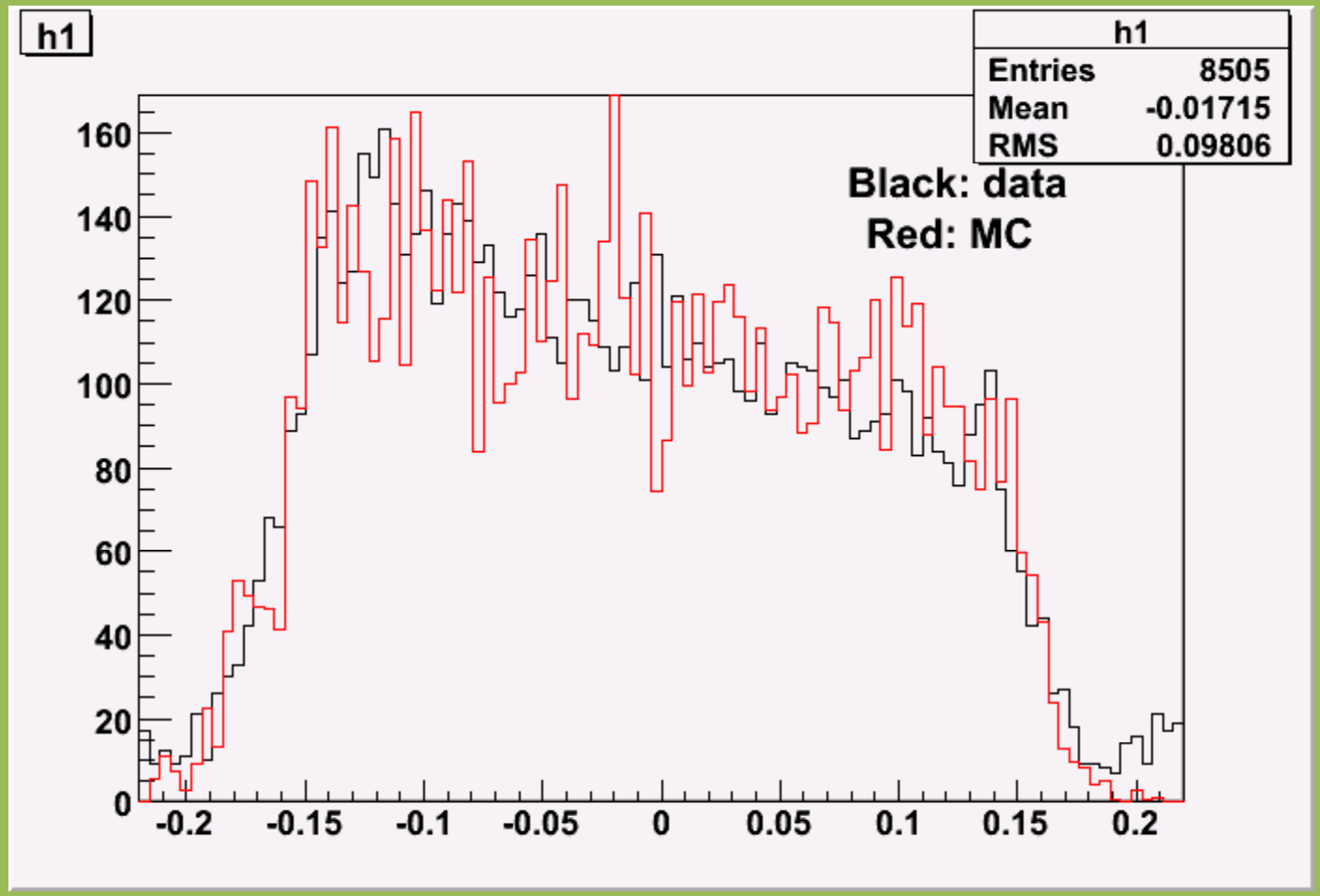
- Vertex is also checked:
- About 1 cm vertex resolution is reached.





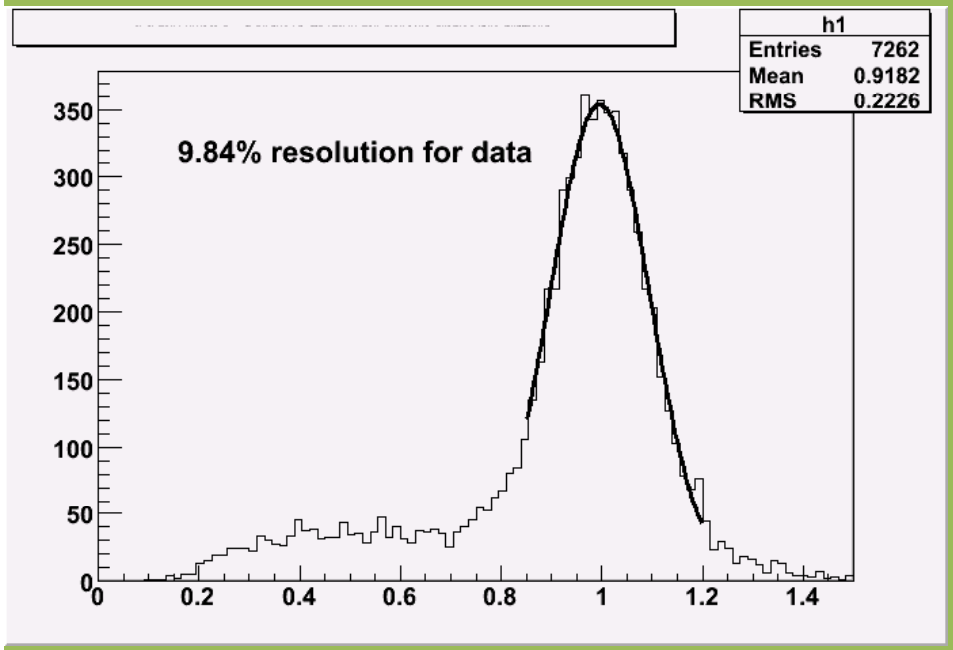
Target Collimator

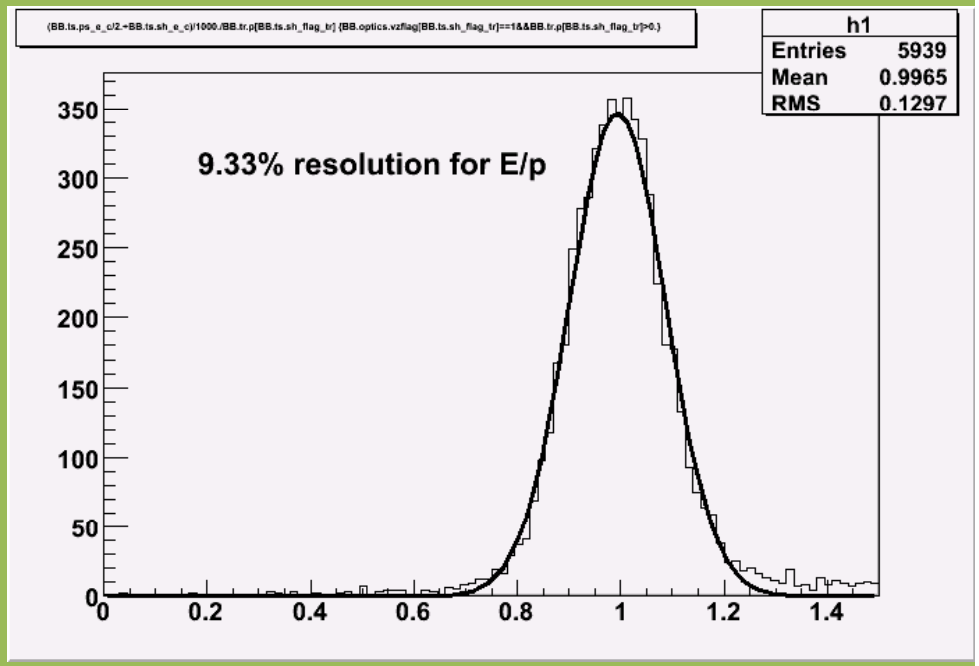
- The position of target collimator are tuned.



Calorimeter Energy Resolution

- Calorimeter Energy Resolution is added in



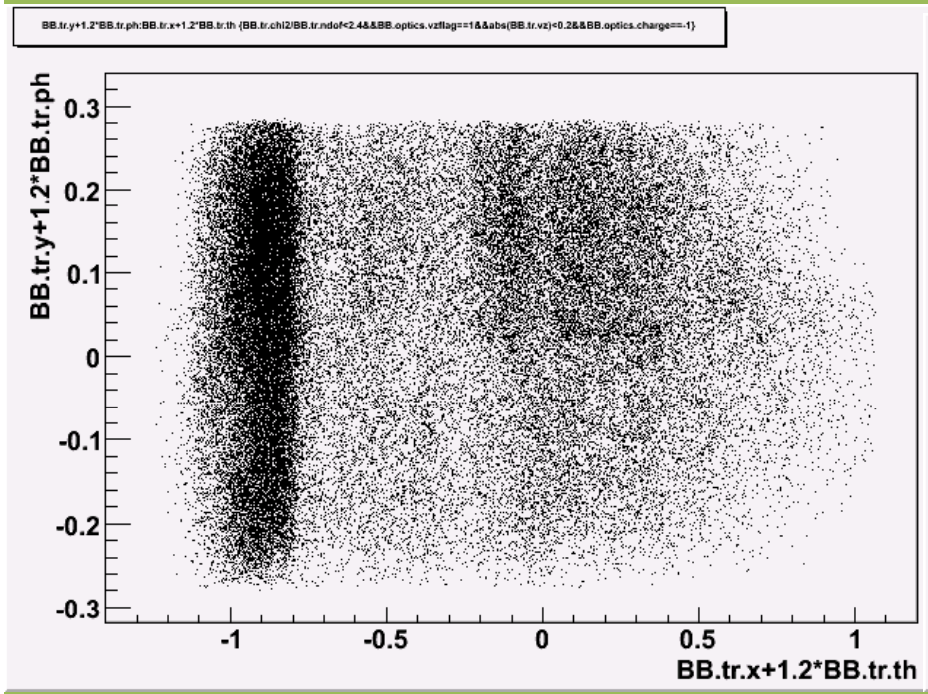


Data

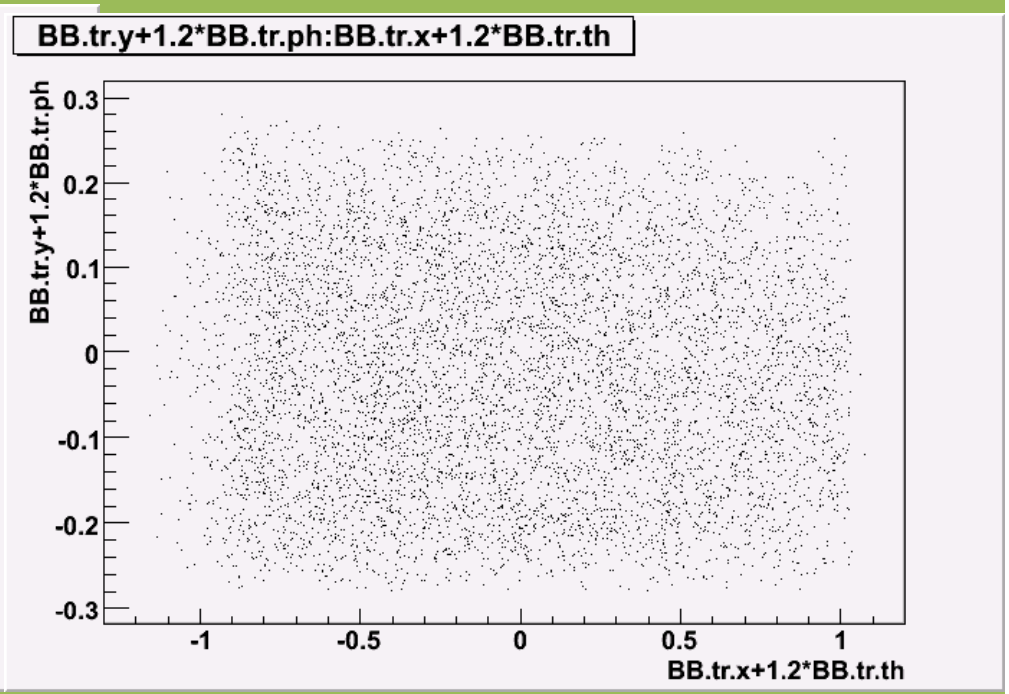
MC

Acceptance

- The acceptance is checked.
- No physics in MC yet.

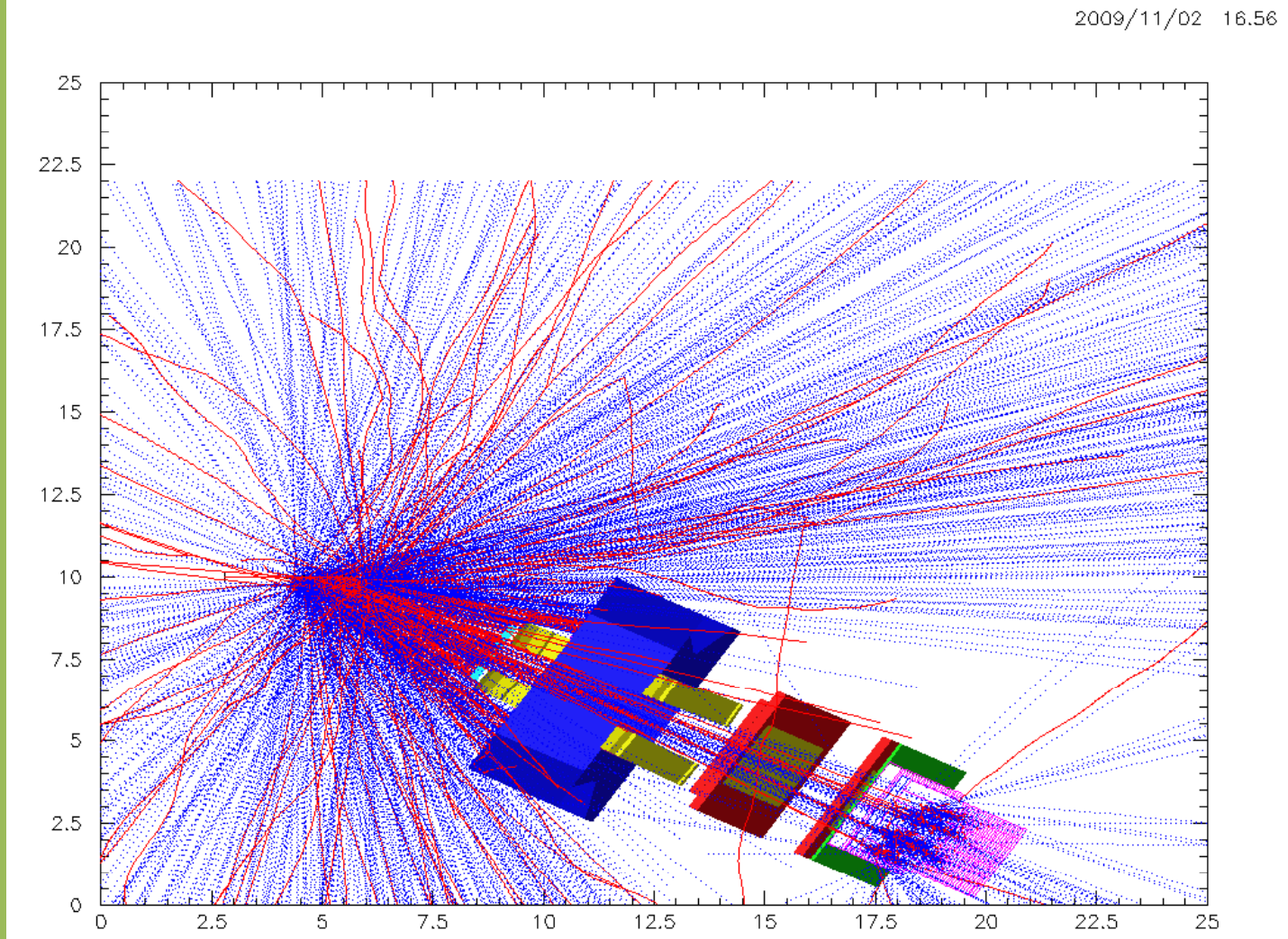


Data

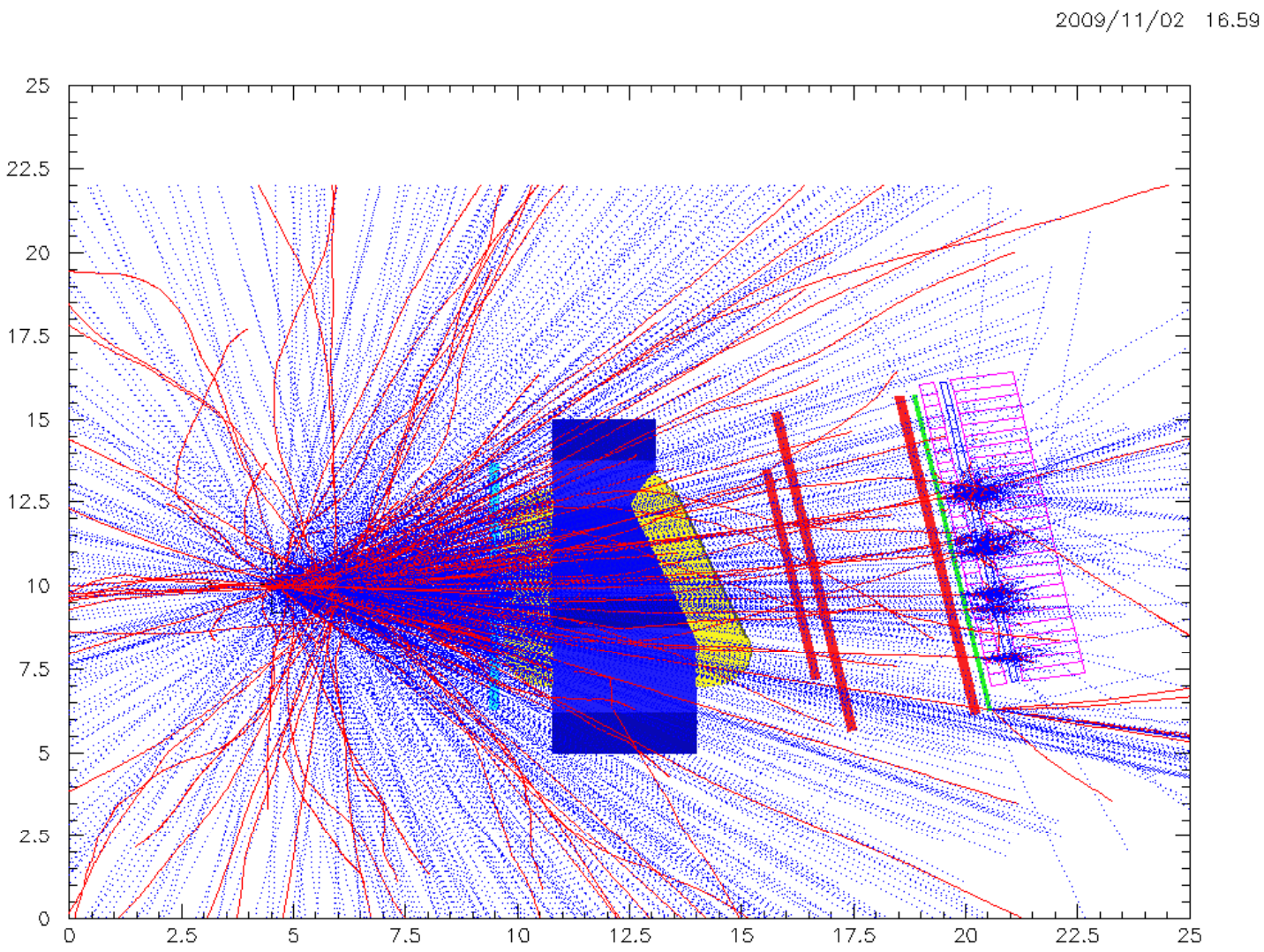


MC

MC simulation

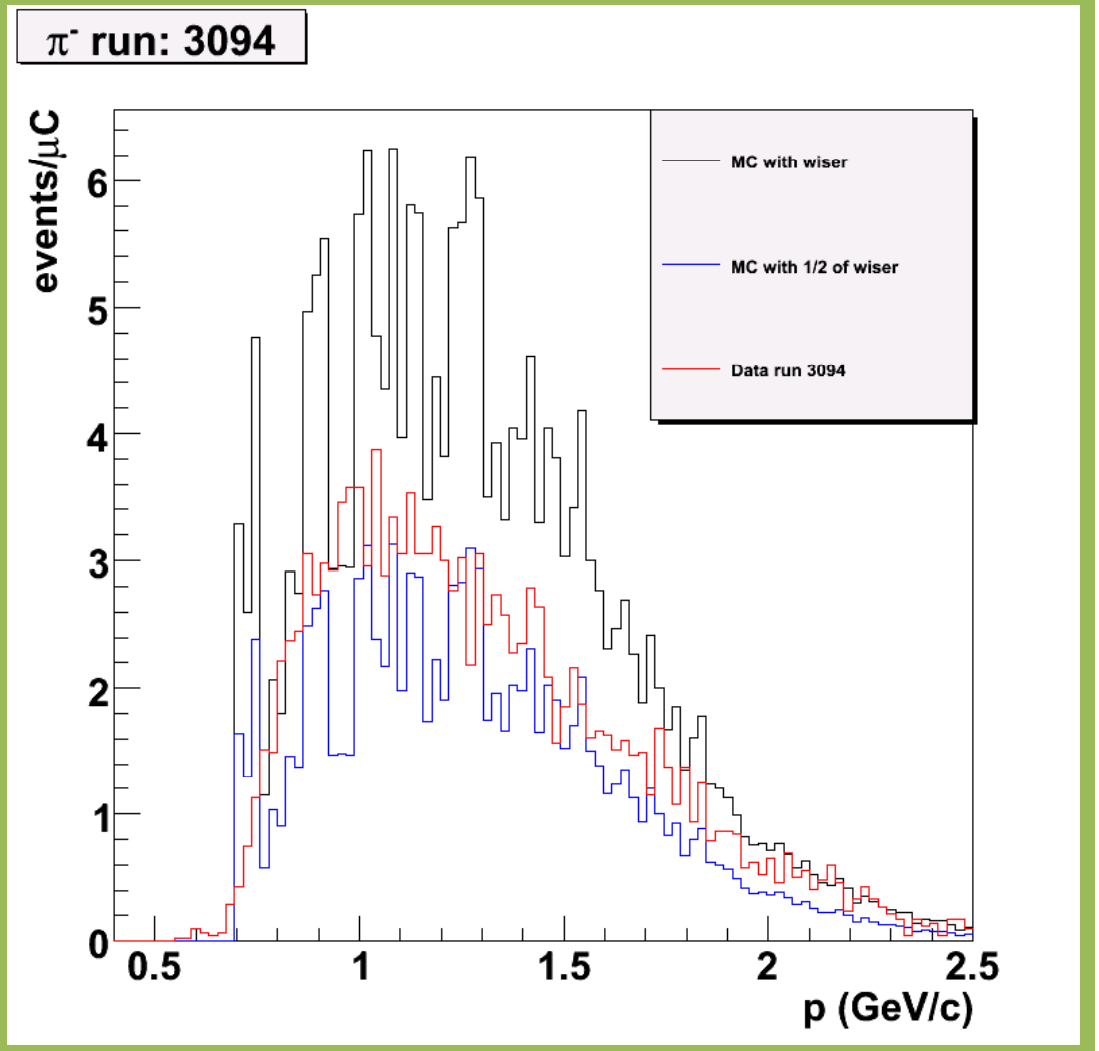


MC simulation



π^- rate comparison

- The MC is weighed by the cross-section of wiser code
- At high momentum, the data match with the wiser code.
- At low momentum the data is in the middle of wiser and ½ wiser.
- Similar comparison are done for photon and electron.



Summary

- The Geant3 model of BigBite is updated
- The interface to analyzer is developed.
- Gaols:
  - Understand the data
    - Understand the contamination to the electron sample
  - Understand the single rates for different particles
  - Forward transportation model for future physics Monte-Carlo (SIMC)
    - Acceptance study
- The same idea can be used in the future to test the software performance.