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MC Workshop

Stauts of TOF Simulation

Outline

- Goal of TOF Simulation
- TOF Signal Flow
- Response Parametrizations
- Summary

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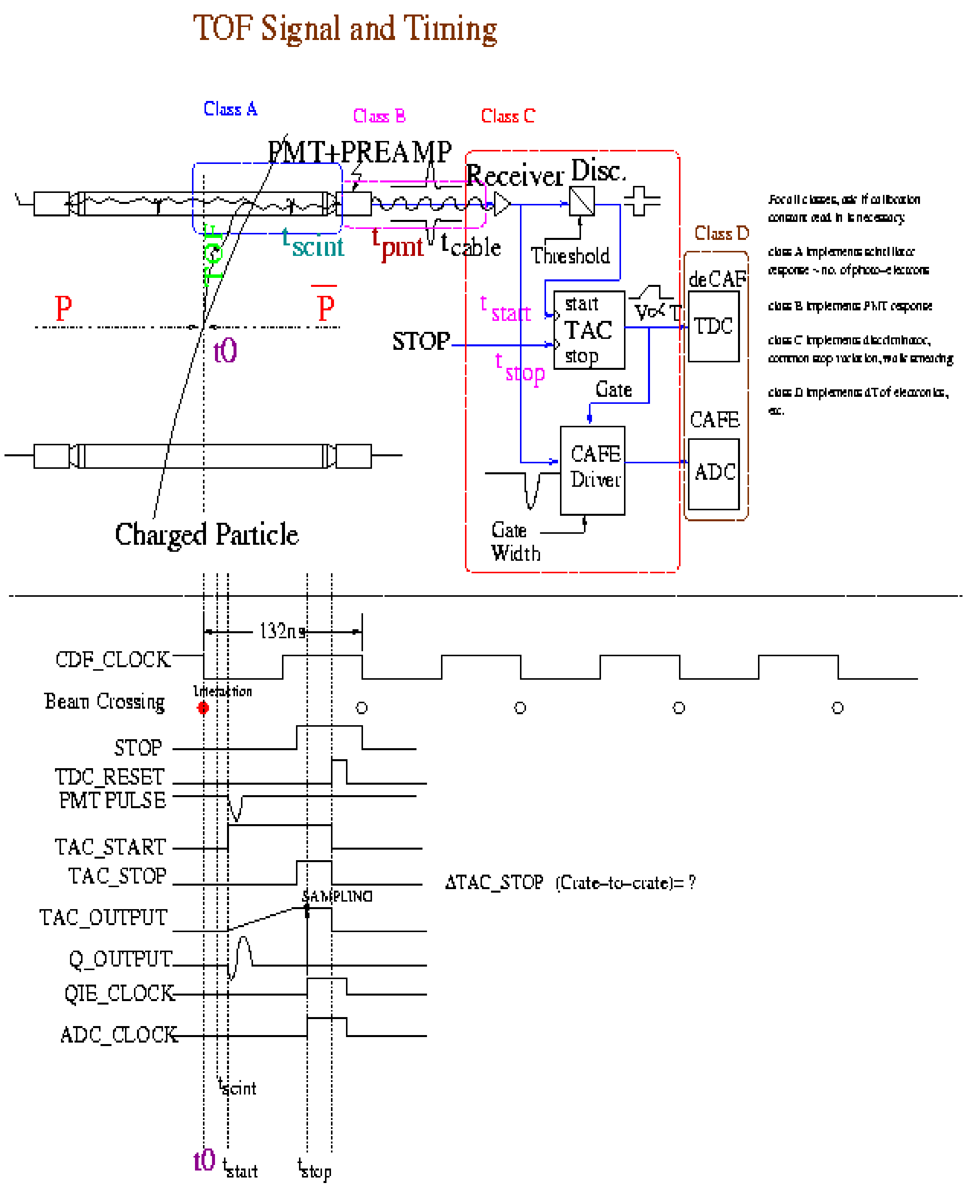
Goal of TOF Simulation

- **Simulate TOF and electronics response to charged particle passage through TOF**
- **Model Bars, PMTs, electronic response to reproduce cosmic and beam data**
- **It should be realistically fast in order to apply for physics analyses**

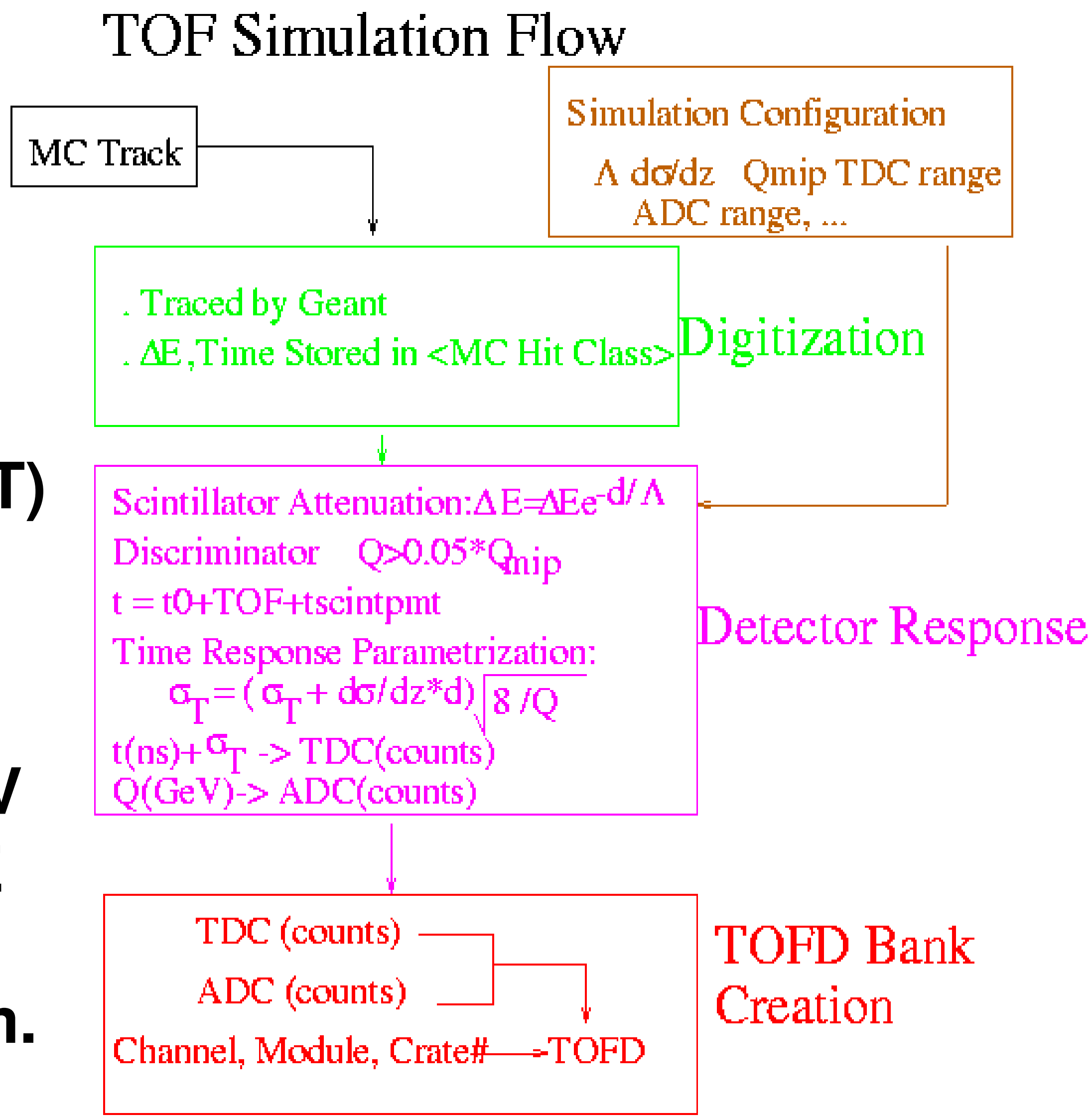
TOF Signal Flow

- Charged particle hit TOF
- Light propagates to PMTs: Differential signal
- Timing measurement
  - Leading edge disc. (start TAC)
  - Common clock (jitter < 25ps) (stop TAC)
  - 12 bit TAC digitization
- Charge measurement
  - Gated 10 bit integration of charge
  - Mainly for slewing correction



Simple Response Parameterization

- Timing Model
  - $T = TOF + t_{\chi} + \Delta T$
    $\Delta T = (100+0.4d)\,(8/\Delta E)^{1/2}$
  - 12 bit TAC 60ns range
    TDC =4096/60* (55-T)
- Charge Model
  - Simulate Disc.
    $\Delta E > 5\%$ of MIPS
  - 16 bit ADC 200 MeV
    $ADC = 2^{16} /200 * \Delta E$
  - No resolution
- Useful checking geom.



Data Tuned Parameterization

- **Follow prescriptions in standalone TOF simulation <- provided by M.Jones**
- **Use calibrated quantities, charge, MIP response, etc to fit to a response parameterization**
- **Some parameters are still a little ad hoc**
- **Parameters are read from files : need to be read from DB**

Data:Charge Measurement

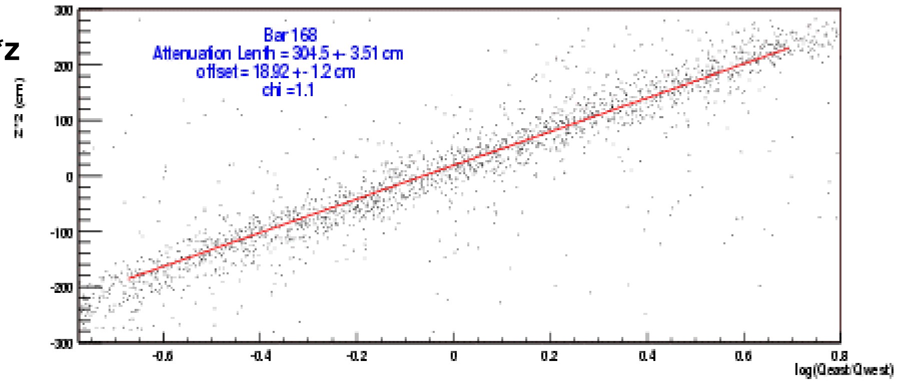
- $Q = Q_0 {*} e^{-(L/2\pm z)/\Lambda + a{*}z^2}$ -> attenuation length
- Landau distribution after attenuation correction:

  electronics resolution is still in the Landau dist.

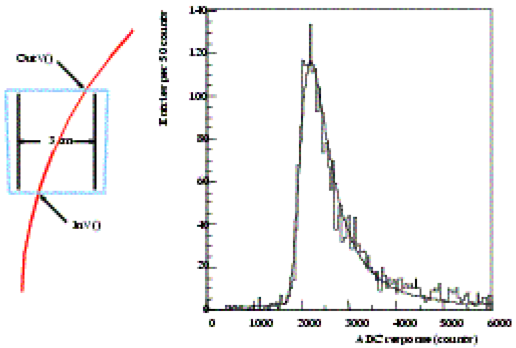
  -> Q_{Peak} and ΔQ_{Landau} (~ 8% of Q_{Peak} typically)
- Residual($\ln(Q_{east}/Q_{west})$ vs z) -> electronics

  resolution

2*z



ln(Qeast/Qwest)

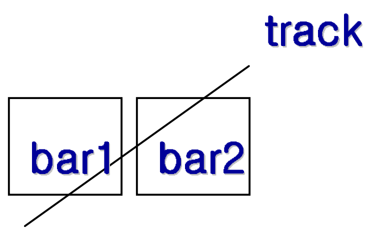


Counts

Data:Time Measurement

- $T_i = t_0 + toff_i + TOF + (L_{bar}/2 \pm z_i)/v_i - F(Q_i,z_i)$
- t_0: interaction time
- $toff_i$: chan-to-chan offset
- v_i : speed of light inside scint. bars $T_{west} - T_{east}$ versus z effectively measures v_i
- $F(Q_i,z_i)$: discriminator walk correction

  $F = a^*\ln(adc_{Landau}) - b^*(\ln(adc_{Landau}))^2$



$toff_i$ and $F(Q_i,z_i)$ is measured using tracks intersecting two scint. bars

MC:Data Tuned Parameterization

- **Charge Model**

  In addition to the parameterization for the attn., Landau, and electronics resolution,

  - **Less than 15 MIPS is required for preamp.**
  - **Larger than 100 ADC counts for discriminator**

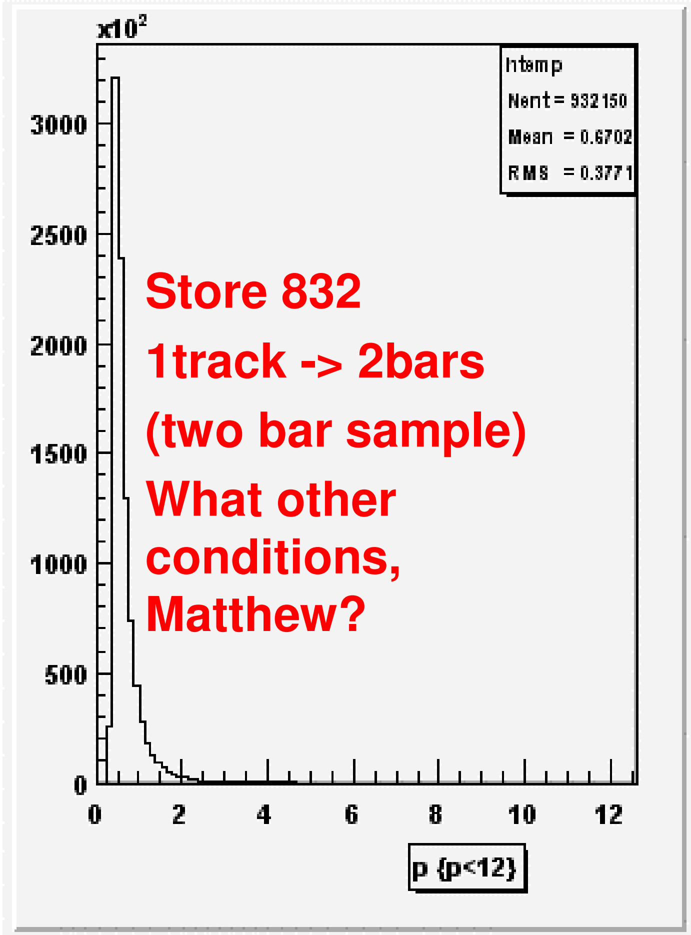
- **Timing Model**

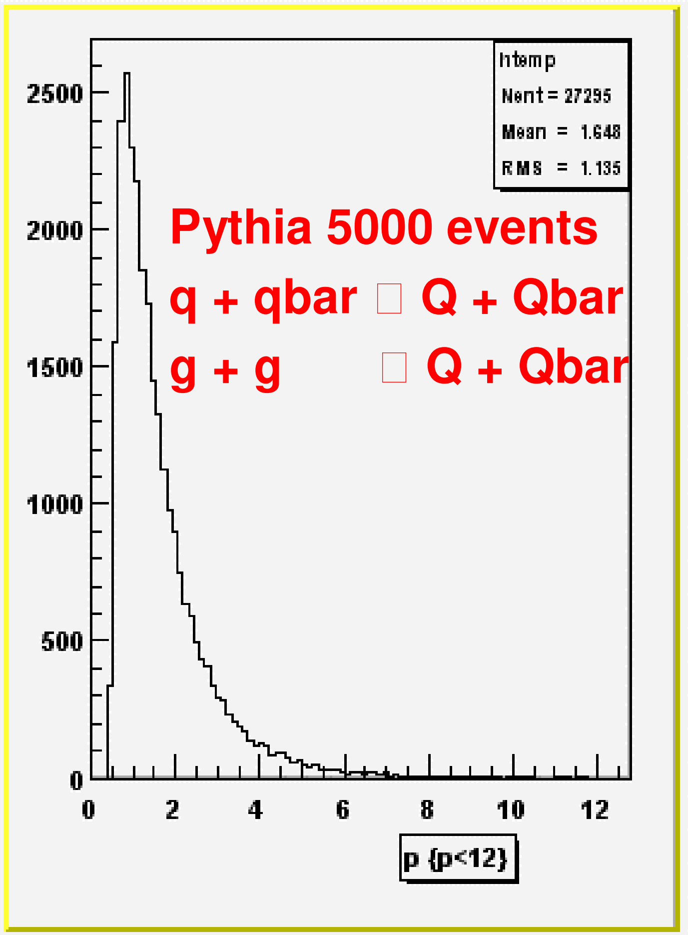
  - $T_i = toff_i + TOF + (L_{bar}/2 \pm z_i)/v_i + F(Q_i, z_i)$
  - $\Delta T = \quad\quad (0.1+0.0004d) \;\; (ns)$

TofSim Codes

- There are three similar levels of simulations, SIMPLE, MODERATE, and USRTUNED and 3 main source codes are:
  - TofSimConfig.cc :Initialization and configuration
  - TofEventdata.cc :Parameterizations are executed here
  - TofSimAnalysis.cc :Checks simulation results
- Most recent sample tcl files and simulation parameters files (calibration files) can be found in TofSim/test/ area
- Runs fine with 4.4.0int6
- Standalone simulation is included in the TofSim/standalone area and can be used for tests

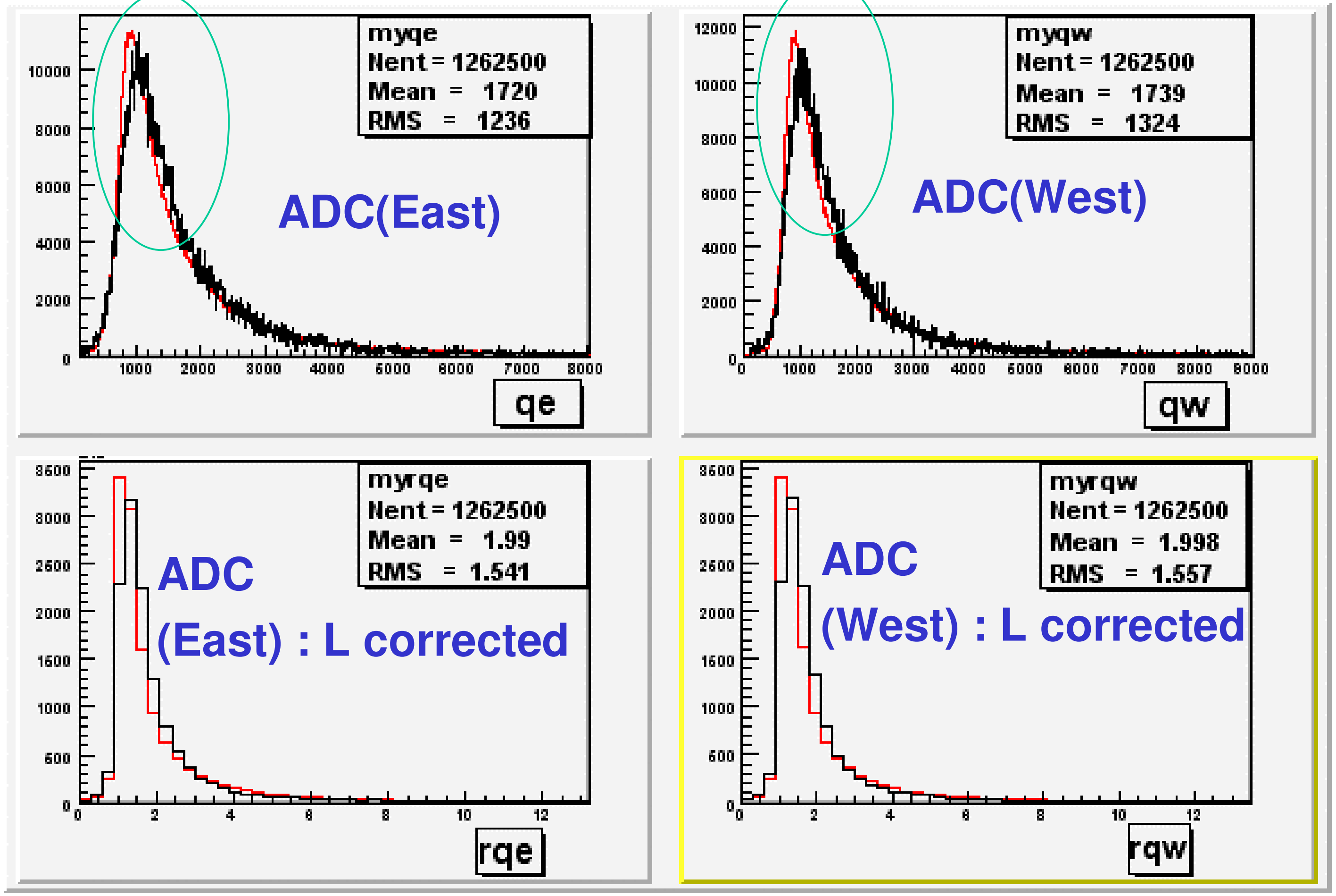
Event Sample





Reconstructed Momentum

ADC Distribution : Data vs MC

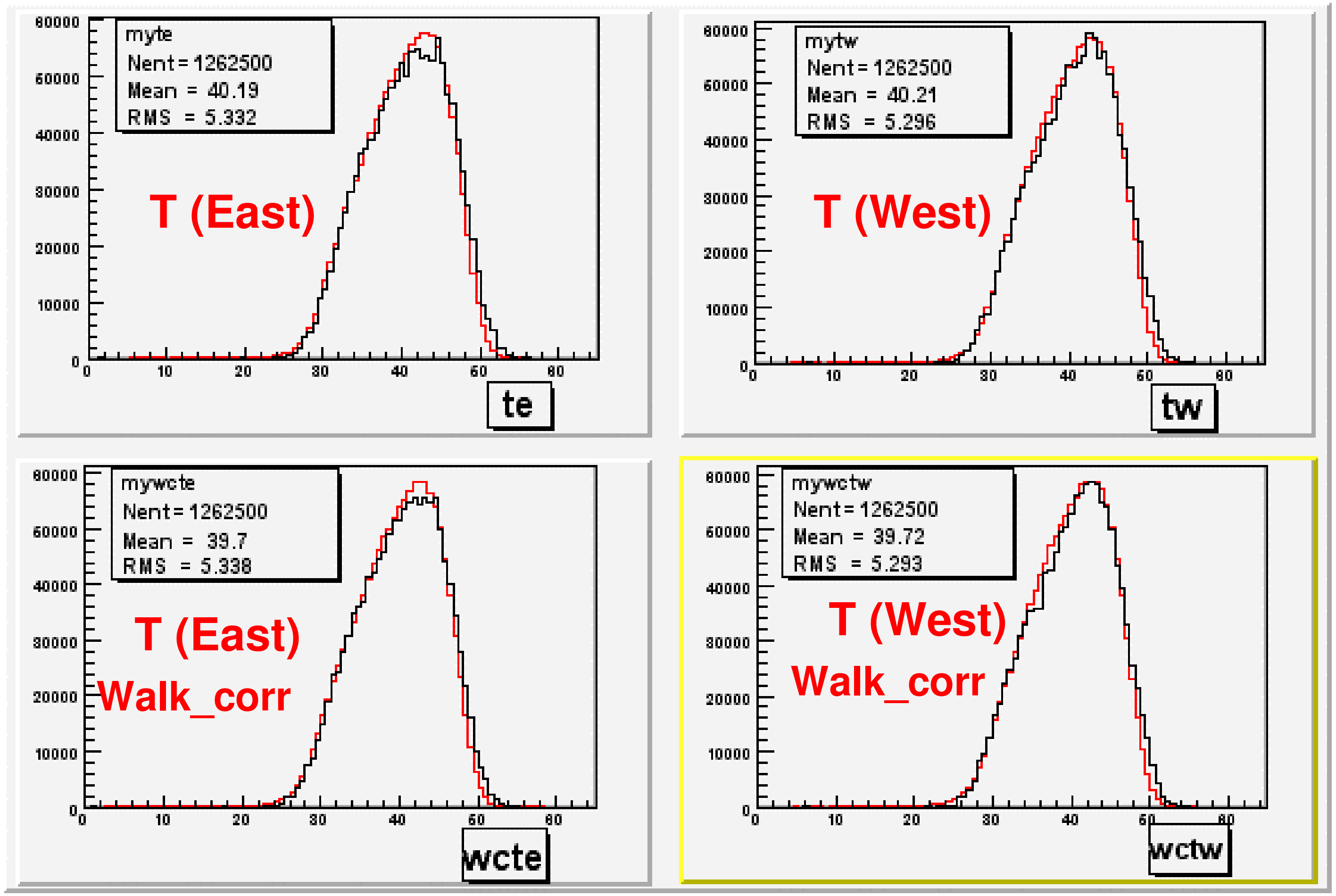


Needs tuning/investiagation

Red : Store832

Black : Simulation

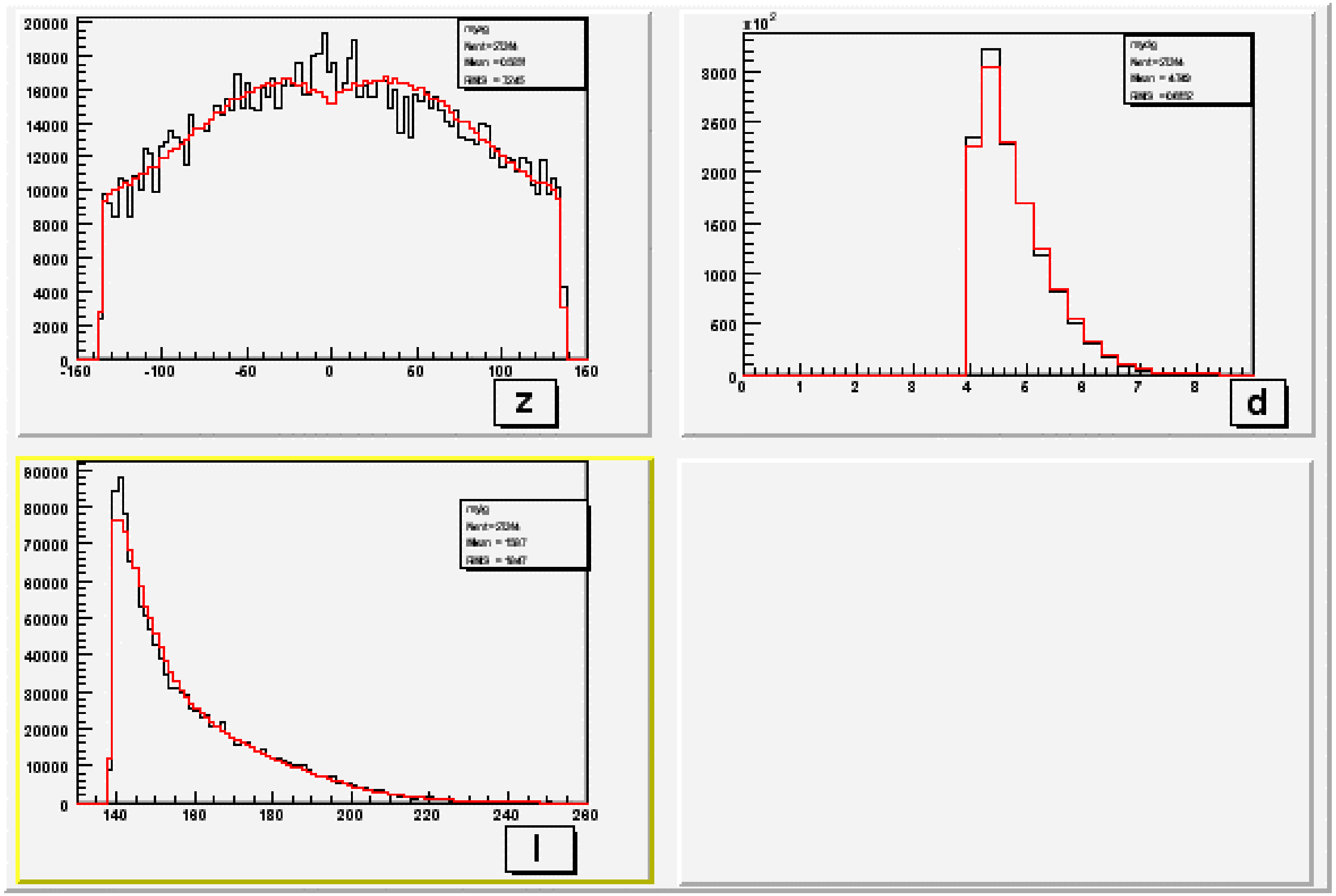
Time Distribution : Data vs MC



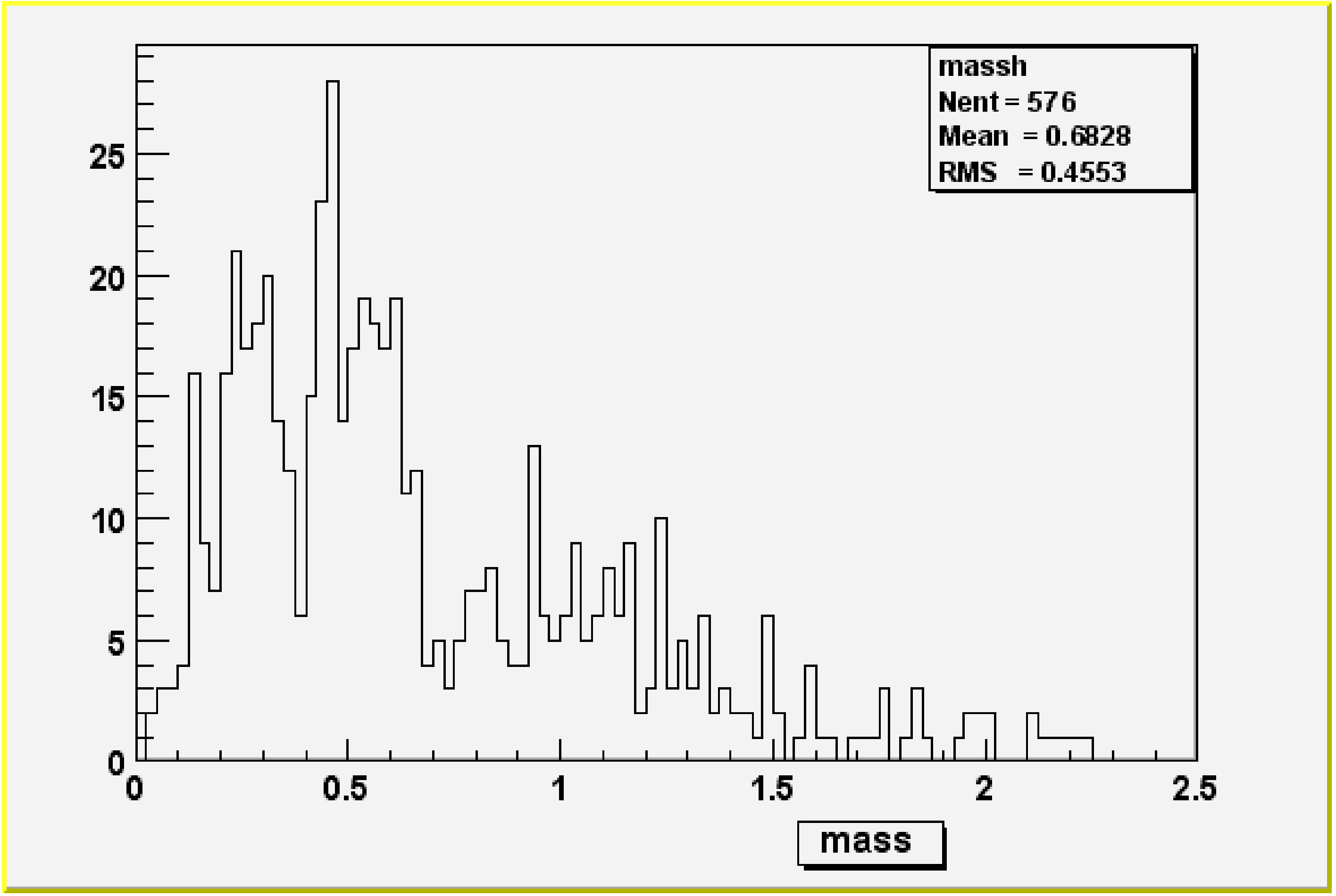
Red : Store832

Black : Simulation

Z, Pathlength, Arclen Distribution



Reconstructed Mass : MC



Summary

- A few simulation parameterizations exist to be tested
- Calibration is used and parameterized to reproduce result of data: ADC simulation needs more tunning
- DB information should be used instead of files
- More detailed simulation can be considered on demand