Dual Readout Simulation

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Outline

- Current Implementation in SLIC
- Changes towards Dual Readout Calorimeter
  - Adding optical properties
  - Change material
  - Include Cerenkov hits in analysis
- Plan of Work
  - Corrections for single particles
  - More realistic reconstructions of clusters/jets and their energy
  - Apply to a benchmark physics process

Setup

- The goal is to model dual readout calorimeters in SLIC
- Using LCPhys physics list
- Using GEANT 4 version 9-01 patch 01
- Using org.lcsim framework

Geometry

- We define the geometry in .xml files, later converted to .lcdd files.
- Our detector is based on the SiD01 compact.xml file
- We changed the detector to match geometry specified by Adam Para.

Geometry

EM barrel calorimeter:

6 layers of TungstenDens24, 5 cm thick

Readout segmentation is 5x5 cm.

EM endcap calorimeter:

6 disks of TungstenDens24, 5 cm thick

Readout segmentation is 5x5 cm.

HAD barrel calorimeter:

9 layers of TungstenDens24 10 cm thick

Readout segmentation is 10x10 cm.

HAD endcap calorimeter:

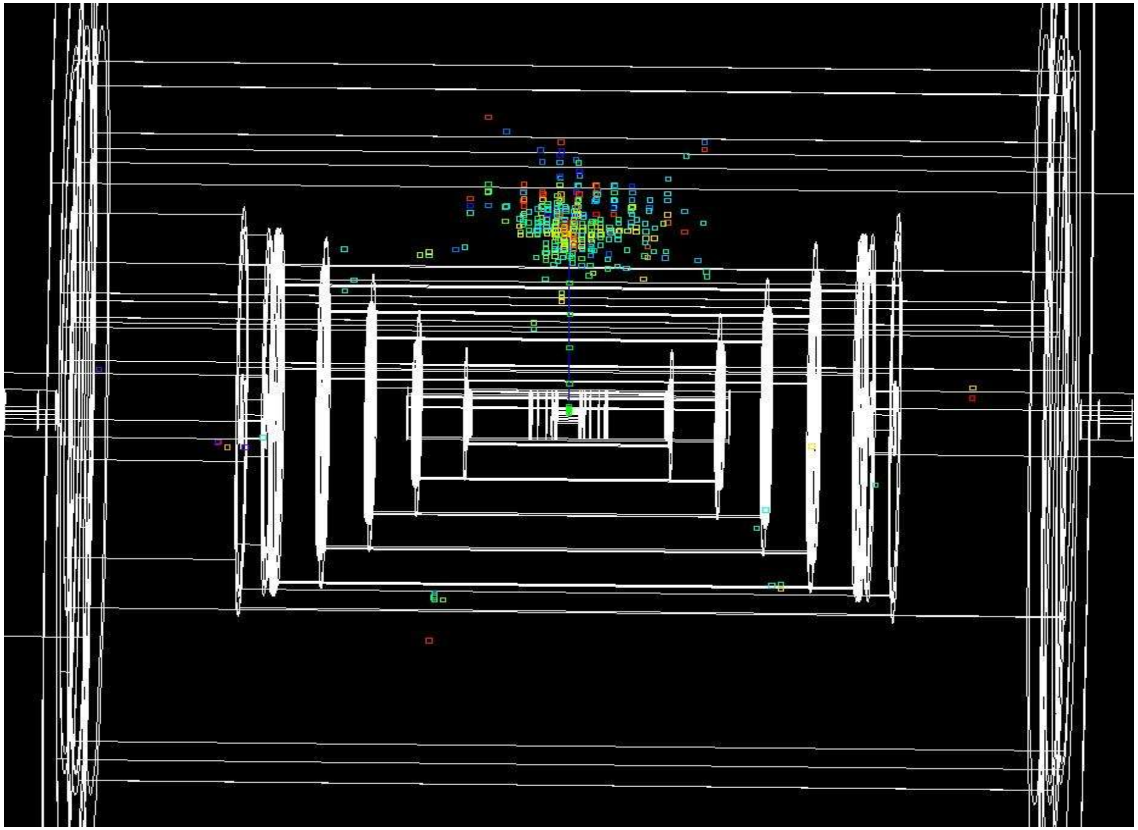
7 disks of TungstenDens24, 9.5 cm thick

Readout segmentation is 10x10 cm.

Simulations

So far, we have run simulations of 300 single particle events with the following particles:

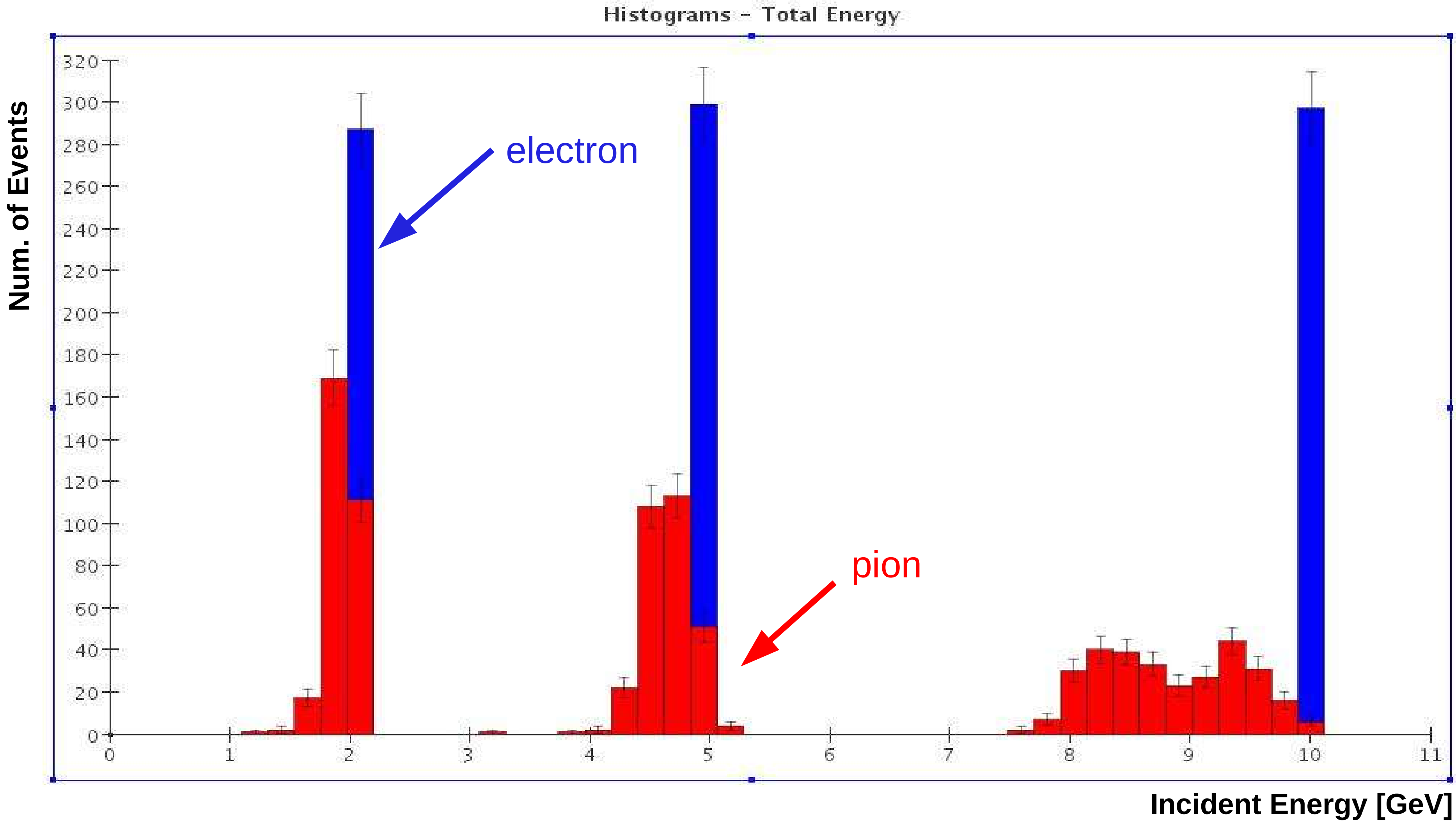
- 2 GeV pi-
- 5 GeV pi-
- 10 GeV pi-
- 2 GeV e-
- 5 GeV e-
- 10 GeV e-



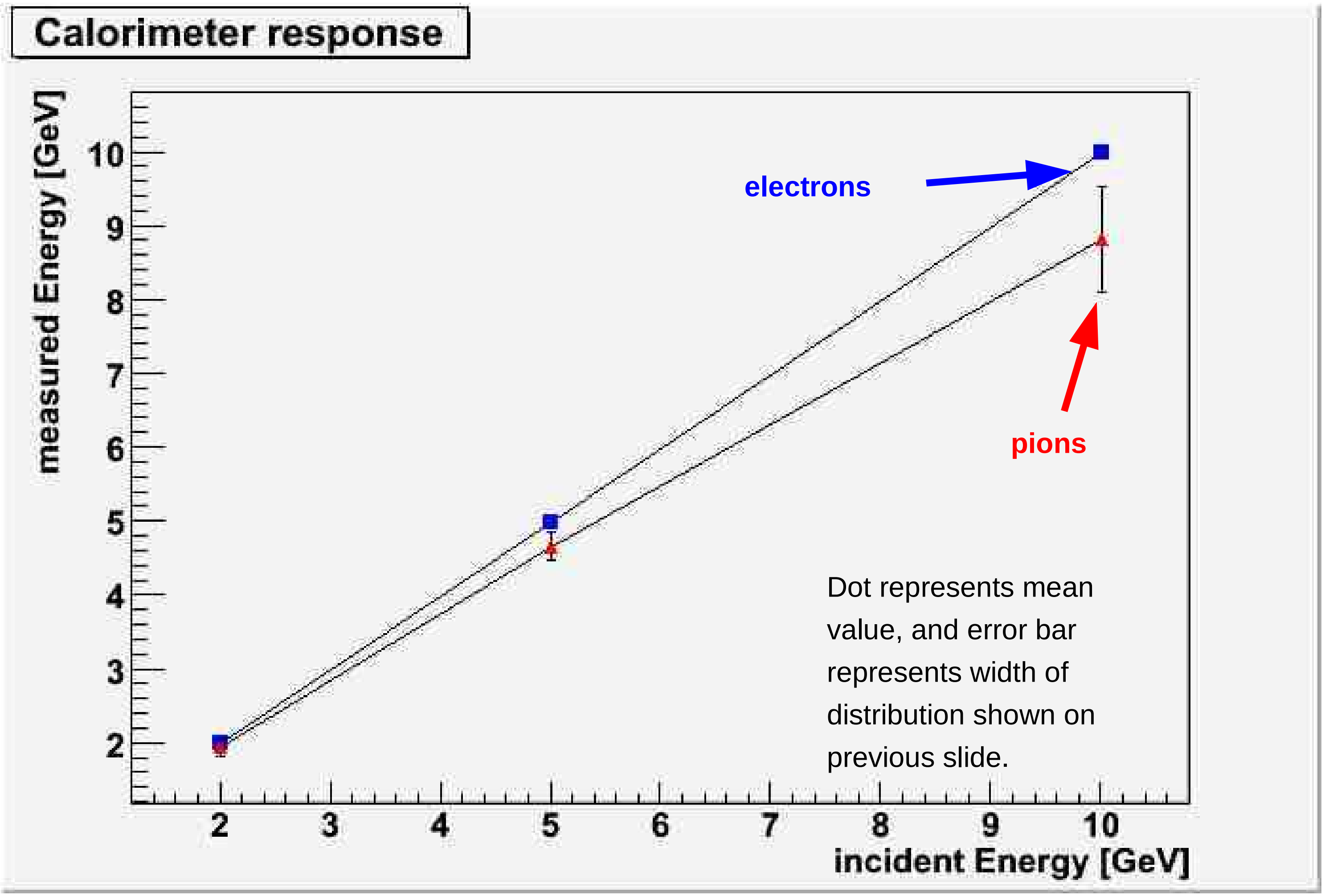
Problem

- Initially, the Hadronic calorimeter was not declared sensitive in the .xml file. The hits were still collected and grouped as part of the EM data.

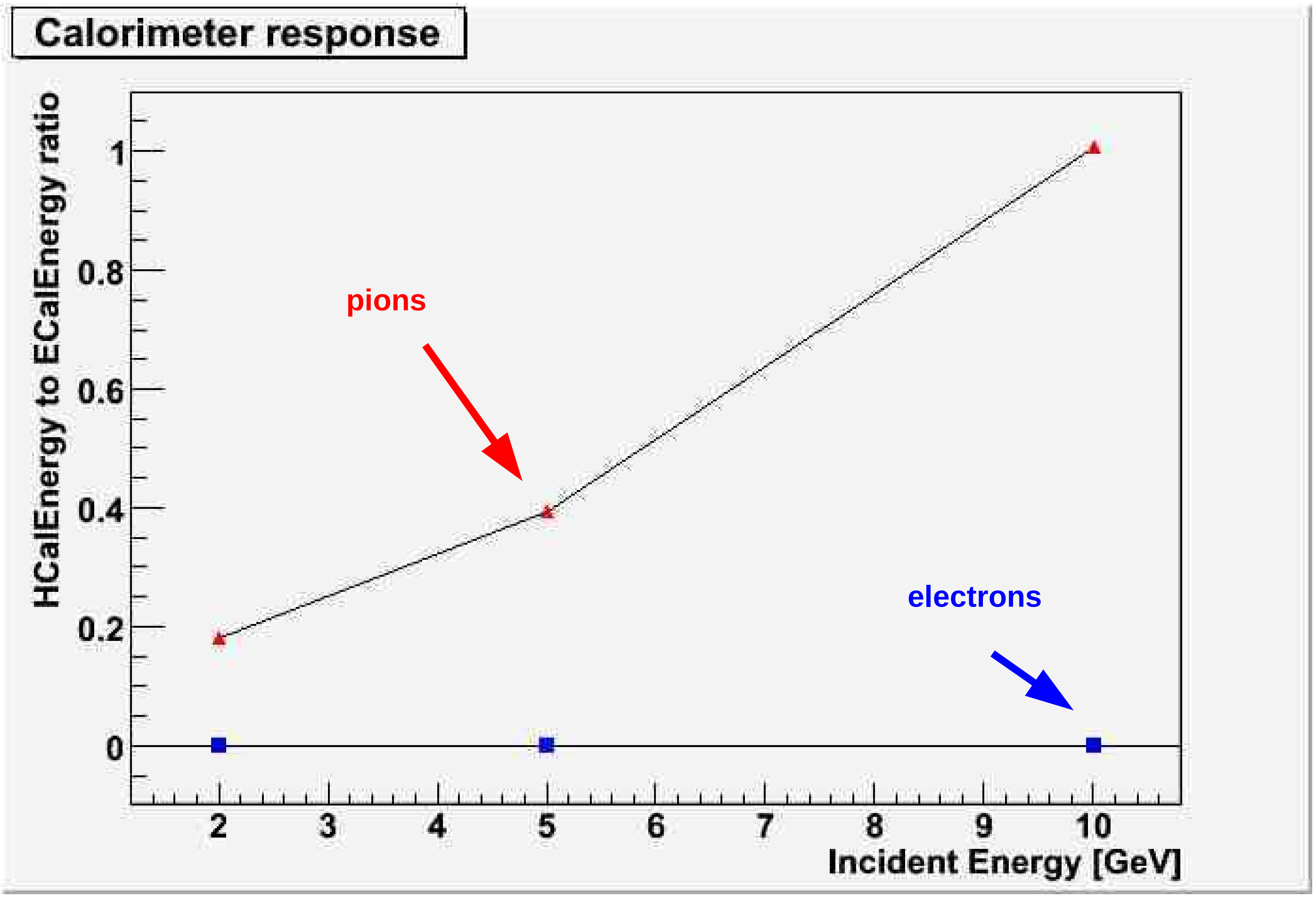
Energy Response to e^- and π^-



Energy Error



E_{HCal}/E_{EMCal}



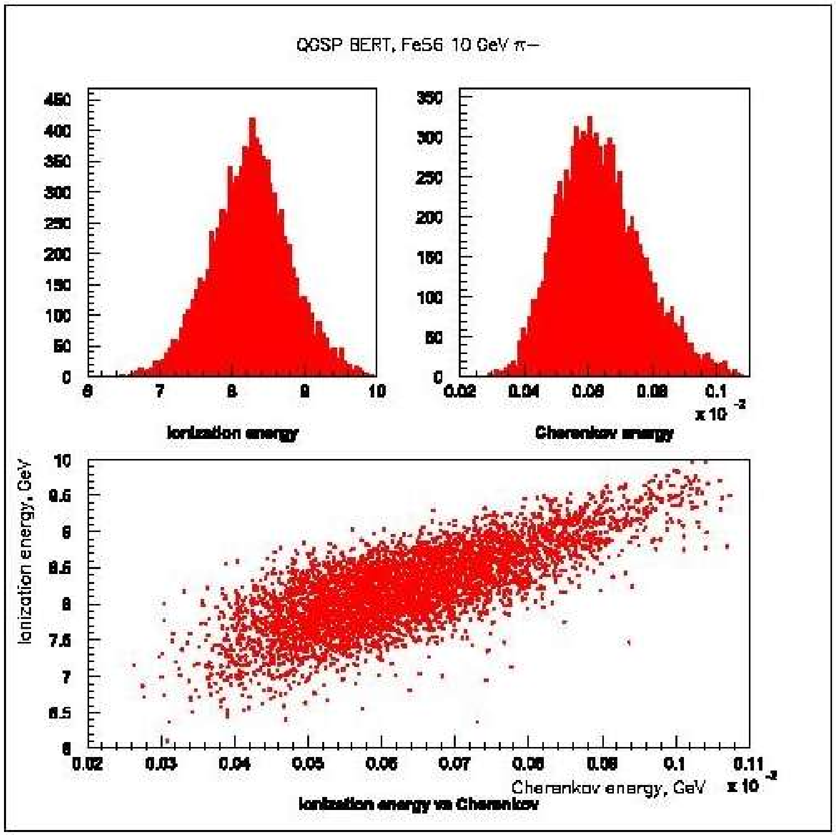
Planned Changes

- Currently, the sensitive material in both calorimeters is tungsten. We will change to BGO crystals
- Change calorimeter type to optical_calorimeter, add optical properties

Plan of Work

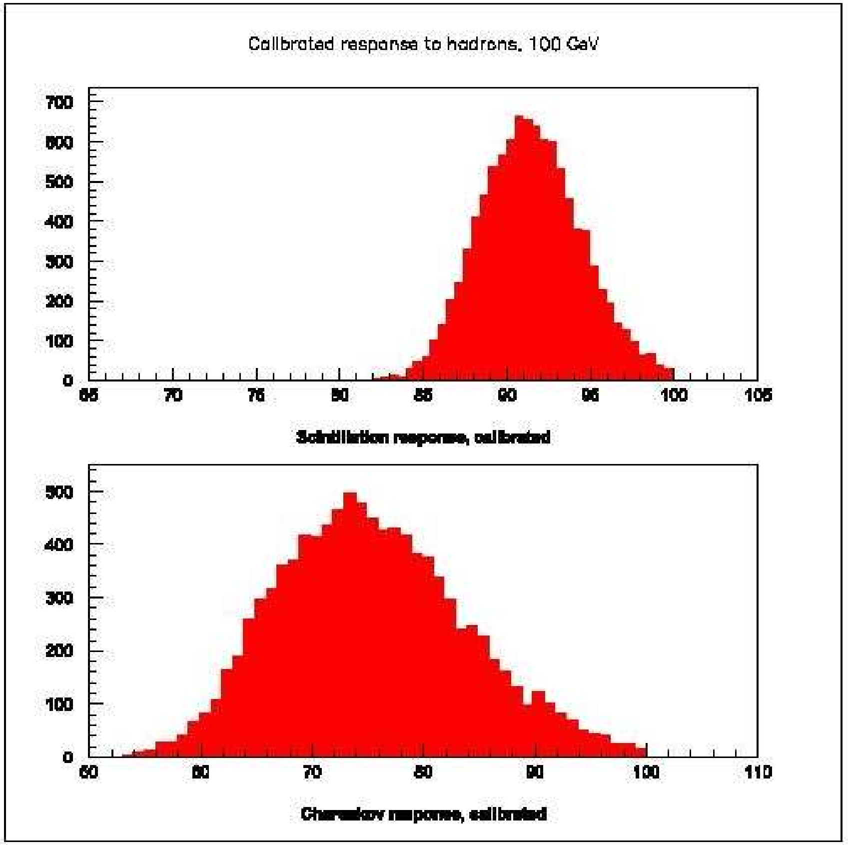
- Make energy corrections on single particle events
- Implement algorithms to find clusters and jets and to correct their energy
- Apply to a benchmark physics process

Derive Corrections for Single Particle Response



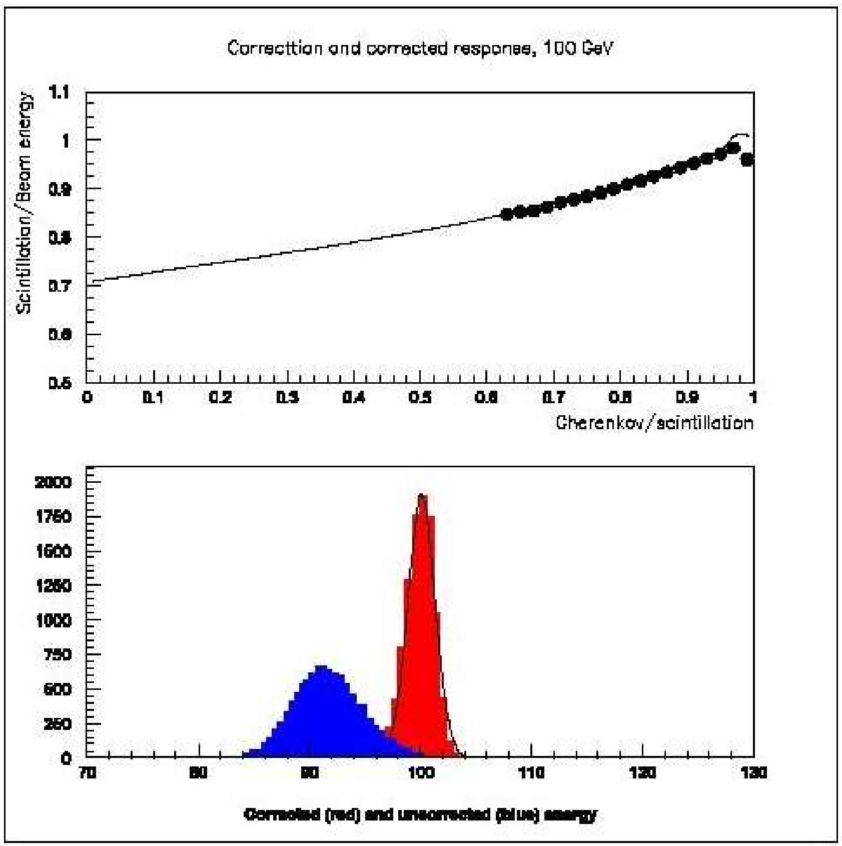
Implement a correction function taking into account the correlation between ionization and Cerenkov energy based on results from Adam Para

Derive Corrections for Single Particle Response (cont.)



Calibrate the response, again based on Adam Para's work

Derive Corrections for Single Particle Response (cont.)



$A_{SC} = \langle \text{scintillation} \rangle / 100$

$A_{C} = \langle \text{cerenkov} \rangle / 100$

$E_{SC} = A_{SC} * S$

$E_{C} = A_{C} * C$

Plan of Work

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Thanks

- Jeremy McCormick
- Adam Para
- Hans Wenzel