

Geant4 FPD Simulations with Hadronic List

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We now try Geant4 simulation of a lead glass “Small Cell” pb glass including hadronic physics lists. The following table describes the physics processes that are used here. These “A1 Physics” lists are found in the Geant4 distribution example/extensions. The optical photon list was added from the library file.

```
// General Physics ( Create ALL Particle and apply Decay )
RegisterPhysics( new A01GeneralPhysics("general" ) );

// EM Physics ( Apply related Processes to gamma and e-/+)
RegisterPhysics( new A01EMPhysics("standard EM"));

// Muon Physics ( Apply related processes to mu and tau
RegisterPhysics( new A01MuonPhysics("muon"));

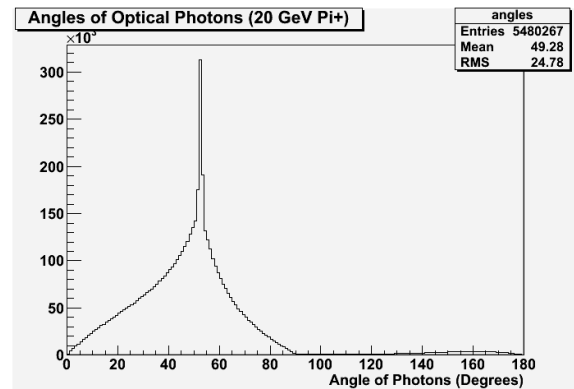
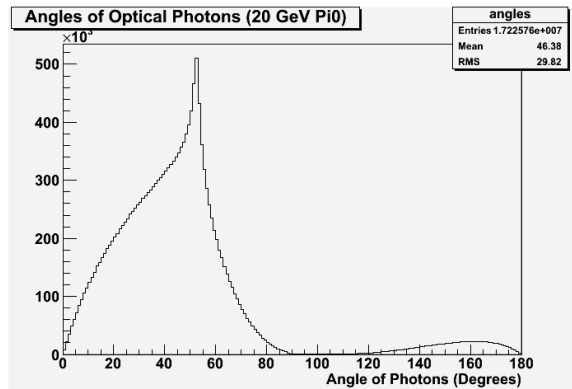
// Hadron Physics ( Apply related processes to hadrons )
RegisterPhysics( new A01HadronPhysics("hadron"));

// Ion Physics ( Apply related processes to ions )
RegisterPhysics( new A01IonPhysics("ion"));

// Optical Photons from Geant code
RegisterPhysics( new G4OpticalPhysics(0));
```

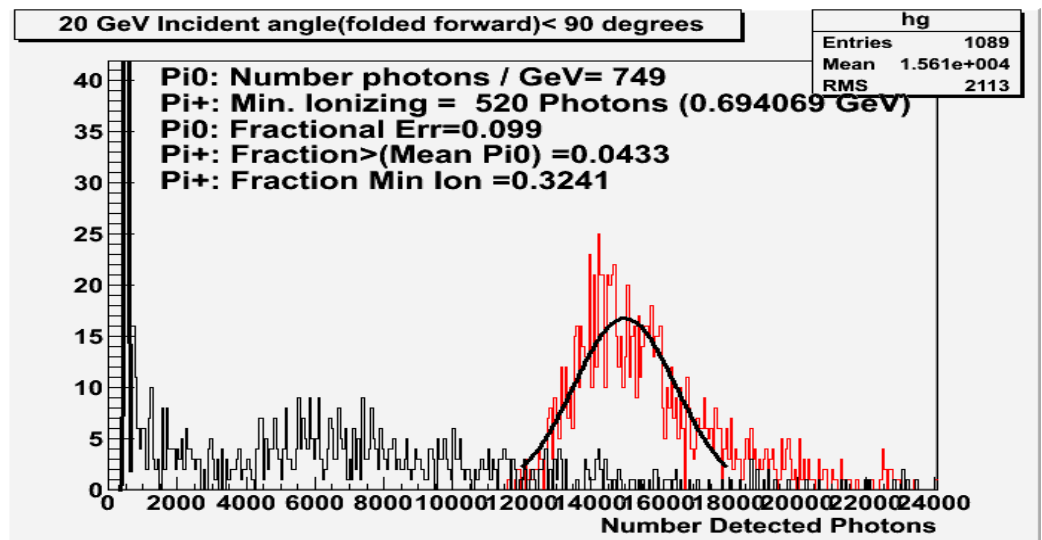
The following plots use a FPD cell with the photocathode in tight contact with the Pb glass.

20 GeV Plots (left Pi0; right pi+)



All angles (< 90 degrees)

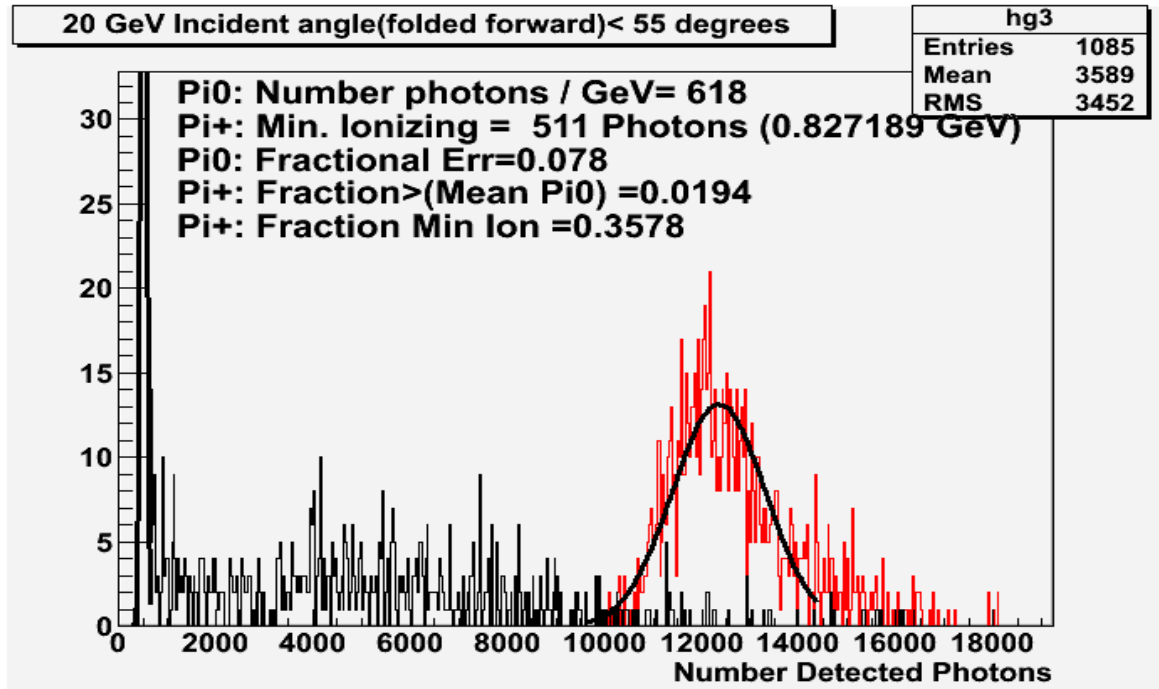
The following plot shows the distribution of the number of detected photons for about 1000 pi0 (red) and 1000 p+ (black) events and a photocathode in close contact with the detector glass.



We note several things about these 20 GeV events:

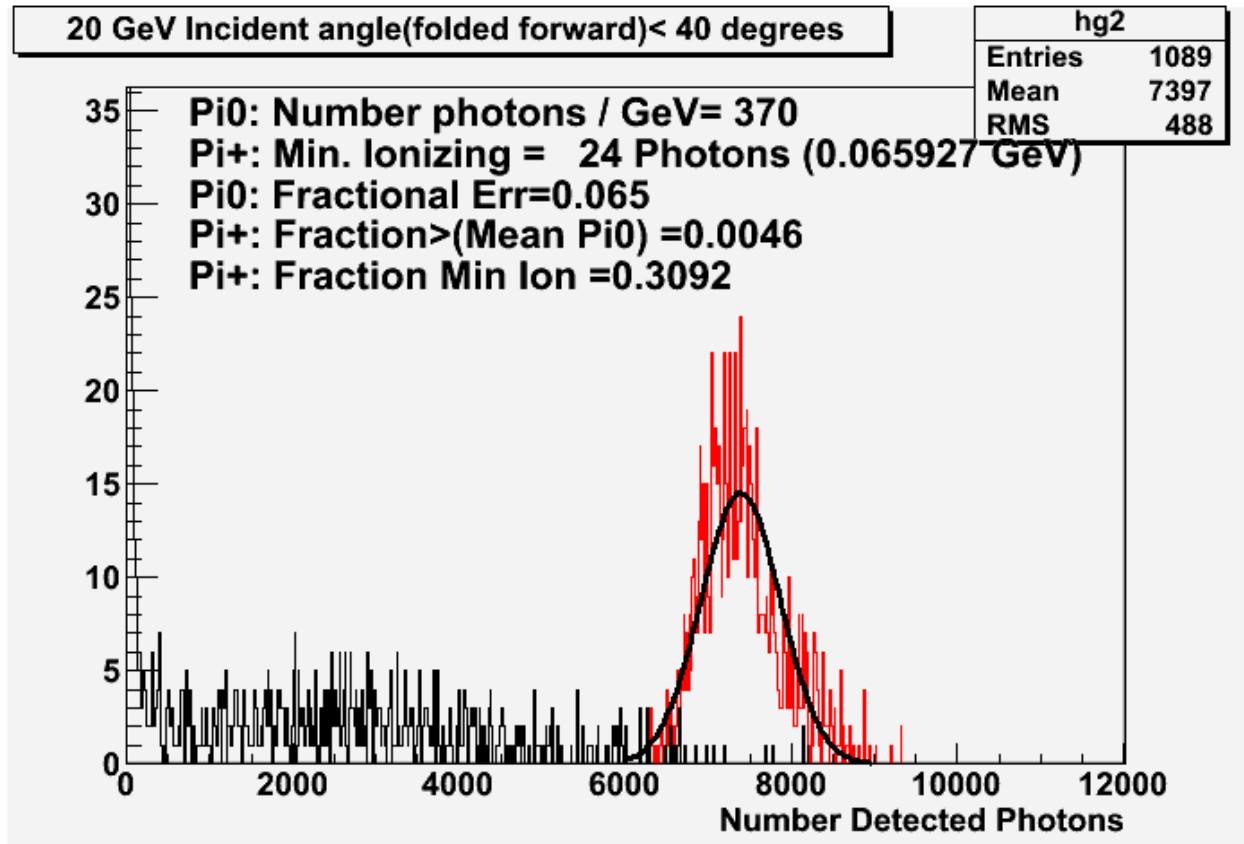
- The **response** for pi0's is about **749 detected photons per GeV** of incident energy.
- The resolution for **pi0's** is about **9.9%** of signal.
- The fraction of **pi+** events that contribute to minimum ionizing peak is about **32%**.
- The single particle pi+ ionization peak is about **520 Photons**, based on pi0's this corresponds to about 0.694 GeV. About **32%** of the Pi+ events are in the minimum ionizing peak.
- About **4%** of the pi+ events produce more photons than the nominal 750 photons per GeV of the pi0 peak.

Select angles 20 GeV (< 55 degrees)



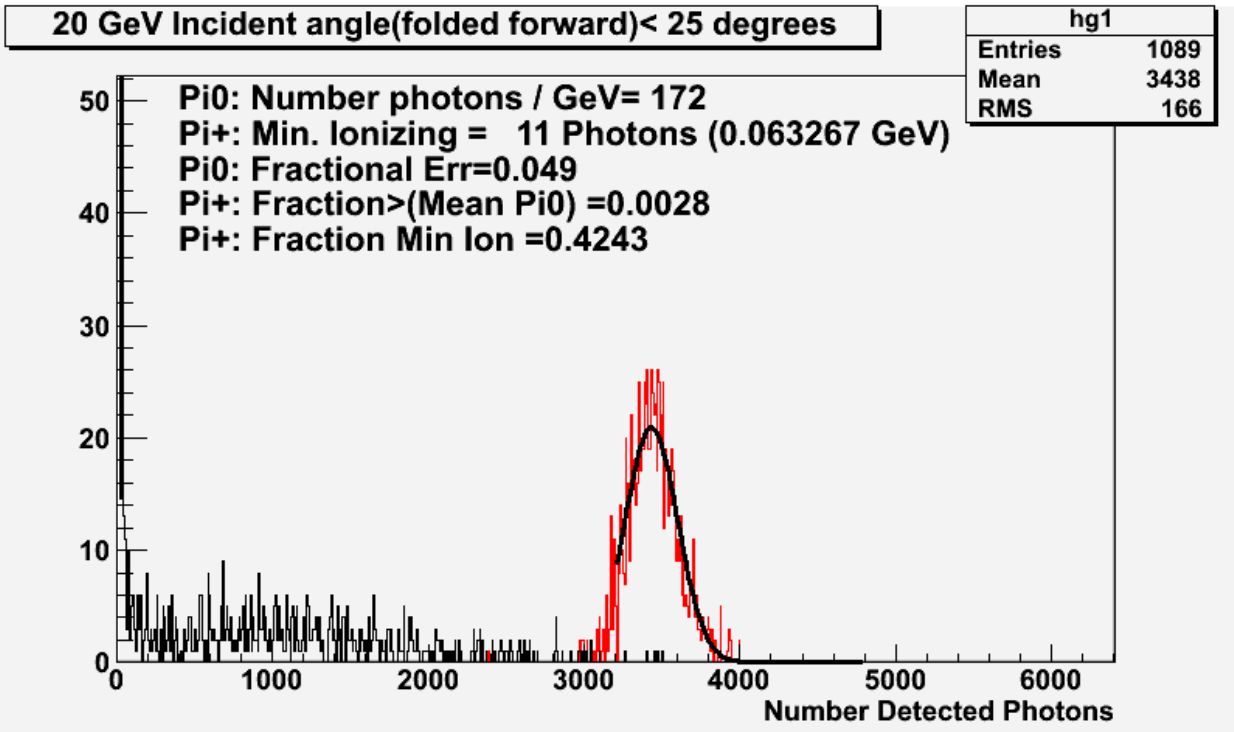
- The **response** for pi0's is about **618 detected photons per GeV** of incident energy.
- The resolution for pi0's is about **7.8%** of signal.
- The fraction of pi+ events that contribute to minimum ionizing peak is about **36%**.
- The single particle pi+ ionization peak is about **511 Photons**, based on pi0's this corresponds to about 0.827 GeV.
- About **1.94%** of the pi+ events produce more photons than the nominal **618 photons per GeV** of the pi0 peak.

Select angles 20 GeV (<40 degrees)



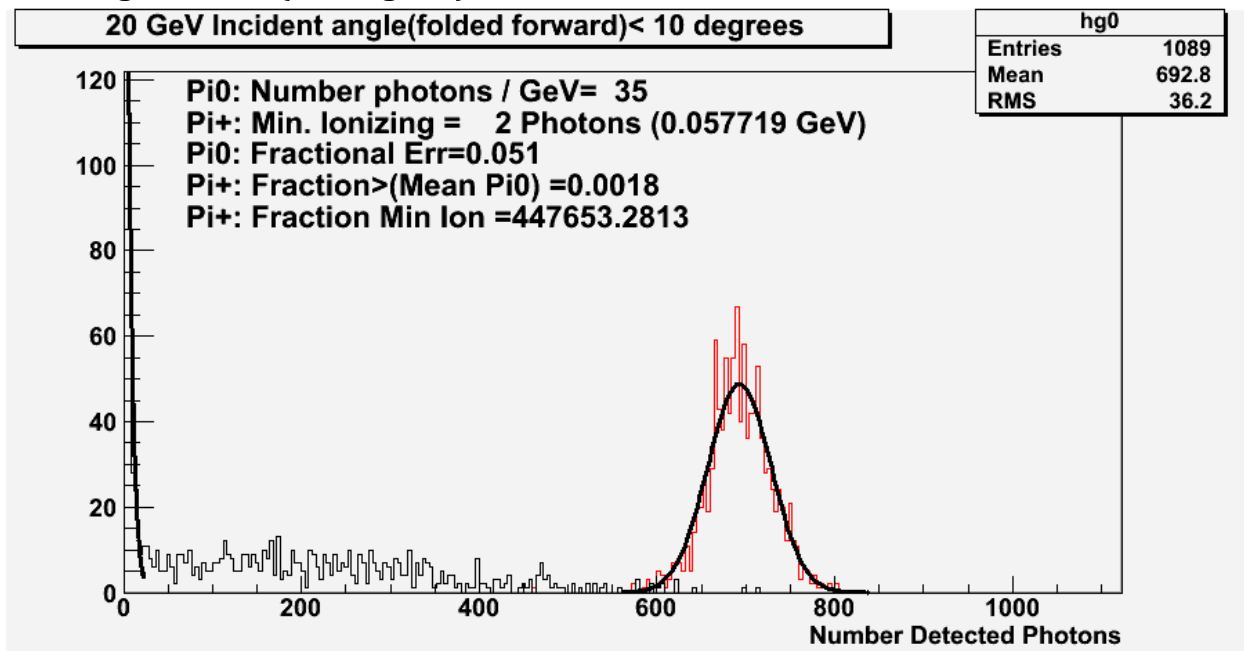
- The **response** for pi0's is about **370 detected photons per GeV** of incident energy.
- The resolution for pi0's is about **6.5%** of signal.
- The fraction of pi+ events that contribute to minimum ionizing peak is about **30.9%**.
- The single particle pi+ ionization peak is about **24 Photons**, based on pi0's this corresponds to about **0.065 GeV**.
- About **.4%** of the pi+ events produce more photons than the nominal **370 photons per GeV** of the pi0 peak.

Select angles 20 GeV (<25 degrees)



- The **response** for pi0's is about **172 detected photons per GeV** of incident energy.
- The resolution for pi0's is about **4.9%** of signal.
- The fraction of pi+ events that contribute to minimum ionizing peak is about **42.0%**.
- The single particle pi+ ionization peak is about **11 Photons**, based on pi0's this corresponds to about **0.063 GeV**.
- About **0.28%** of the pi+ events produce more photons than the nominal **172 photons per GeV** of the pi0 peak.

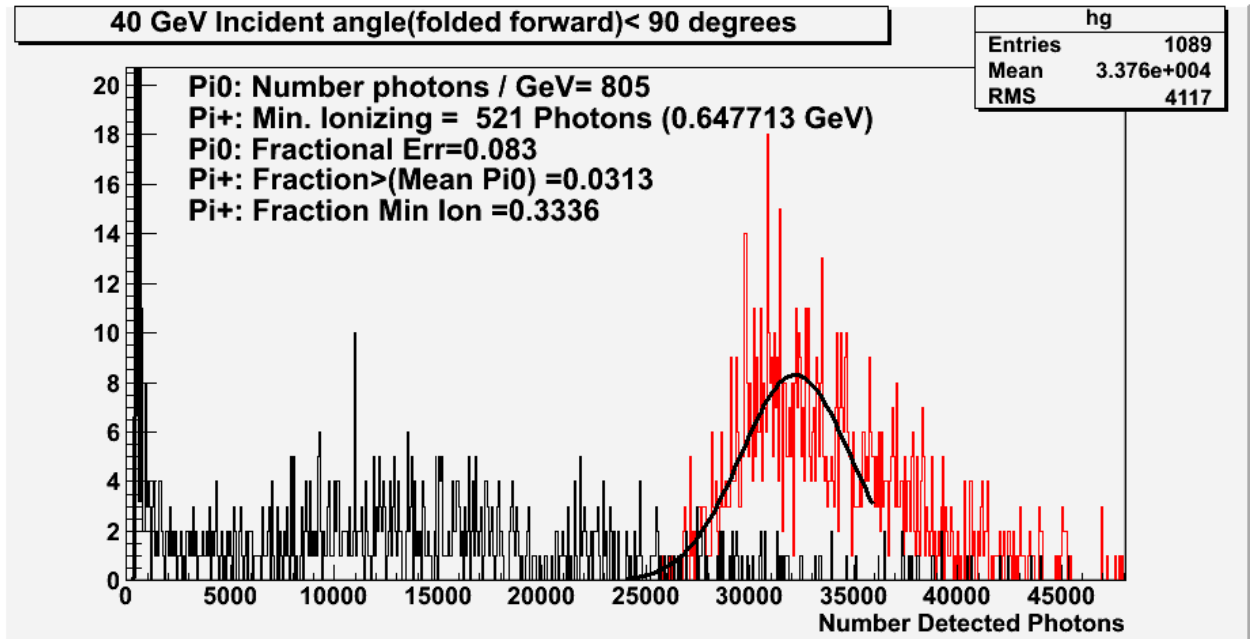
Select angles 20 GeV (<10 degrees)



- The **response** for pi0's is about **35 detected photons per GeV** of incident energy.
- The resolution for pi0's is about **5.1%** of signal.
- The fraction of pi+ events that contribute to minimum ionizing peak is about **30%**.
- The single particle pi+ ionization peak is about **5 Photons**, based on pi0's this corresponds to about **0.058 GeV**.
- About **0.18%** of the pi+ events produce more photons than the nominal **35 photons per GeV** of the pi0 peak.

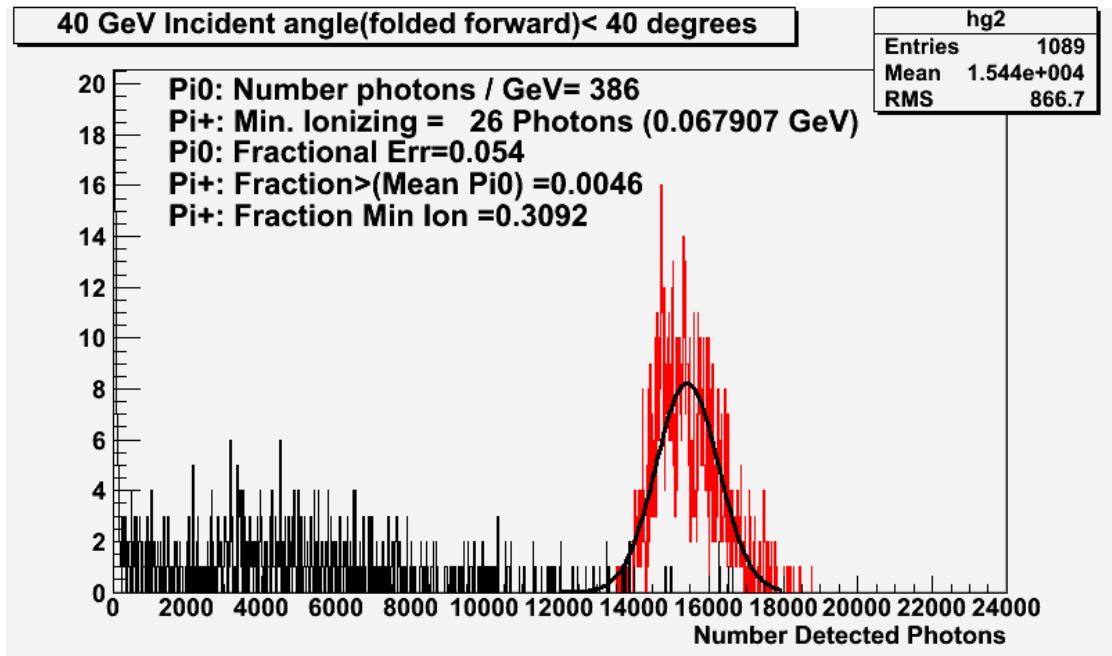
40 GeV Plots

Select angles 40 GeV All angles (<90 degrees)

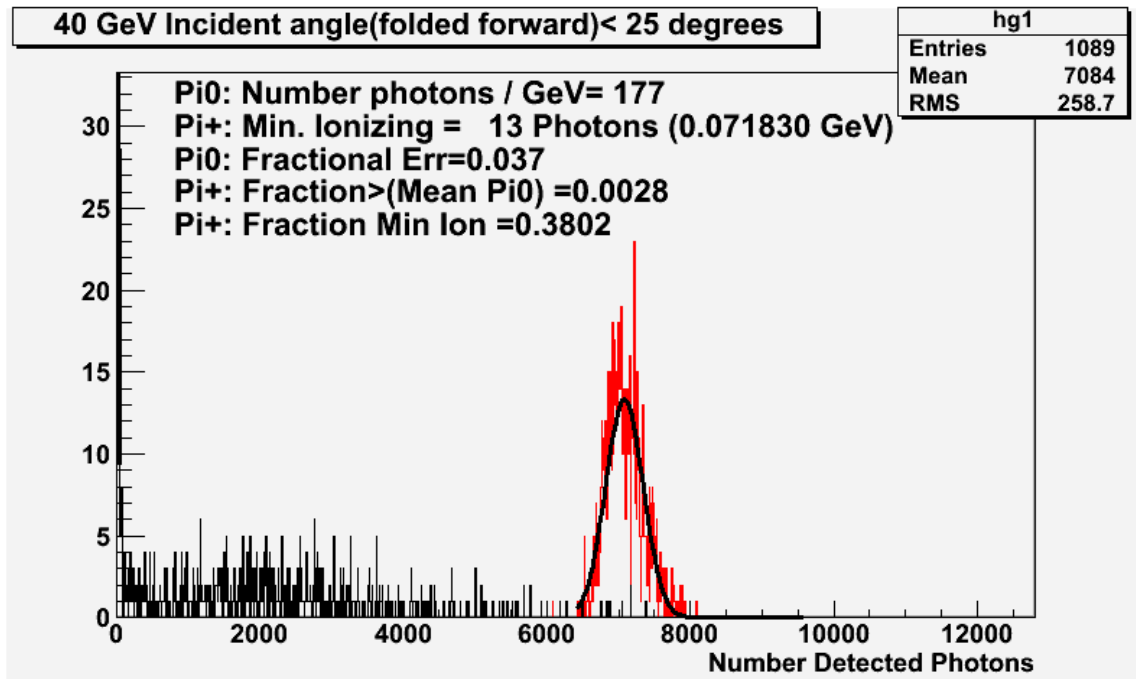


- The **response** for pi0's is about **805 detected photons per GeV** of incident energy.
- The resolution for pi0's is about **8.3%** of signal.
- The fraction of pi+ events that contribute to minimum ionizing peak is about **33%**.
- The single particle pi+ ionization peak is about **521 Photons**, based on pi0's this corresponds to about **0.547 GeV**.
- About **3.1%** of the pi+ events produce more photons than the nominal **35 photons per GeV** of the pi0 peak.

Select angles 40 GeV (<40 degrees)



Select angles 40 GeV (<25 degrees)



- The resolution for pi0's is about 3.7% of signal.