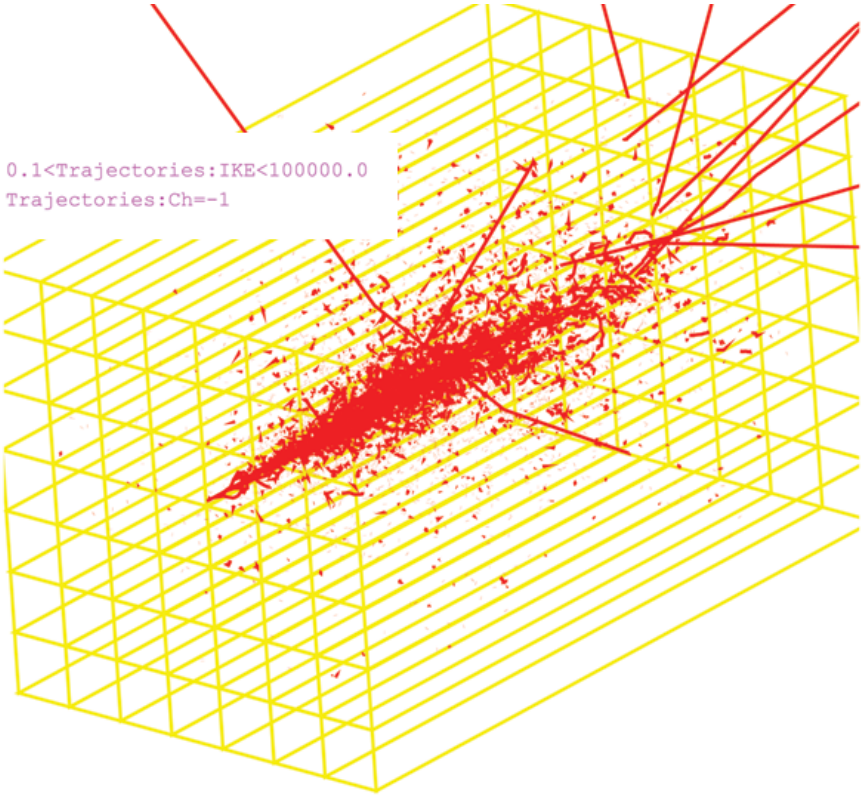
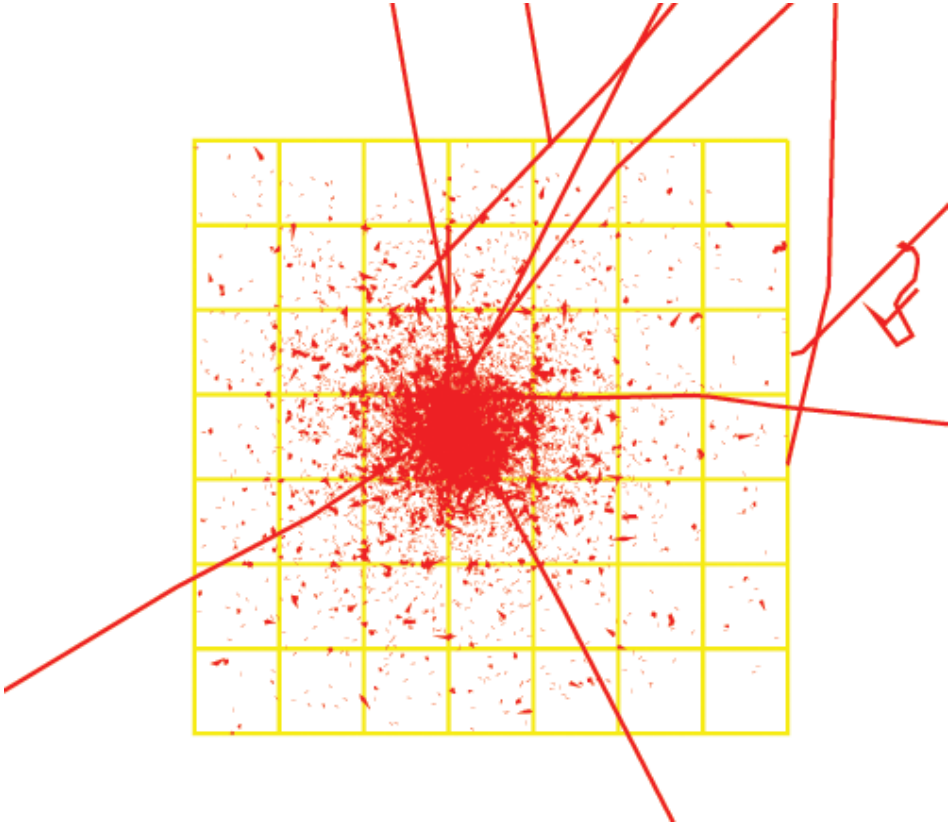
# Geant 4: “Pb Glass” Showers

7x7 Array Pb Glass (3.81x3.81 ) blocks
20 GeV Photon ;
Normal incidence
X=-1.41.4 cm  Y=0. cm (from center)
Shown are all electrons with KE>100 KeV



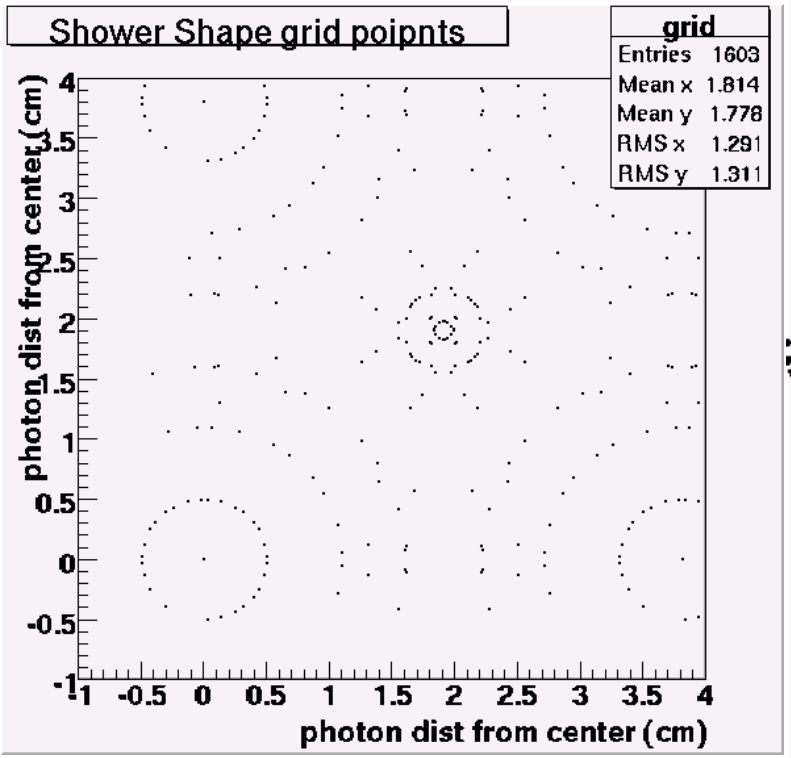
# Pb Glass

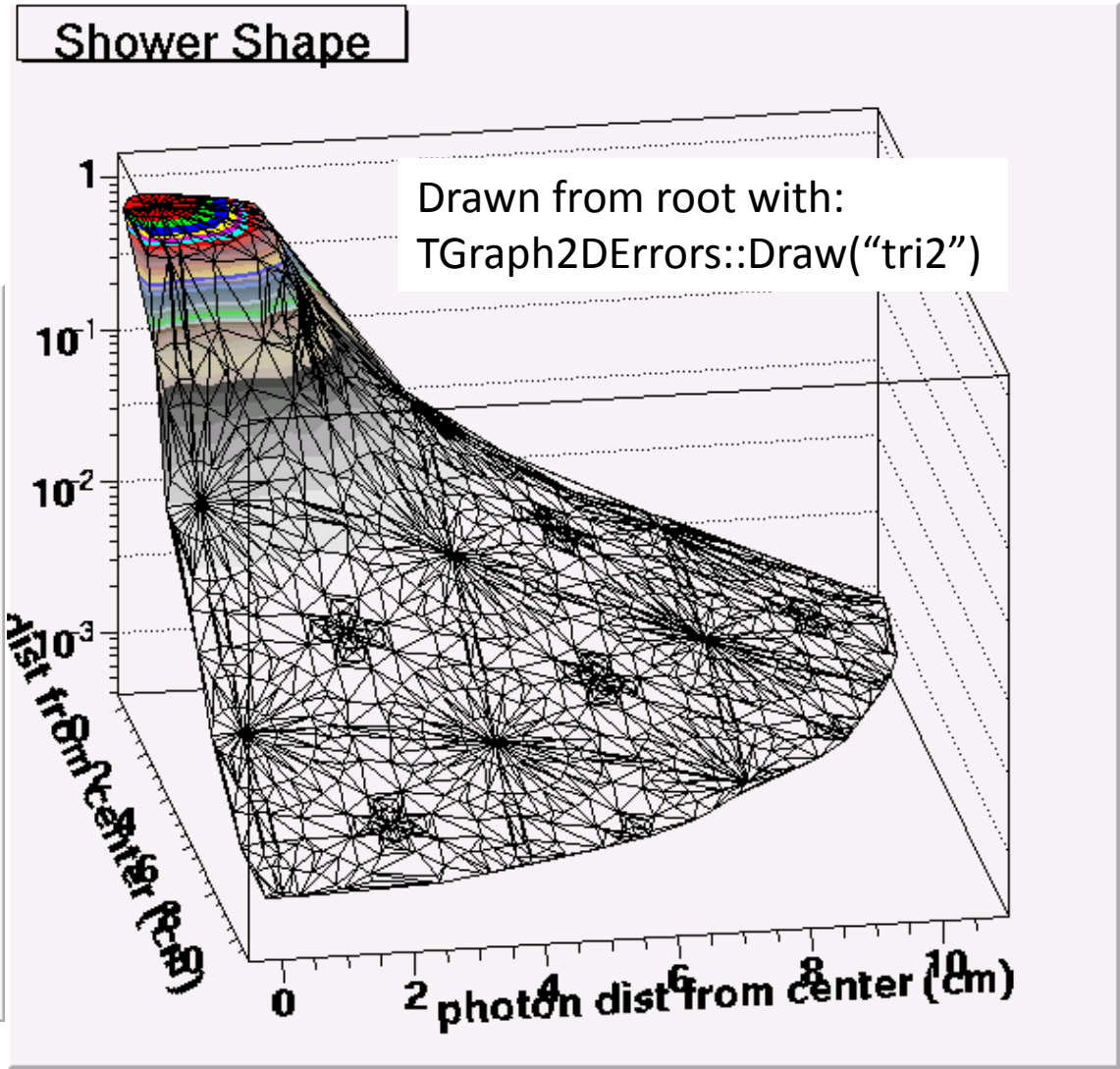
```
//Pb Glass

G4Material* Pbg386 = new G4Material("PbGlass386", density= 3.86*g/cm3, nel=5);

 G4double fudge=65.4/60.712;
 G4double fudge2=(100.-65.4)/(100.-60.712);
 fudge=1.;
 fudge2=1.;

 Pbg386->AddElement(PbE,fudge*60.712*perCent);
 Pbg386->AddElement(K,2.324*perCent*fudge2);
 Pbg386->AddElement(Si,14.771*perCent*fudge2);
 Pbg386->AddElement(O,22.041*perCent*fudge2);
 Pbg386->AddElement(As,.152*perCent*fudge2);
 G4Material* PbGl=Pbg386;



  NbOfCells = 49;
  CellWidth = 3.81*cm;
  CellSpacing=3.82*cm;
  CellLength=45.*cm;
```

Generate 1000 photons at each location (x,y) shown below-left. Photons incident directions are along “z” axis. Resulting shape shown below-right.

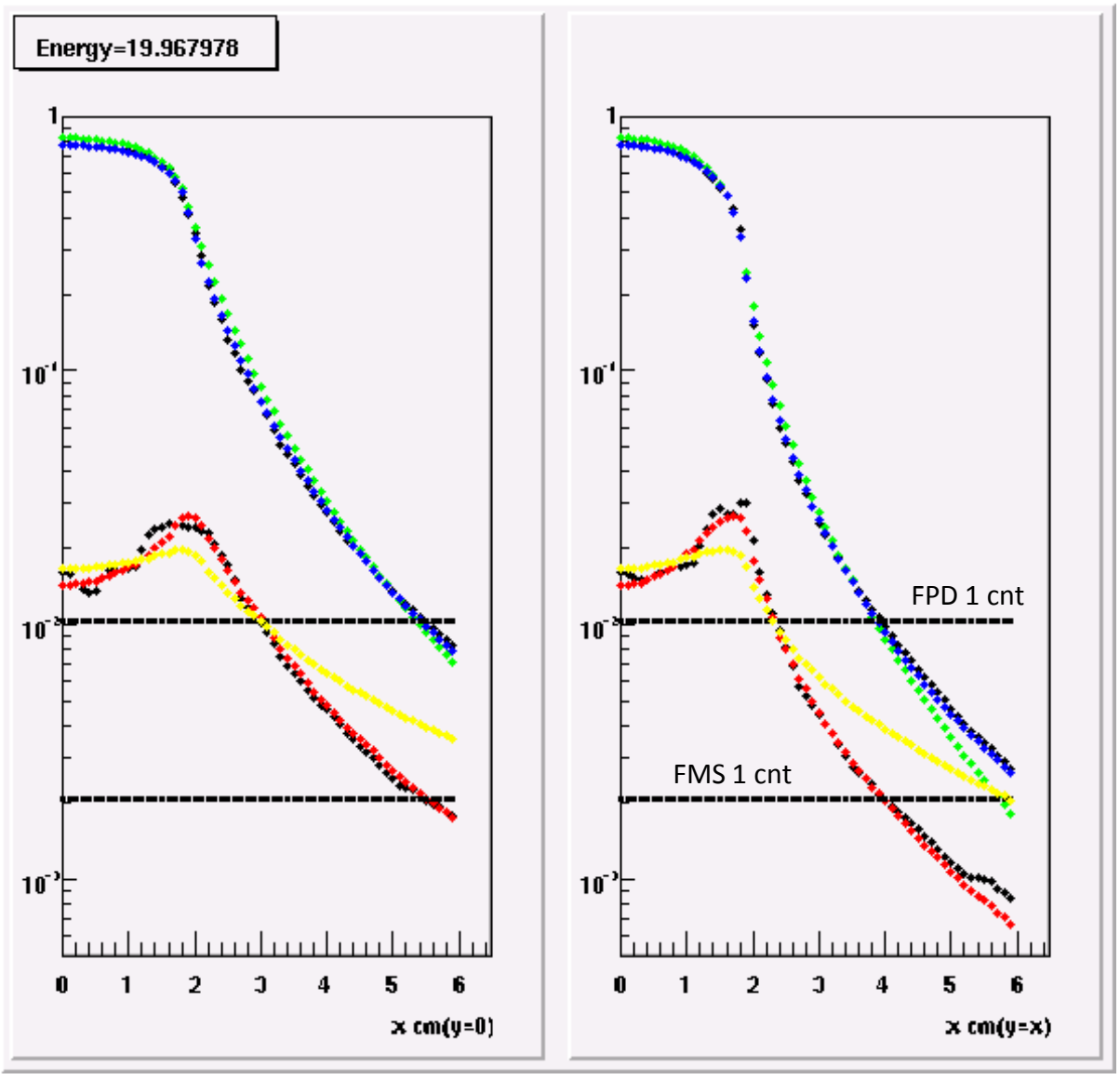
Triangular interpolation between Generated points .

To generate continuous function Shape(x,y).



# Various Shower Shapes and Errors with 20 GeV Photon.




Black upper: Shower shape from Geant4 analysis.

Black lower: Error shape from Geant4 analysis.

Green: default Shower Shape from reconstruction

float a0[3]={.8,.3,-.1};
float b0[3]={.8,.2,7.6};

Yellow: default Error shape

$$\Delta E_{cell} = \sqrt{(.03)E_{cell}\left(1-\frac{E_{cell}}{E_{photon}}\right)}$$

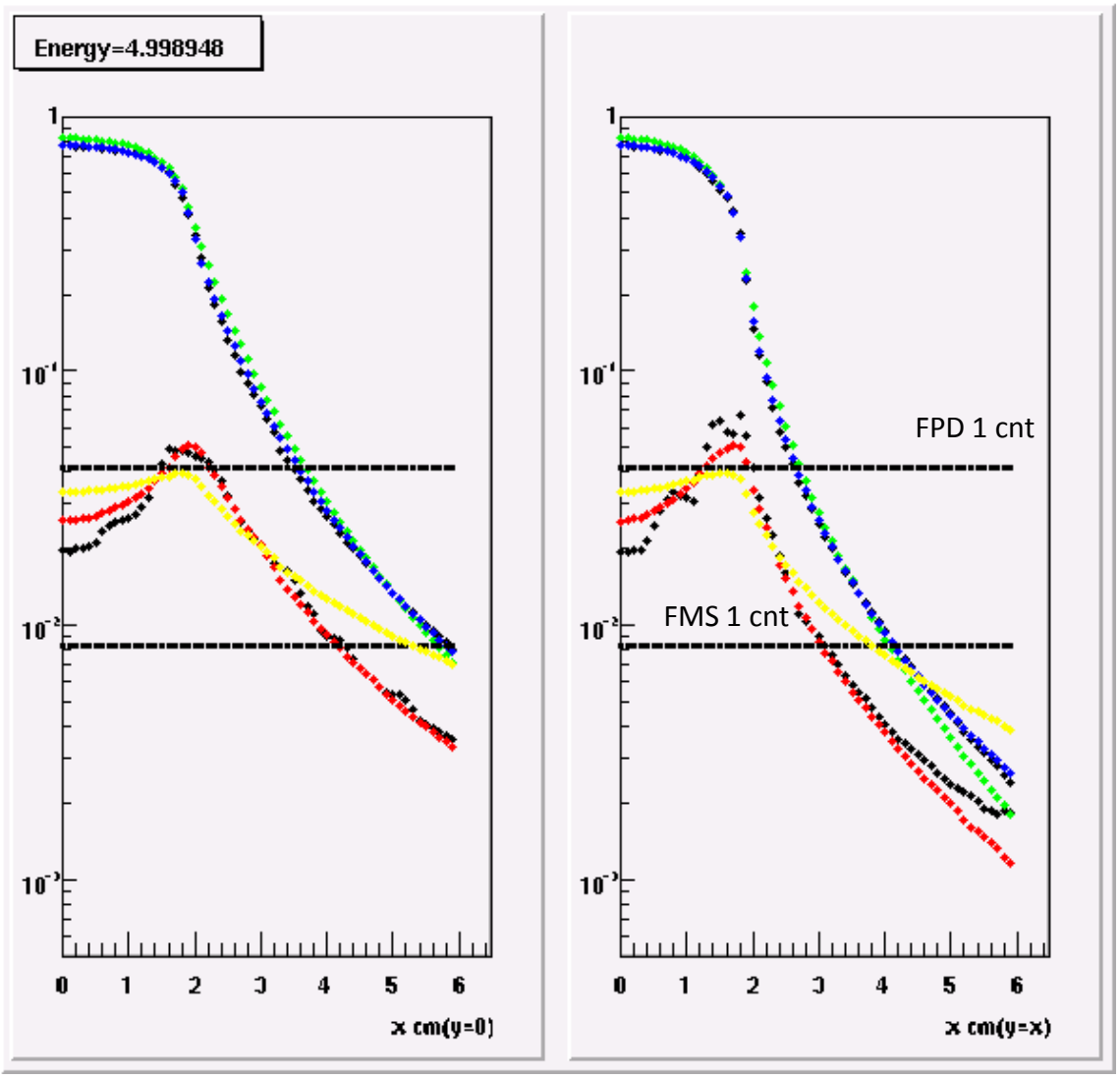
Blue: Suggested Shape:

float b1[3]={.82,.16,7.6};
float a1[3]={.66,.34,.0};

Red: Suggested Error:

$$\Delta E_{cell} = \sqrt{(.24)\left(\frac{E_{cell}}{E_\gamma}\right)^{(1.75-(.001)E_\gamma}\left(1-\frac{E_{cell}}{E_\gamma}\right)^{2.72-.012E_\gamma}E_\gamma}$$

# Same (5 GeV photon)




Black upper: Shower shape from Geant4 analysis.
Black lower: Error shape from Geant4 analysis.

Green: default Shower Shape from reconstruction

```
float a0[3]={.8,.3,-.1};
float b0[3]={.8,.2,7.6};
```

Yellow: default Error shape

$$\Delta E_{cell} = \sqrt{(.03)E_{cell}\left(1-\frac{E_{cell}}{E_{photon}}\right)}$$

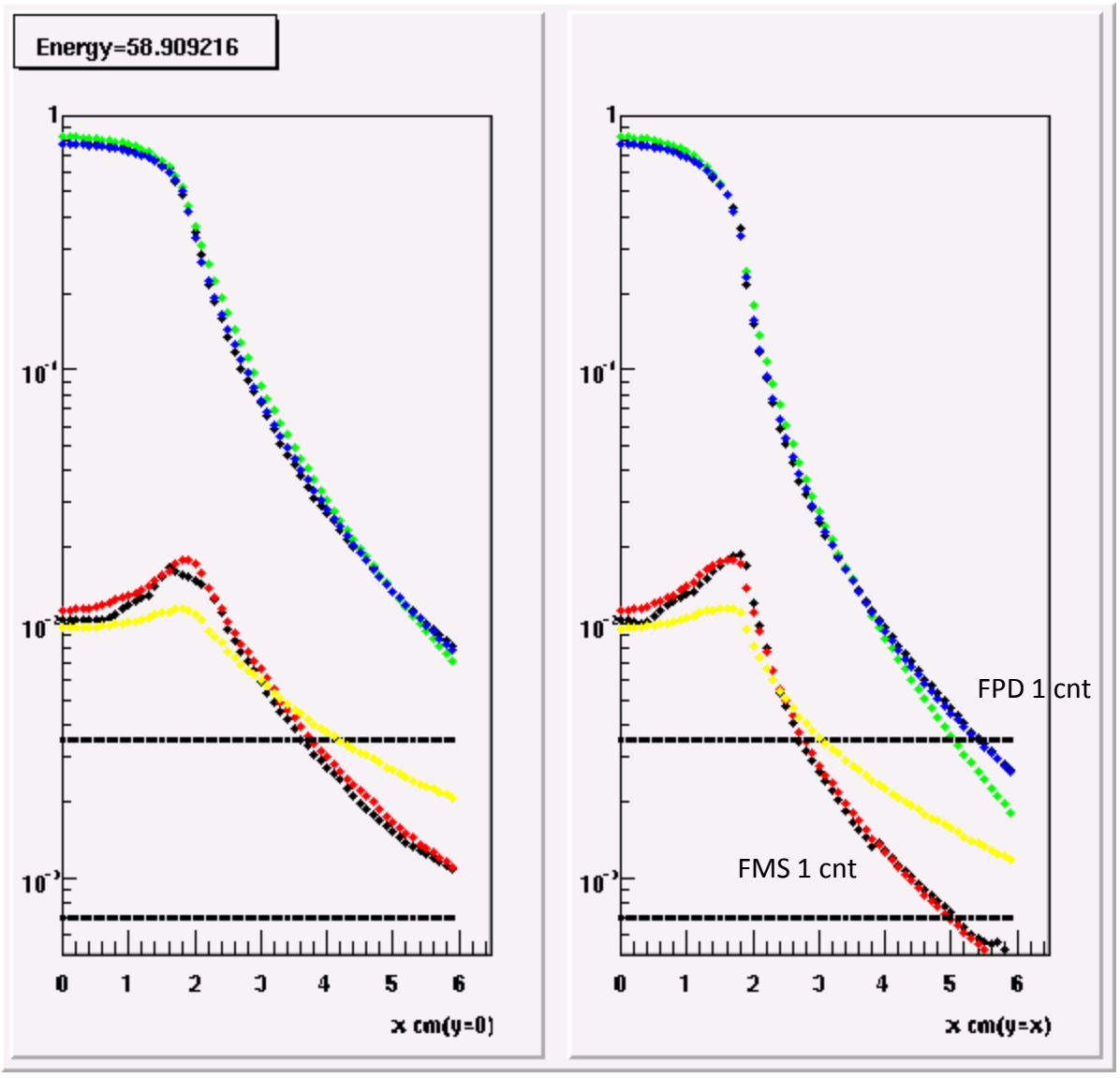
Blue: Suggested Shape:

```
float b1[3]={.82,.16,7.6};
float a1[3]={.66,.34,.0};
```

Red: Suggested Error:

$$\Delta E_{cell} = \sqrt{(.24)\left(\frac{E_{cell}}{E_{\gamma}}\right)^{(1.75-(.001)E_{\gamma}}\left(1-\frac{E_{cell}}{E_{\gamma}}\right)^{2.72-.012E_{\gamma}}E_{\gamma}}$$

# Same (60 GeV photon)




Black upper: Shower shape from Geant4 analysis.

Black lower: Error shape from Geant4 analysis.

Green: default Shower Shape from reconstruction

float a0[3]={.8,.3,-.1};
float b0[3]={.8,.2,7.6};

Yellow: default Error shape

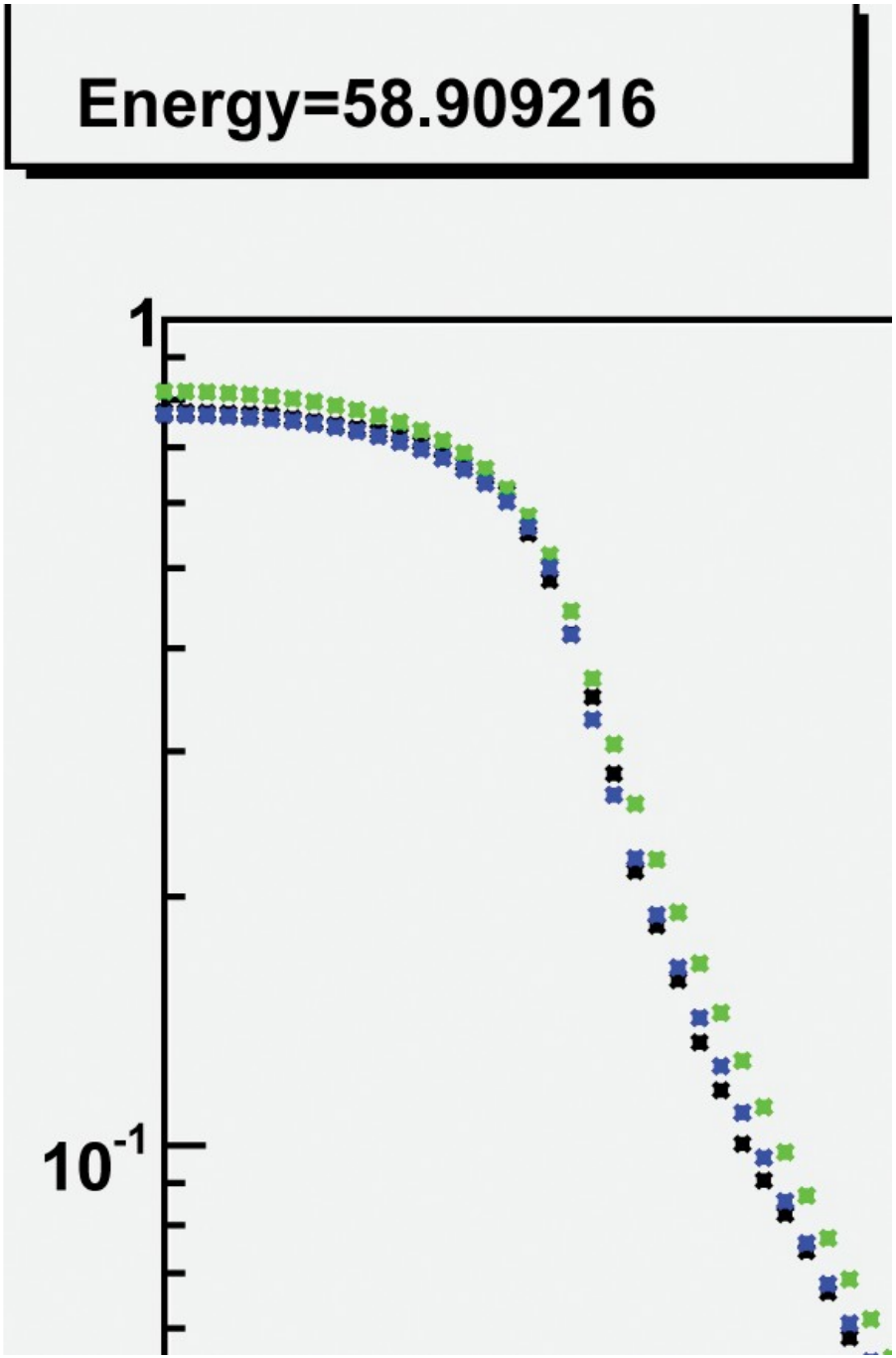
$$\Delta E_{cell} = \sqrt{(.03)E_{cell}\left(1-\frac{E_{cell}}{E_{photon}}\right)}$$

Blue: Suggested Shape:

float b1[3]={.82,.16,7.6};
float a1[3]={.66,.34,.0};

Red: Suggested Error:

$$\Delta E_{cell} = \sqrt{(.24)\left(\frac{E_{cell}}{E_\gamma}\right)^{(1.75-(.001)E_\gamma}\left(1-\frac{E_{cell}}{E_\gamma}\right)^{2.72-.012E_\gamma}E_\gamma}$$




Black upper: Shower shape from Geant4 analysis.
Black lower: Error shape from Geant4 analysis.

Green: default Shower Shape from reconstruction

```
float a0[3]={.8,.3,-.1};
float b0[3]={.8,.2,7.6};
```

Yellow: default Error shape

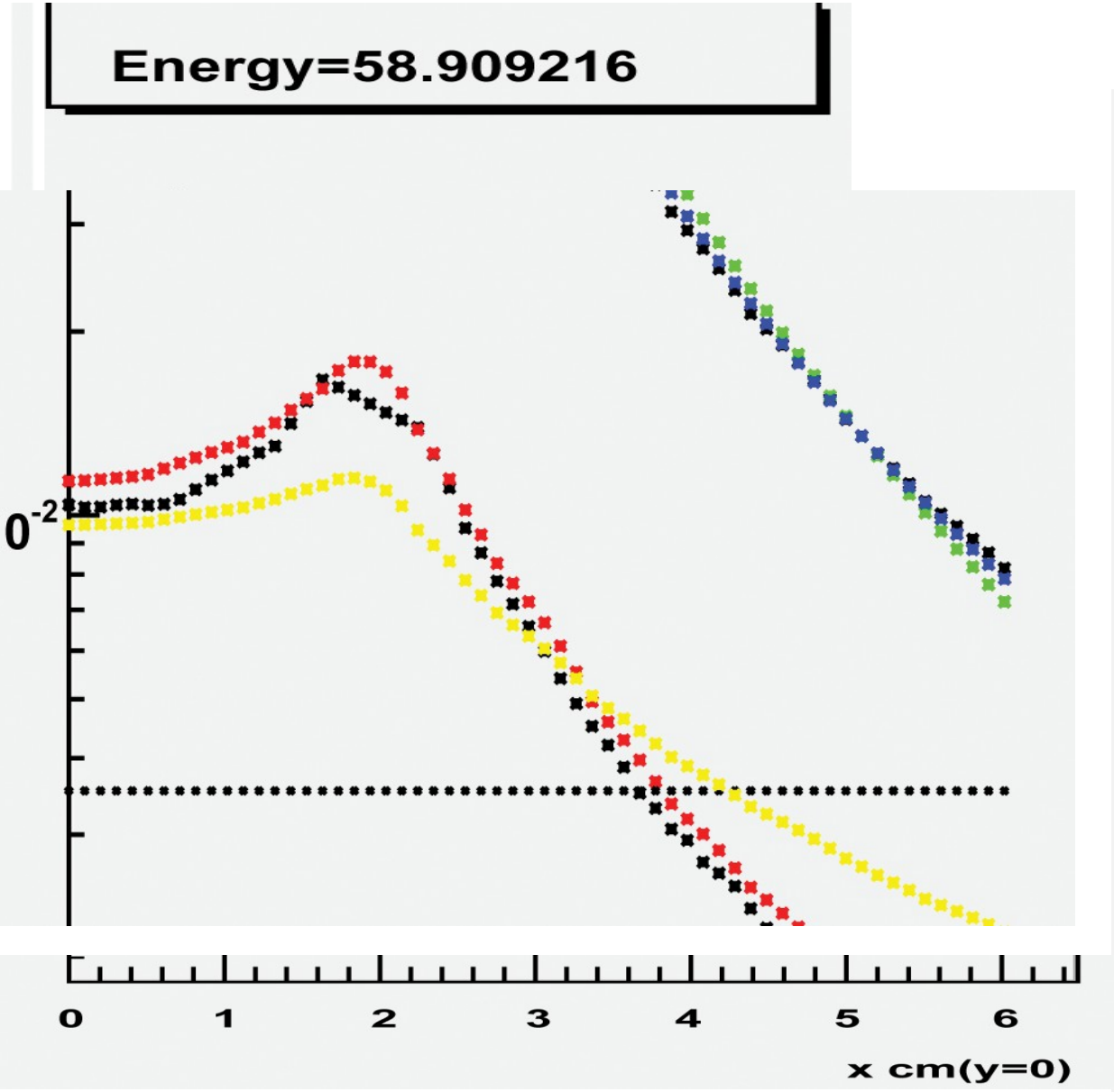
$$\Delta E_{cell} = \sqrt{(.03)E_{cell}\left(1-\frac{E_{cell}}{E_{photon}}\right)}$$

Blue: Suggested Shape:

```
float b1[3]={.82,.16,7.6};
float a1[3]={.66,.34,.0};
```

Red: Suggested Error:

$$\Delta E_{cell} = \sqrt{(.24)\left(\frac{E_{cell}}{E_{\gamma}}\right)^{(1.75-(.001)E_{\gamma}}\left(1-\frac{E_{cell}}{E_{\gamma}}\right)^{2.72-.012E_{\gamma}}E_{\gamma}}$$




Black upper: Shower shape from Geant4 analysis.

Black lower: Error shape from Geant4 analysis.

Green: default Shower Shape from reconstruction

```
float a0[3]={.8,.3,-.1};
float b0[3]={.8,.2,7.6};
```

Yellow: default Error shape

$$\Delta E_{cell} = \sqrt{(.03)E_{cell}\left(1-\frac{E_{cell}}{E_{photon}}\right)}$$

Blue: Suggested Shape:

```
float b1[3]={.82,.16,7.6};
float a1[3]={.66,.34,.0};
```

Red: Suggested Error:

$$E_{cell} = \sqrt{(.24)\left(\frac{E_{cell}}{E_\gamma}\right)^{(1.75-(.001)E_\gamma}\left(1-\frac{E_{cell}}{E_\gamma}\right)^{2.72-.012E_\gamma}E_\gamma}$$