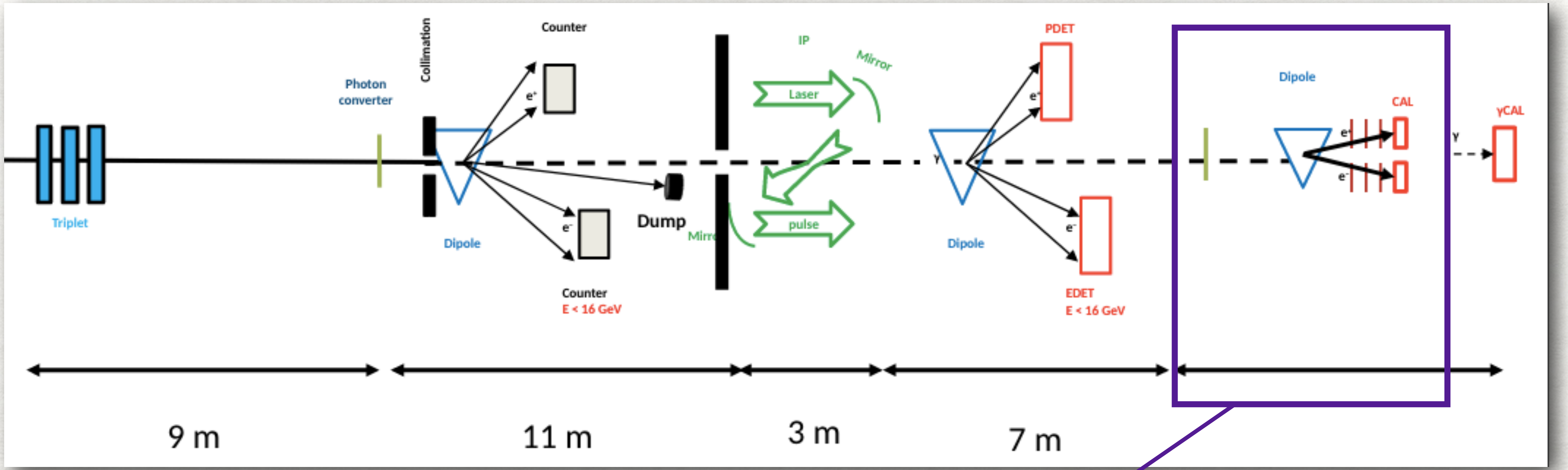
FORWARD PHOTONS

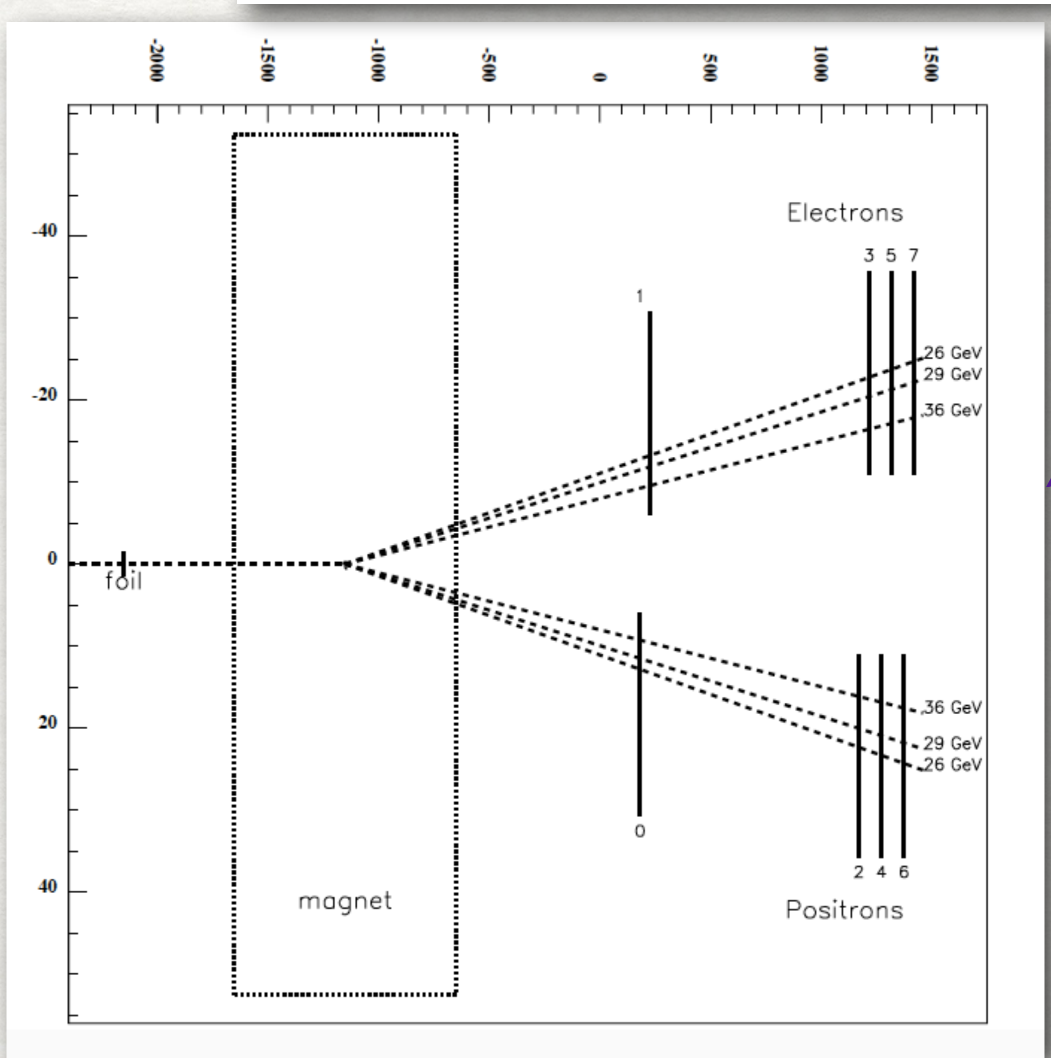
Borysova Maryna

07/01/19

LAYOUT FOR THE LUXE EXPERIMENT

Photons produced at IP1 proceed down their own beamline through the converter foil and the tracking spectrometer





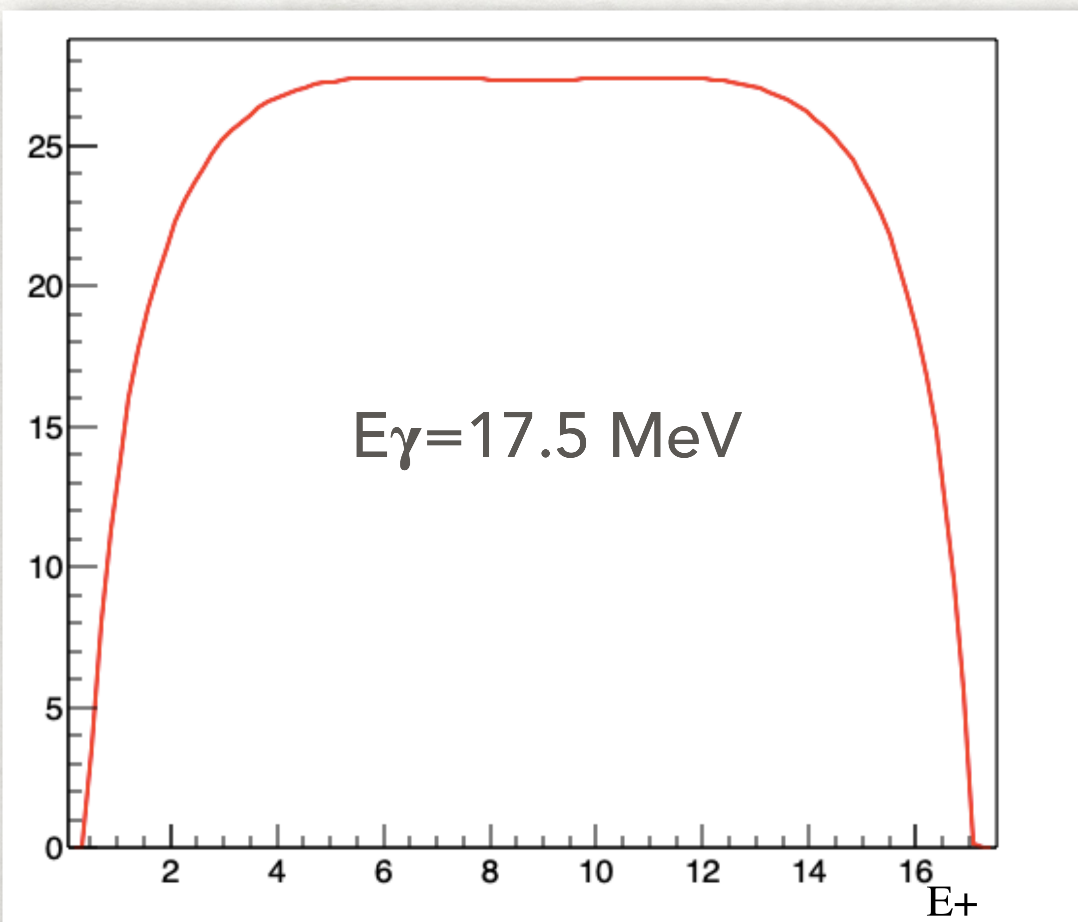
In E144 the data in the two arms of the spectrometer were analyzed independently, and then combined the reconstructed single-particle momentum spectra for comparison to a model spectrum calculated by convolving the simulated photon spectrum with the Bethe-Heitler pair spectrum

THE CLASSICAL BETHE-HEITLER PAIR SPECTRUM

The classical Bethe-Heitler formula is currently used:
H.Bethe, W.Heitler, Proc.Roy.Soc.A146 (34)83

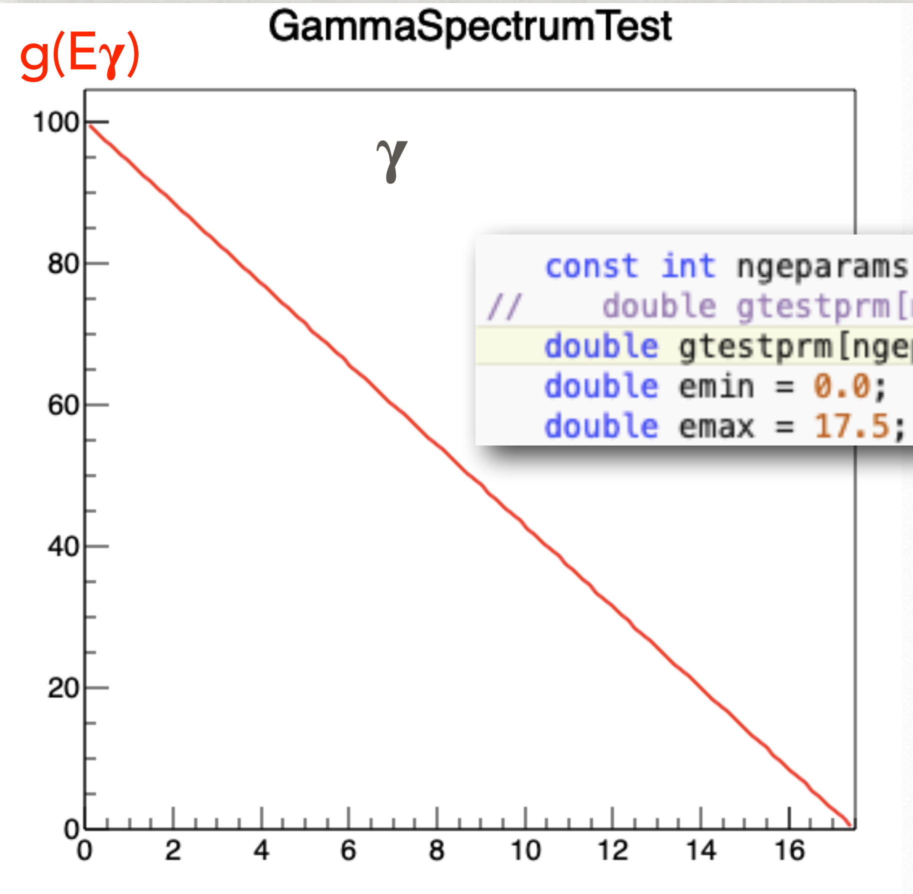
$$\Phi(E_0)\,dE_0 = \frac{Z^2}{137}\left(\frac{e^2}{mc^2}\right)^2 4\,\frac{E_0{}^2 + E_+{}^2 + \frac{2}{3}E_0E_+}{(h\nu)^3}\,dE_0\left(\log\frac{2E_0E_+}{h\nu mc^2}-\frac{1}{2}\right).$$

energies involved are large compared with mc^2



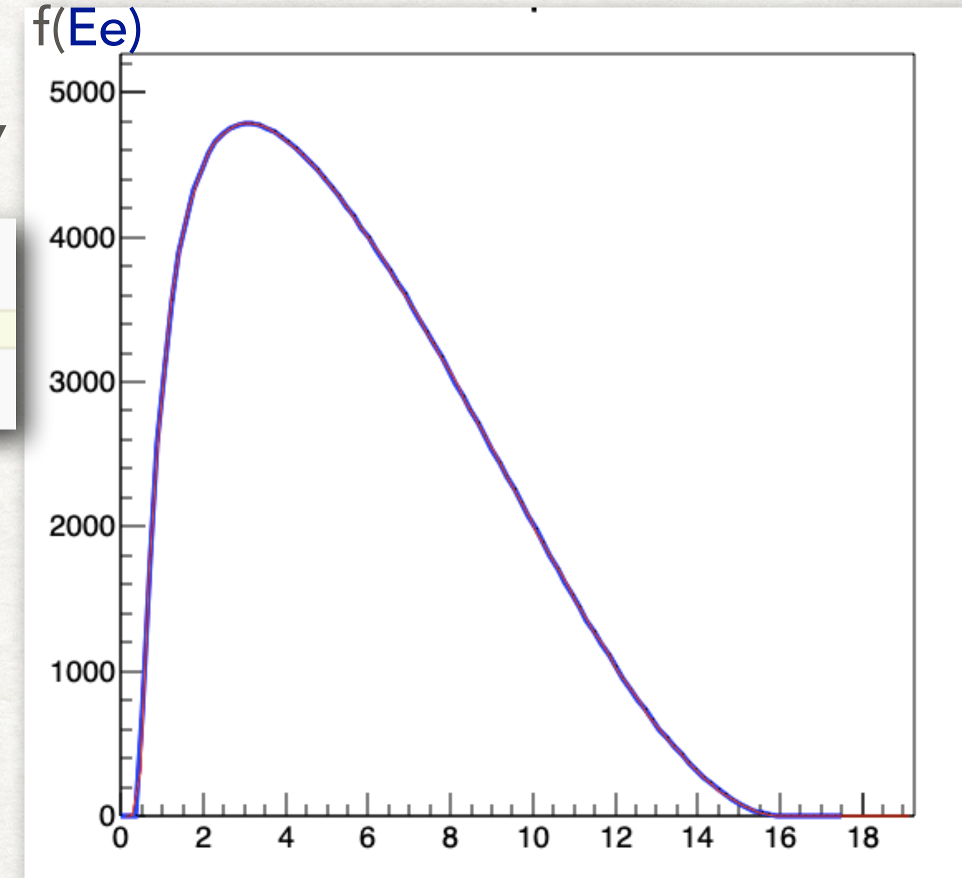
The idea - to check if in a toy model any photon spectrum could be restored if we have the classical BH distribution and characteristic shapes of photon spectrum

TESTING: LINEAR



$$f(Ee)=\int \sigma(E\gamma, Ee)\,g(E\gamma)\,dE\gamma$$

```
    const int ngeparams = 2;
//     double gtestprm[ngeparams] = {100.0, 17.5};  // linear
    double gtestprm[ngeparams] = {105.0, 0.3};    // exp
    double emin = 0.0;
    double emax = 17.5;
```

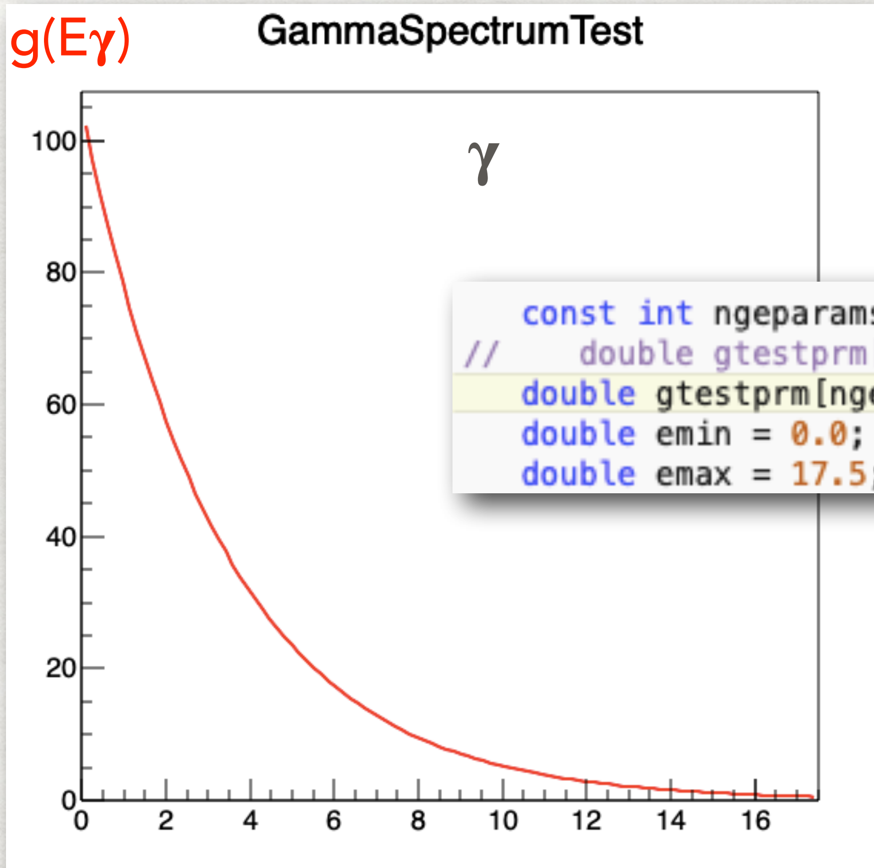


$$\int \sigma(E\gamma, Ee)\,g(E\gamma,p1,p2)\,dE\gamma$$

fitting allows finding the parameters quite well

```
****************************************
Minimizer is Minuit / Migrad
Chi2                      =  5.73475e-09
NDf                       =           98
Edm                       =  1.13143e-08
NCalls                    =          189
p0                        =          100    +/-    1.06734e-07
p1                        =         17.5    +/-    6.94118e-09
```

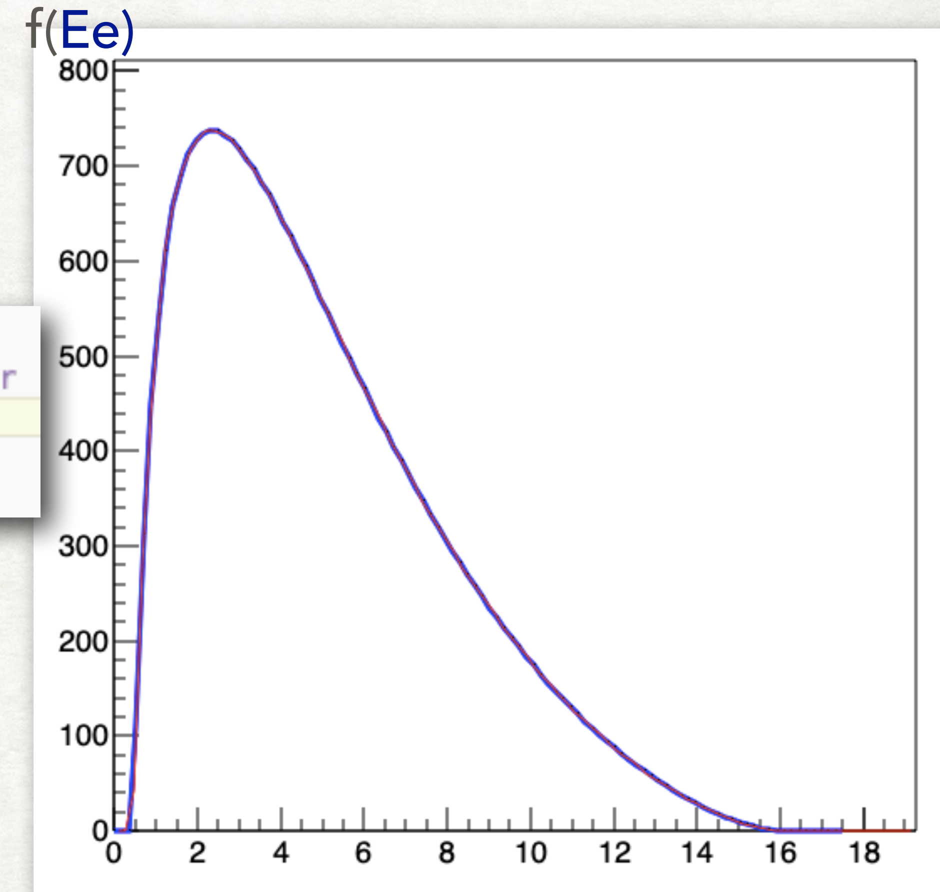
TESTING: EXPONENTIAL



BH

$E_e = \int \sigma(E_\gamma, E_e) g(E_\gamma) dE_\gamma$

```
   const int ngeparams = 2;
//     double gtestprm[ngeparams] = {100.0, 17.5};   // linear
   double gtestprm[ngeparams] = {105.0, 0.3};    // exp
   double emin = 0.0;
   double emax = 17.5;
```

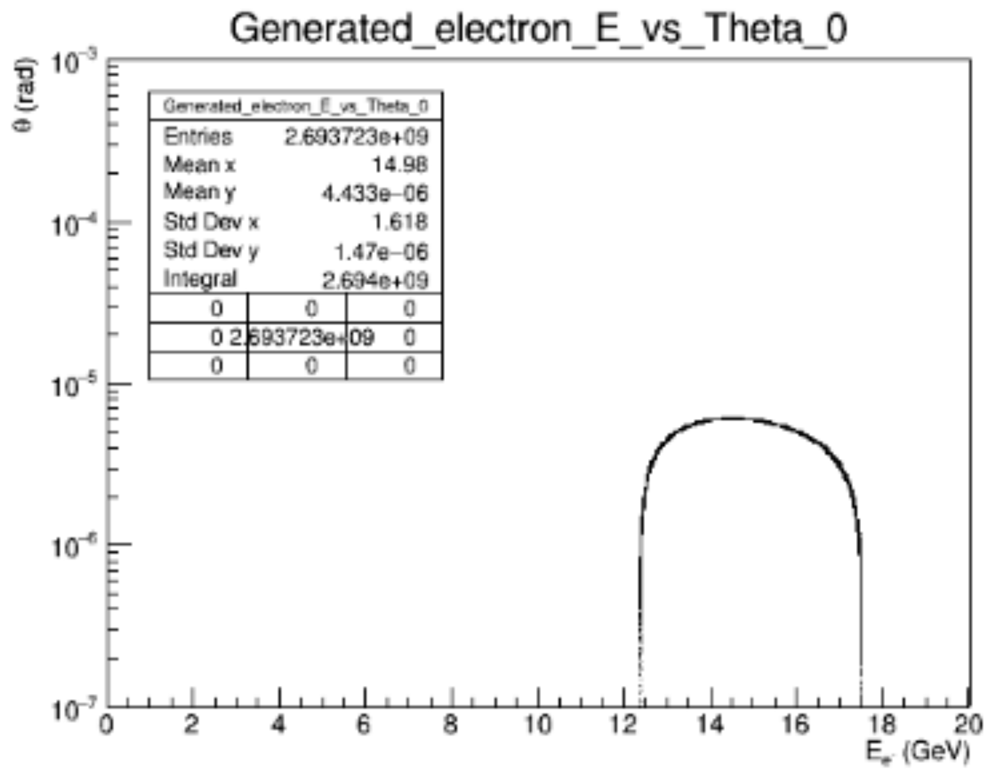


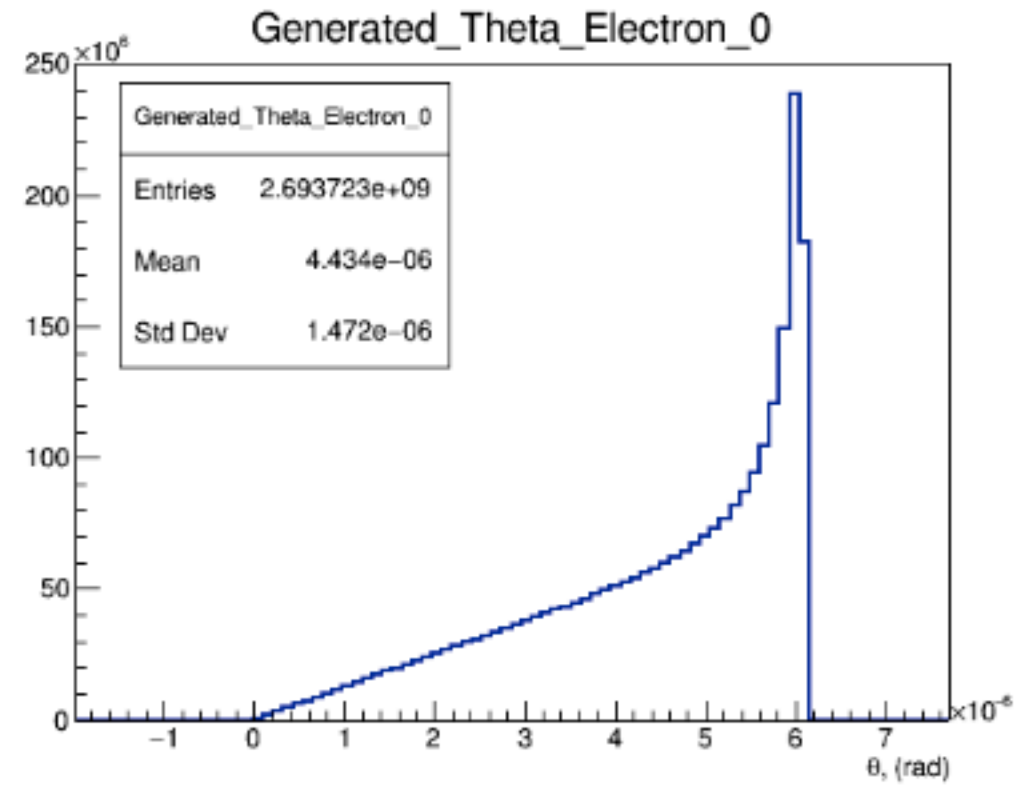
$\int \sigma(E_\gamma, E_e) g(E_\gamma, p1, p2) dE_\gamma$

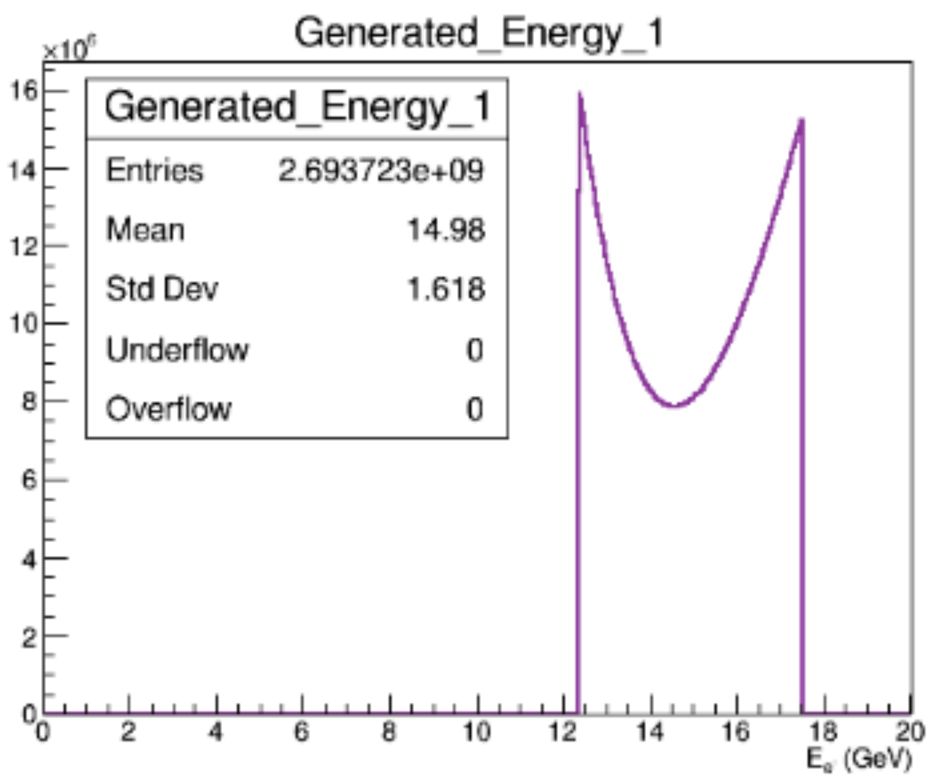
fitting allows finding the parameters with high precision

```
****************************************
Minimizer is Minuit / Migrad
Chi2                      =  8.52694e-11
NDf                       =           98
Edm                       =  1.70646e-10
NCalls                    =          167
p0                        =          105   +/-   1.72634e-07
p1                        =          0.3   +/-   1.73966e-10
```

Electrons after interaction







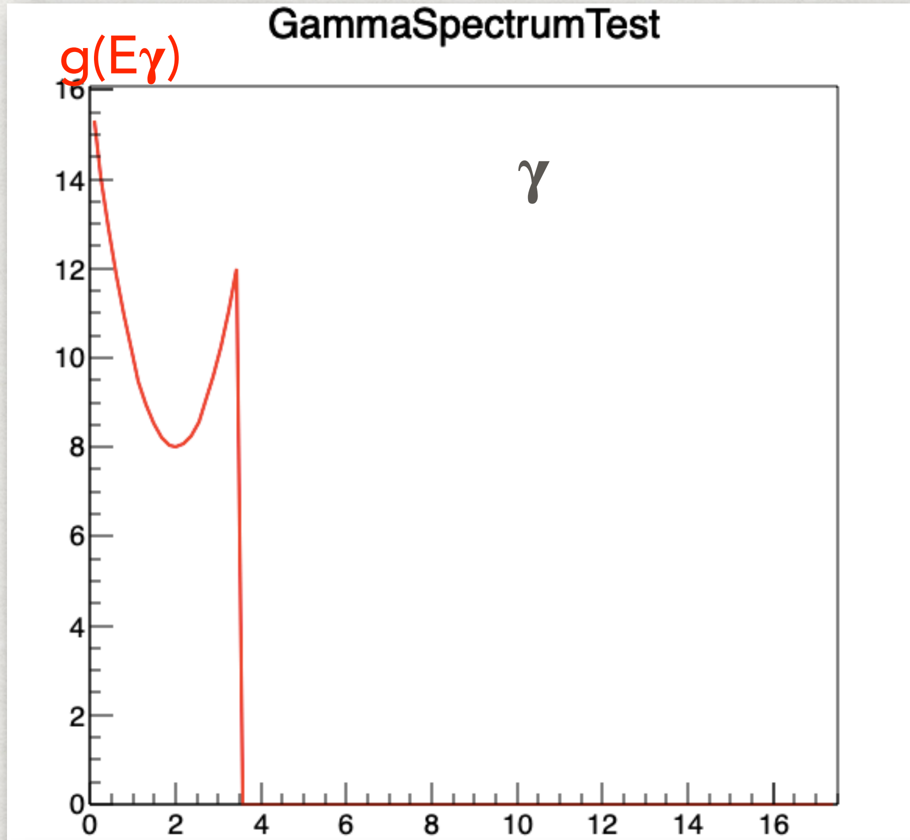
Integrated over azimuthal angle

Compton events in simulation

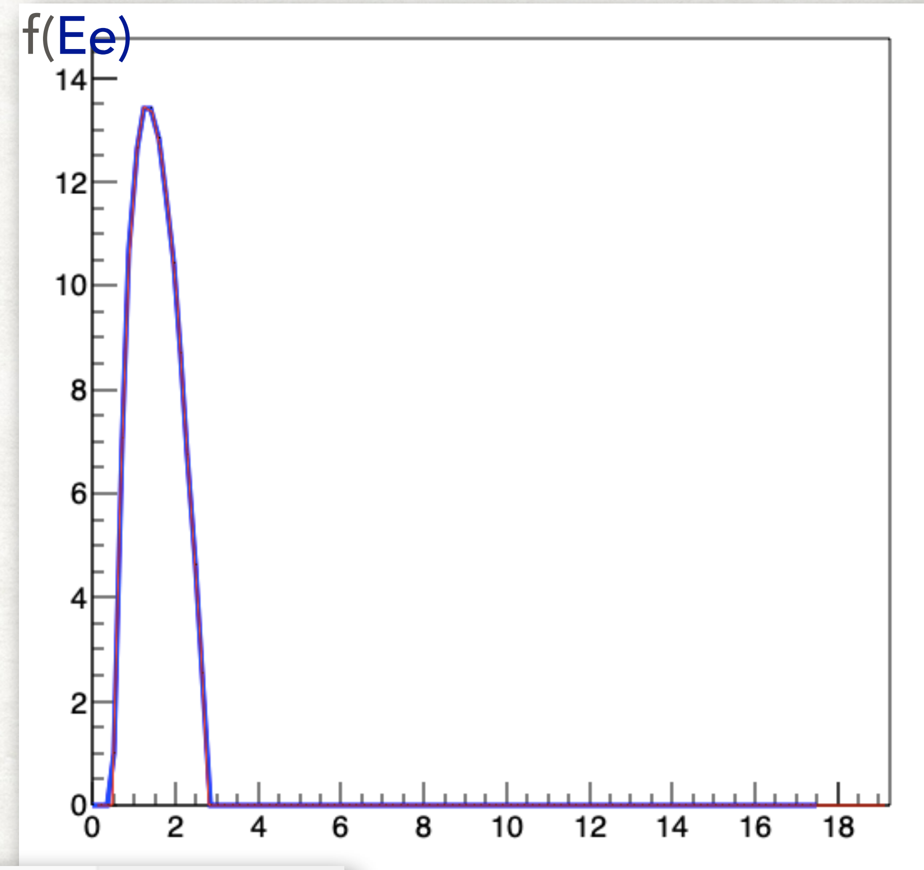
Oleksandr Borysov

LUXE Meeting
September 24, 2018

TESTING: COMPTON-LIKE



$Ee = \int \sigma(E\gamma, Ee) g(E\gamma) dE\gamma$




```
//    double gtestprm[ngeparams] = {100.0, 17.5};  // linear
//    double gtestprm[ngeparams] = {105.0, 0.3};   // exp
  const int ngeparams = 3;    double gtestprm[ngeparams] = {2.0, 2.0, 8.0};  // parabola like Compton
```

$\int \sigma(E\gamma, Ee) g(E\gamma, p1, p2) dE\gamma$

fitting allows finding the parameters quite well :

```
******************************************
Minimizer is Minuit / MigradImproved
Chi2                      =  5.92197e-07
NDf                       =           97
Edm                       =  1.27179e-06
NCalls                    =          342
p0                        =       1.9899   +/-   0.00109921
p1                        =      1.99569   +/-   0.000468708
p2                        =      7.99435   +/-   0.000639219
```

WHAT'S NEXT

- use Geant4 produced photon and e+/e- spectra.
- test if we could fit and find other parameters describing the process: target material (Z), its thickness.