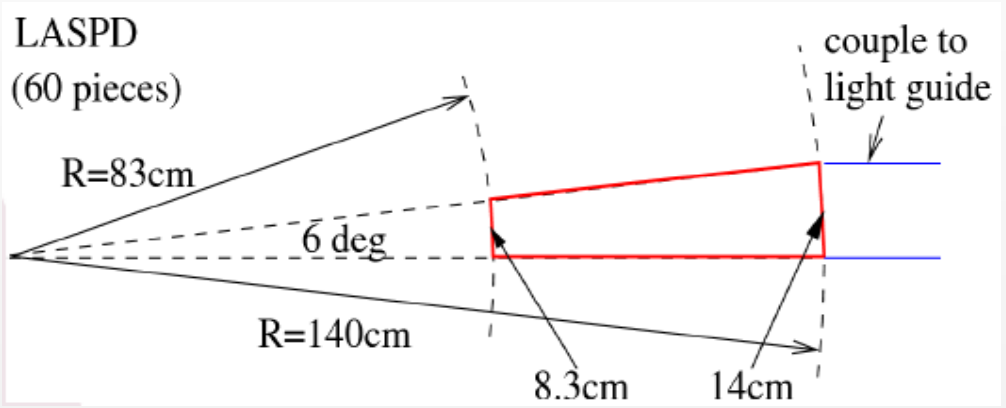
SoLID LASPD Segmentation Study

Zhihong Ye
12/23/2014

SoLID LASPD Segmentation

Assuming we need 60 pieces:



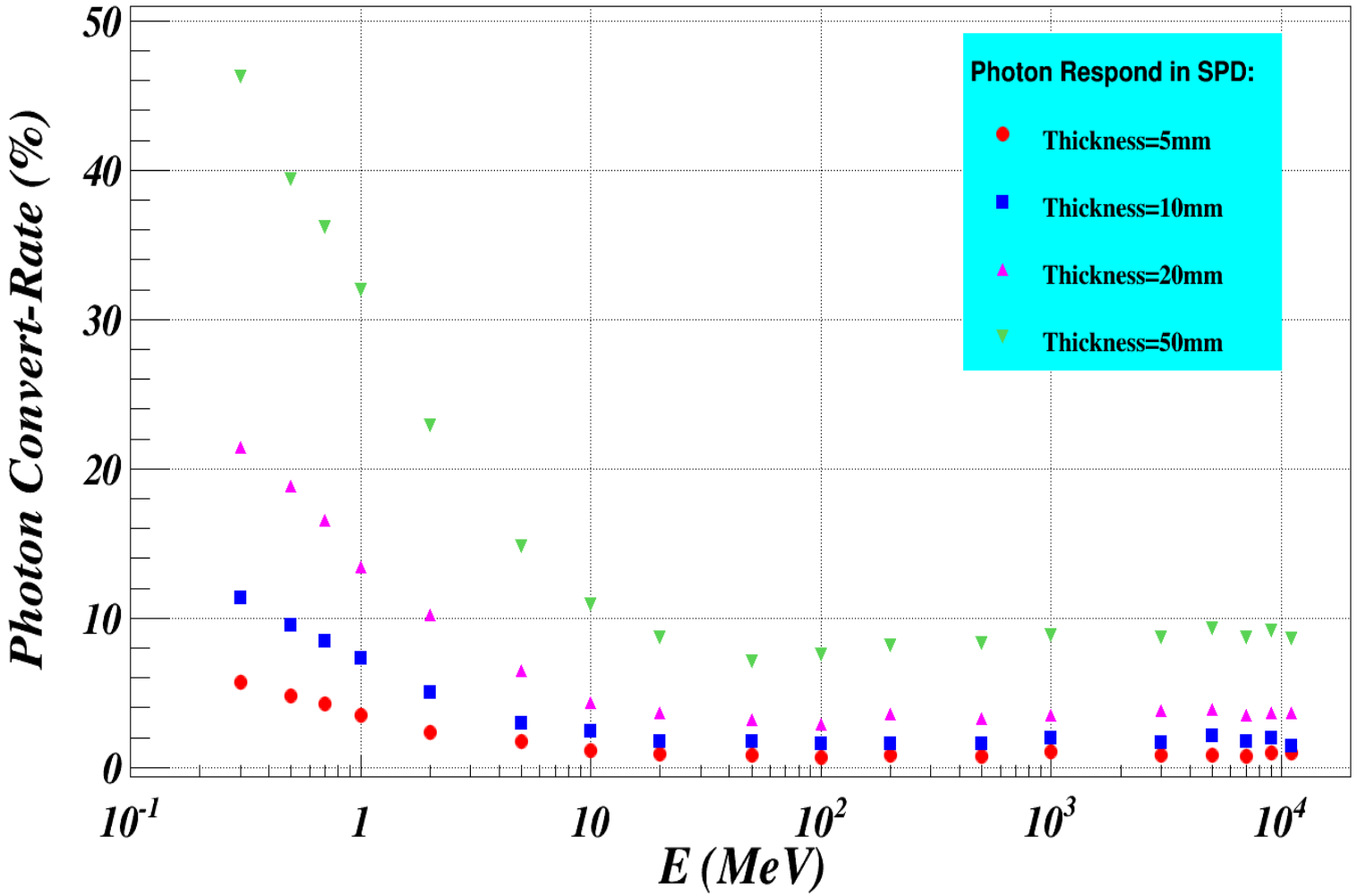
LASPD:

R_Min = 80.0 cm
R_Max = 135.0 cm
Z = -67. cm, right in front of EC
Thickness = 5mm or 1cm or 2cm or ...

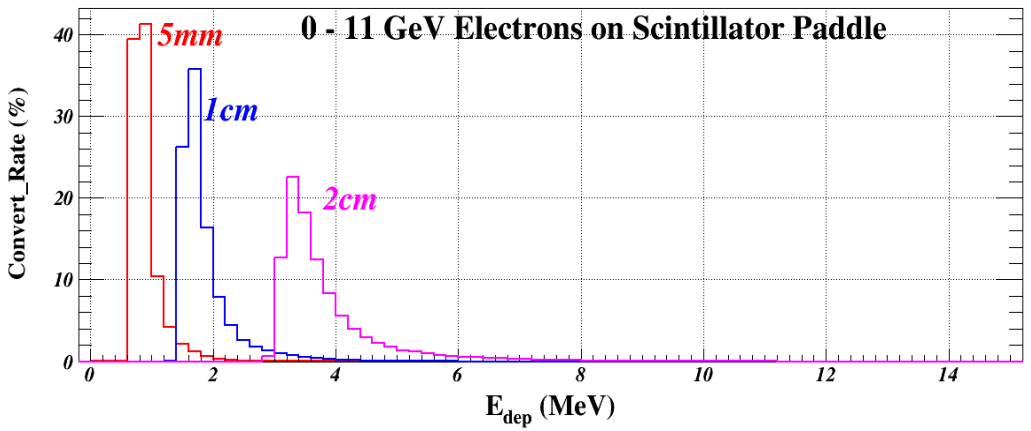
Time Resolution ~ 100 ps
Photon Rejection ~ 10 : 1

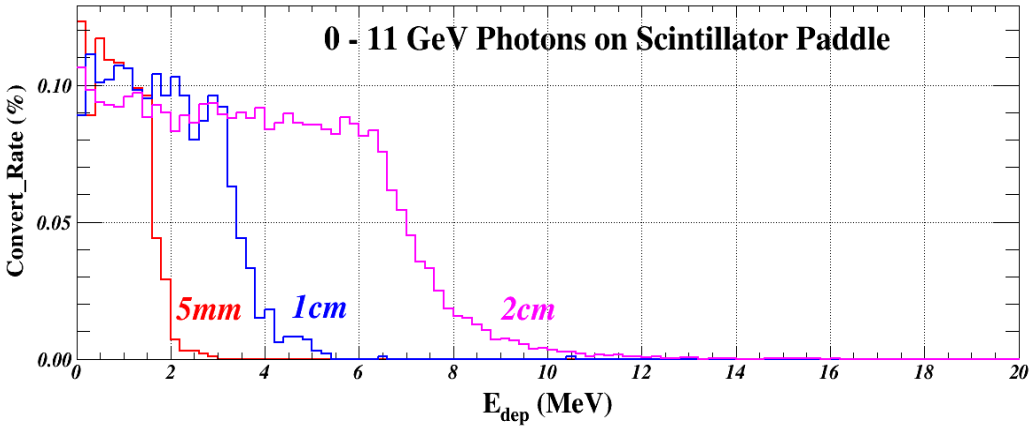
Photon Conversion

Send photons with fixed energy from 0.3 MeV to 11 GeV,
and for each setting, count how many photons can convert into electrons.

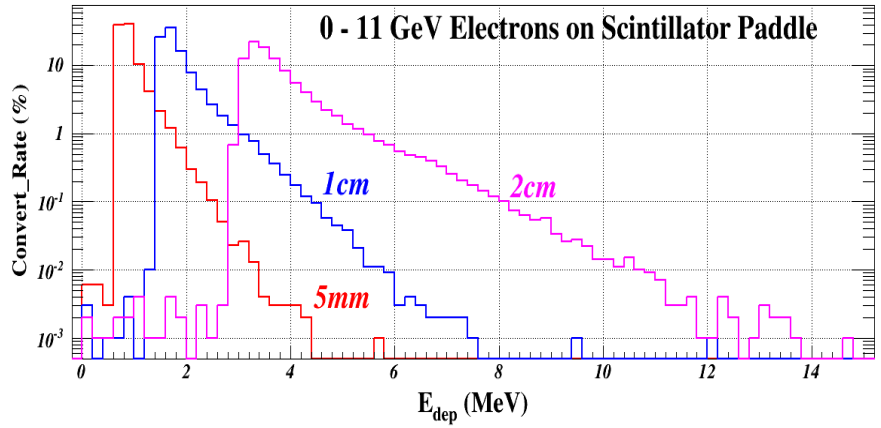


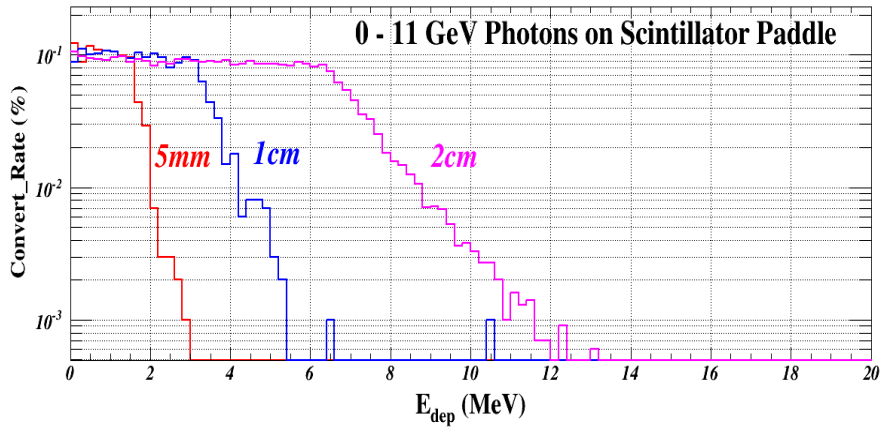
Energy Deposition



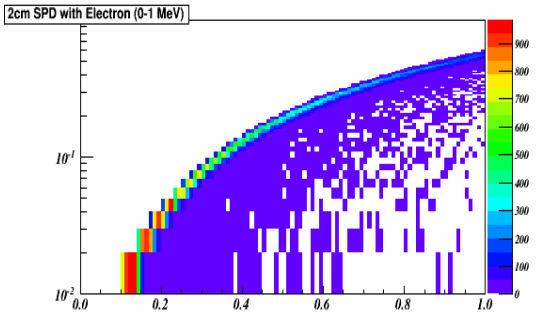


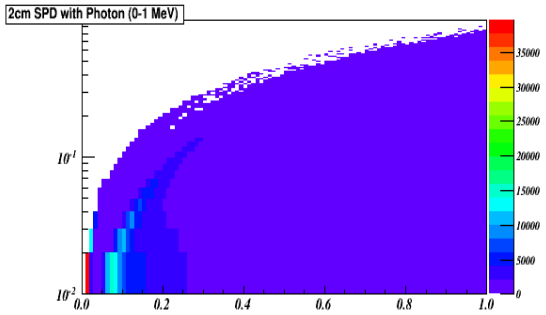
Quick Check where the MIP is for SPD with different thickness

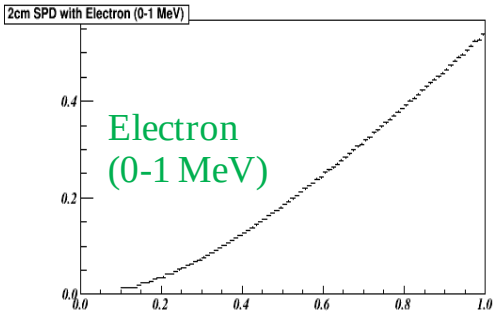


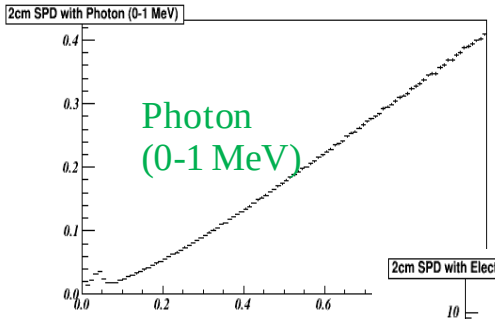


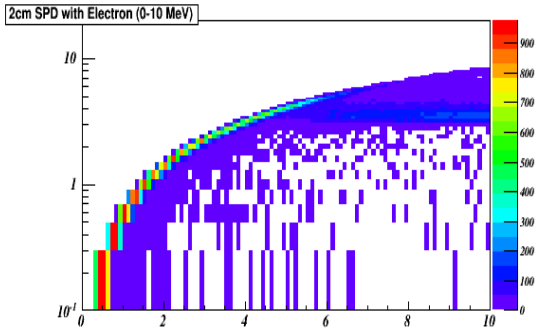
Energy Deposition in 2cm SPD

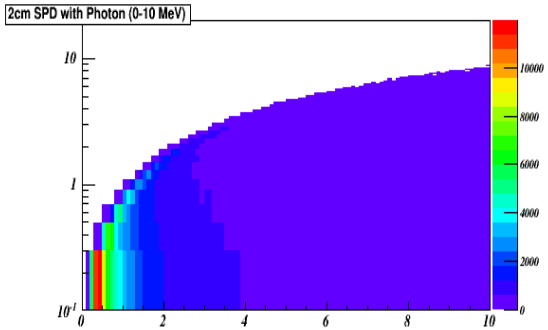


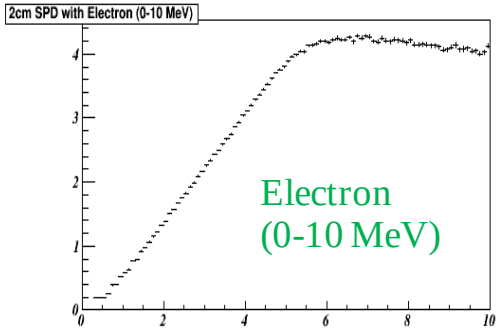


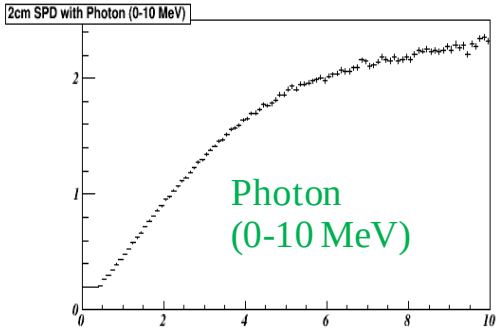




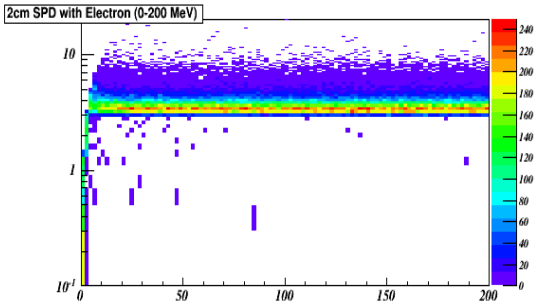


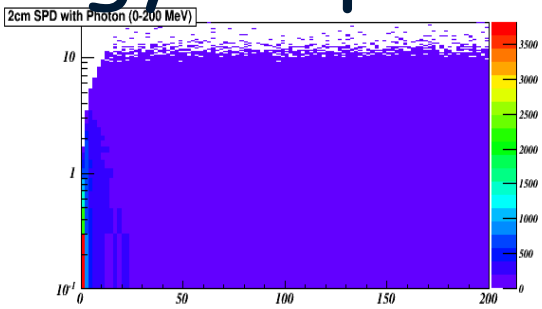


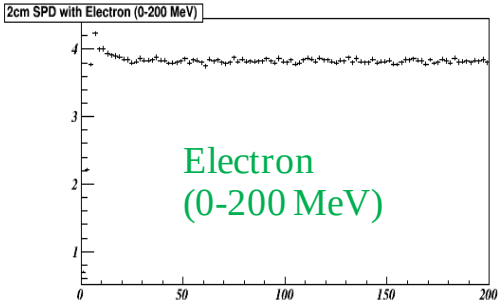


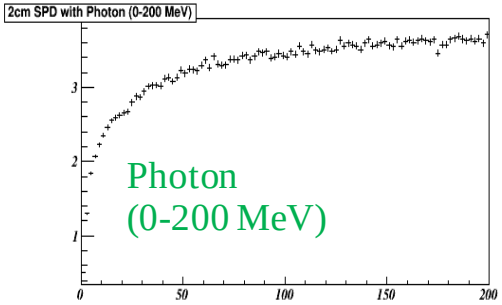


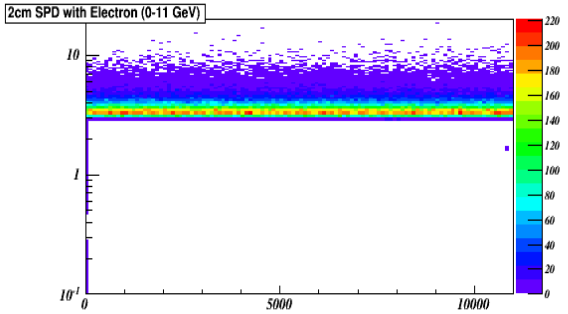
Energy Deposition in 2cm SPD

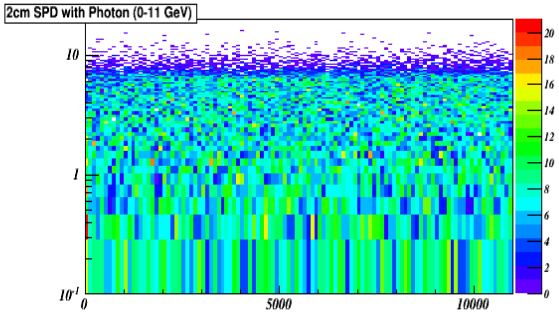


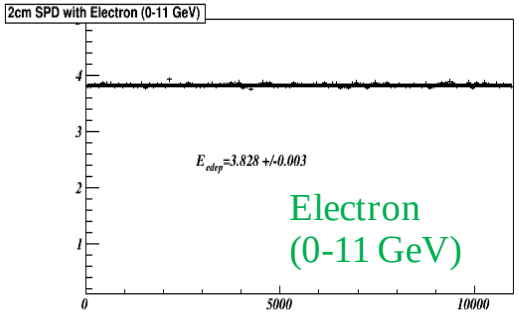


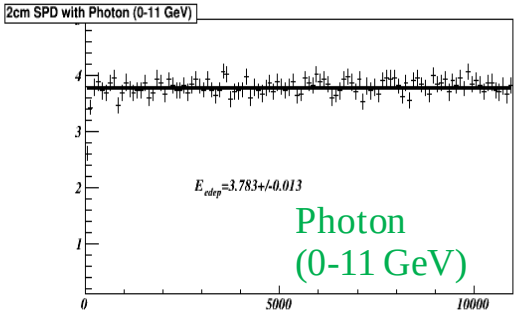




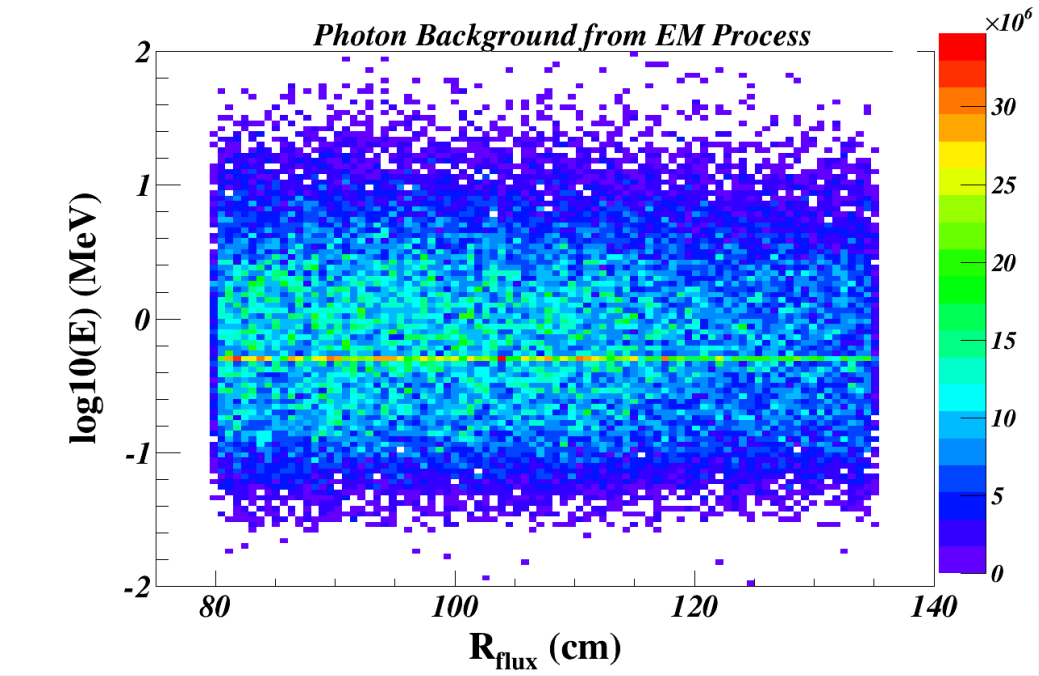






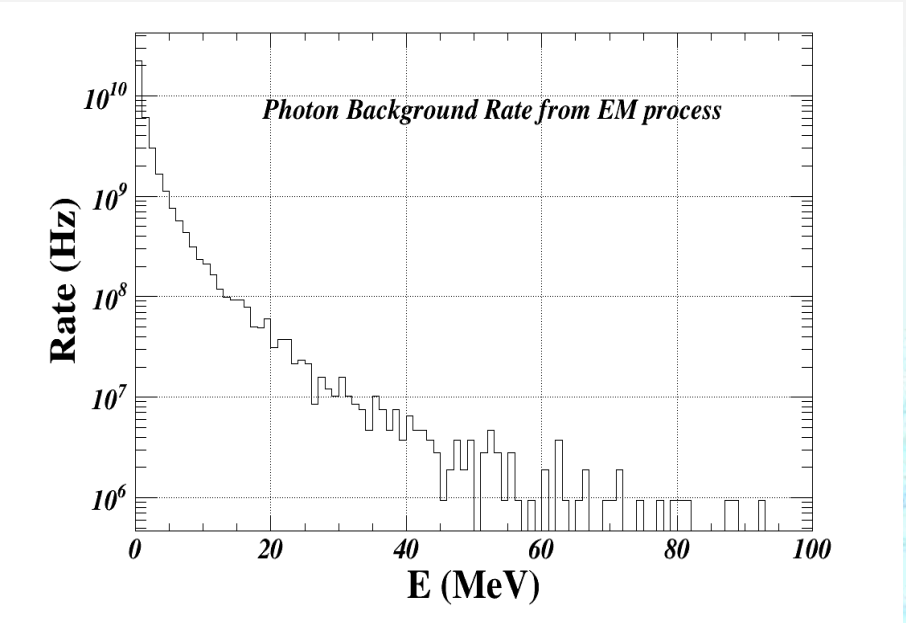


EM background



EM background is dominated by low energy photons and electrons are rare:
R (photon : electron) = 200 : 1

From the 2D plot, background particle energy is roughly independent of the radius



LASPD Segmentation Study Strategy

1. Study the conversion rate for a photon with certain energy in the SPD

2. Study the energy deposition of an electron or a photon with certain energy in the SPD

3. With the pi0 background events generated from Wiser and propagating through GEMC, obtain the position and energy distribution on the SPD, with the rate.

4. For each photon from pi0 decay, consider two cases:

   (1) its probability to become electrons.

   Assuming its energy is 2GeV, its probability to convert is 4%, and its energy deposition from Slide#5 is 3.82 MeV (a MIP!) , so the chance to fire if it passes the half-MIP cut is:

   if (3.82>0.5*MIP), fire1 = 4% = 0.04; else, fire1 = 0;

   (2) it does not convert but the energy-deposition-sum of background particles may pass the half-MIP cut.

   Assuming for one photon passing through the SPD, there are 10K photons and 50 electrons passing through the *ENTIRE* plane. I randomly generate the energies of these particles from the 1D plot in slide#6, look for their energy-depositions from slide#5, and sum their values, e.g. EDep_Sum. Assuming there are N segments, the chance to fire the SPD is:

   if(EDep_Sum/N>0.5*MIP), fire2 = (1-4%)=0.96; else, fire2 = 0.0;

   The "chance" that this photon fires the SPD is then given by:

   Fire = (fire1+fire2)

5. Loop through all events, e.g. , and calculate Rejection Factor: Reject = Total / SUM(Fire)

LASPD Segmentation Study Strategy

More details:

(1) Generate 100K pi0 events with Wiser

(2) Work on the virtual plane in front of the 2cm-thick LASPD

(3) For one photon with known energy (e.g. 2GeV), look for the conversion rate (5%)

(4) Look for its energy deposition by randomly picking from the 2-D plot (3.8 MeV)

(5) Now add the EM background which are mostly <10MeV photons

(a) Calculate how many photons+electrons hit on LASPD within 50ns:

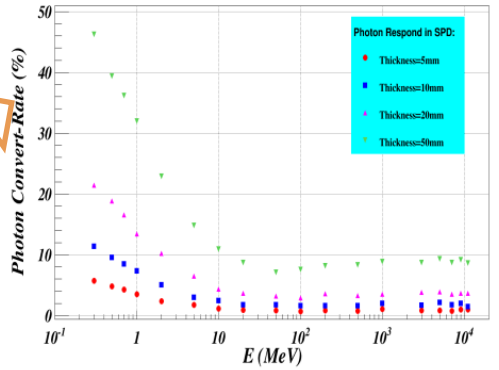
e.g., on a 1-degree slice (1/360 total area): (EM rate on the SPD is 3.78e10Hz/cm^2

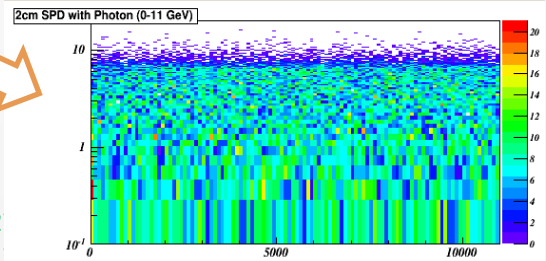
photons about 1e8 + electrons about 5e5

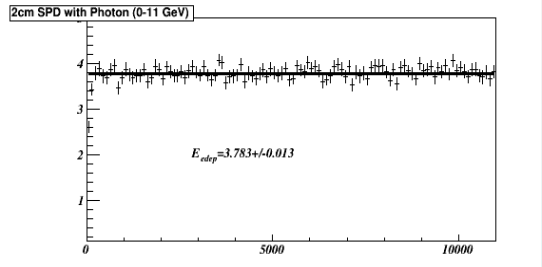
(b) Generate 1e8 photons with random energy from the 2-D below

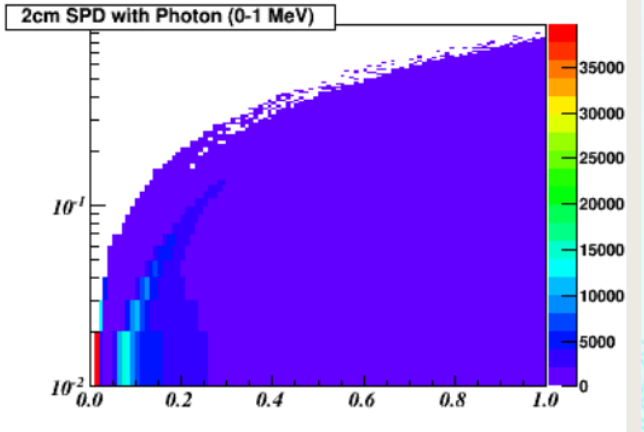
(c) Look for the energy deposition by randomly picking from the 2-D plot

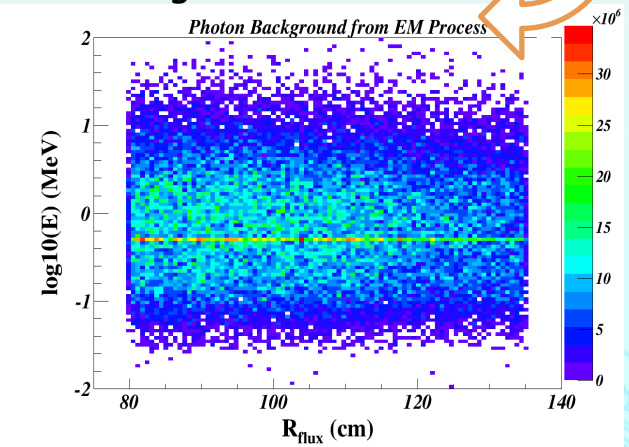
(d) Add the energy deposition of these 1e8 photons together

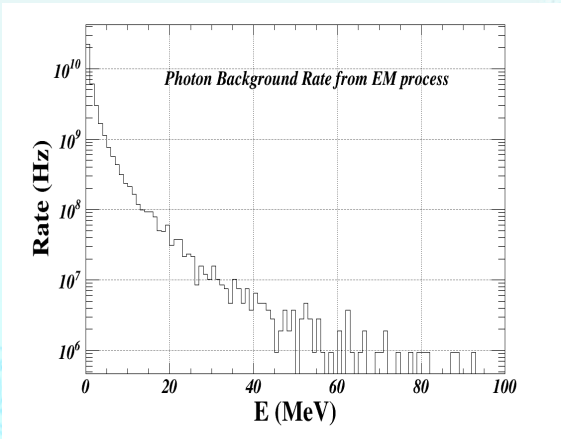












Problem

For a 1-degree slice and within 50ns, I have: (EM rate on the SPD is 3.78e10Hz/cm^2)

total of energy deposition from 5e5 electrons ~ 2MeV

total of energy deposition from 1e8 photons ~ 2GeV!

To Do

1. Debug
2. Adding EC Cut?