LASPD Study

Zhihong Ye
Duke
01/13/2015
Updated on 01/20/2015 (slide#7)

New Simulation Method

- Discard "Photon Converting Profile"
- Discard "Energy Deposition Profile"
- Put 2cm LASPD in the simulation and shoot pi0 photons
- Let Geant4 take care of the converting and energy deposition for each event.
- In GEMC, add a feature to trace the source ("Mother") of the each events.
- For every photon in front of the SPD, I look at all particles inside the SPD and see if they were originally from the photon (itself+secondary particles).
- Add their energy depositions together and assign the sum to the photon as its overall energy deposition.

Correction:

The rate unit is actually only Hz (previously I treated it as Hz/cm2). The Edep went down to ~2GeV with my previus method (Don't scare this number! I have a much lower value!)

Adding the background

- Similarly, let Geant4 takes care of the converting and energy deposition (Edep)
- Calculate the total photon+electron rate for the entire LASPD plan (only apply the LASPD boundary cuts)

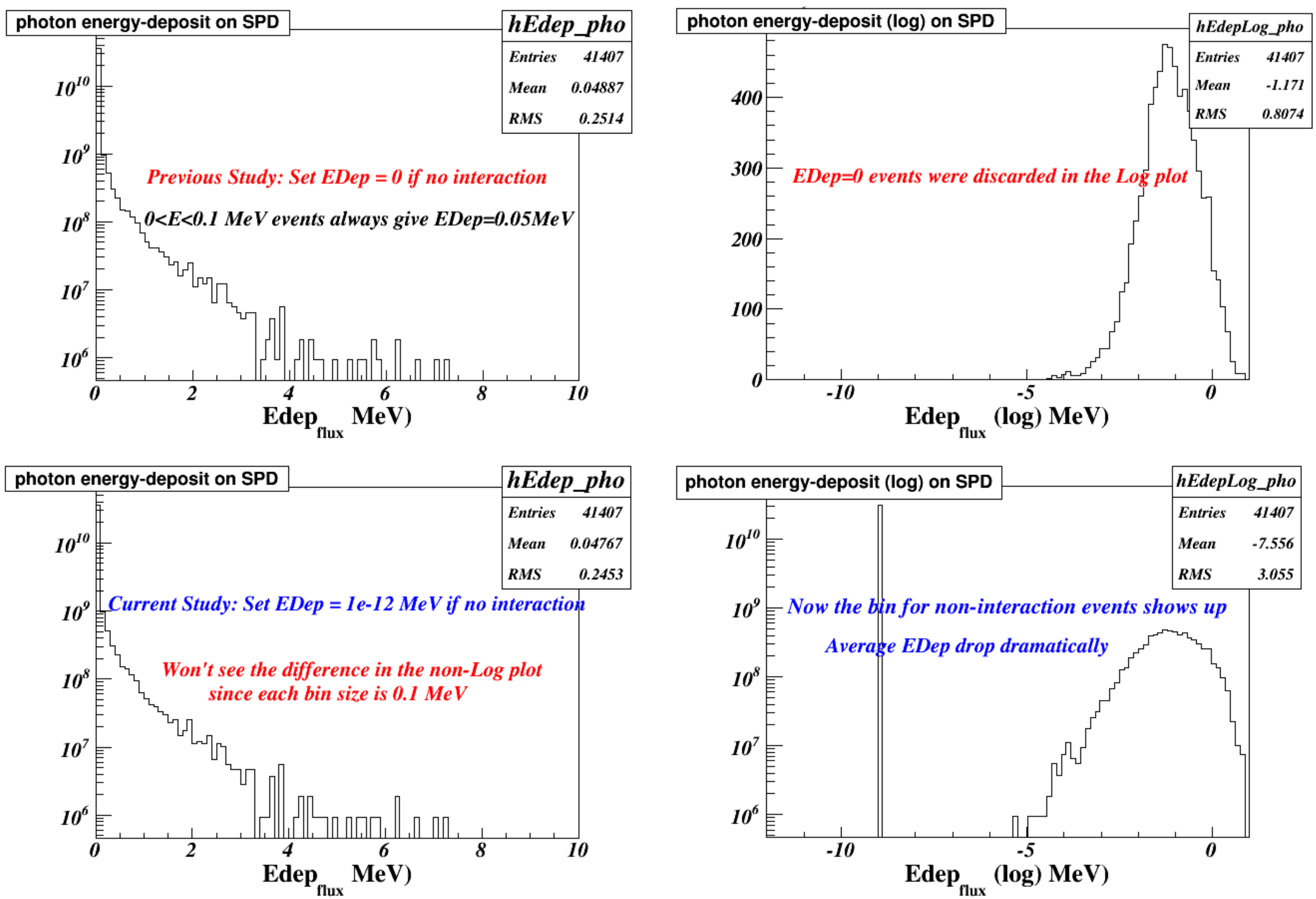
Photon Rate ~ 38GHz, Electron Rate ~ 211 MHz

- Within 30ns --> #1153 Photon, #6 Electron
- Plotting the 1D-distribution of Edep on the entire LASPD plan for photons and electrons separately.
- Randomly pick Edep values for #1153 times for photons, and #6 times for electrons. Add these values together as Edep_background.
- Assuming the segmentation is #N, then the Edep for one high energy photon:

Edep_each = Edep_itself + Edep_background/N

Previous Issues

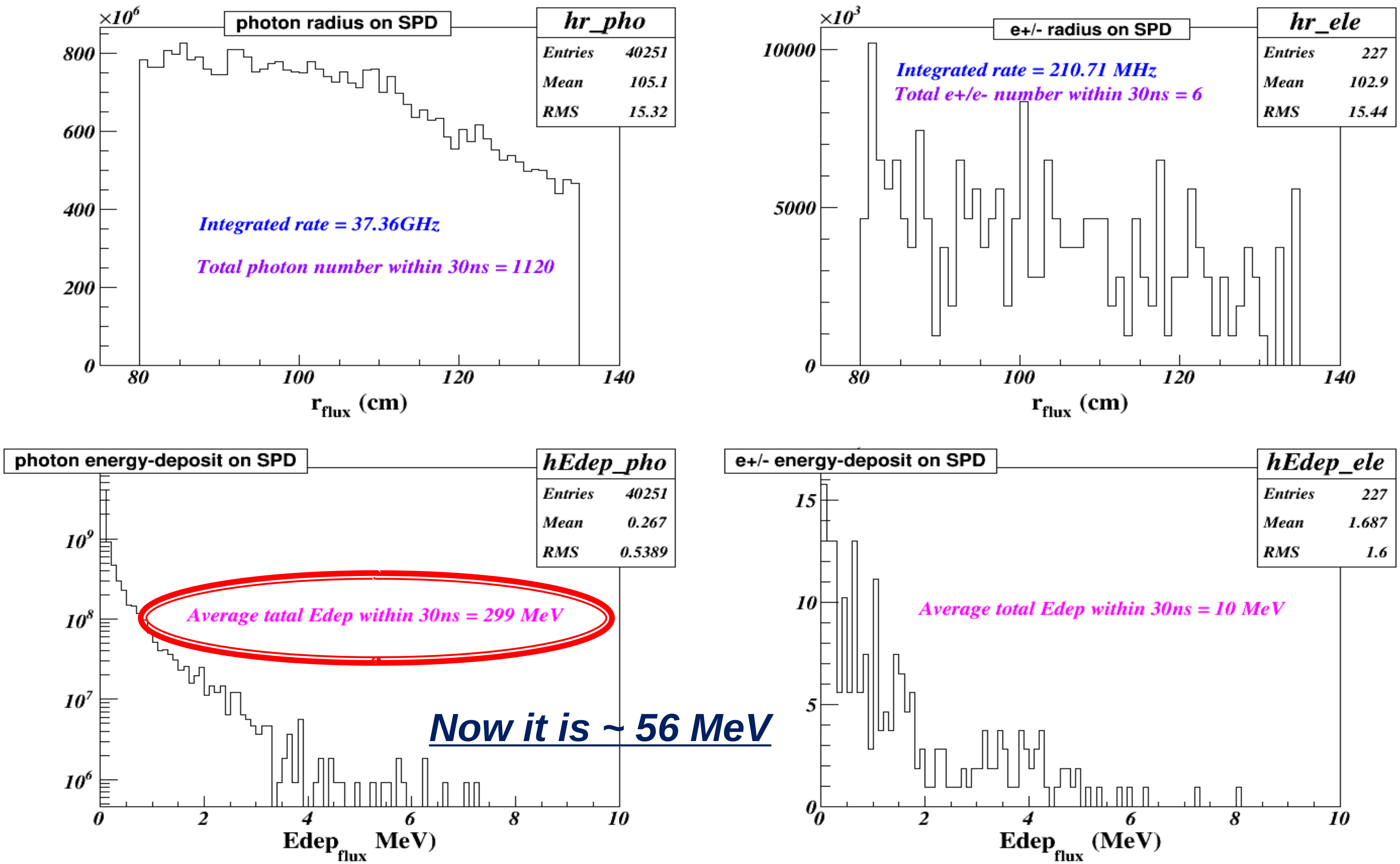
- This method should roughly give the similar results as I did before. However, I do discover why the previous study give HUGE Edep



So it is a binning issue!!!

Previous Issues

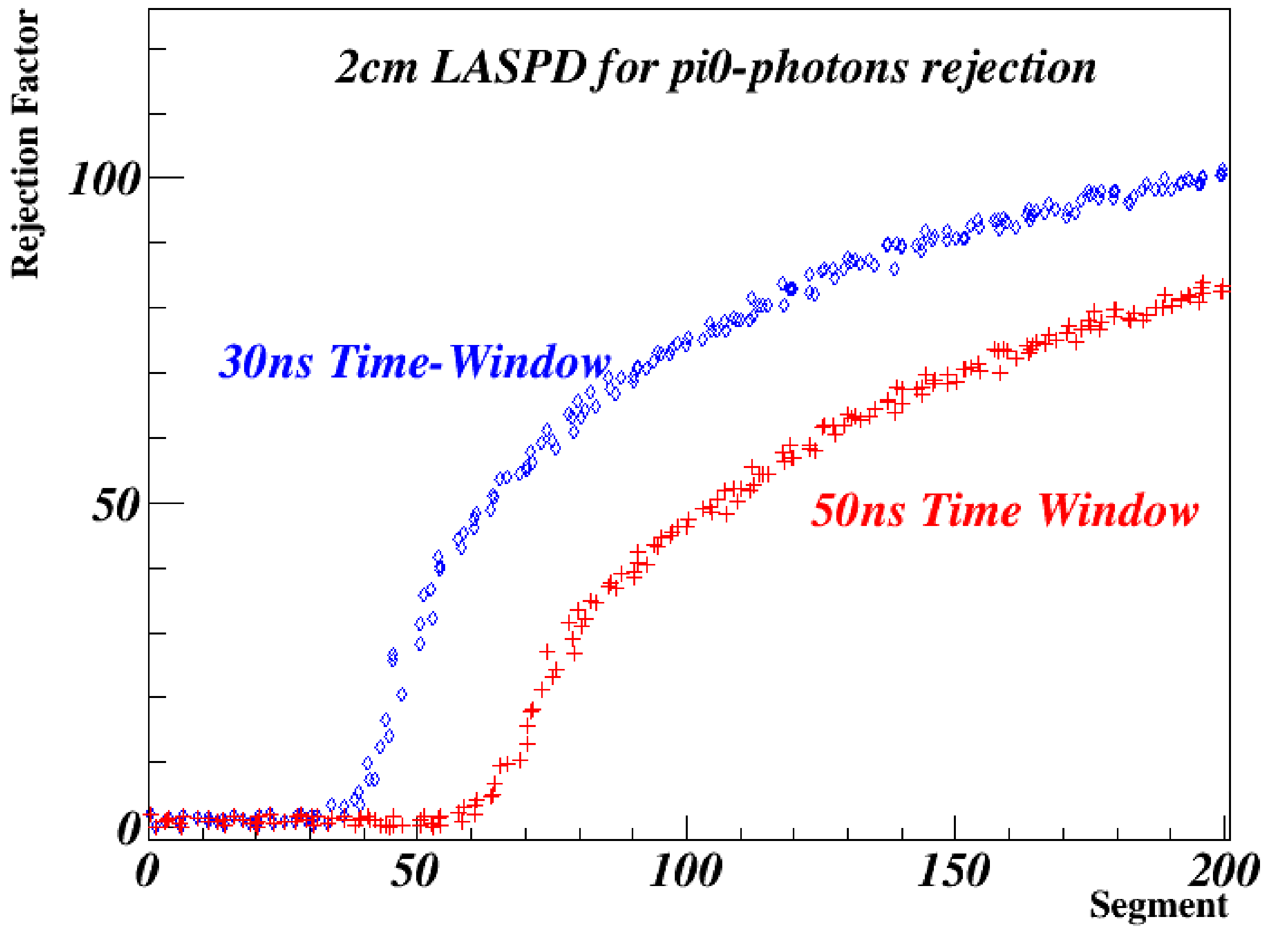
- This method should roughly give the similar results as I did before. However, I do discover why the previous study give HUGE Edep values.



Segementation

- Assuming the segmentation is #N, then the Edep for one high energy photon:

Edep_each = Edep_itself + Edep_background/N



Rejection Factor = N_Total/N_Fire

Adding the backward scattering

- LASPD is very close to LAEC
- Shower produced in the EC will create secondary particles going backward and hit the SPD
- EM background has very low energy particles so their backward particles are very rate. Ignored here.
- Backward particles from high energy pi0-photons could be significant. Their energy deposition inside the SPD must be added up.

- So the total Edep for each pi0-photon is:

Edep_each = Edep_itself + Edep_backward+ Edep_background/N

Adding the backward scattering

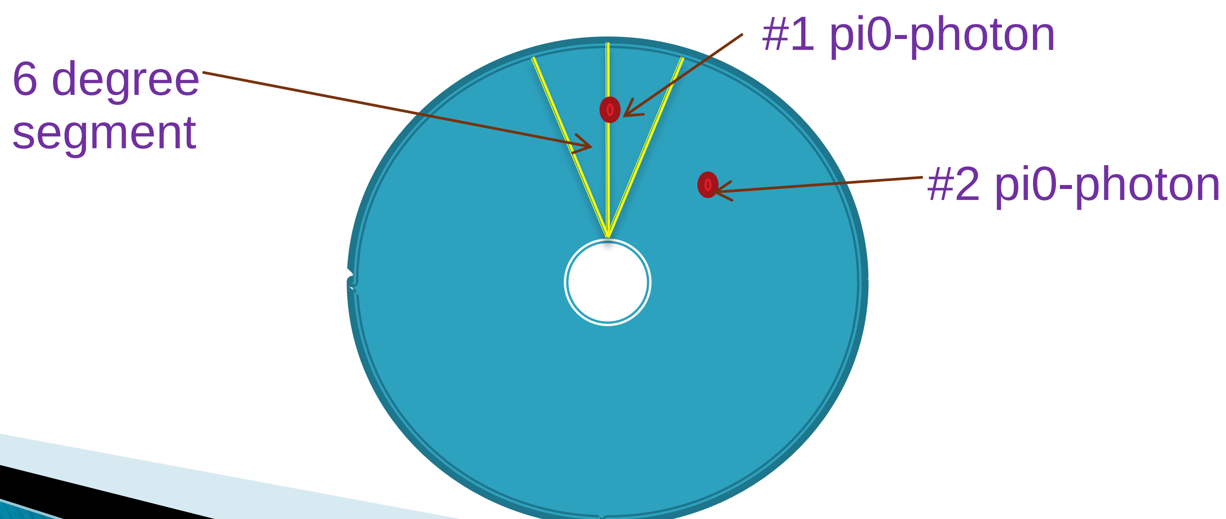
- Problem: If there are more than one pi0-photon, adding up the energy deposition of all backward particles will have bias.
- Solution:

  a) Assuming two pi0-photons can be well separated.

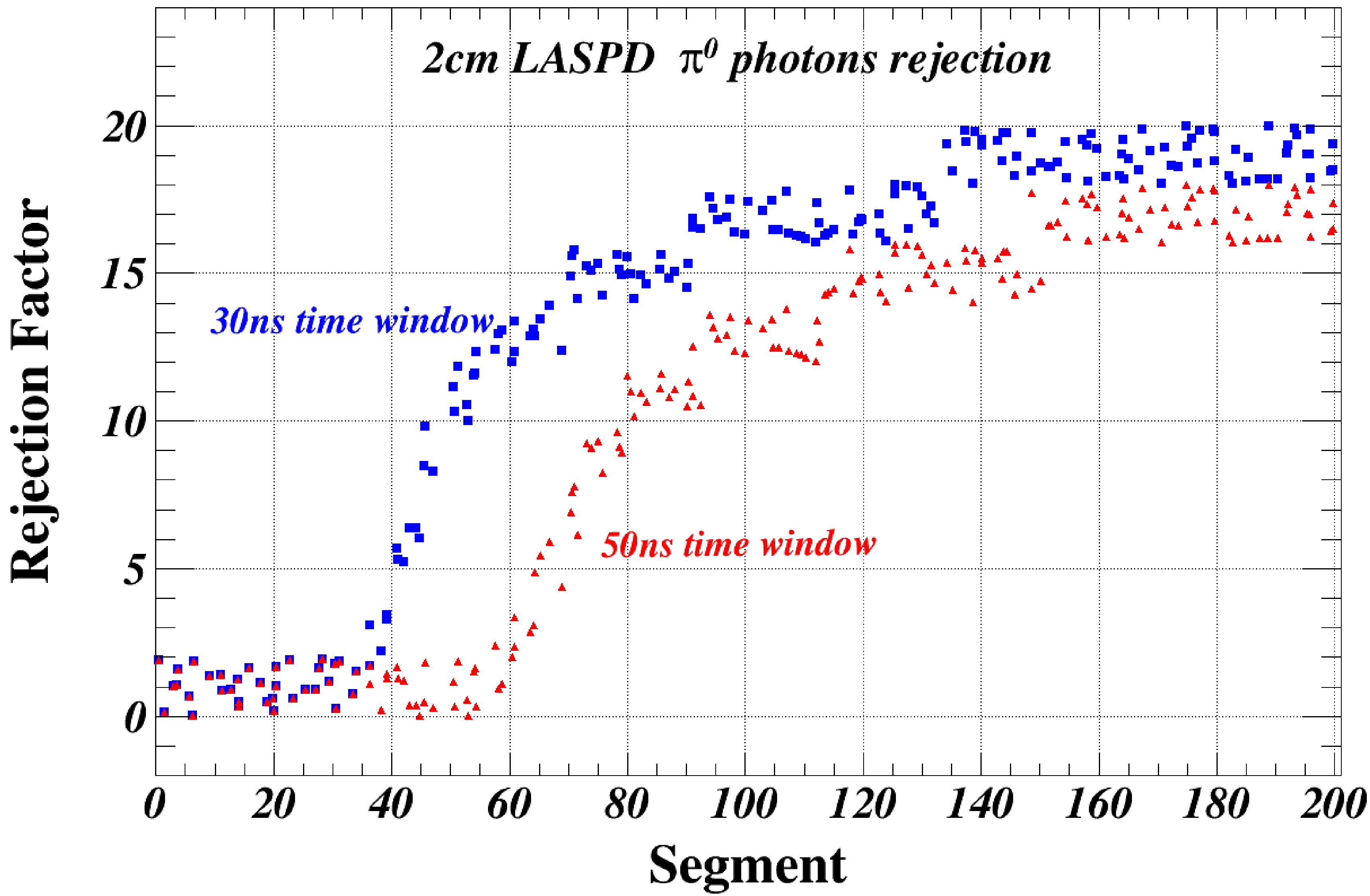
  b) Locating where the current pi-photon goes in (its Phi-angle)

  c) Using its phi-angle as starting point, dividing the SPD into 60 segmentations (6 degree per piece)

  d) Only adding the backward particles within the neighboring two segments.



Adding the backward scattering



Futher Improvements

- I studied the Edep on the entire SPD plane first then divided it by the segments, which means that I studied the average effect.
  However, there are statistical fluctuation in each segment. The best way is to determine the segment size first, then do all the study in this single piece. When changing the size, do everything again. Very slow!

- A simplication way was suggested by Jin. Need take sometime to modify my code.

- Use Kirk's Law to estimate the scintillating lights, considering the collection efficiency of the SPD, as well as PMT quantum efficiency etc, so we have the "number of photon-electrons" info. (Take much longer time)

  - FASPD is also needed to be re-studied.

- **Where to stop?**