Update Simulation for Adding a Tube

Li Ye
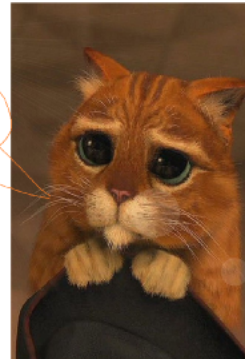Prad
04-04-2014

Correction
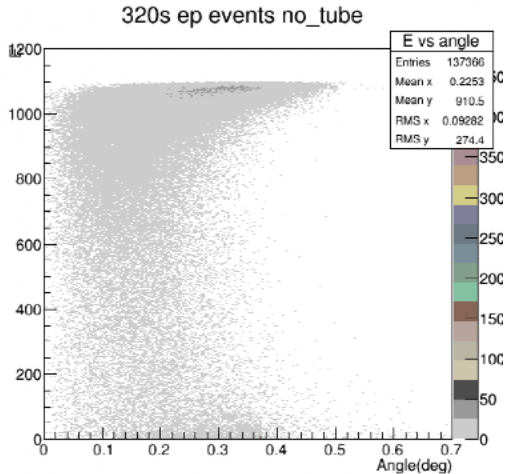
Use the wrong input data file name
Should be 320s beam time for ep and moller events not 1 hour.
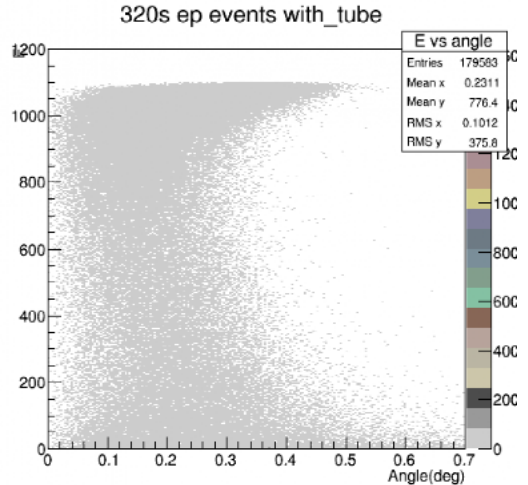
Last week simulation for 320s ep events

320s ep events no_tube

E vs angle	
Entries	137366
Mean x	0.2253
Mean y	910.5
RMS x	0.09282
RMS y	274.4

320s ep events with_tube

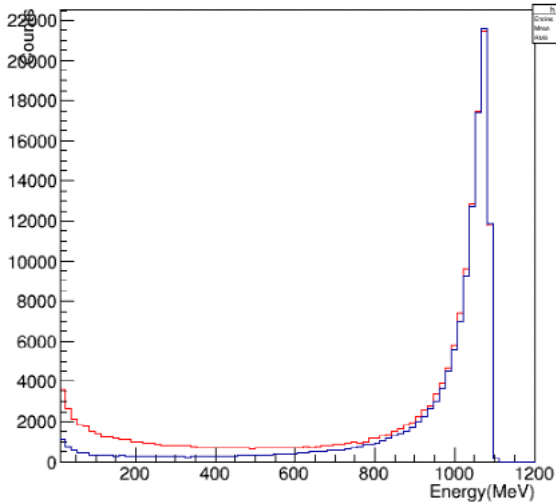| E vs angle	
Entries	179583
Mean x	0.2311
Mean y	776.4
RMS x	0.1012
RMS y	375.8

Left : plot on Hycal without tube

Right : plot on Hycal with the tube

From the plots, after adding the tube,
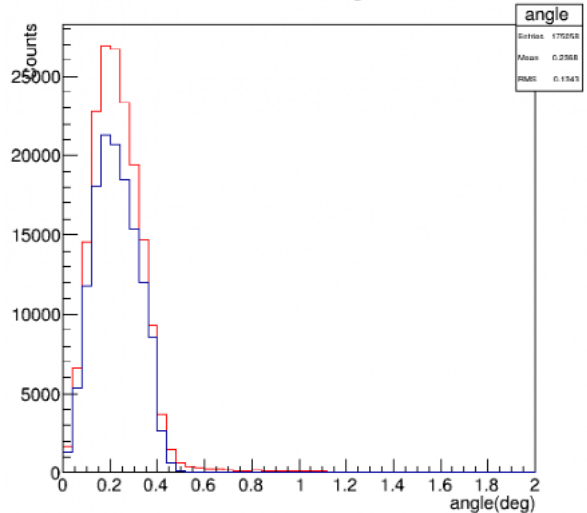it will generate 175206-136744= 38462 additional events

Last week simulation for 320s ep events

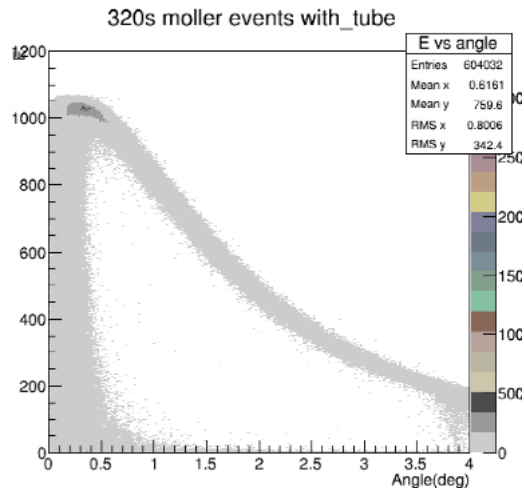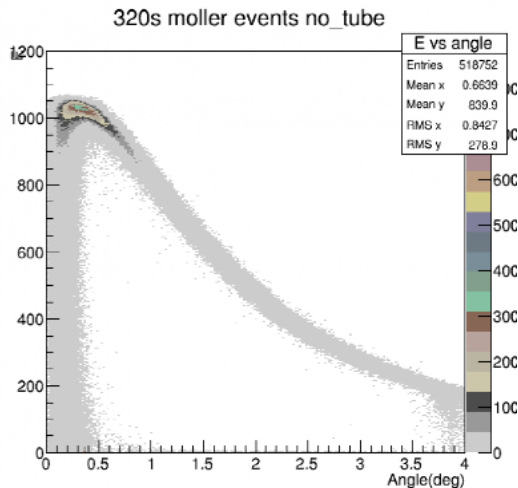Left: energy distribution   Right: angle distribution

From the plots, most additional events are low energy (<500 MeV) and stay at low angle (<0.5deg)

Simulation for 320s moller events

320s moller events no_tube

E vs angle	
Entries	518752
Mean x	0.6639
Mean y	839.9
RMS x	0.8427
RMS y	278.9

320s moller events with_tube

| E vs angle	
Entries	604032
Mean x	0.6161
Mean y	759.6
RMS x	0.8006
RMS y	342.4

From the plots, after adding the tube,
it will generate 604032-518752= 85280 additional events

Simulation for 320s moller events

Energy distribution no_tube(blue) VS add tube(red)
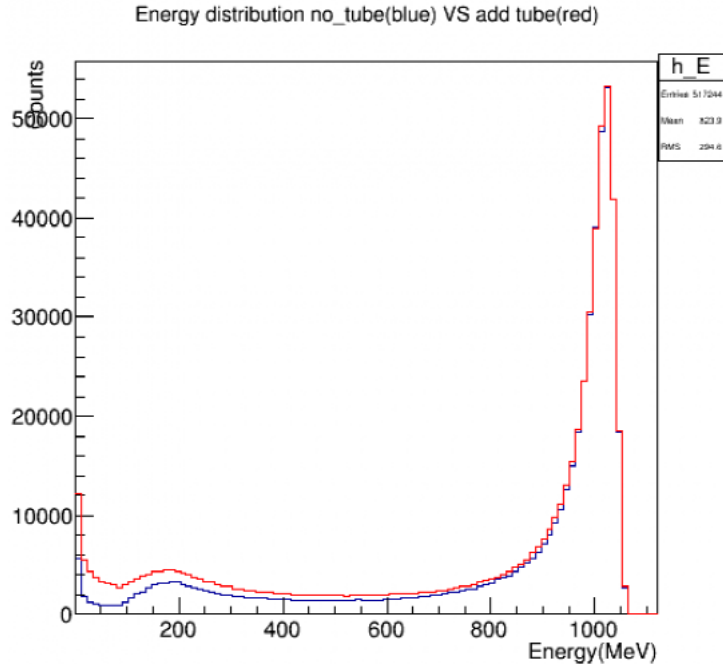
Energy distribution shows that most of the additional events greated by tube

are low energy events (<500MeV) very similar to ep case

Simulation for 320s moller events

events vs angle (blue_notube, red_tube)
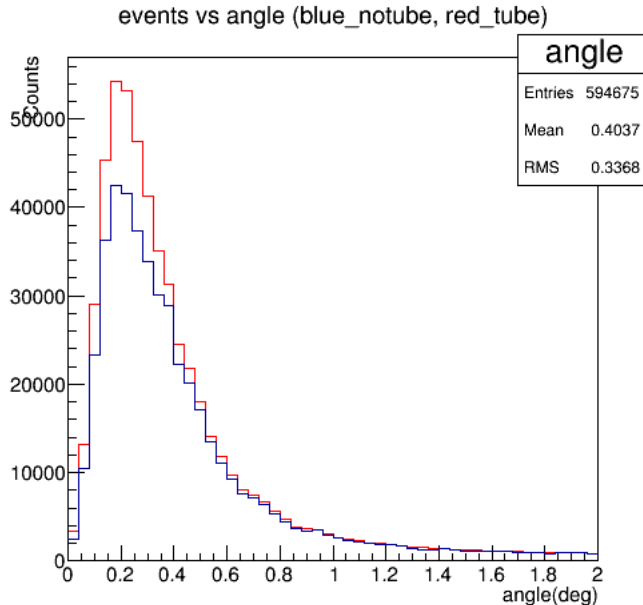
Angle distribution shows that most of the additional events greated by tube are

low angle events (<0.5deg) very similar to ep case

Conclusion

The simulation shows that for 320s beam time, certain additional events will be created by the ep and moller events, 38462 events for ep and 85280 events for moller, total 38462+85280 = 123742 events.

Most of these events (back ground) are low energy events(<500MeV) at low angle (<0.5deg). The event rate is 123742/320s= 386.7 Hz .

So, the effect that use a tube(pipe) is small and the back ground rate is low.This design has great advantage for our experiment compare to the other designs which has material on the beam line.

Further study(add a flange)
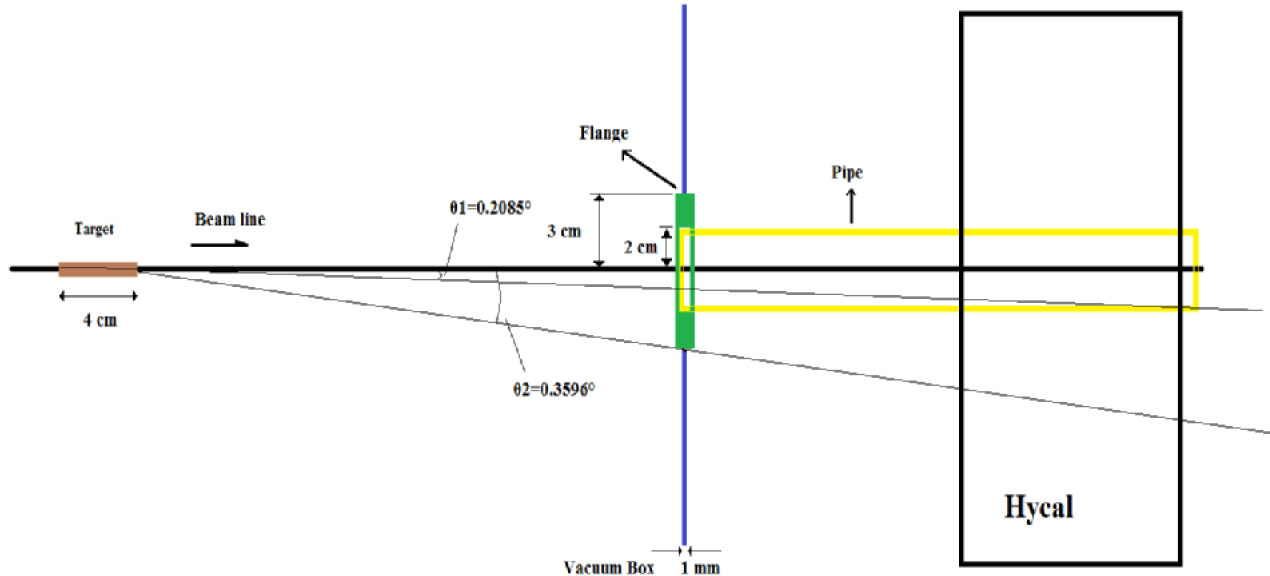
Simulation geometry setup:

Vacuum box :
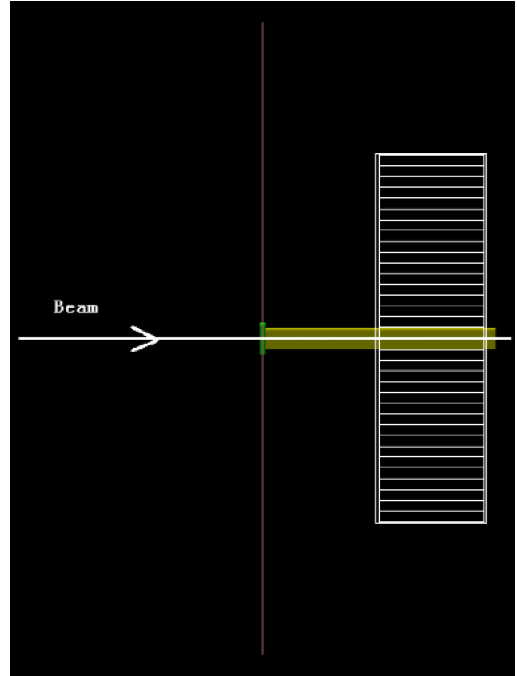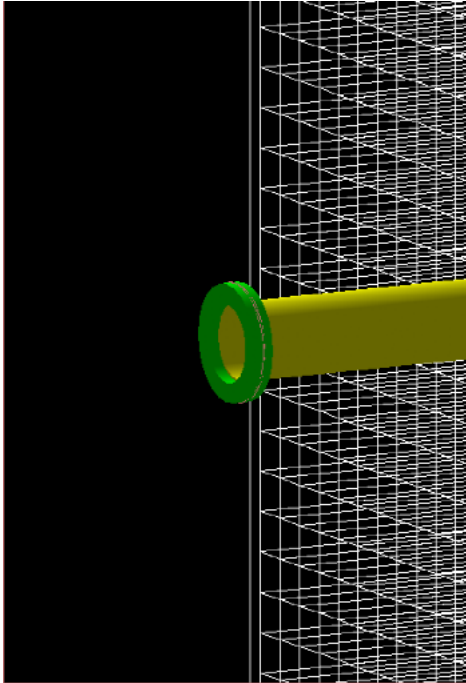material:Al, thickness 1mm , 20cm distance

Flange:
material Al, outer radius 3cm , inner radius 2cm, thickness 1cm

Pipe:
material Al, outer radius 2cm, inner radius 1.9cm, length 40cm

Flange Geometry

Angle calculation and beam test

Angle calculation (target length is considered)

Less than $\theta 1 = 0.2085°$ events will pass through without hit anything

0.2085 - 0.3596 deg events will hit the flange, the pipe and Hycal

Larger than $\theta 2 = 0.3596°$ events will hit vacuum box then Hycal

In the simulation, use 1.1GeV electron beam

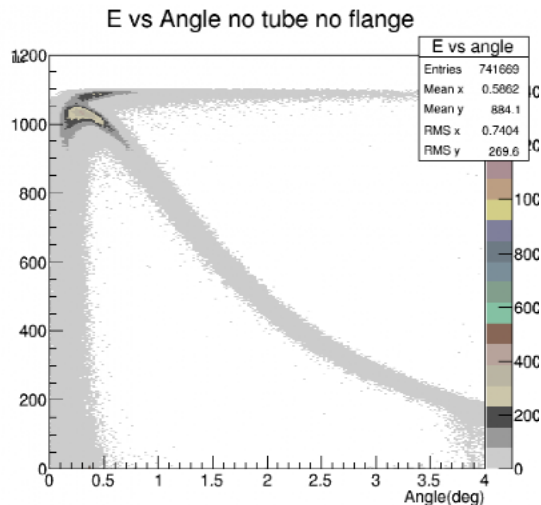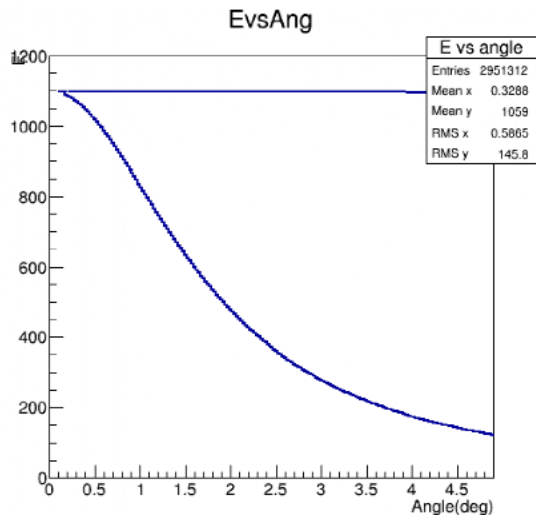1, position +- 100um from the center

2, with a small angle 1mrad ~ about 5mm shift at Hycal

Both have 0 events on Hycal in 10^{-3} second beam time
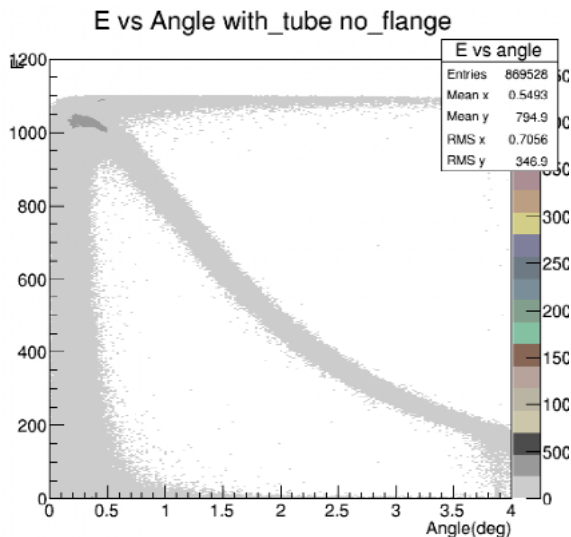
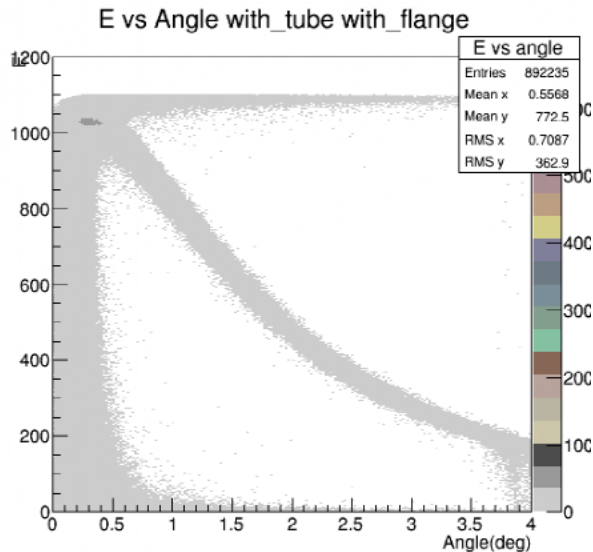# Simulation with 320s ep and moller events

Input file :
0.1-6deg , 320s beam time , ep and moller events from event generator

Simulation with 320s ep and moller events

E vs Angle with_tube no_flange

E vs angle	
Entries	869528
Mean x	0.5493
Mean y	794.9
RMS x	0.7056
RMS y	346.9

E vs Angle with_tube with_flange

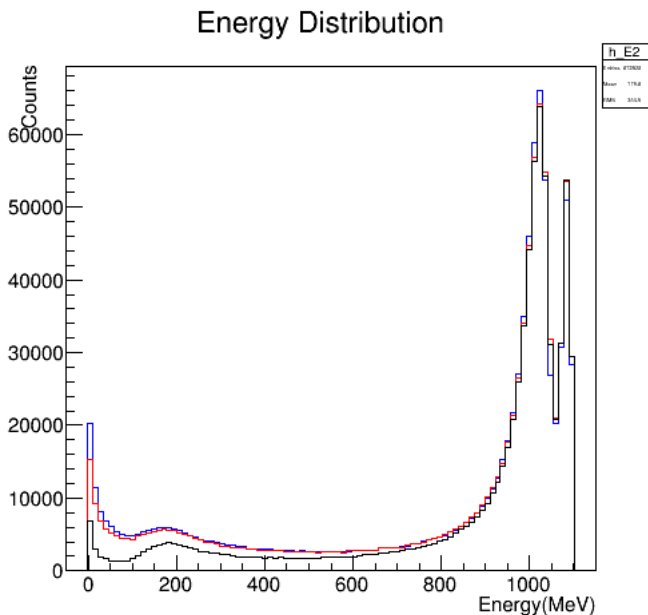| E vs angle	
Entries	892235
Mean x	0.5568
Mean y	772.5
RMS x	0.7087
RMS y	362.9

Adding a pipe will creat
(869528-741669)/320s=399.6 Hz
  additional events (back ground)

Adding a pipe and a flange will creat
(892235-741669)/320s=470.5 Hz
  additional events (back ground)

Energy Distribution

Energy Distribution

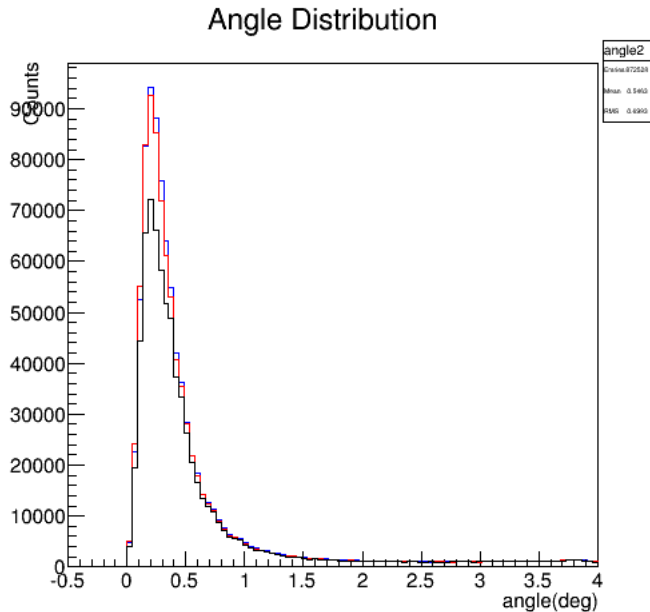
Black: vacuum box , Hycal
Red: vacuum box + pipe , Hycal
Blue: vacuum box + pipe + flange , Hycal

From the plot ,

around 1.0GeV blue has more events because , some low angle (around 0.3deg ,please check page9) ep events will hit the flange and scatter to 0.5deg .

More material will creat more low energy back ground

Angle Distribution

Angle Distribution

Black: vacuum box , Hycal
Red: vacuum box + pipe , Hycal
Blue: vacuum box + pipe + flange , Hycal

Most of the created events are low angle
(<0.5deg)

Summary

The simulation shows that , certain additional events will be created by adding a flange and pipe. Most of these events (back ground) are low energy events(<500MeV) at low angle (<0.5deg). The event rate is about 400 Hz(only pipe no flange) , 470 Hz (pipe and flange).

Add more materials will have more back grounds , but these back grounds are low angle low energy events (will have some high E events due to the flange) , it is still safe for us as long as there is nothing on the beam-line.