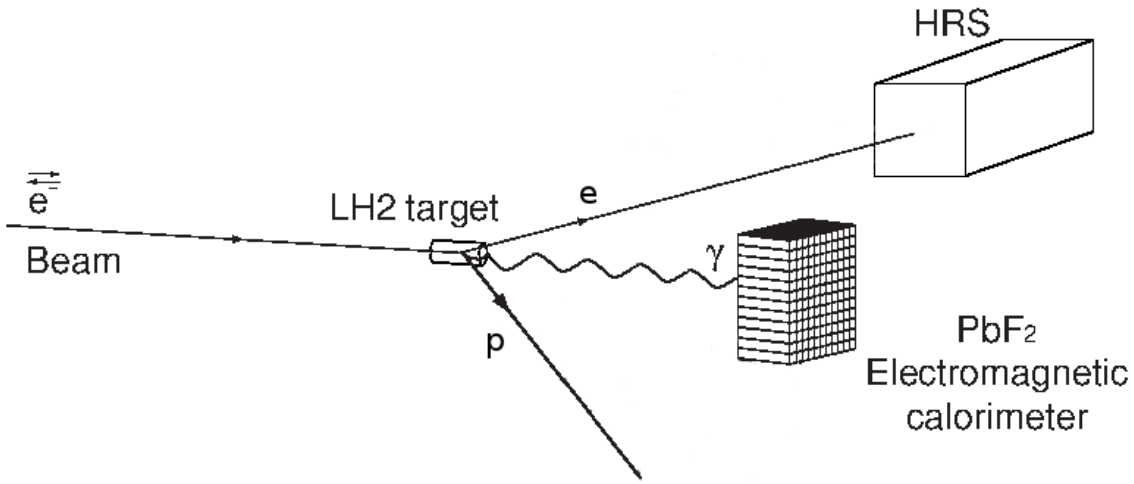
An Attempt to Get Pi0 Cross Section

Ye Tian

Shandong University

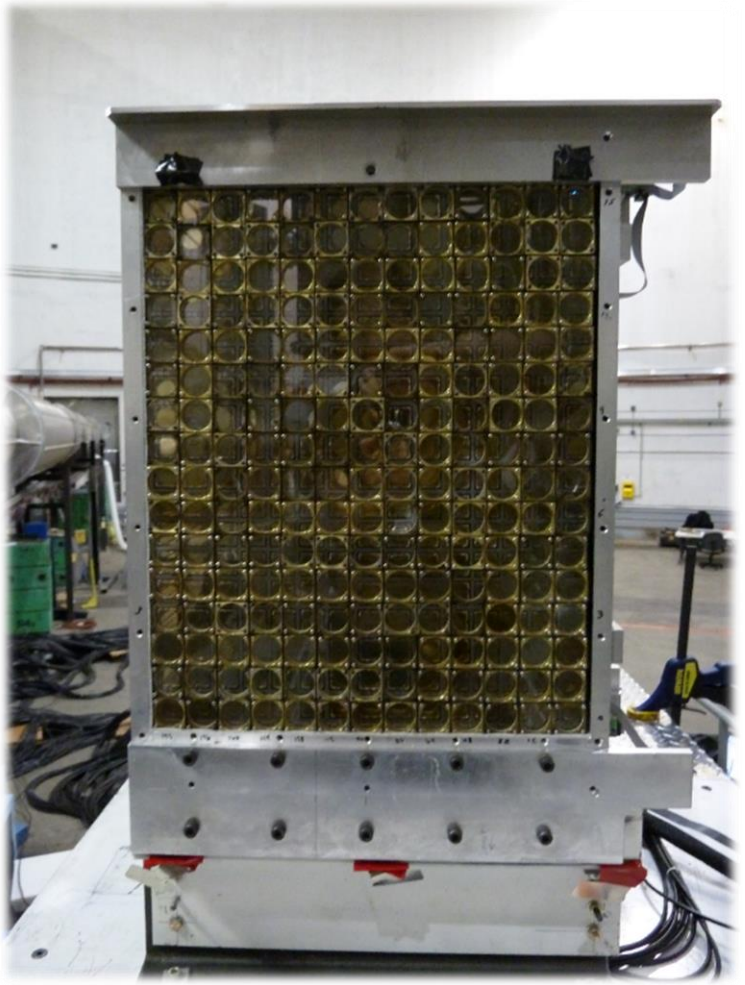
π_0 cross section extraction from DVCS experiment in HallA

- Utilizing updated 11GeV beam, detect two photon events in DVCS calorimeter to reconstruct π_0



Experimental Setup

Geometry setting for following result: 8.8GeV beam, distance from target to Calo center 2.5m, center theta angle 11.7 degree.(DVCS kin48_3)

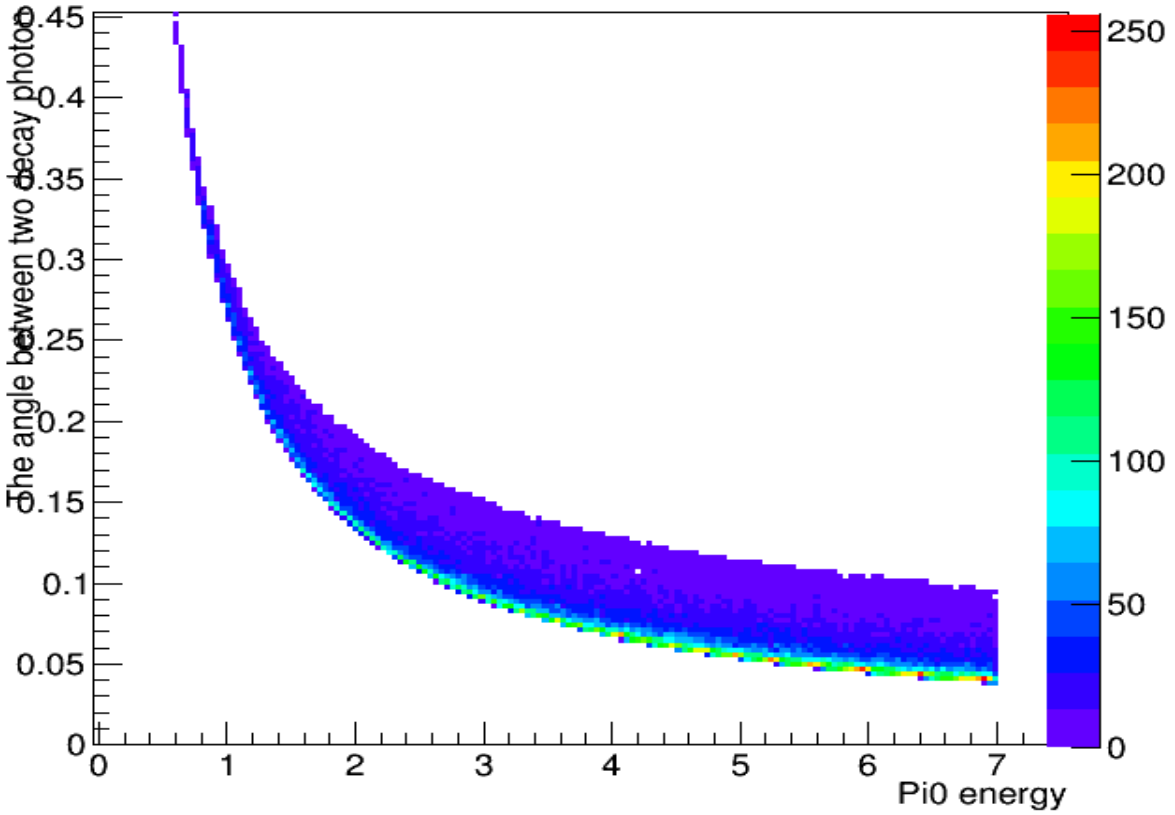


PbF_2 Electromagnetic calorimeter
(39cm × 48cm)

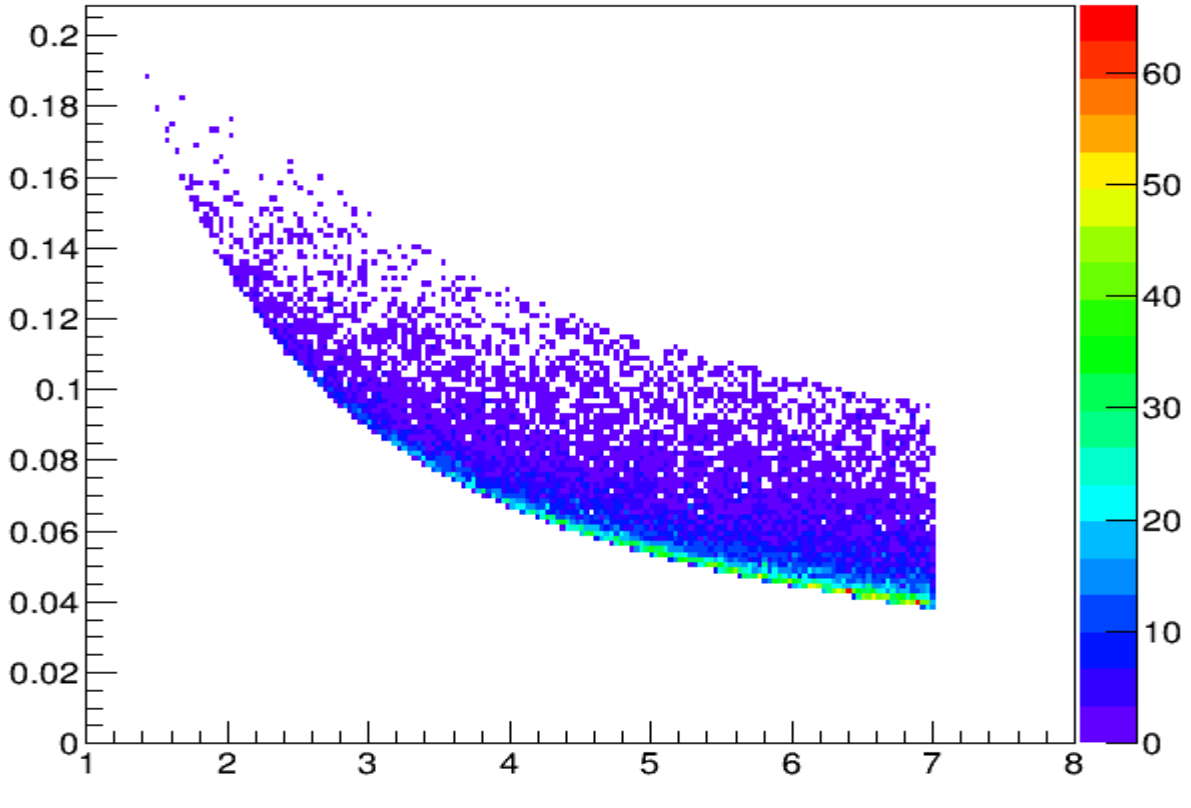
Pi0 acceptance simulation

distribution of Pi0 energy and angle between two decay photon

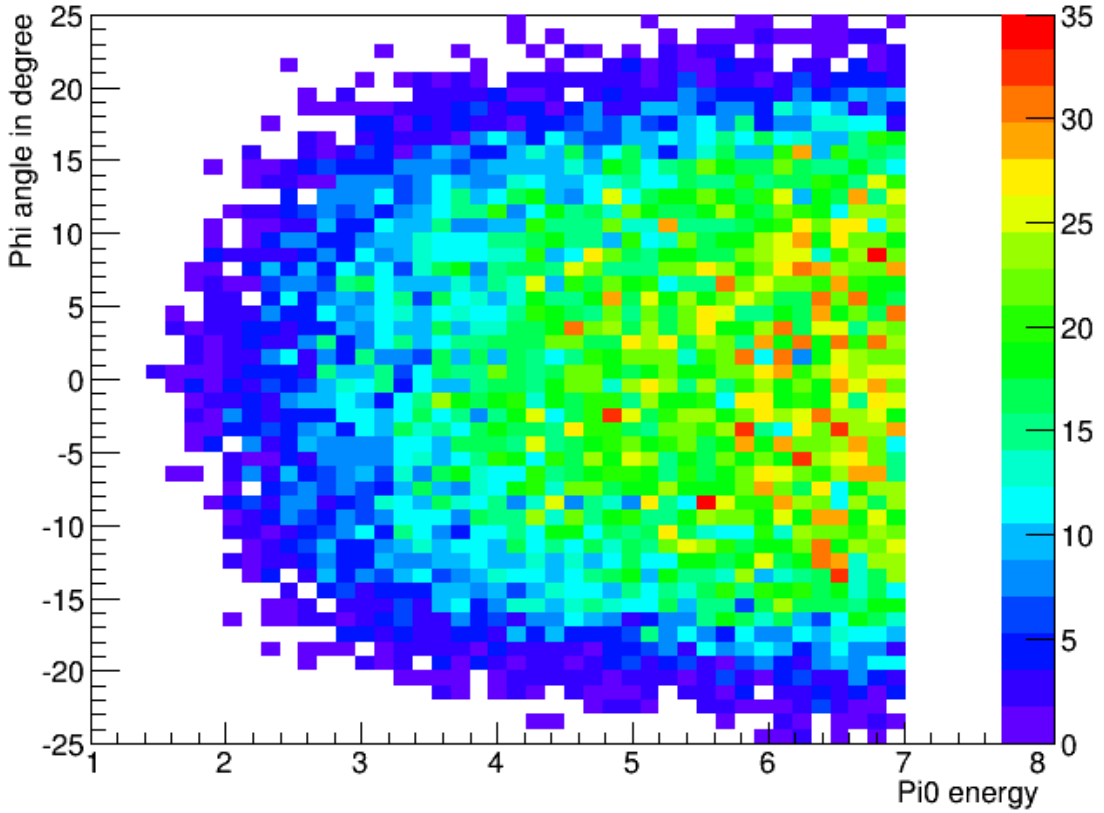
Ideal situation, no geometry cut,
only consider 0.3 GeV energy cut



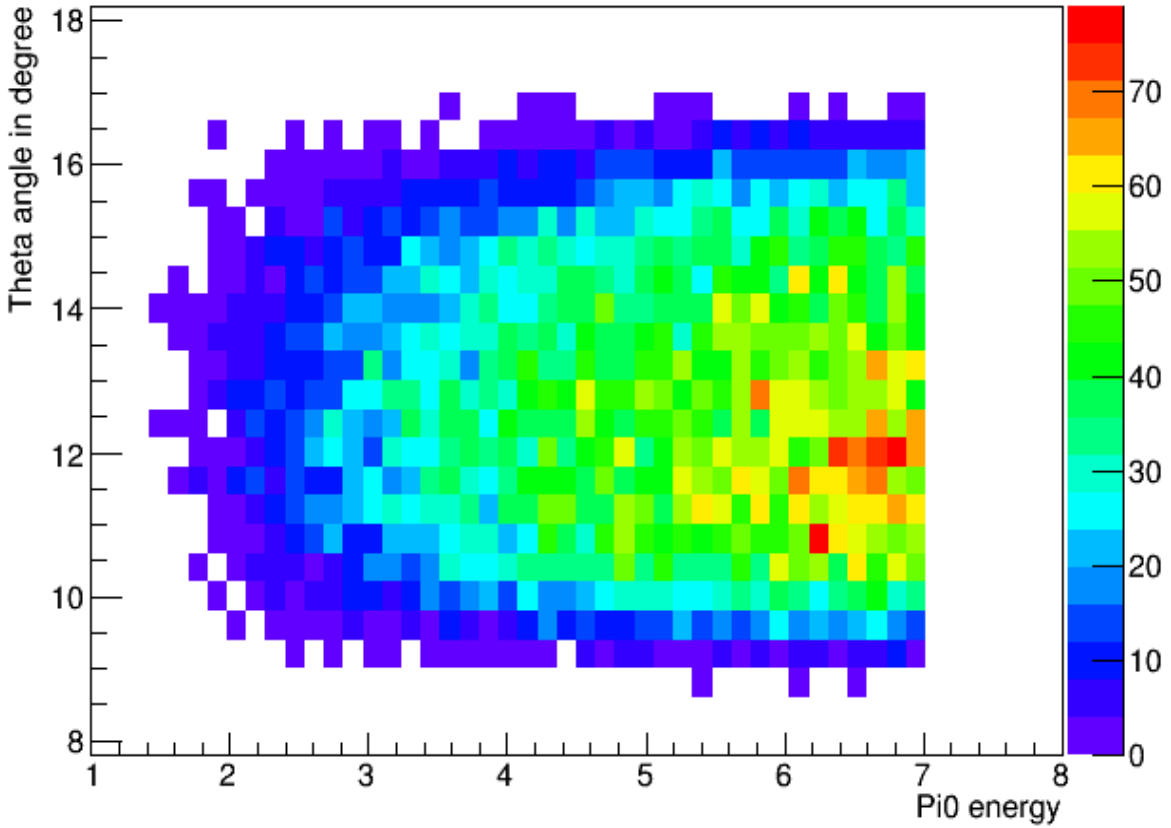
Real acceptance of calorimeter detector
simulation with 0.3GeV cut



Detector acceptance simulation
(low energy cut 0.3GeV)



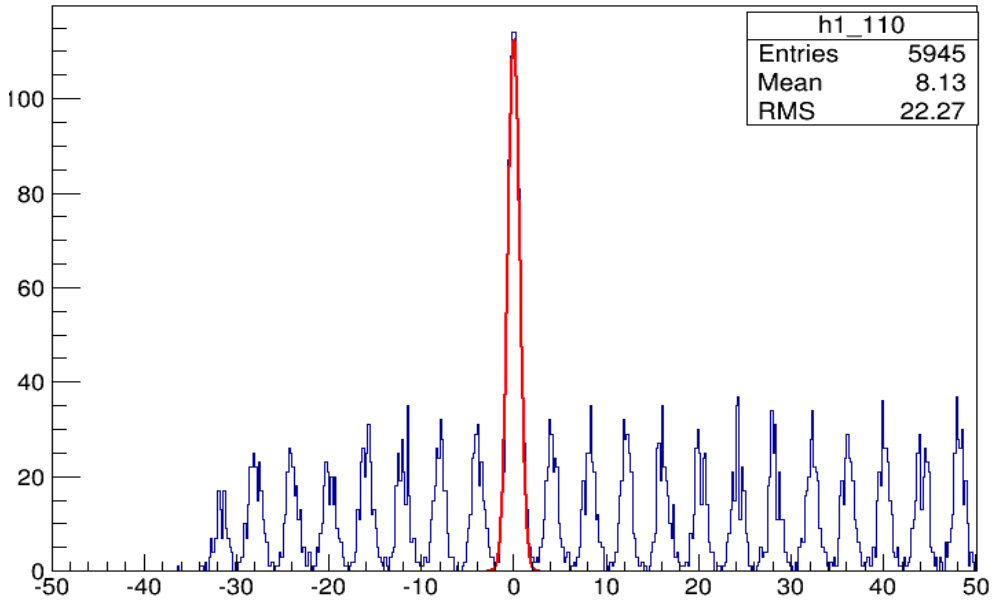
Energy vs. Phi angle



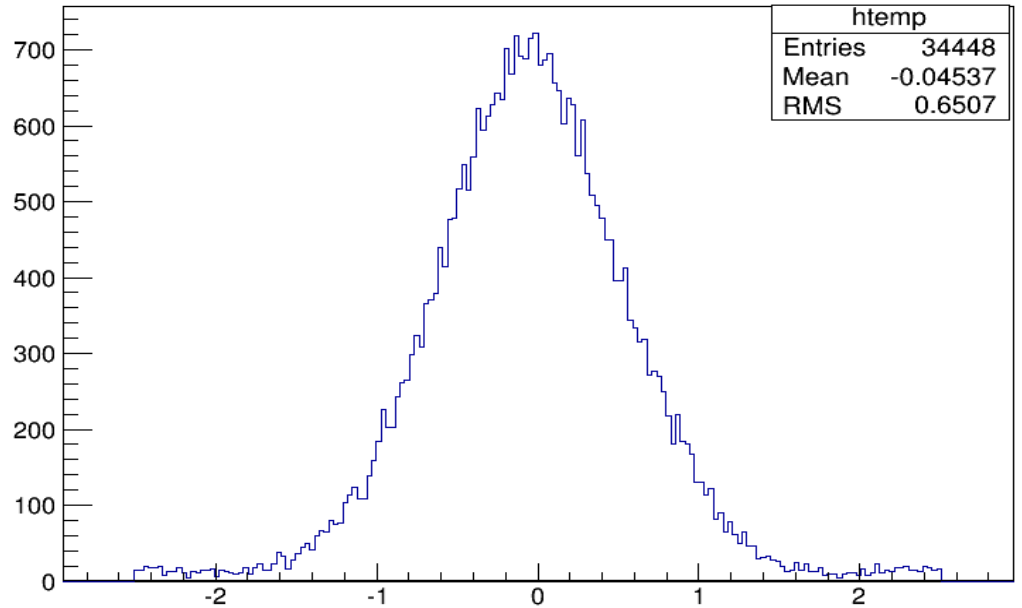
Energy vs. Theta angle

Data for analysis and Selection

- 8.8GeV 15uA beam
- 15cm Liquid Hydrogen target
- Get valid 740K events after cut from original 2M events
- Using 7 separate accidental bunches signal which is outside the DVCS time interval
- Select cluster energy above 0.8GeV
- Pi0 energy range 2~3GeV (just for the beginning)
- Supposing Pi0 created from the center of target



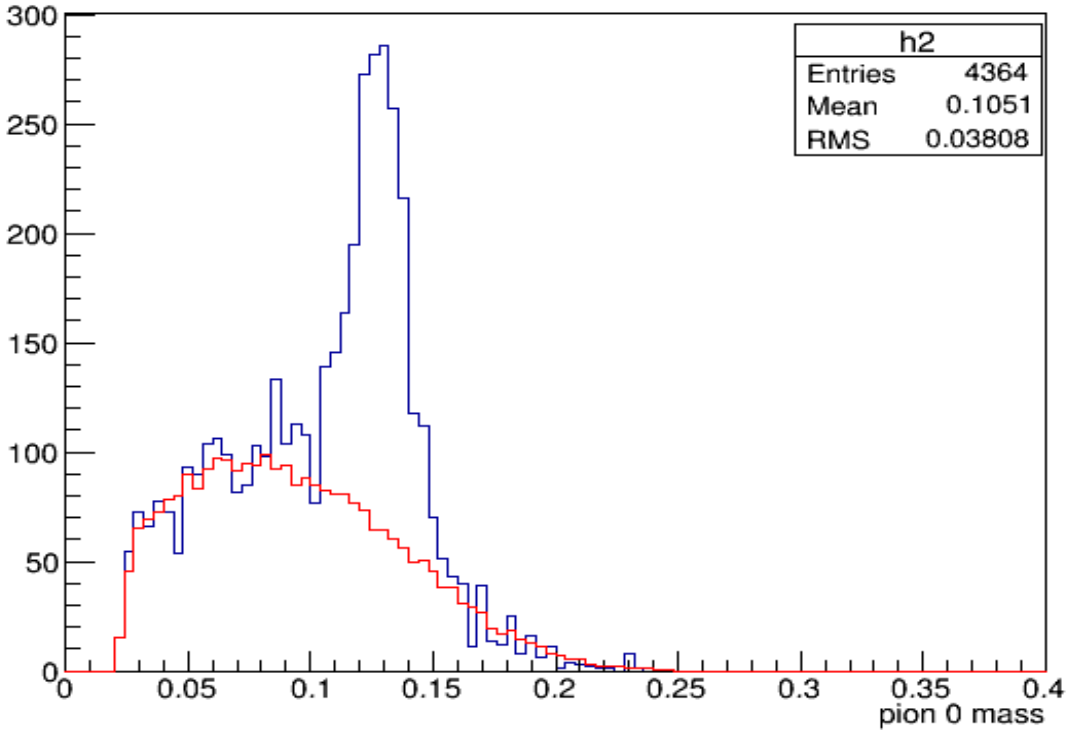
Time distribution in one block

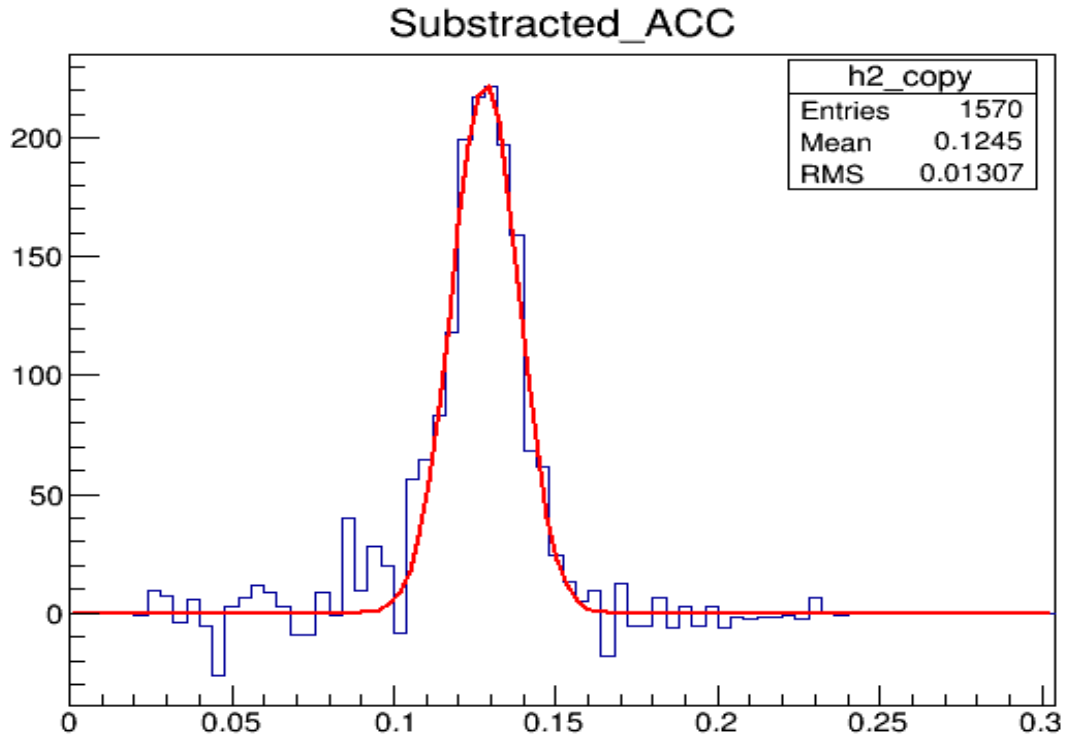


Time distribution in one photon cluster

Two cluster events

(Energy range 2~3GeV, every cluster energy above 0.8GeV)





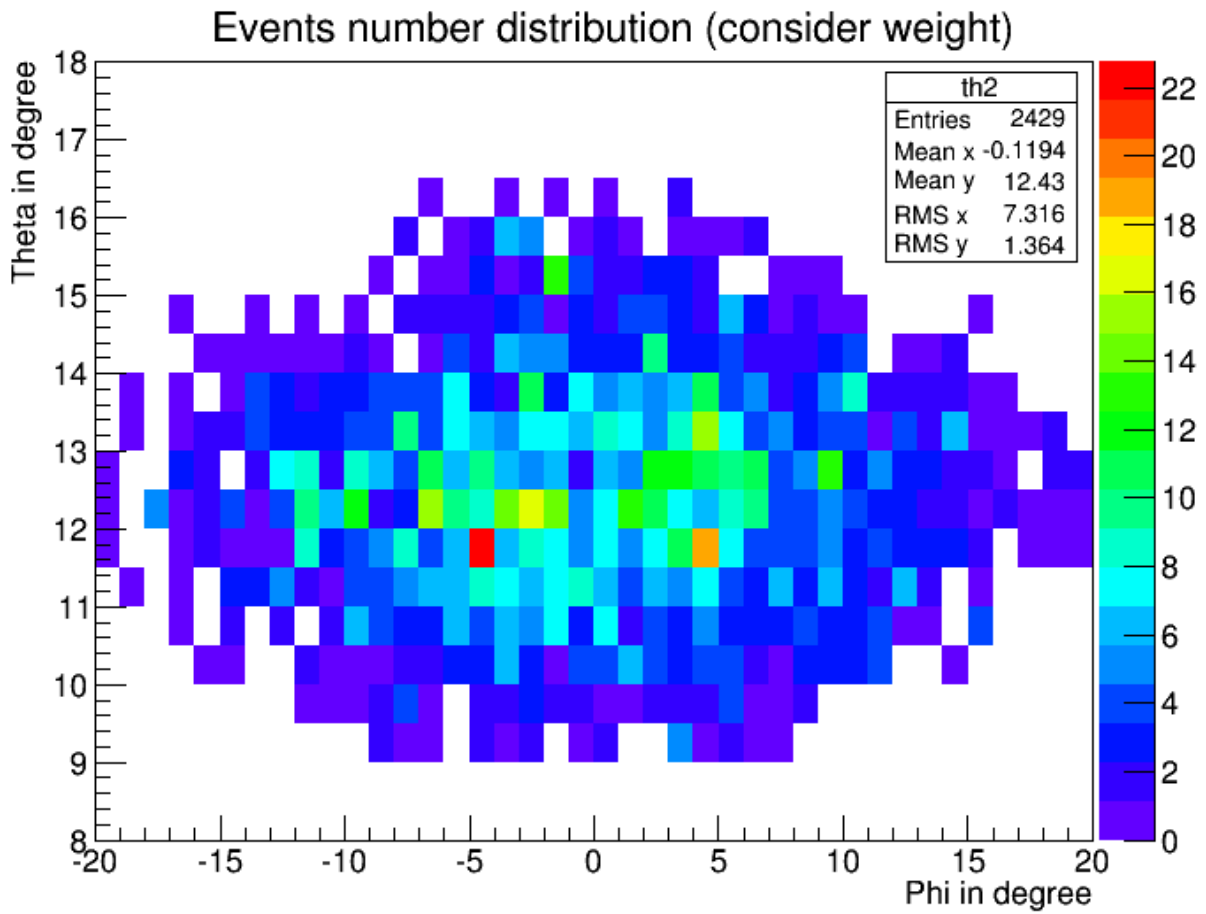
The red curve get from accidental simulation from one cluster, and add angle cut.

Fit the signal area, evaluate the valid number, and add a weight for every event in mass range [0.1, 0.16]

$$\text{Weight}=\frac{Fit\ value\ in\ specific\ mass}{Total\ number\ in\ that\ mass}$$

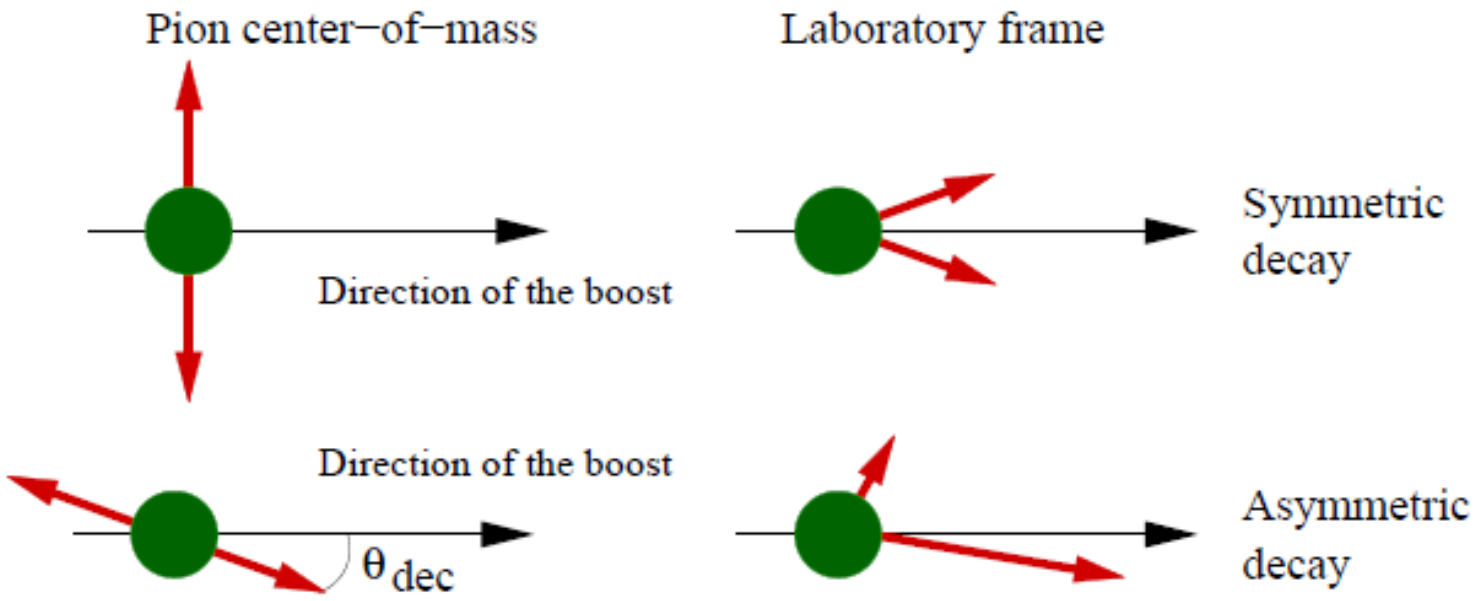
Should add time cut, but program error make some events miss time information, need to check the bug

The distribution of events

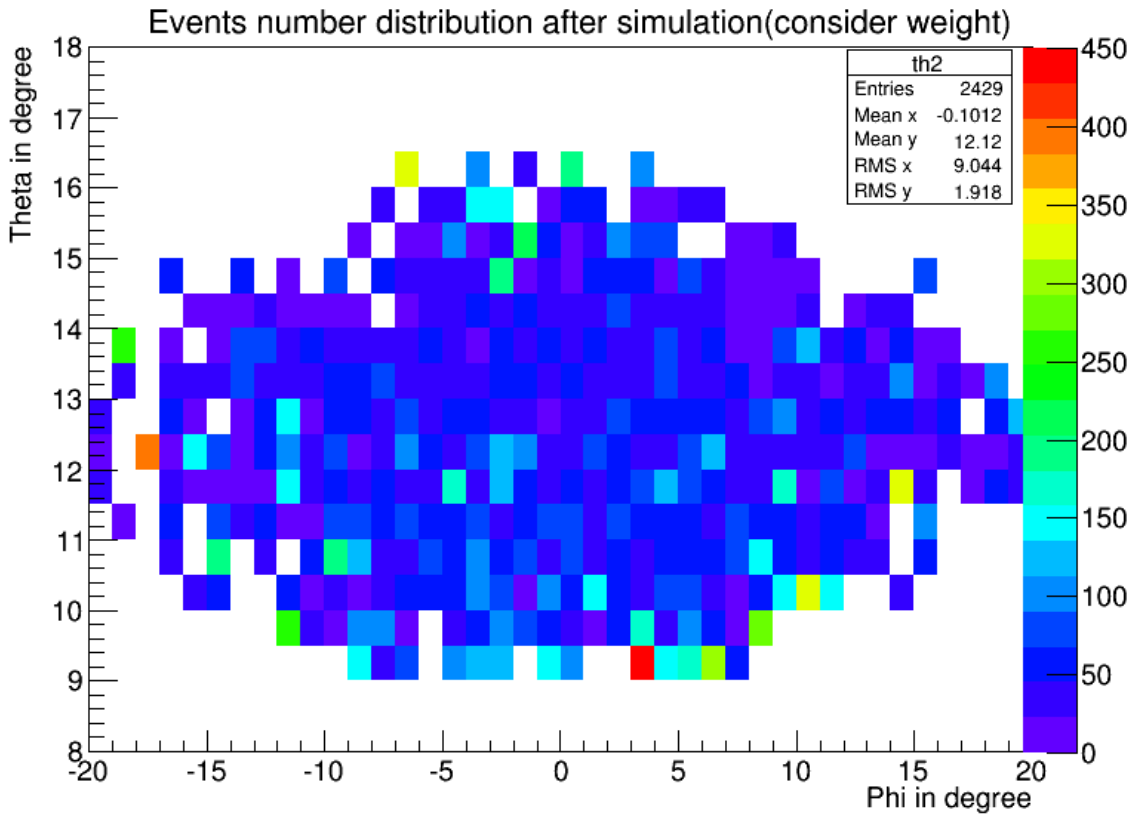


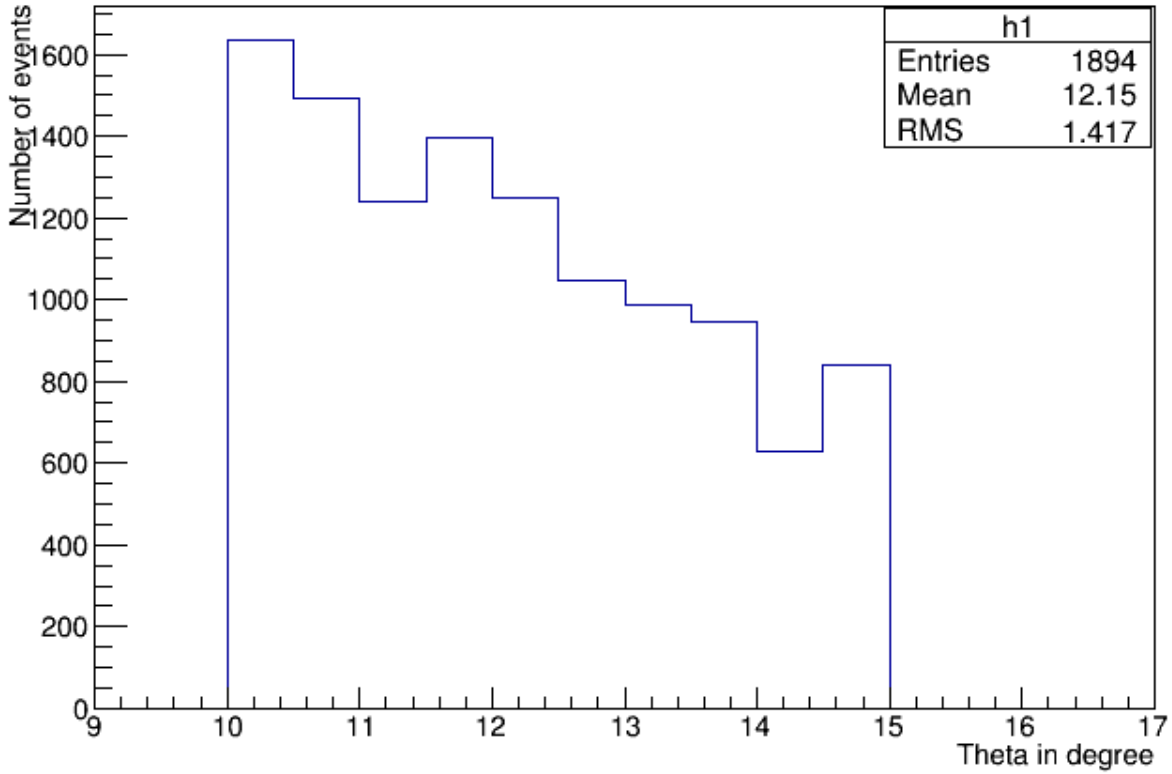
Utilize acceptance to simulate missing events

- Simulate possibility of two photons for every specific energy and momentum of detected pi0, and get the ratio of detected events comparing with total simulation events, which means another weight (How rare the event is)



Result after simulation and range selection



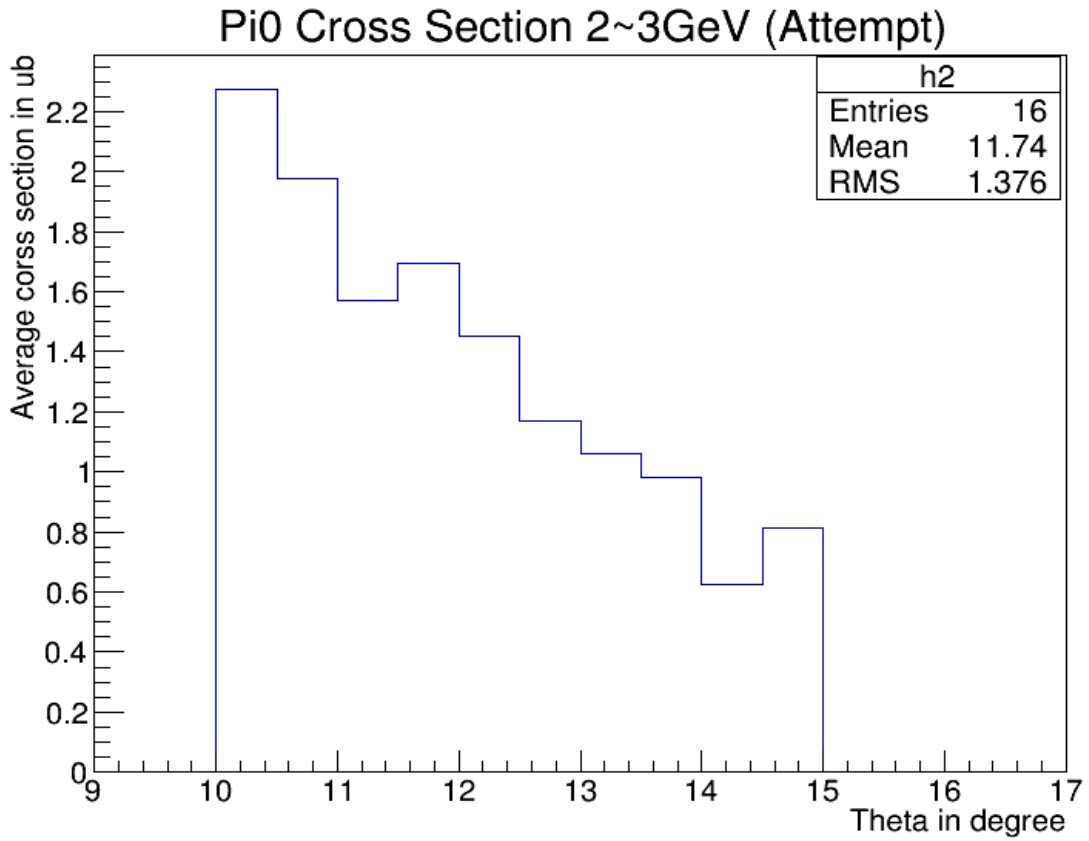


Select range, Choose same phi range [-11,11]

Cross section calculation and result

$$\sigma = \frac{1}{N_{target} \times N_{beam}} \times \frac{N_{photon}}{\Delta\varphi \times \Delta\theta \times sin\theta \times \Delta E}$$

- $N_{target} = \frac{L \times \rho \times N_A}{A} = \frac{15cm \times 0.071 \times 6.02 \times 10^{23}}{1}$
- $N_{beam} = \frac{time \times Current}{e} = \frac{734080 \times 7 \times 4ns \times 15\mu A}{1.6 \times 10^{-19}}$
- $\Delta\varphi = \frac{22}{180} \times \pi$
- $\Delta\vartheta = \frac{0.5}{180} \times \pi$
- $\Delta E = 1$



Error and todo list

- The accuracy of energy
- Get two cluster from three cluster events
- The influence of target vertex uncertainty
- Separate signal from noise
- ……