PROPOSAL FOR THE GAMMA RAY POSITION MEASURING SYSTEM USING e^+/e^- PAIR PRODUCTION EVENTS

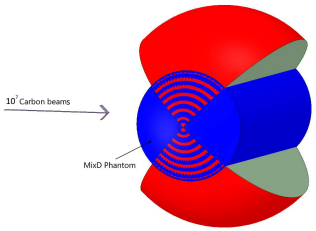
Shota KIMURA, Yusaku EMOTO, Kento FUJIHARA, Hiroshi ITO, Naomi KANEKO,
Hideyuki KAWAI, Atsushi KOBAYASHI, and Takahiro MIZUNO
Dept. of Physics, Chiba University, 1-33, Yayoi-cho, Inage-ku, Chiba-shi, Chiba, JAPAN

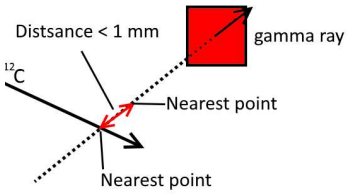
Introduction

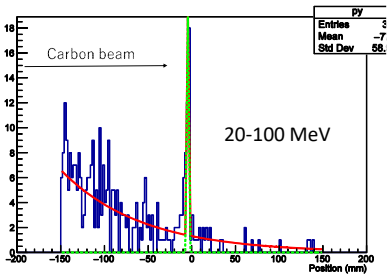
- How is the energy and angular dependence of gamma rays generated when a particle beam is applied to the human body?
- Can we observe such gamma rays in high resolution?

Simulation

- Simulated on GEANT4, Monte Carlo simulation code.



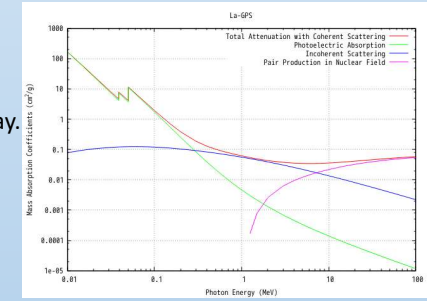




Photon Cross Section

- Over 20 MeV gamma rays
  Pair production in the detector
- The e^+/e^- pair goes in the travelling direction of the gamma ray.

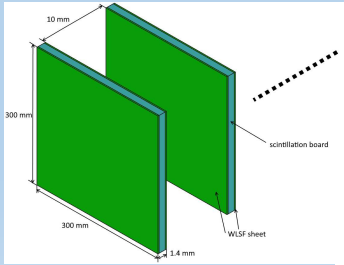
Using pair production event is the best way to detect high energy gamma rays

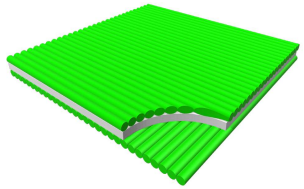


Method

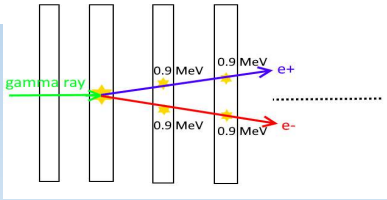
- Constitution of the new system

20 layers of detectors
scintillator block
beam monitor





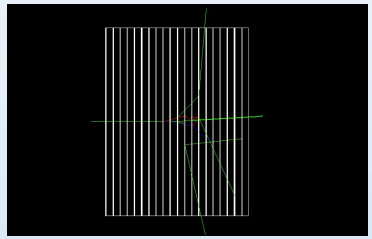
- *Pair production events can be extracted if there are 1.3-2.3 MeV loss of energy at few layers continually.*
- Fitting centroid of the energy deposit by straight line
  →Trajectory of the gamma ray



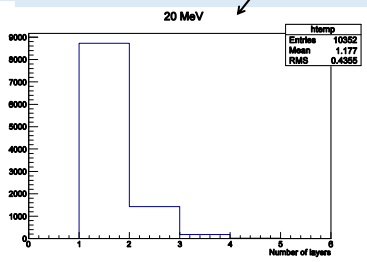
Simulation

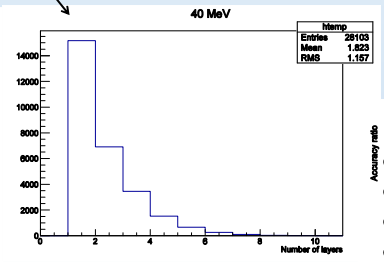
- Shot 10-100 MeV gamma rays to the system
  *WLSF sheets are simplified as polystyrene boards

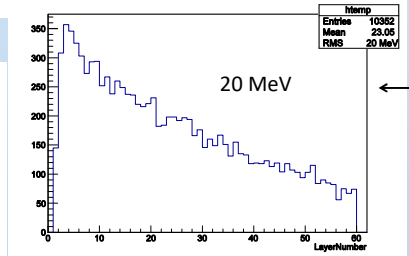
Number of layers
(1.3 MeV<deposit energy<2.3 MeV)
continually



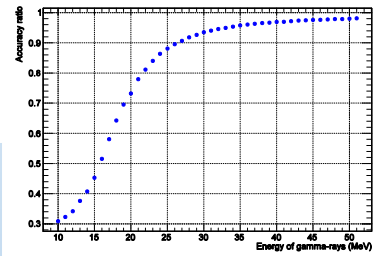
2 layers are limit







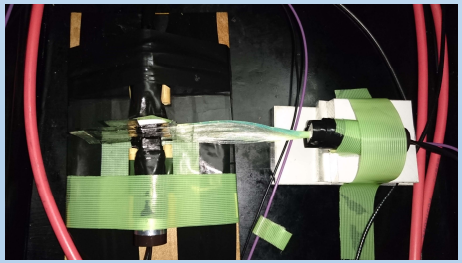
Layer Number of pair originally produced
20 layers →50%
30 layers →67%

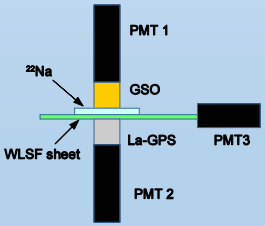


Accuracy ratio of our method
~73% @20 MeV
~96% @40 MeV

Experiments

- Counting the number of photoelectrons.
- The setup of experiment
- On going





Conclusion

This system has a possibility to measure gamma rays' position in high resolution.

References

[1] Berger M J; Hubbell J H; Seltzer S M; Chang J; Coursey J S; Sukumar R; Zucker D S; Olsen K: NIST XCOM: Photon Cross Section Database http://physics.nist.gov/PhysRefData/Xcom/html/xcom1.html (retrieved on the 1st of December 2016)