

Study Plan and GATE Simulation

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(cylindrical coordinate)

Study plan

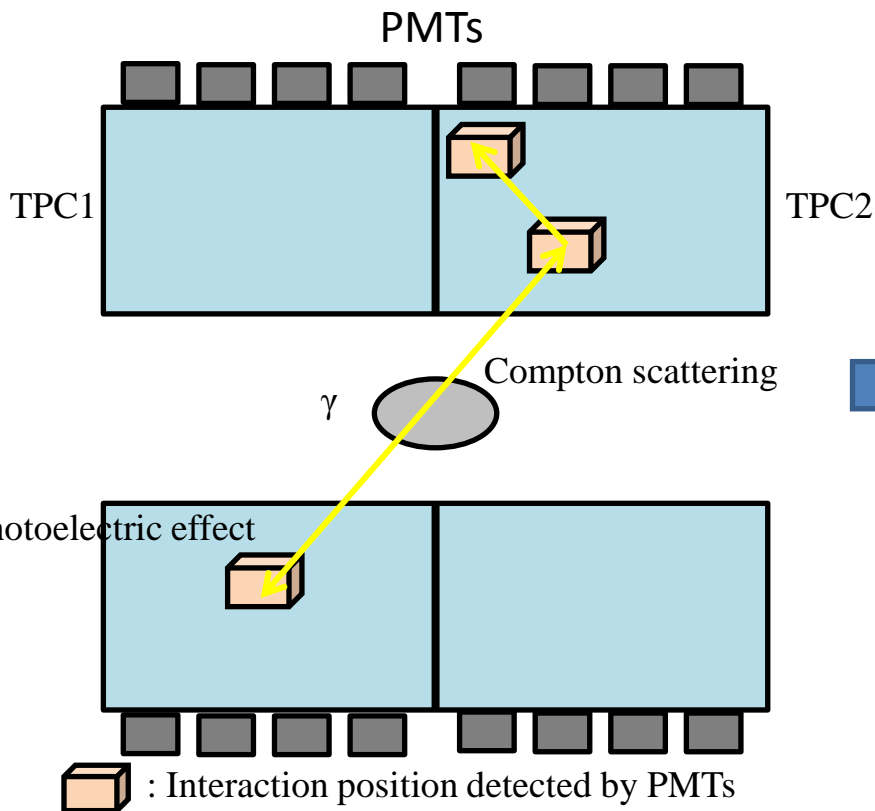
Study plan

- For TPC, we will establish the algorithm, which gets the interaction position and energy deposit by analyzing photon distribution.
- I will study the algorithm which detects the interaction position. MEG experiment group (Mr. Satoshi Mihara) uses it, so I will refer to their theory.
- After study for algorithm and forming algorithm, I want to talk about it with you directly, in Nantes (October or November?).

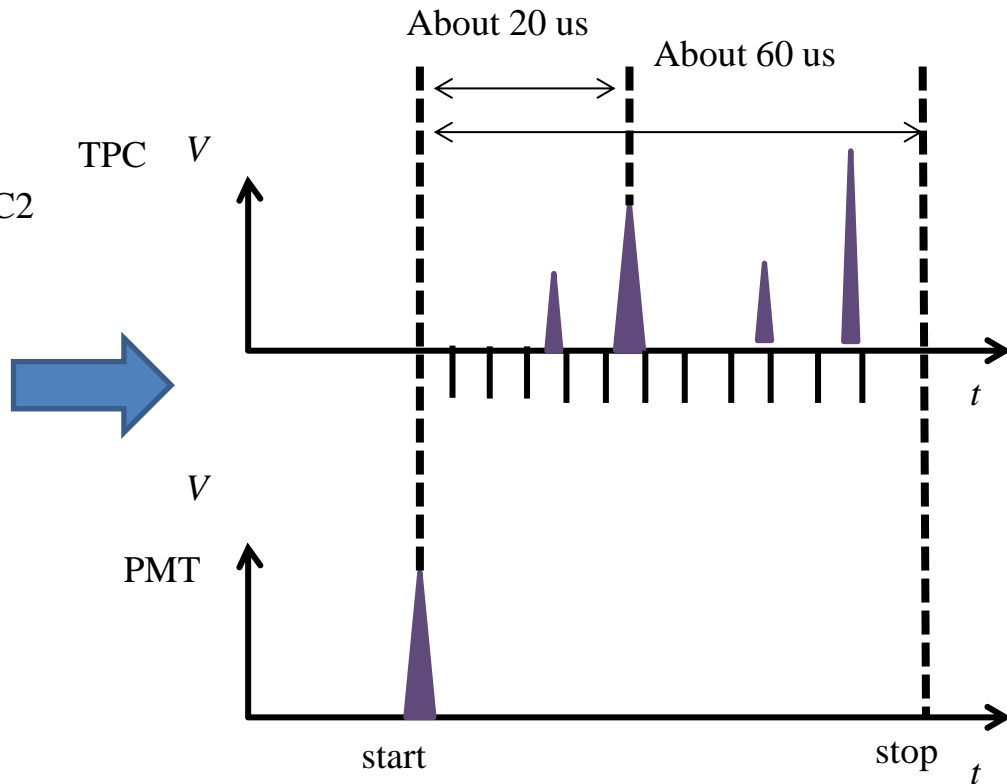
Study purpose

- The purpose
 - Establishing the algorithm for detecting interaction position, which has a few mm as target value
 - Some pulses are detected by TPC in the one trigger. In this case, PMTs information very valid for TPC to get the exact interaction position.

Study purpose



Deposit energy information will be used to distinguish Photoelectric effect events and Compton scattering events

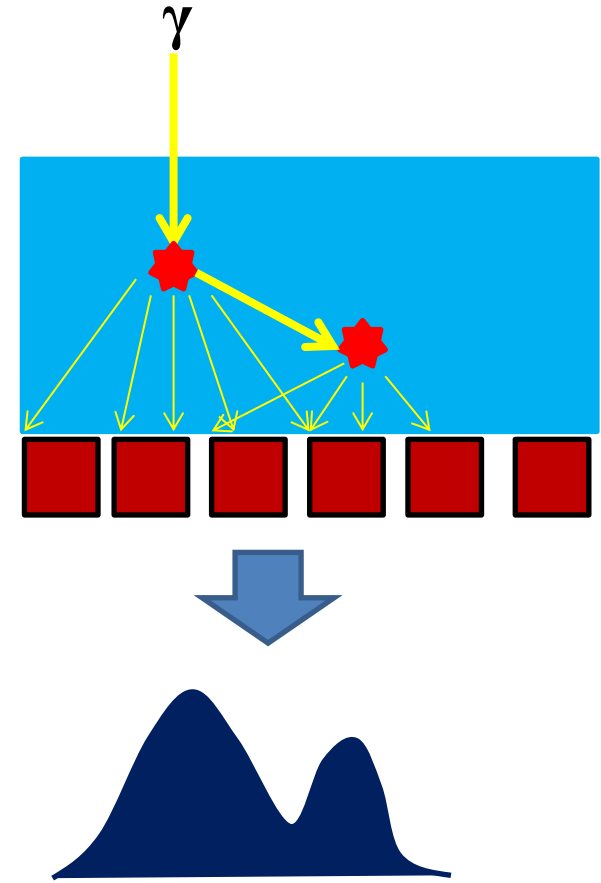


We can choose the region of TPC pulse from interaction position detected by PMTs. And pulse height of TPC signal has a relationship with deposit energy in liquid xenon.

Algorism

Algorithm

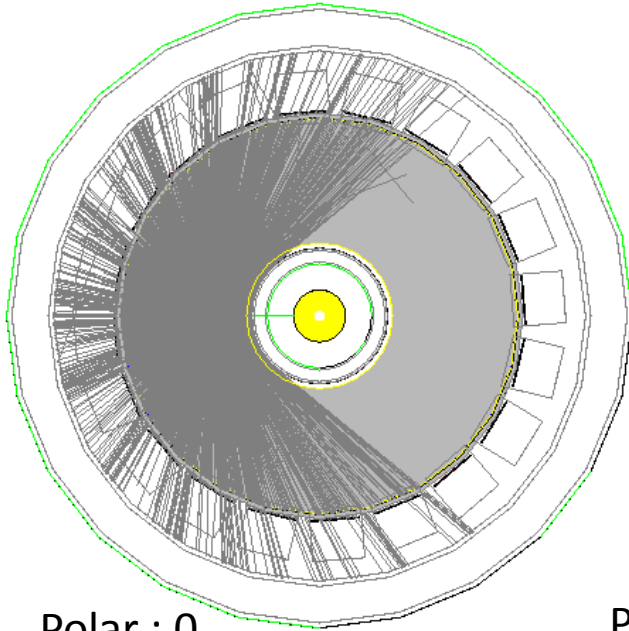
- **Algorithm for interaction position**
 - Clustering the PMT signals to distinguish interaction
 - Finding the peak position of signal from each PMTs
 - Fitting the photon distribution detected by PMTs (only some PMTs which locate center position from peak)
 - Calculating the depth of interaction position by σ (fitting parameter)



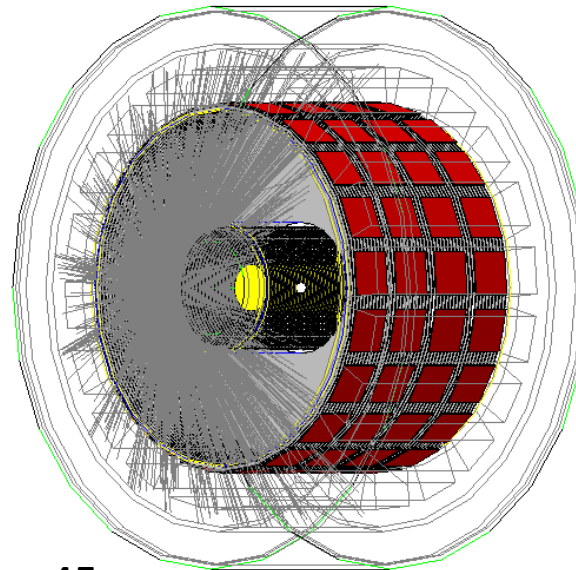
GATE simulation

Confirm PMTs position

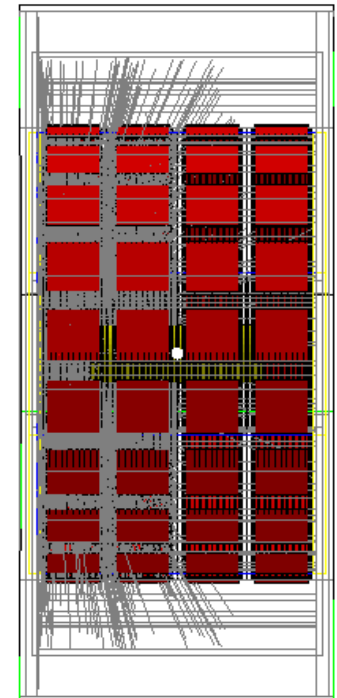
- To confirm relationship of moduleID and crystalID and (x, y, z) , I made the event which γ incident to liquid xenon with θ 225 and φ 0 direction.



Polar : 0
Azimuthal :0



Polar : 45
Azimuthal :0



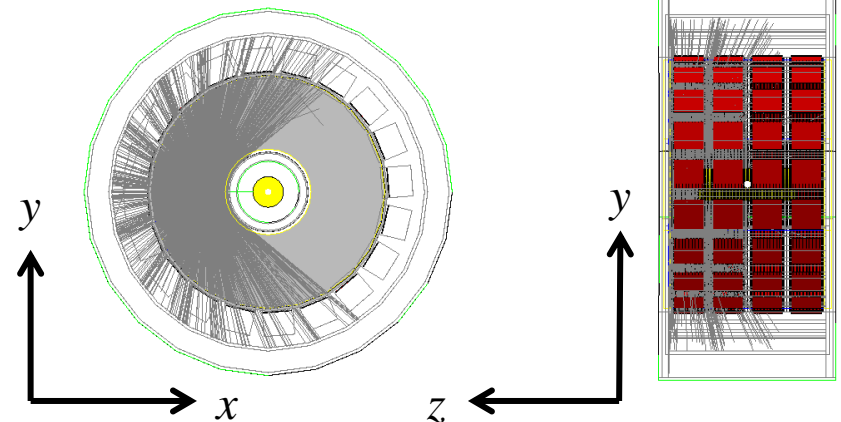
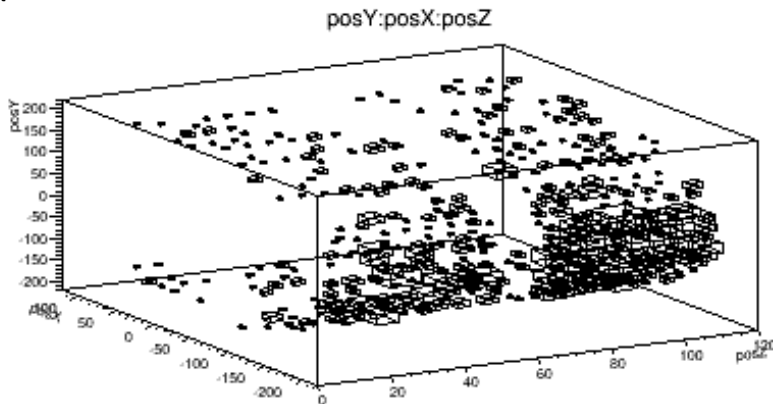
Polar : 90
Azimuthal :0

Confirm PMTs position

- The distribution (x, y, z)

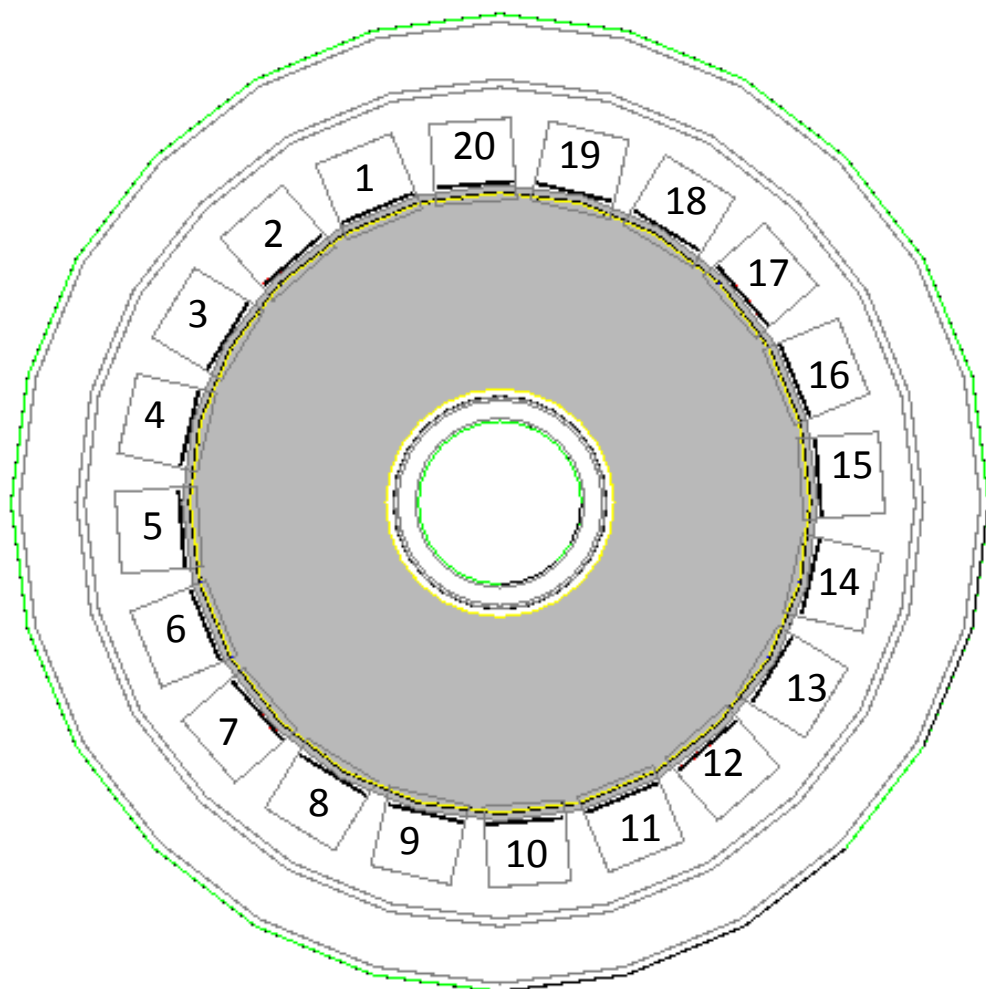
- No1 = (-71.5mm , 181.5 mm , -91.0 mm) , No2 = (-126.5 mm , 148.5 mm , -91.0 mm)
- No3 = (-170.5 mm , 104.5 mm , -91.0 mm) , No4 = (-187.0 mm , 49.5 mm , -91.0 mm)
- No5 = (-192.5 mm , -16.5 mm , -91.0 mm) , No6 = (-181.5 mm , -71.5 mm , -91.0 mm)
- No7 = (-148.5 mm , -126.5 mm , -91.0 mm) , No8 = (-104.5 mm , -170.5 mm , -91.0 mm)
- No9 = (-49.5 mm , -187.0 mm , -91.0 mm) , No10 = (16.5 mm , -192.5 mm , -91.0 mm)
- No11 = (71.5 mm , -181.5 mm , -91.0 mm) , No12 = (126.5 mm , -148.5 mm , -91.0 mm)
- No13 = (170.5 mm , -104.5 mm , -91.0 mm) , No14 = (187.0 mm , -49.5 mm , -91.0 mm)
- No15 = (192.5 mm , 16.5 mm , -91.0 mm) , No16 = (181.5 mm , 71.5 mm , -91.0 mm)
- No17 = (148.5 mm , 126.5 mm , -91.0 mm) , No18 = (104.5 mm , 170.5 mm , -91.0 mm)
- No19 = (49.5 mm , 187.0 mm , -91.0 mm) , No20 = (-16.5 mm , 192.5 mm , -91.0 mm)
- After No21, only z positions are changed.

(No21~No40 : -32.5 mm, No41~No60 : 32.5 mm, No61~No80 : 91 mm)

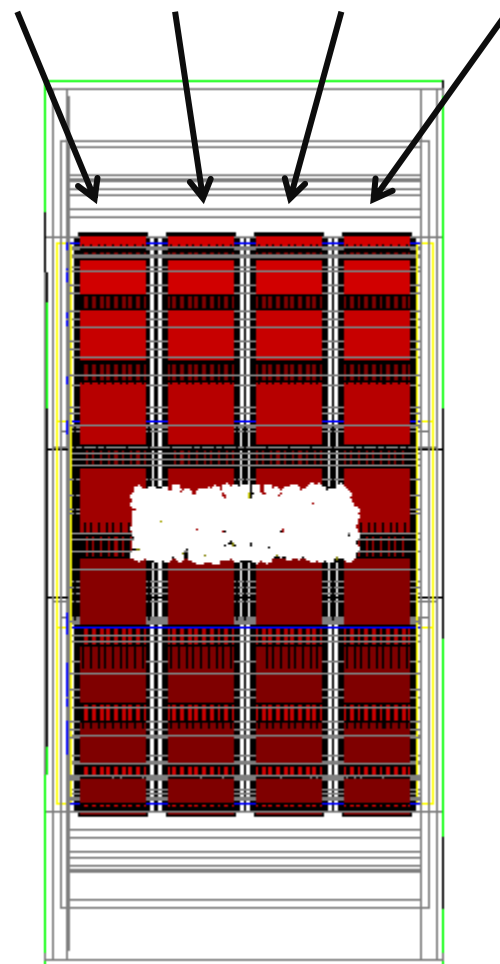


Confirm PMTs position

- Assign the PMT serial number

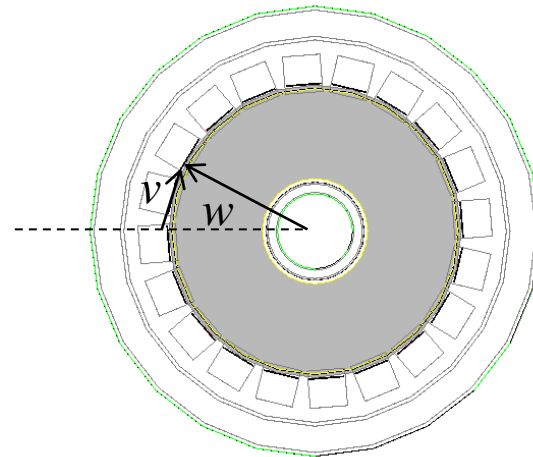


No1~20 No21~40 No41~60 No61~80



Convert coordinates

- Converted
 (x, y, z) to (u, v, w)
 (Cartesian coordinate
 → Cylindrical coordinate)



PMT_No1 = (-91.0 mm , 369.8mm , 195.1 mm) , PMT_No2 = (-91.0 mm , 432.5 mm , 195.1 mm)
 PMT_No3 = (-91.0 mm , 492.4 mm , 199.9 mm) , PMT_No4 = (-91.0 mm , 547.7 mm , 193.4 mm)
 PMT_No5 = (-91.0 mm , -580.6 mm , 193.2 mm) , PMT_No6 = (-91.0 mm , -525.6 mm , 195.0 mm)
 PMT_No7 = (-91.0 mm , -462.8 mm , 195.1 mm) , PMT_No8 = (-91.0 mm , -402.9 mm , 199.9 mm)
 PMT_No9 = (-91.0 mm , -347.6 mm , 193.4 mm) , PMT_No10 = (-91.0 mm , -282.2 mm , 193.2 mm)
 PMT_No11 = (-91.0 mm , -227.1 mm , 195.0 mm) , PMT_No12 = (-91.0 mm , -164.4 mm , 195.0 mm)
 PMT_No13 = (-91.0 mm , -104.5 mm , 199.9 mm) , PMT_No14 = (-91.0 mm , -49.2 mm , 193.4 mm)
 PMT_No15 = (-91.0 mm , 16.2 mm , 193.2 mm) , PMT_No16 = (-91.0 mm , 71.30 mm , 195.0 mm)
 PMT_No17 = (-91.0 mm , 134.0 mm , 195.0 mm) , PMT_No18 = (-91.0 mm , 193.4 mm , 199.9 mm)
 PMT_No19 = (-91.0 mm , 249.3 mm , 193.4 mm) , PMT_No20 = (-91.0 mm , 314.6 mm , 193.2 mm)

Photo Cathode was set at 19.5 cm from center, so it is almost correct. The resolution of detecting (x, y, z) due to these error