

# Simulation Geometry in GEANT4

Email: [zhaor25@mail2.sysu.edu.cn](mailto:zhaor25@mail2.sysu.edu.cn)

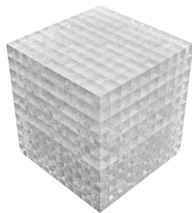
School of Physics


# Outline

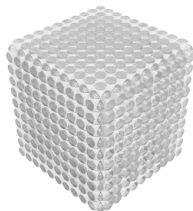
- ① Brief Introduction
- ② physcis and scoring
- ③ simulation output
- ④ summary


# Priliminary Geometry Design

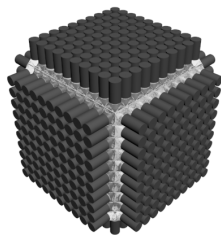
- 1 scintillator cubes  $10 \times 10 \times 10$
- 2 flat film as neutron detector: 4layers
- 3 six light guide arrays
- 4 six PMT [SiPM] arrays




: scintillator cube



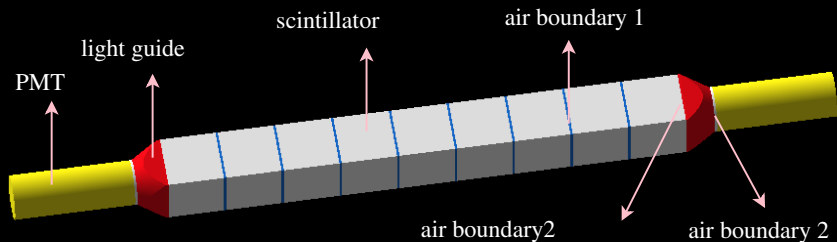
: scintillator cube+light guide




: scintillator cube+light guide+PMT

# Details about the Geometry Set-up

The structure of one dimension detector:



 Geometry structure: PMT-lightguide-scintillator-air boundary between [scintillators; scintillator and lightguide; lightguide and PMT cathode]

# Details about the Geometry Set-up

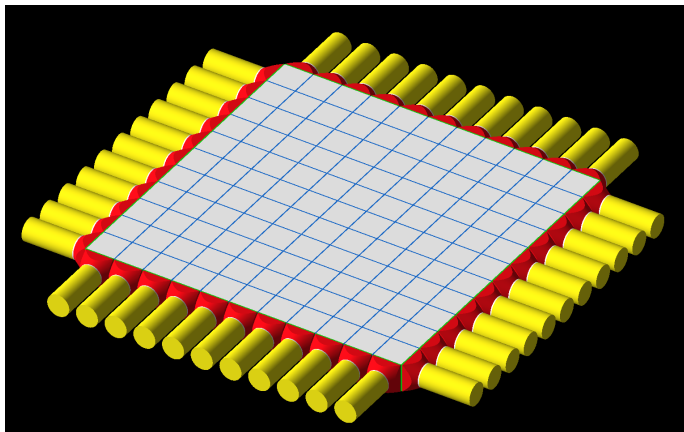


图: two dimation detector layout

# Details about the Geometry Set-up

Not finished yet.

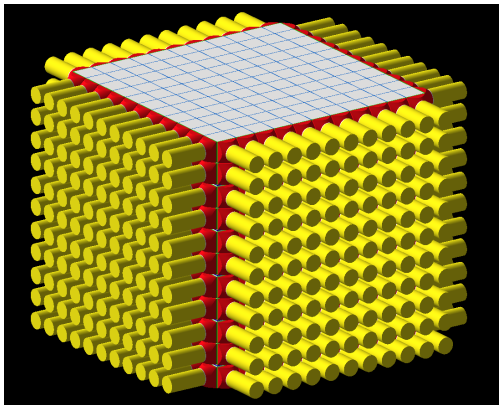
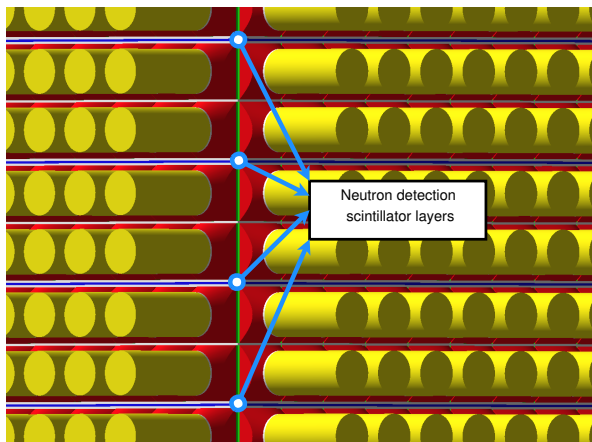


图: 3 dimension detector layout

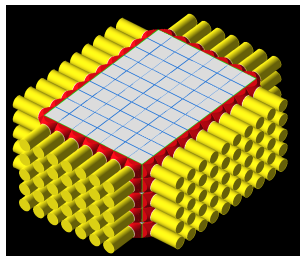
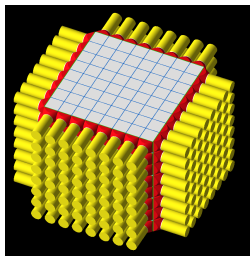
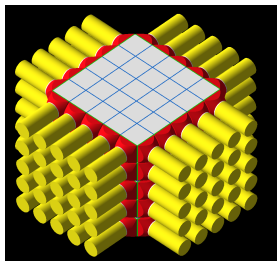
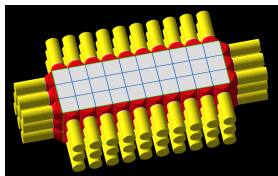
# Details about the Geometry Set-up



: neutron detection scintillator layers in the y direction.

# flexiable size adjustment

Easy to change the full detector size according to experimental requirements.

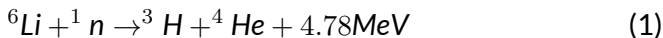




# THERMAL NEUTRON DETECTOR

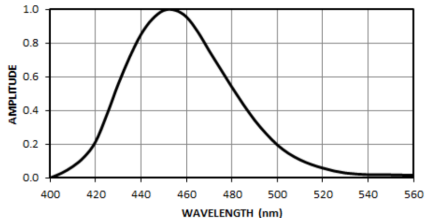
- the neutron detector EJ-426.
- flat white thin sheet,  ${}^6\text{LiF} : (\text{ZnS:Ag})$

detection principle:



The resulting triton and alpha particle are detected by ZnS:Ag phosphor with the broad blue fluorescent spectrum.

EJ-426 EMISSION SPECTRUM



DETECTION PROPERTIES

DETECTION PROPERTIES			
Screen Type		EJ-426-0	EJ-426HD2
${}^6\text{LiF}:\text{ZnS}$ Mass Ratio		1:3	1:2
${}^6\text{Li}$ Density (atoms/cm <sup>3</sup> )		$8.81 \times 10^{21}$	$1.39 \times 10^{22}$
Theoretical N <sup>TH</sup> Efficiency	0.32 mm thick	0.23	0.34
	0.50 mm thick	0.34	0.48

# parameter adjustment

- ① choose the formula: EJ-426-0 or EJ-426HD2 ?
- ② switch the thickness: 0.32mm or 0.5mm?
- ③ sheet size: 60mm× 60mm?
- ④ do we need backing material?

BACKING		
MATERIAL TYPE	DESCRIPTION	SUFFIX
Aluminum Foil	50 μm thick foil	(none)
Clear Polyester Sheet	0.25 mm thick sheet	-PE
	Laminated between two 0.25 mm thick sheets	-PE2
Aluminized Mylar	0.12 mm thick sheet	-AM
Pure Aluminum	0.5mm thick plate	-PA
High Reflective Aluminum	0.4mm thick plate	-A

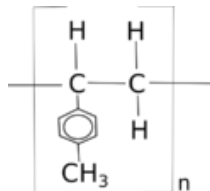
# next to be done

- detector construction .
  - add remain geometry [lightguides and PMTs].
  - attach correct material to each logical volume.
  - other components
- adjustment of physics list
  - about scintillator material and their **optical properties**
  - optical performance of lightguides
  - response of PMT [SiPM]
  - optical boundaries
- add different primary **particle sources**
  - alter the particle type, position, momentum, energy etc.
  - use gps to control the particle source
- sensitive detector and scoring
- more user actions for output and analyze.

# material of detector components

- gamma scintillator:EJ-200

Base: Polyvinyl toluene formula :  $[\text{CH}_2\text{CH}(\text{C}_6\text{H}_4\text{CH}_3)]_n$



Density:  $1.023 \text{ g/cm}^3$

Refraction Index: 1.58

Light Output: No change from  $-60^\circ\text{C}$  to  $20^\circ\text{C}$

- thermal neutron scintillator:EJ-426HD2

$^6\text{LiF}$  : *ZnS MassRatio*1 : 3

$^6\text{Li}$  Density(atoms/ $\text{cm}^3$ ) :  $8.81 \times 10^{21}$

$^6\text{Li}$  enriched to minimum of 95 atom percent.

# sensitive detector

# summary

- almost finish simple detector geometry.
- other parts of simulation program still in progress.

*BEHUP*