Scintillator_Sensor

ILC Tokusui workshop 2012

21th/12/2012

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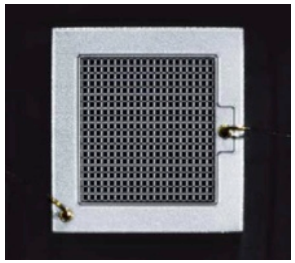
What is ScECAL?

- A strip scintillation counter using MPPC would be powerful sensor for ScECAL
- Because of Segmentation, High acceptance, Feasibility ,Good cost performance, etc..

MPPC + Scintillator = Scintillation Counter

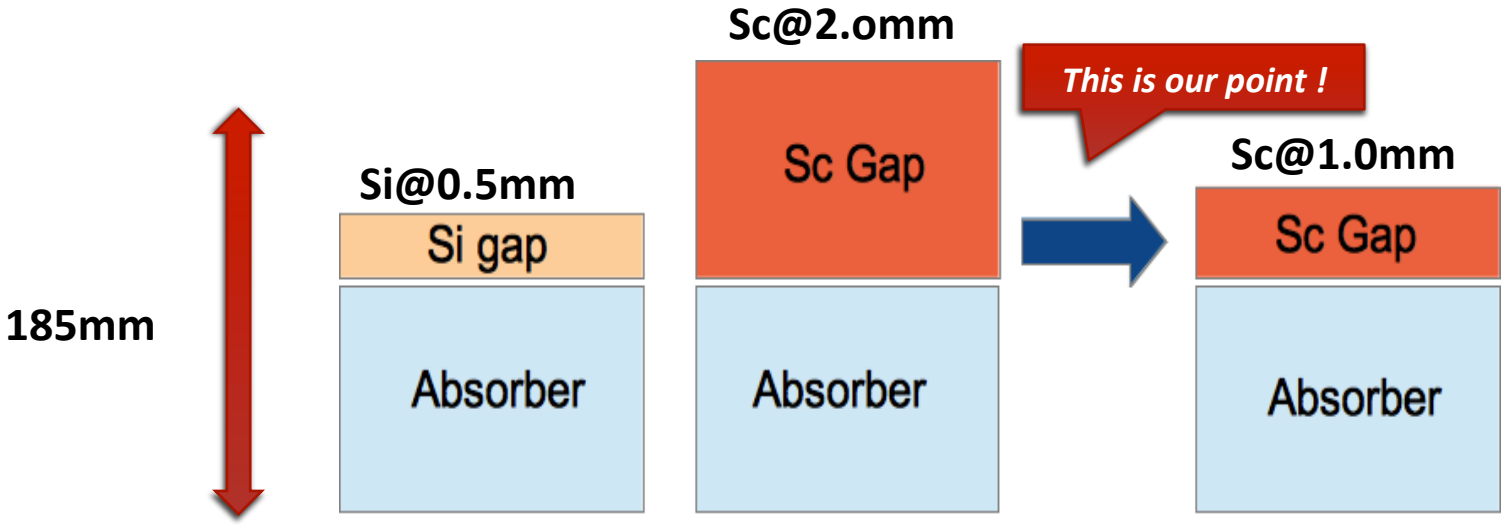


Scintillation Counter × 10^{7} = ScECAL

Purpose

Making Things Smaller

- Total module thickness by ECAL design is just 185mm.
- We tried to use a thinner scintillator such as 1.0mm thickness.



- We tested for adequate light intensity performance which has been for 7 P.E. in the range of 1.0mm ~ 2.0mm thickness.

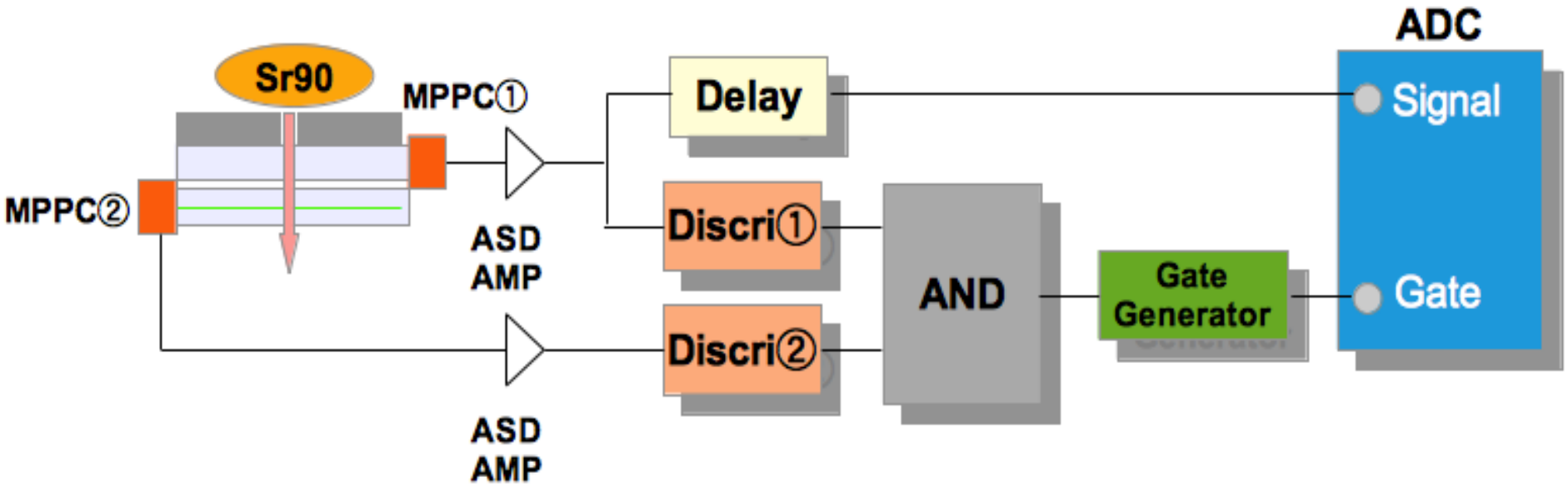
Measurement

“ Light Intensity Measurement Tests “

～Test1. Thickness Dependence
～Test2. Voltage Dependence
～Test3. Temperature Dependence

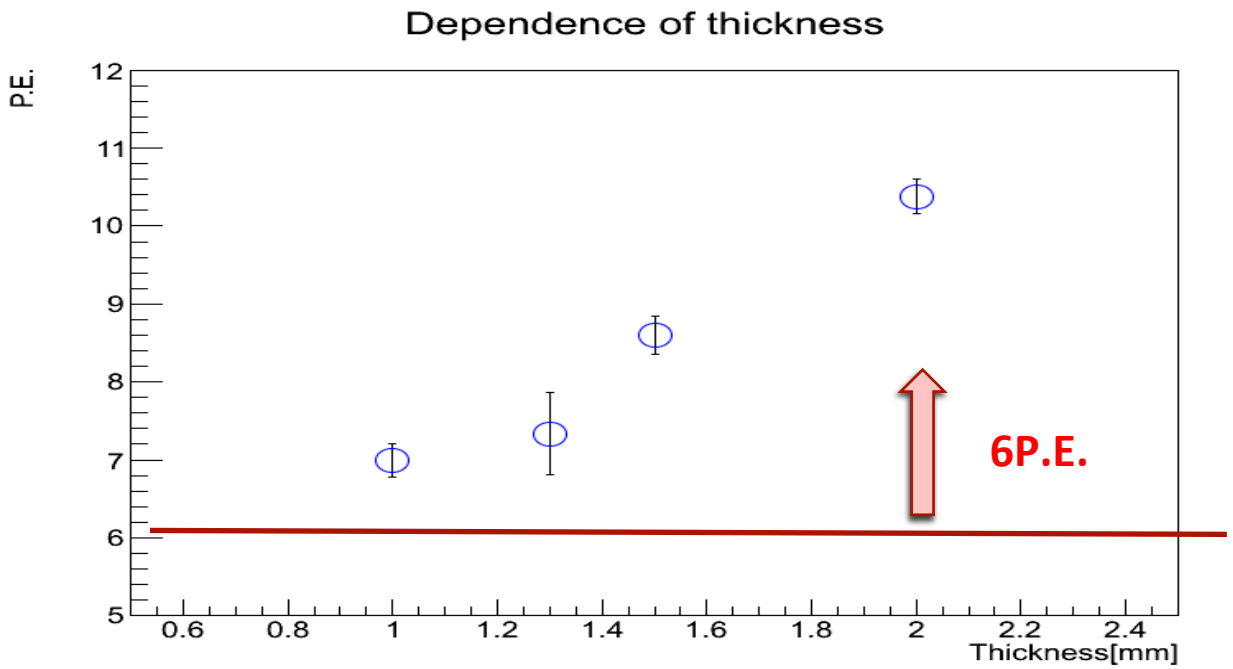
Setup of Tests 1 & 2

Light Intensity Measurement



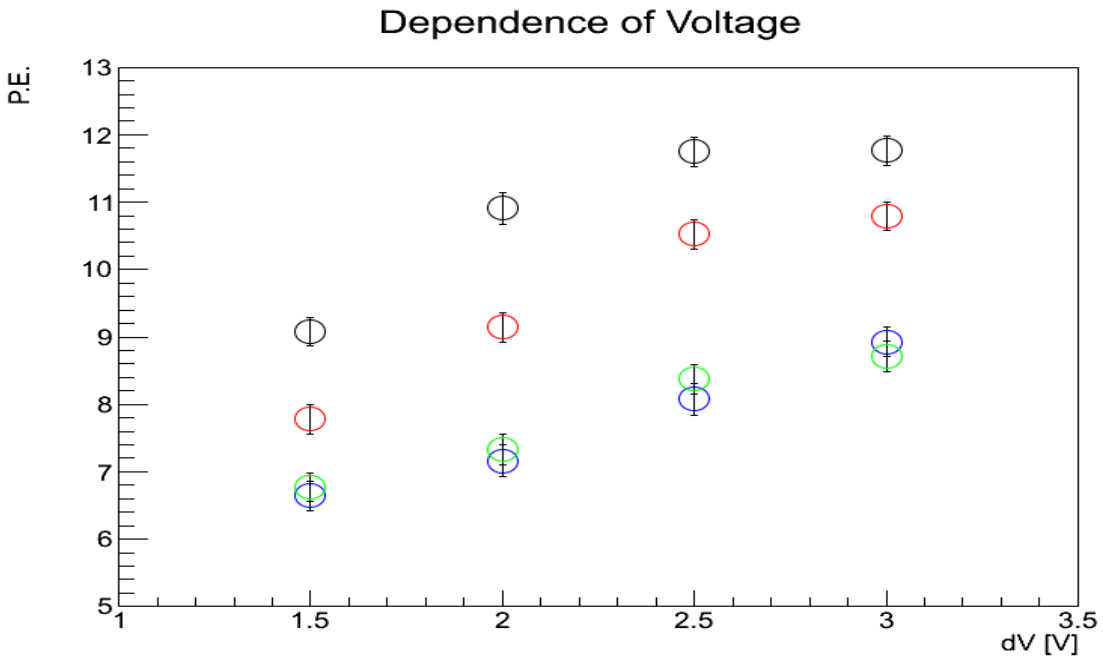
Using 2 MPPC 1600 pixels MPPC @25℃, Discri①=30[mV], Discri②=40[mV],G.G=100[ns]

Results of Test 1



- We compared the light intensity measured at four thicknesses.
- (1.0mm, 1.3mm, 1.5mm, 2.0mm) × 5mm × 45mm
- We used with same MPPC and operating Voltage dV=2[V] , @25℃
- At all thicknesses, light intensity was confirmed to be over 6 P.E.

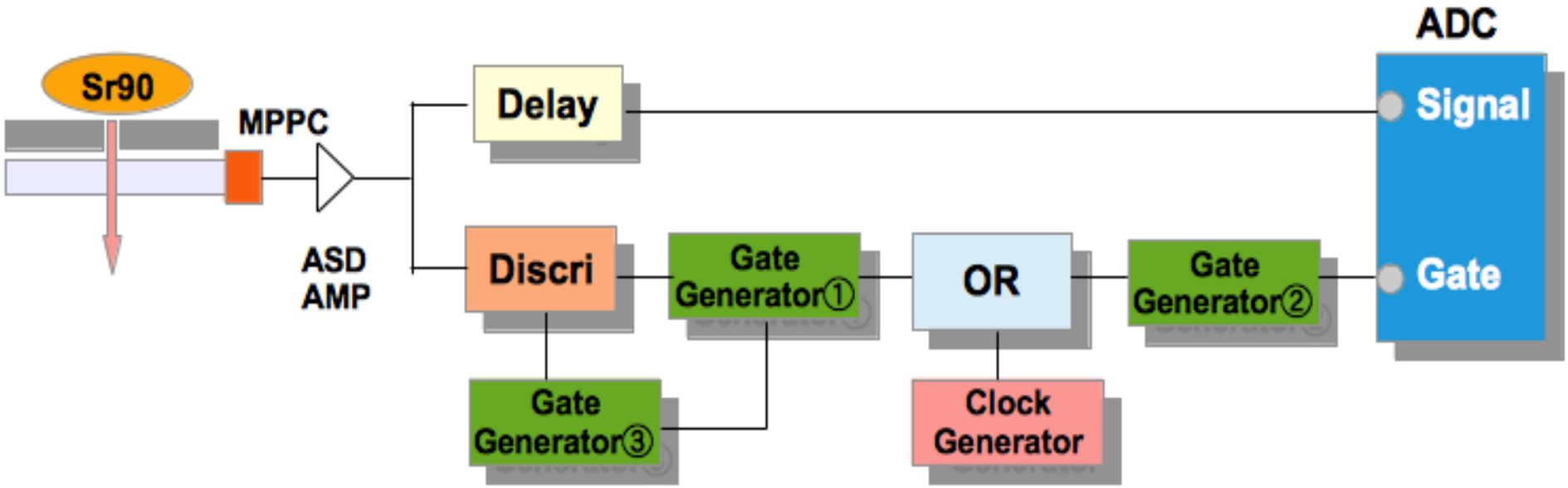
Results of Test 2



- We compared the light intensity at four voltages.
- A scintillator size of (1.0mm, 1.3mm, 1.5mm, 2.0mm) × 5mm × 45mm
- We used with same MPPC and operating Voltage dV= 1.5V, 2.0V, 2.5V 3.0V @ 25℃
- The relationship of light intensity to voltage was found to be nearly linear with MPPC.

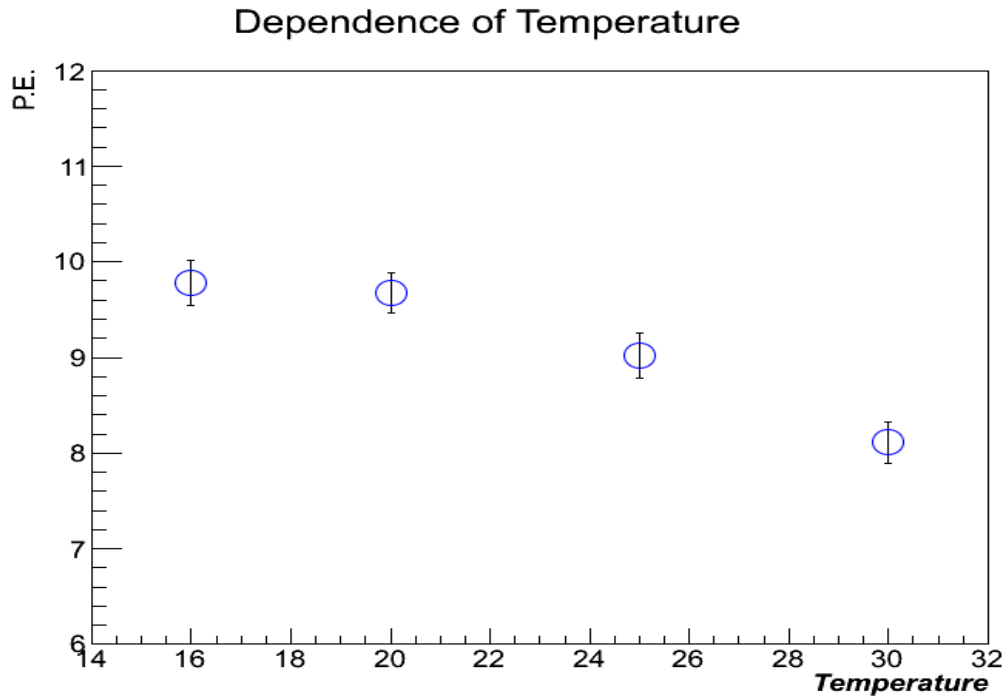
Setup of Test 3

Light Intensity Measurement of temperature dependence



Using MPPC 1600 pixels MPPC @25℃, Discri=30[mV], G.G②=100[ns]

Results of Test 3



- We compared the light intensity at four temperature.
- A scintillator size of 2.0mm×5mm×45mm
- Temperature = @ 15℃@ 20℃@ 25℃@ 30℃
- The relationship of light intensity to temperature was found to be nearly linear with MPPC.

Summary

- **At all thicknesses, light intensity was confirmed to be over 6 P.E. over voltages 2[V]@25℃ .**
- **Actually plastic scintillator at 1.0mm thickness has almost 7 P.E. average light intensity using 90 Sr source which depend on the situation about matching between MPPC and Scintillator.**
- **The relationship of light intensity to voltage was found to be nearly linear with MPPC**

Plan

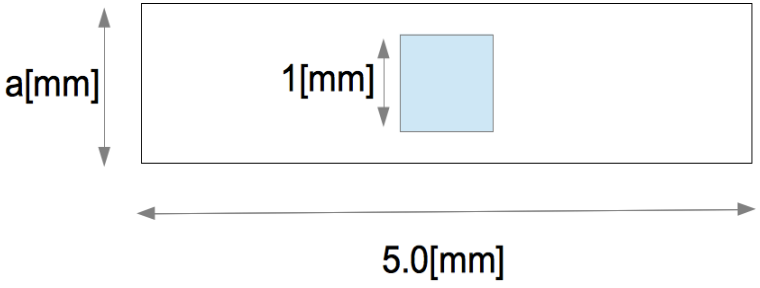
- To make a jig for Precise measurements
- To measure using the other's pixel size of MPPC
- To measure timing resolution study of the MPPC +Scintillator which is the other important parameter

Back Up

Case1:

Efficiency = Receiving Area of MPPC/Receiving Area of scintillator

Below figure shows side view of Scintillator with MPPC (blue box)



Light intensity is linear to thickness by measurements. However, the right green tables shows constant condition.

Thickness	0<a<1	1<a
Receiving area of MPPC	a	1
Receiving area of Scintillator	5a	5a
Efficiency	1/5	1/5a
The number of the incident photos	ax	ax
The number of the detection photons	(1/5)ax	(1/5)x

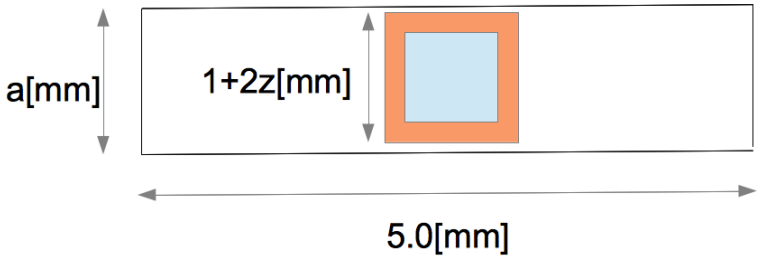
Linear Constant

■**This case is that light intensity is constant(thickness@1<a)**

Case2 :

This case is that light is leaking out .Below red zone light come to receiving area of MPPC.

Below figure shows is Side view of Scintillator with MPPC



coming the light intensity from above orange zone .

Thickness	0<a<1	1<a
Receiving area of MPPC	a(1+2z)	a(1+2z)
Receiving area of Scintillator	5a	5a
Efficiency	(1+2z)/5	(1+2z)/5
The number of the incident photos	ax	ax
The number of the detection photons	ax(1+2z)/5	ax(1+2z)/5

Linear Linear

■**This case is that light intensity is linear(thickness@1<a)**