

Development of fine strip scintillator with extrusion technique

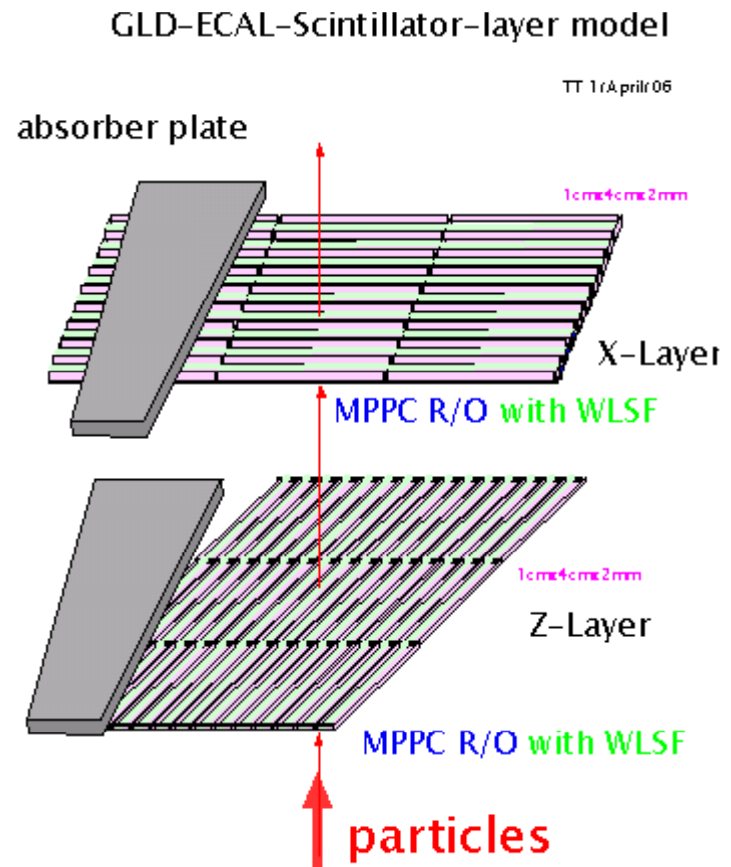
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Motivation

- Concept of strip calorimeter

- Sampling calorimeter with scintillator and W for ECAL
- Realize fine granularity (effective segmentation $\sim 1\text{cm} \times 1\text{cm}$) for PFA with strip structure
- Huge number of readout channels for a ILC detector
~10M channels for ECAL
- Readout by MPPC



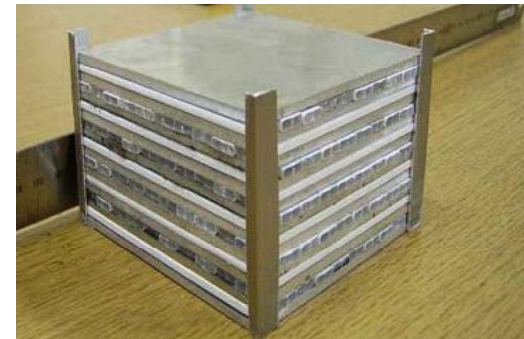
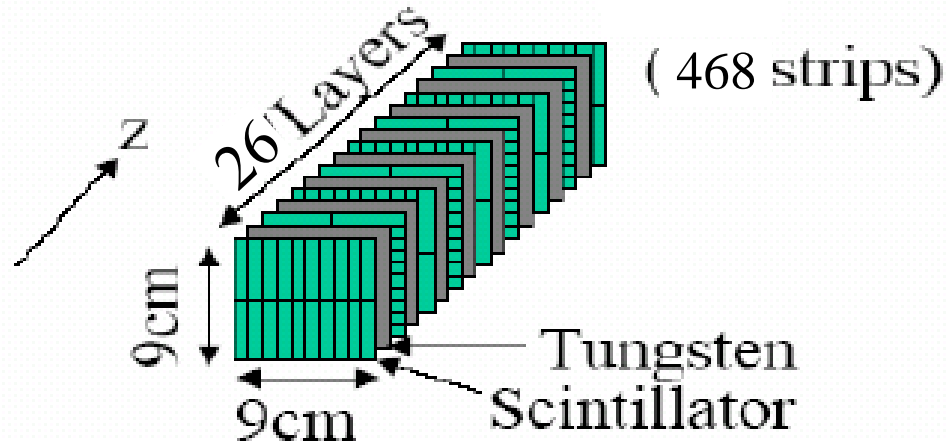
Basic Configuration

- Prototype for EM Calorimeter

One Layer : Tungsten : 90mm x 90mm x 3.5mm

Scintillator : 10mm(width) x 45mm(length) x 3mm(thickness)
x 18 strips

Total : 26 Layers (~ $18X_0$)

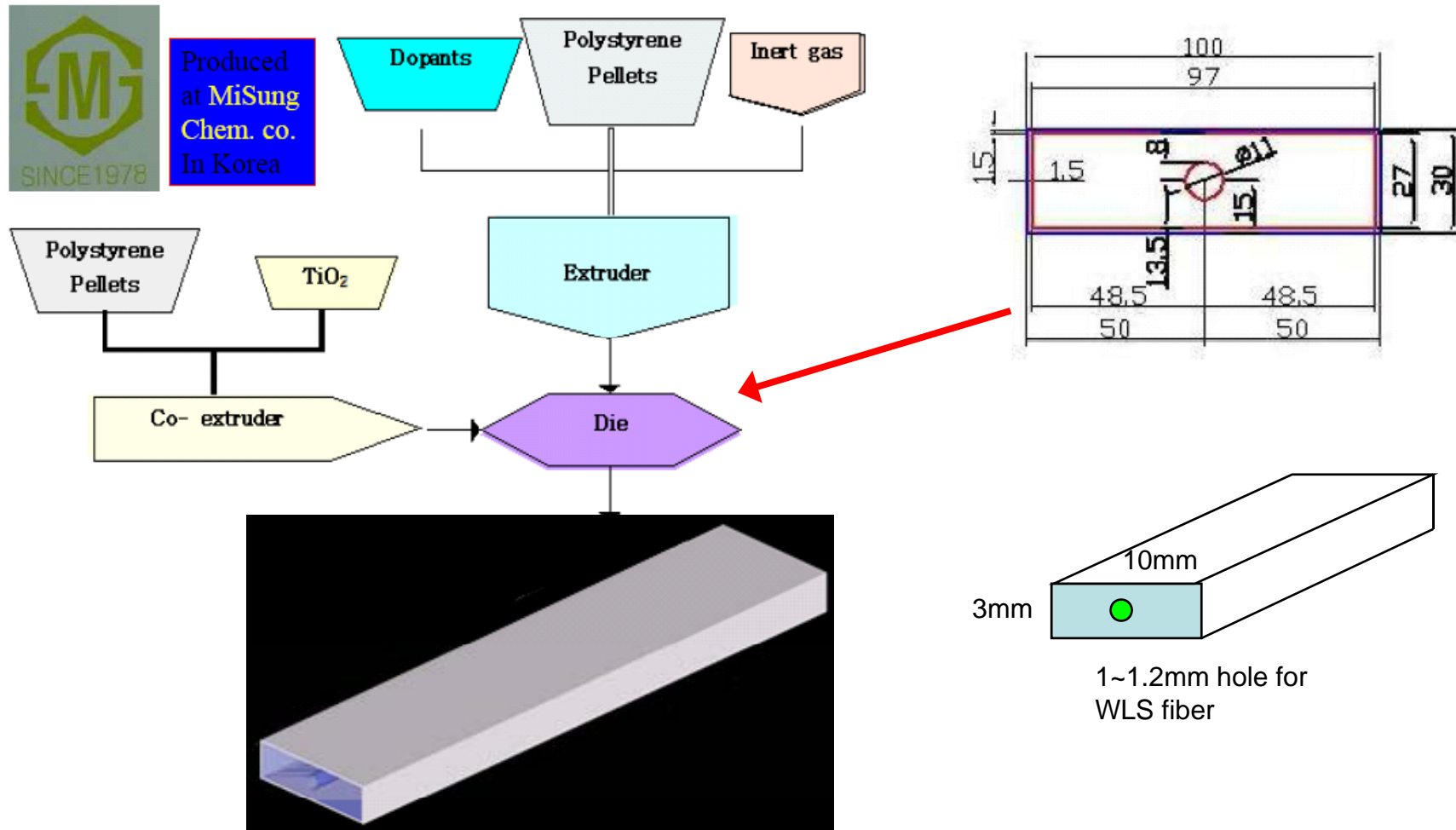


Fine strip scintillator required !

Plastic Scintillator

- Component : **Polystyrene** pellets
+ Dopants(primary & secondary)
- Dopants
 - Primary dopants (**blue** - emitting)
 - **PPO**(2,5-biphenyloxazole)
1.3 % (by weight) concentration
 - Secondary dopants (**green** – emitting)
 - **POPOP**(1,4-bis(5-Phenyloxazole-2-yl)benzene),
0.1 % (by weight) concentration
- Production : Extrusion method
 - **Extrusion is easy to make numerous type of scintillator**
 - **Lower cost than casting method**

Extrusion Process

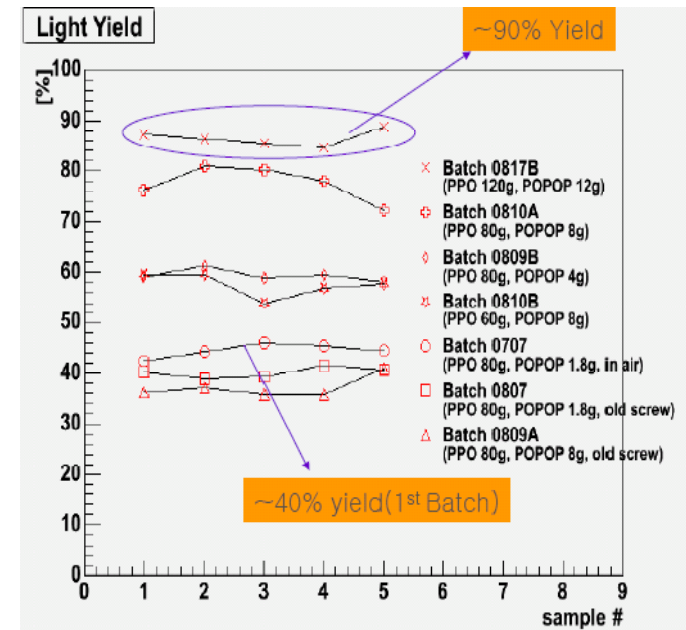


Very early R&D results

- First polystyrene bar (MINOS) was produced, 40mm(width) x 10mm(thickness)
-> The Mechanical process has been established

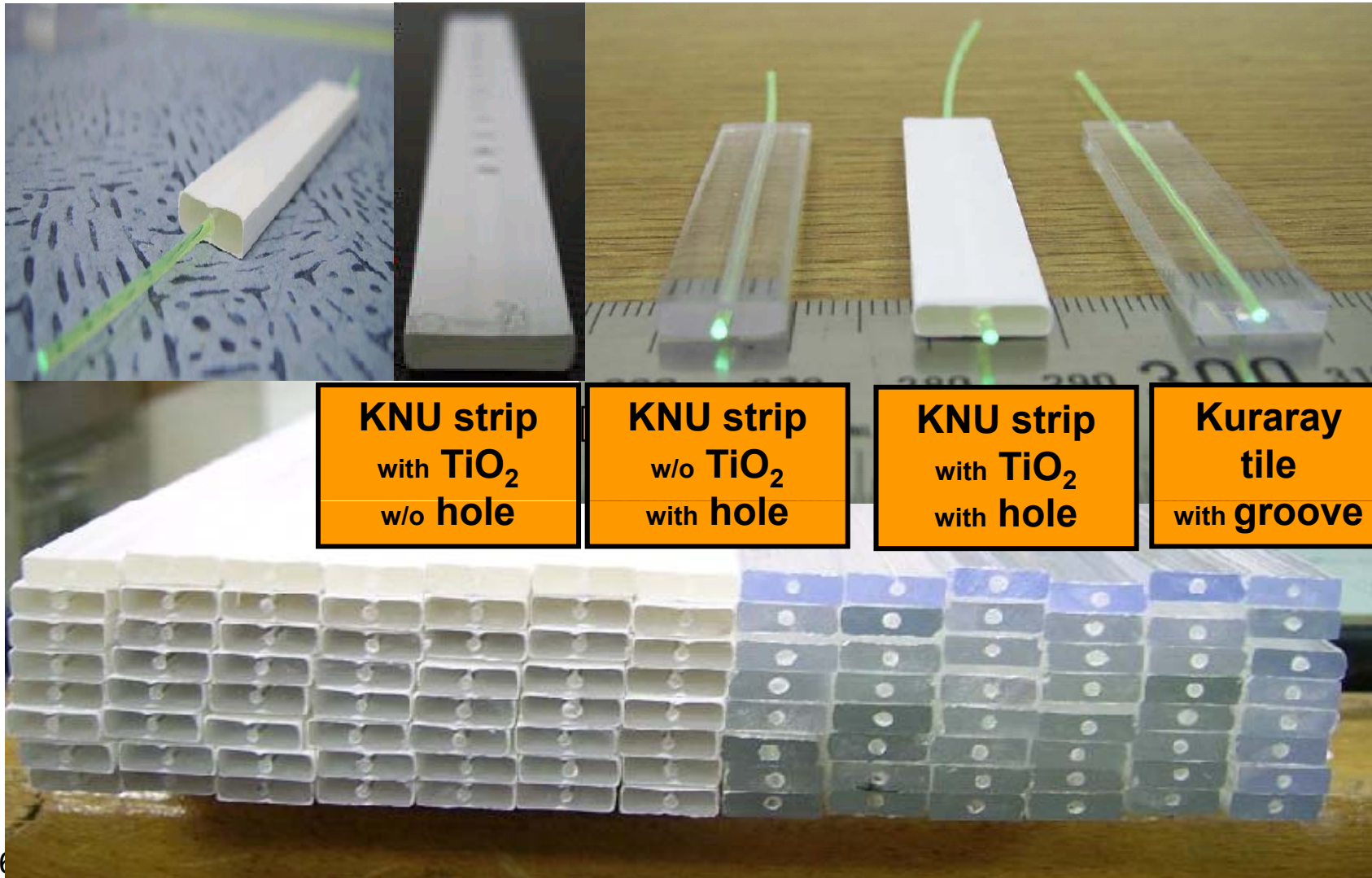


- Light Yield measurement for our tiles and reference
-> the best samples show $(93 \pm 8)\%$ light yield of the reference sample



- Ready to produce fine strip scintillator from previous results

Produced fine scintillator strips



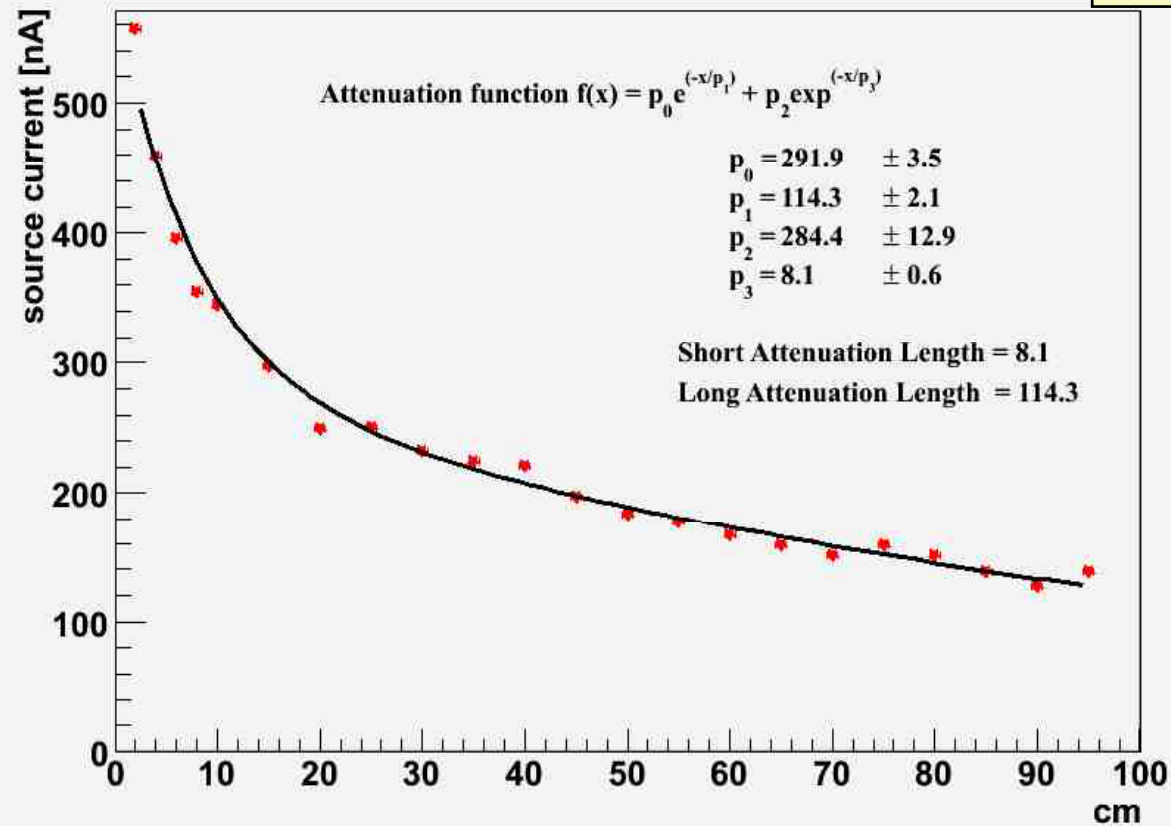
Specification for test

- Readout PMT : H6568 MAPMT (16 channels)
HV = -800V , QE = ~13% (~500nm)
- Beta-ray source : ^{90}Sr (with collimator)
- WLS fiber : Kuraray Y-11
- Pico Ammeter : Keithly 485
- QDC : CAEN v792
(32ch, 0~400pC , 12 bit resolution.)
- PCI interface between VME and PC

Attenuation Length measurements

Plastic Scintillator Attenuation Length Test

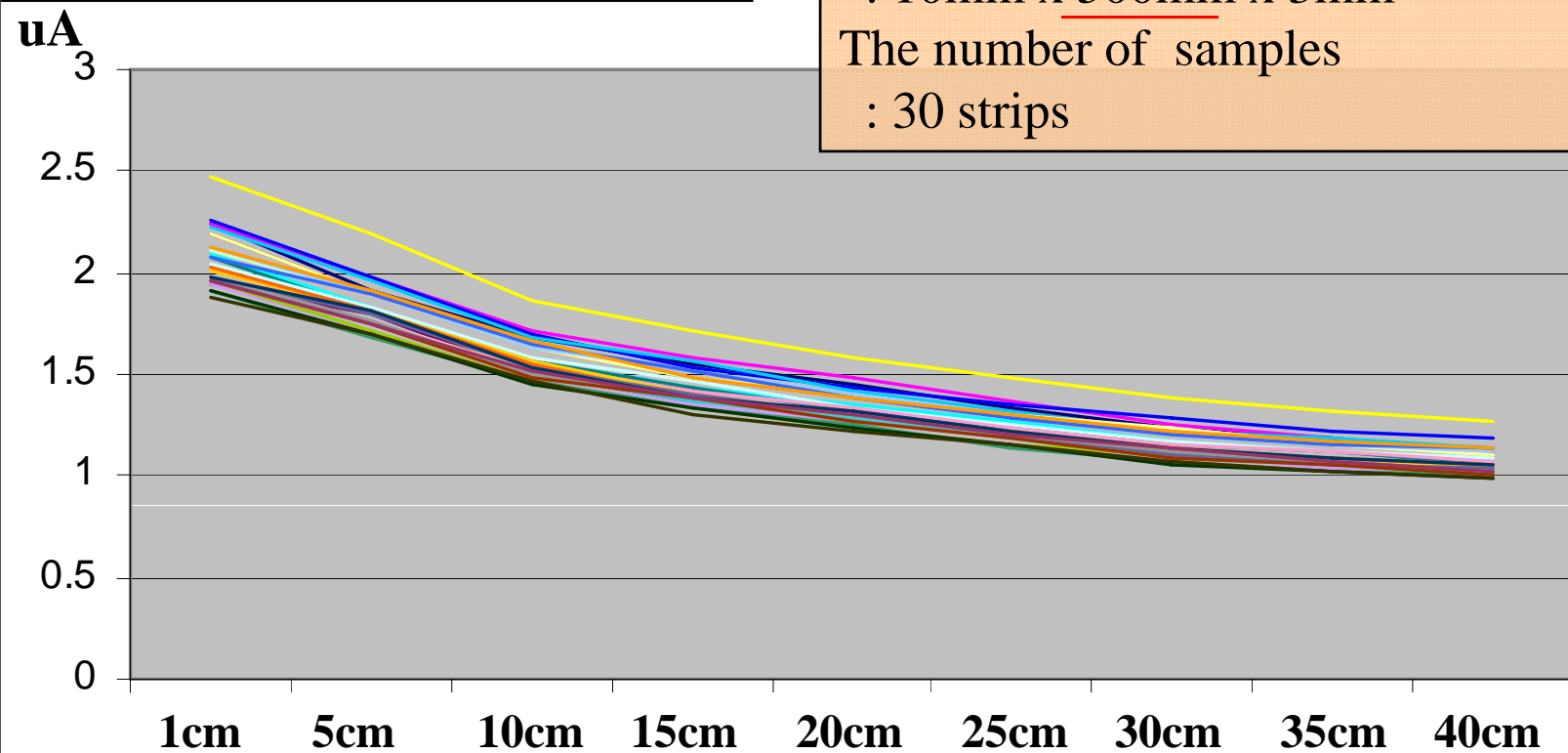
Sample : KNU tile with hole
10mm x 1000mm x 3mm



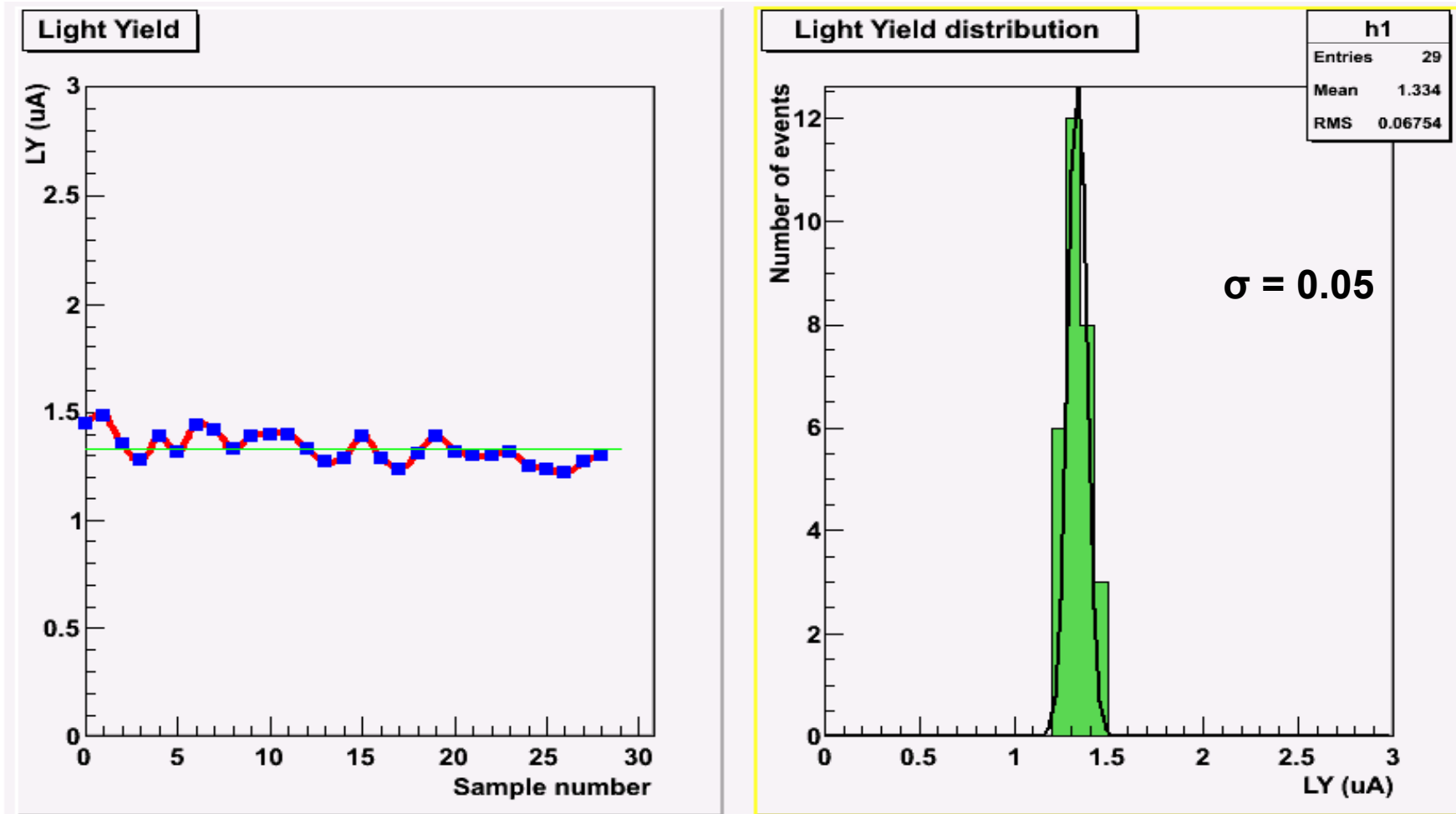
Light Yield along position for each strips

Samples : KNU tile with hole & TiO₂
with fiber

Sample size
: 10mm x 500mm x 3mm
The number of samples
: 30 strips



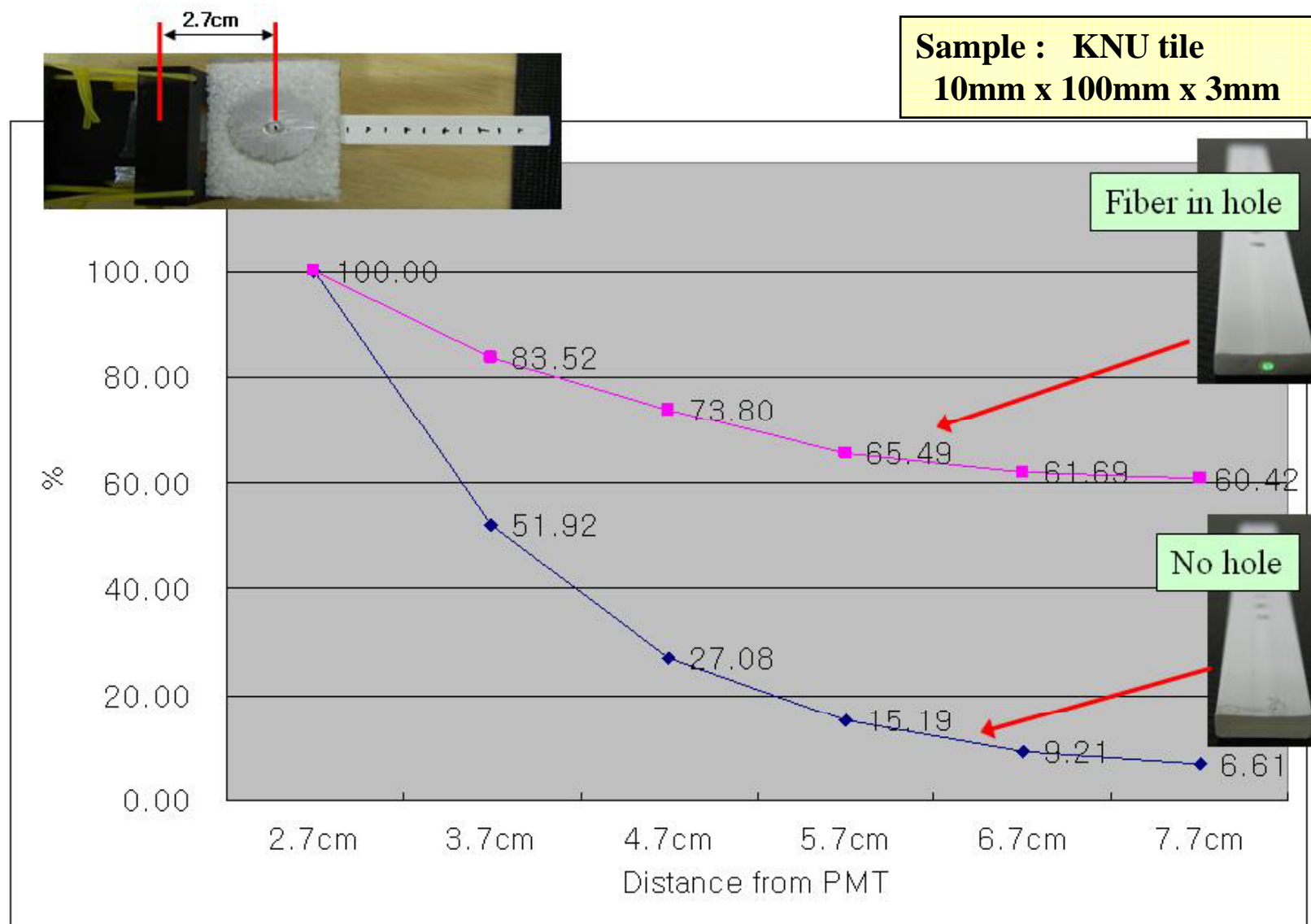
Light Yield Uniformity for all strips



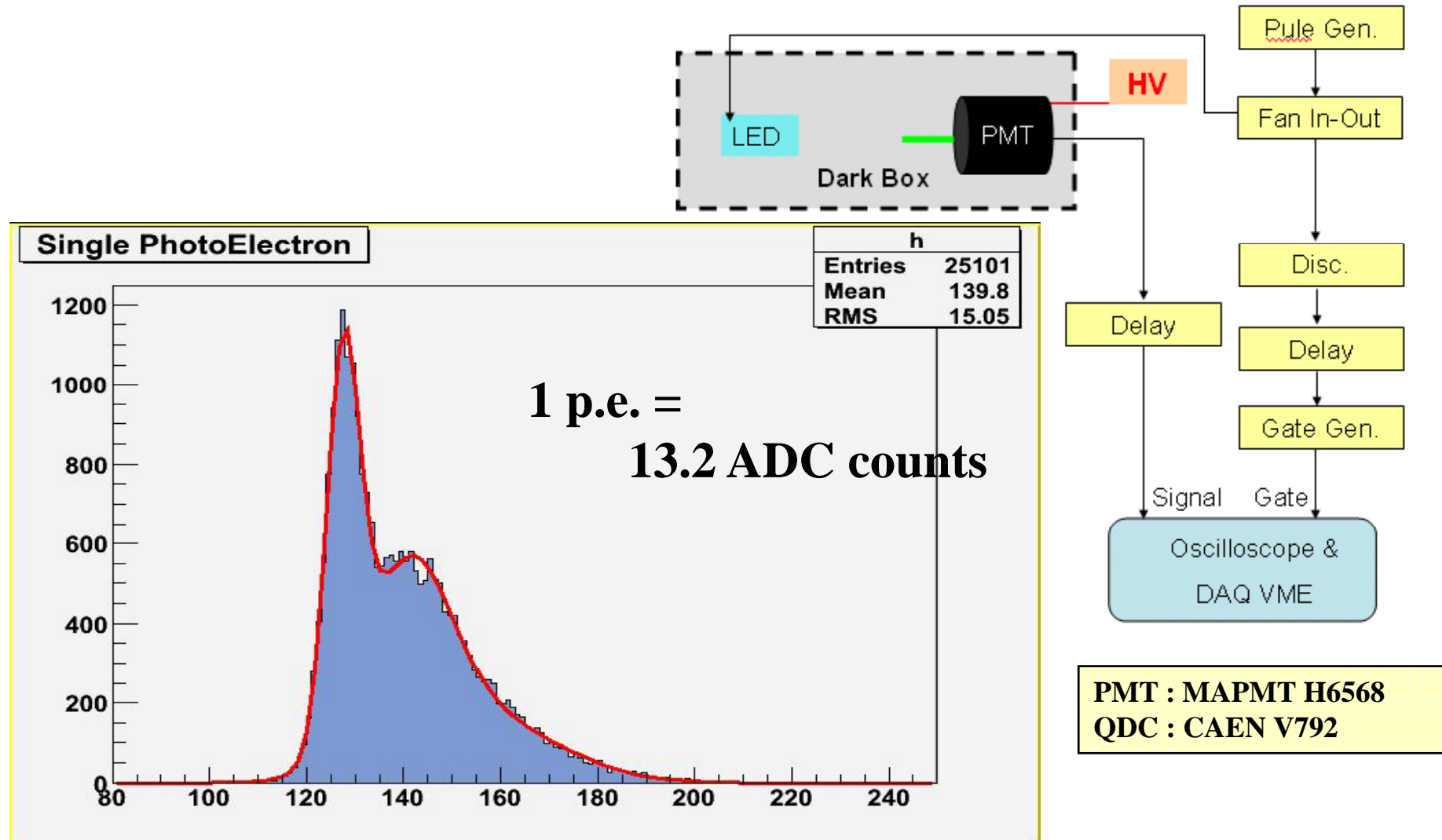
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9th ACFA

Position dependence along the strip types

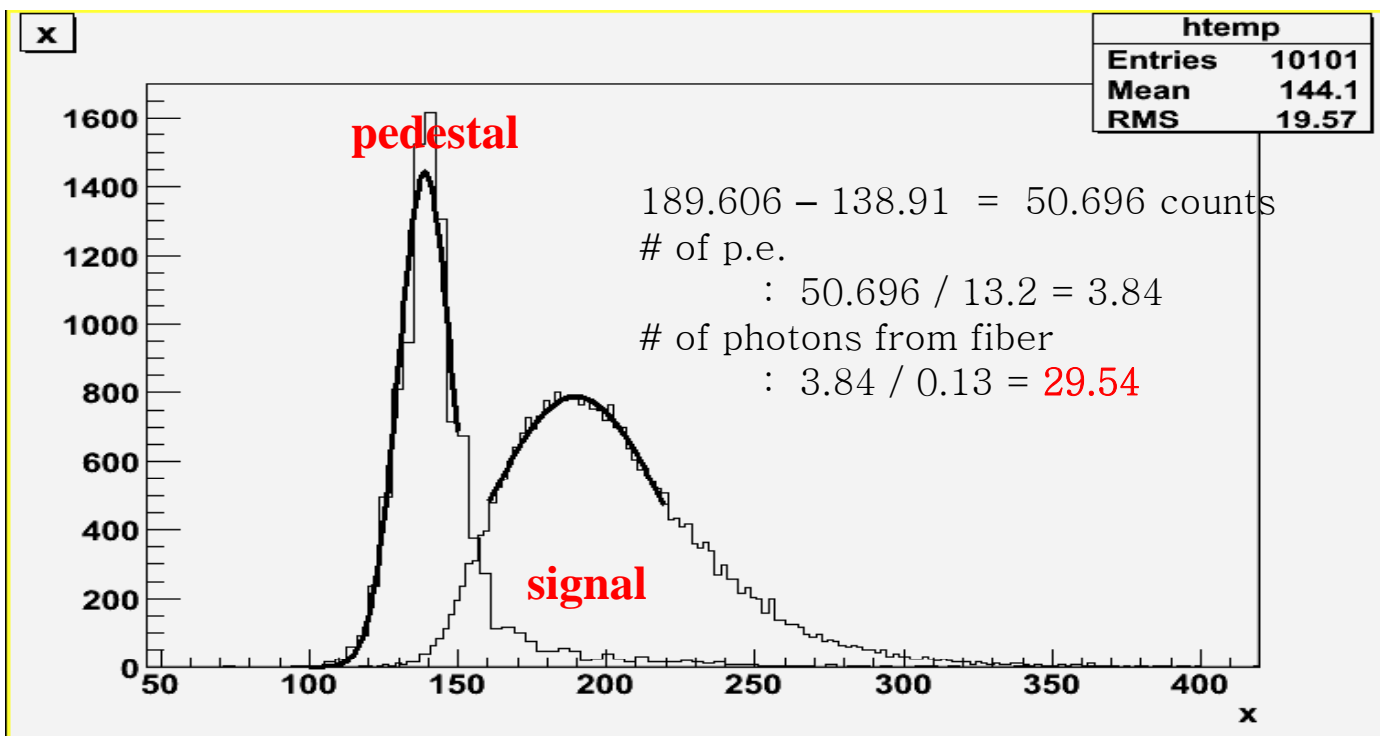
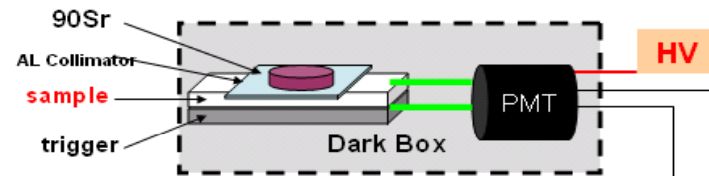


Measurement of p.e. PMT



Measurement of absolute Light Yield

Sample : KNU tile with hole with TiO₂
10mm x 50mm x 3mm

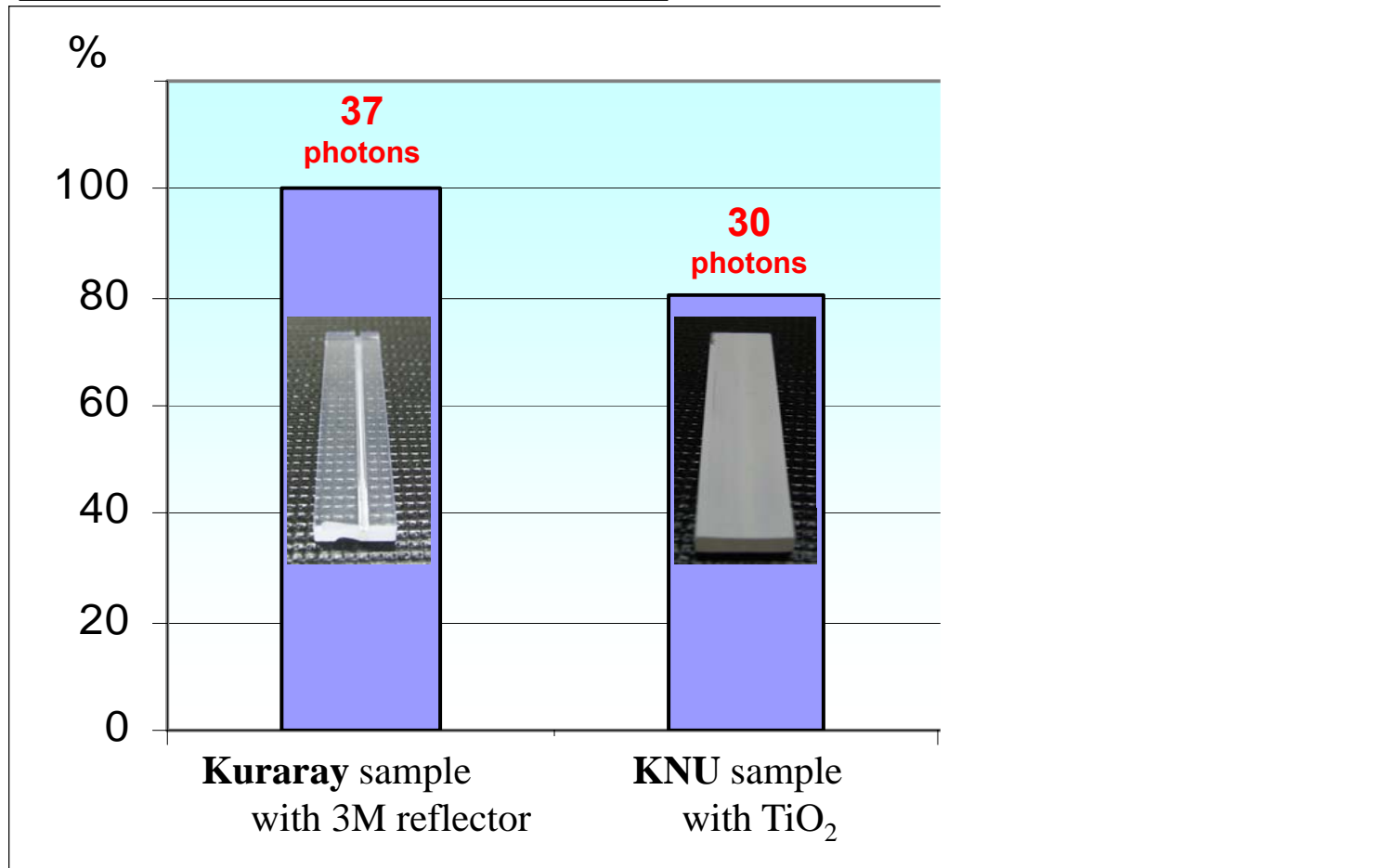


Fiber : 30cm kuraray Y11
PMT : MAPMT H6568
QDC : CAEN V792

$$\# \text{ of photon from fiber} = \frac{\text{Pulse height (ADC counts)}}{13.2 \text{ (ADC count / 1pe)} * \text{Q.E.}} = \sim 30 \text{ photons}$$

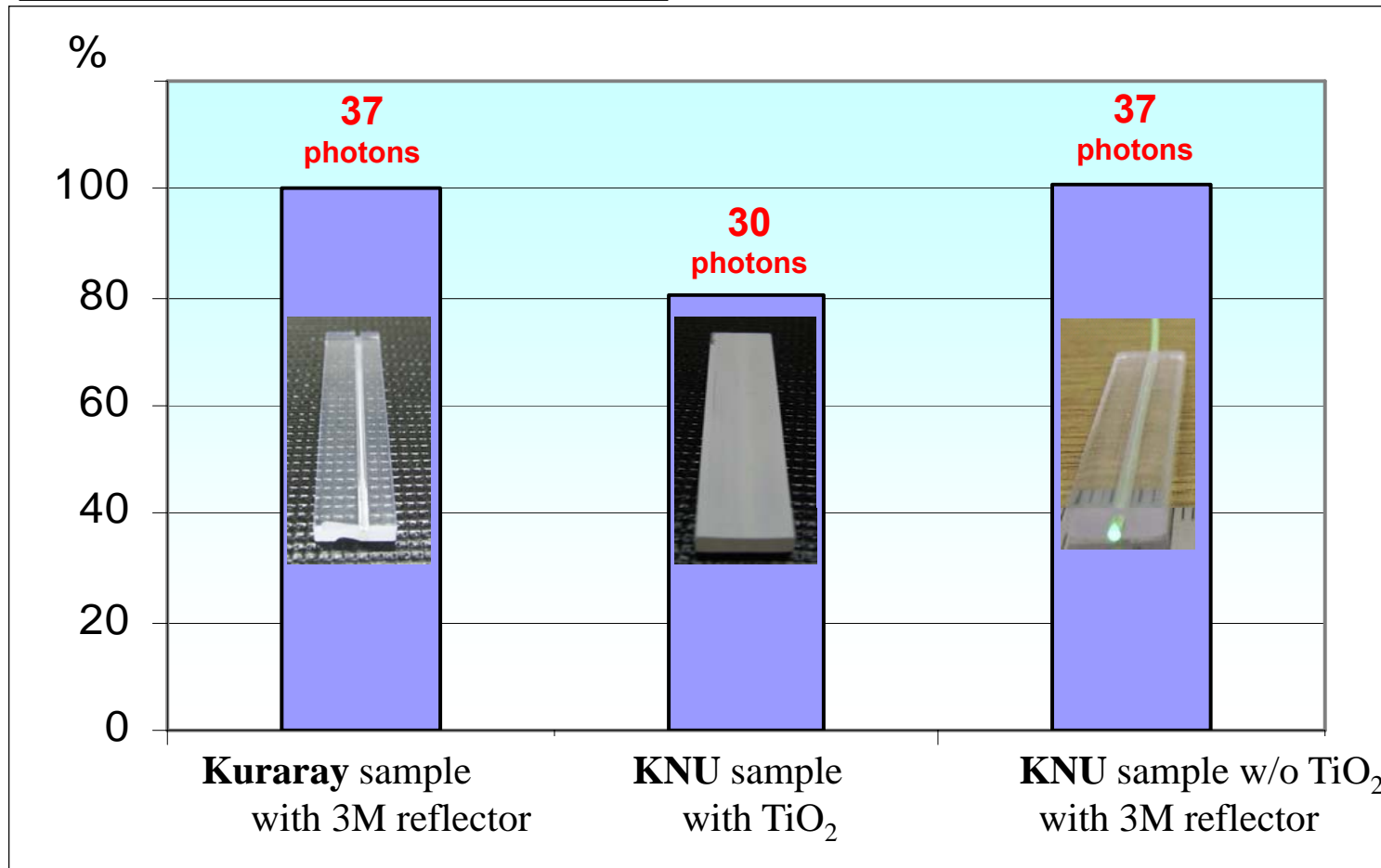
Light Yield Comparison

Sample size : 10mm x 50mm x 3mm

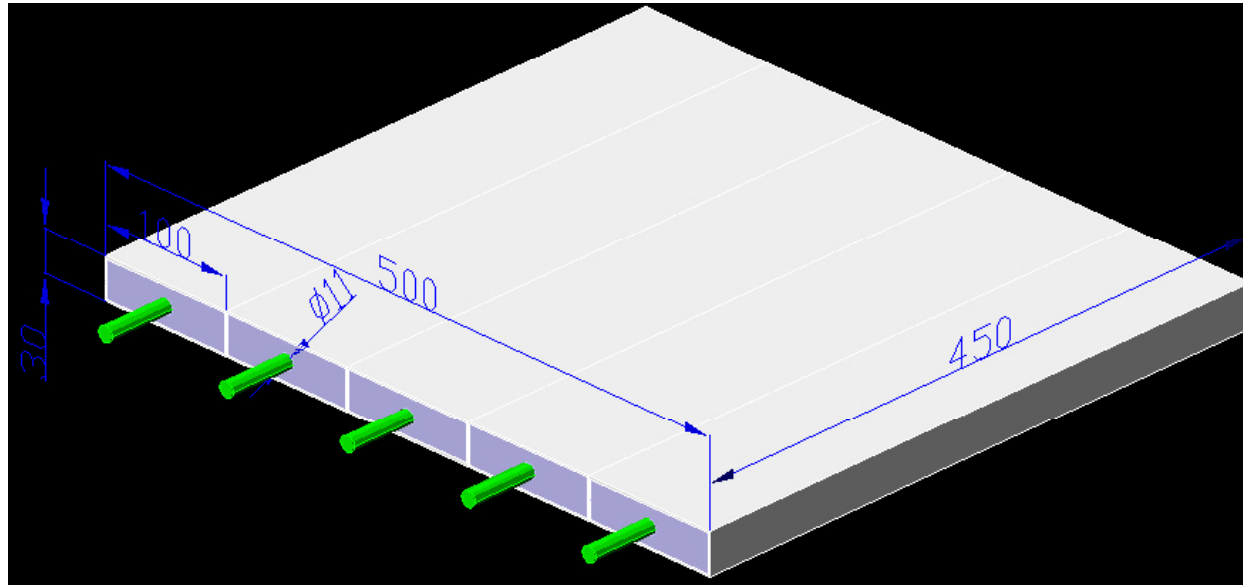


Light Yield Comparison

Sample size : 10mm x 50mm x 3mm



Mega strip concept



- 5 strips together
- All with TiO_2 as reflector
- Each cell optically isolated
- It is under development

Summary

- **Fine strip has been mechanically established.**
- **Enough light yield (~30 photons)**
KNU sample (10mm x 50mm x 3mm).
- **Good uniformity can be handled by quality controlled.**
- **Under development of mega strips.**