Strip based on Scintillation Detector Dual-Readout High-Granularity Calorimetry

H. Ogawa[A], J. Freeman[B], C. Gatto[C], E. Hahn[B], D. Jeans[D], T. Kamiyama[A], W. Li[A], K. Matsuoka[D], W. Ootani[A], T. Suehara[A], T. Takeshita[e]

([A]The University of Tokyo, [B]FNAL, [C]NIU, [D]KEK, [E]Shinshu University)

Abstract

We are developing next-generation technology of calorimeter that integrates three technologies: high granularity, dual readout, and good time resolution at the picosecond level. High-granularity scintillation detector under development as a key technology for the new calorimeter will be presented.

1. Calorimeter Concept

Dual readout

High – granularity

Pico sec

New Calorimeter for Future Colliders

Oral presentation(Kamiyama 101)

Poster session(Li 91)

Dual-readout

Cherenkov detector

Cherenkov radiator + UV-GasPM

- **High-granularity** readout
- **psec timing**
- Low-cost

Cherenkov

Scintillation

Scintillation detector

SiPM-on-strip technology

- **High-granularity**
- low-cost

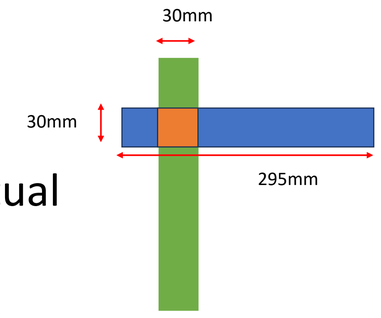
2. Strip-based High-granularity Scintillation Detector

Concept of strip scintillation detector

Strips are aligned alternately in horizontal and vertical directions

→High granularity can be realized with virtual square cells

→Reduce the number of readout channels



Development of a 30mm square high-granularity detector

Strip

Design

i. Scintillator characteristics
ii. Readout methods

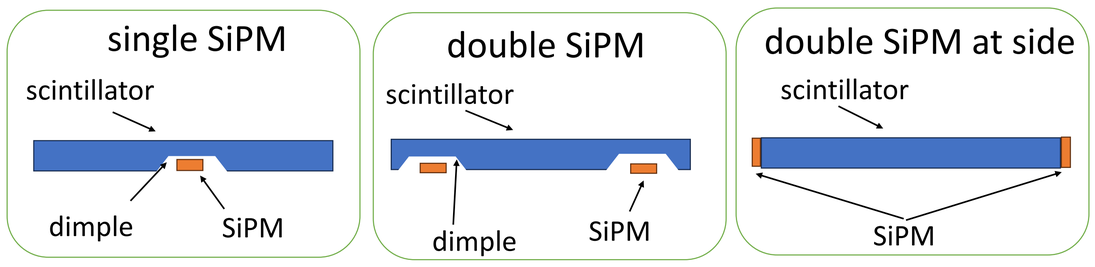
Performance

- Light yield
- Uniformity
- Time resolution

Scintillator characteristics

	EJ200	EJ232
light yield[photo/1MeV]	10,000	8,400
attenuation length[cm]	380	17
rise time[ns]	0.9	0.35
charactaristic	standard	fast

Candidate of readout method



minimum Ch number of readout channels

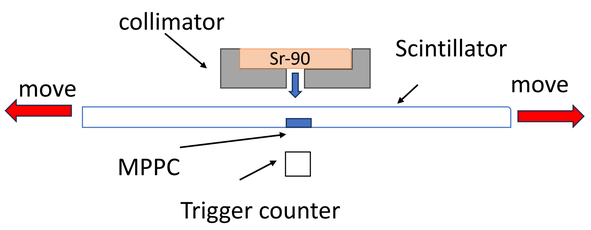
higher light yield + uniformity + reconstruct hit position

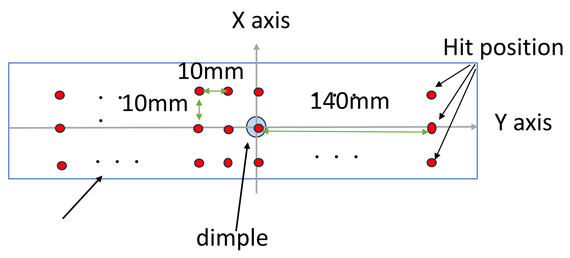
Better time resolution

measurement

- Light yield overall
- Time resolution
- Hit position reconstructiton

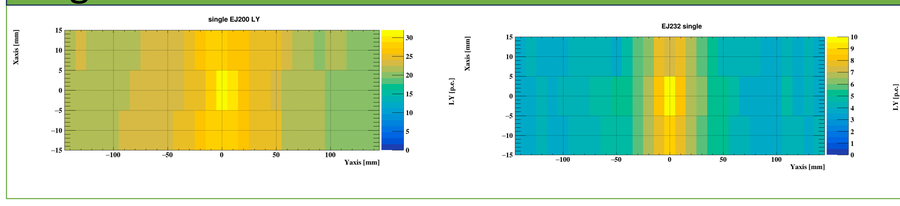
Set up





3. Result

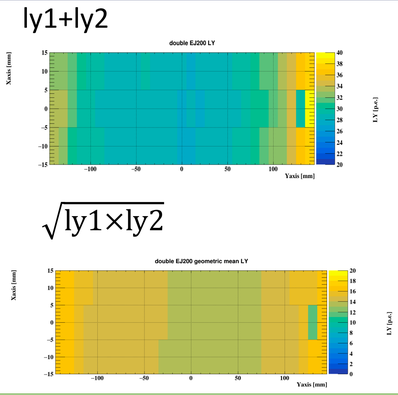
Single SiPM



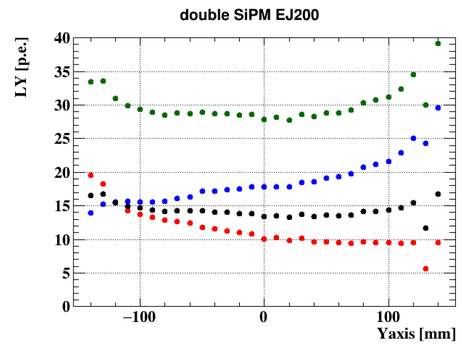
Higher light yield difference than catalog value
-> the reason is not clear
Good uniformity even one SiPM

EJ200 Double SiPM

ly1+ly2



$\sqrt{ly1 \times ly2}$

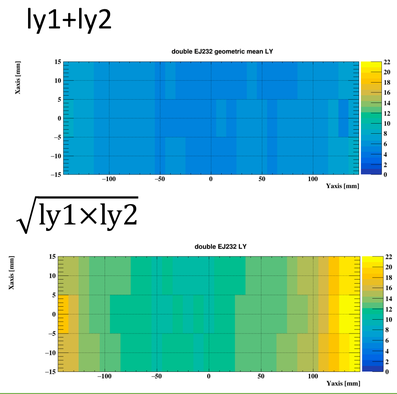


Enough light yield near SiPM
Good uniformity apart from dimple

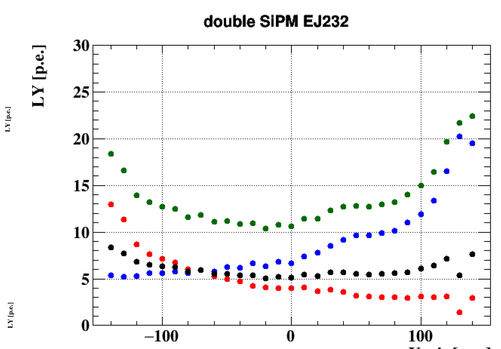
- ch1 light yield(ly1)
- ch2 light yield(ly2)
- ly1 + ly2
- $\sqrt{ly1 \times ly2}$

EJ232 Double SiPM

ly1+ly2



$\sqrt{ly1 \times ly2}$

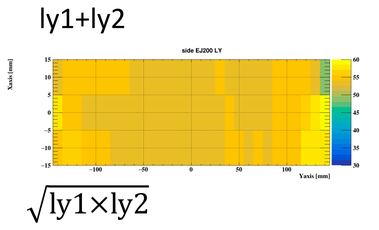


less light yield
Good uniformity for geometric mean
Decrease light yield near dimple

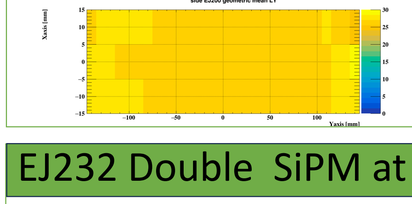
- ch1 light yield(ly1)
- ch2 light yield(ly2)
- ly1 + ly2
- $\sqrt{ly1 \times ly2}$

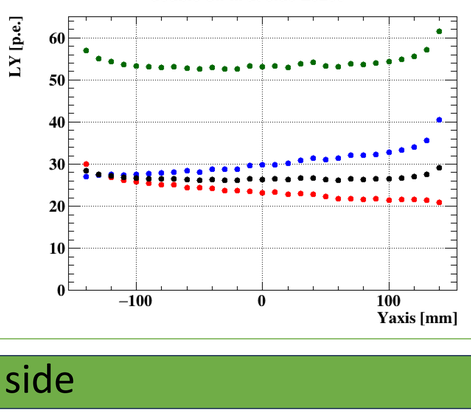
EJ200 Double SiPM at side

ly1+ly2



$\sqrt{ly1 \times ly2}$



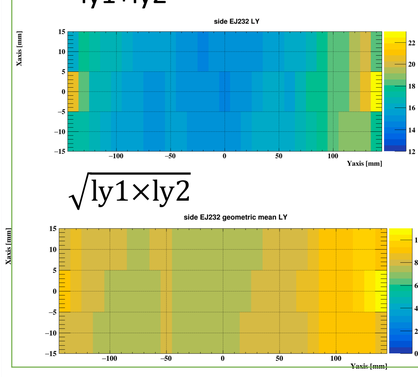


Enough light yield than double SiPM
At corner, it's hard to detect photon
Good uniformity for sum of ly1 and ly2

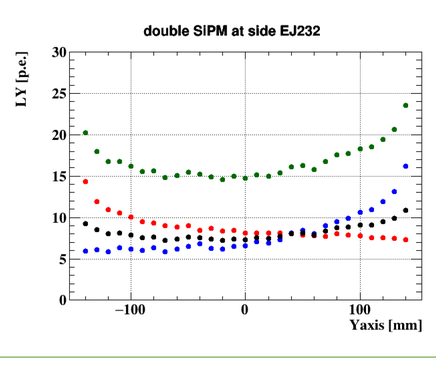
- ch1 light yield(ly1)
- ch2 light yield(ly2)
- ly1 + ly2
- $\sqrt{ly1 \times ly2}$

EJ232 Double SiPM at side

ly1+ly2



$\sqrt{ly1 \times ly2}$



More light yield near SiPM, but less light yield position despite near SiPM
uniformity is better by taking geometric mean

- ch1 light yield(ly1)
- ch2 light yield(ly2)
- ly1 + ly2
- $\sqrt{ly1 \times ly2}$

4. Summary and Prospect

- EJ200 has enough light yield
- EJ232 light yield is less than expected
- Better uniformity by taking geometric mean
- Optimize shape of dimple to deal with peaky response near SiPM
- For double readout, reconstruction hit position by light yield ratio and time difference

Acknowledgement

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