Development of a room-temperature-curable plastic scintillator

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Introduction

We, in collaborated with Niigata Univ. and Carlit Holdings Co., Ltd have developed a plastic scintillator **manufactured at room temperature** focusing on the production cost reduction.

Today, I'll talk about the sample production method and the performance of our plastic scintillator.

Materials and methods (1)

Merits of curing at room temperature

Manufacturing inexpensively

Easier manufacturing method

Forming freely

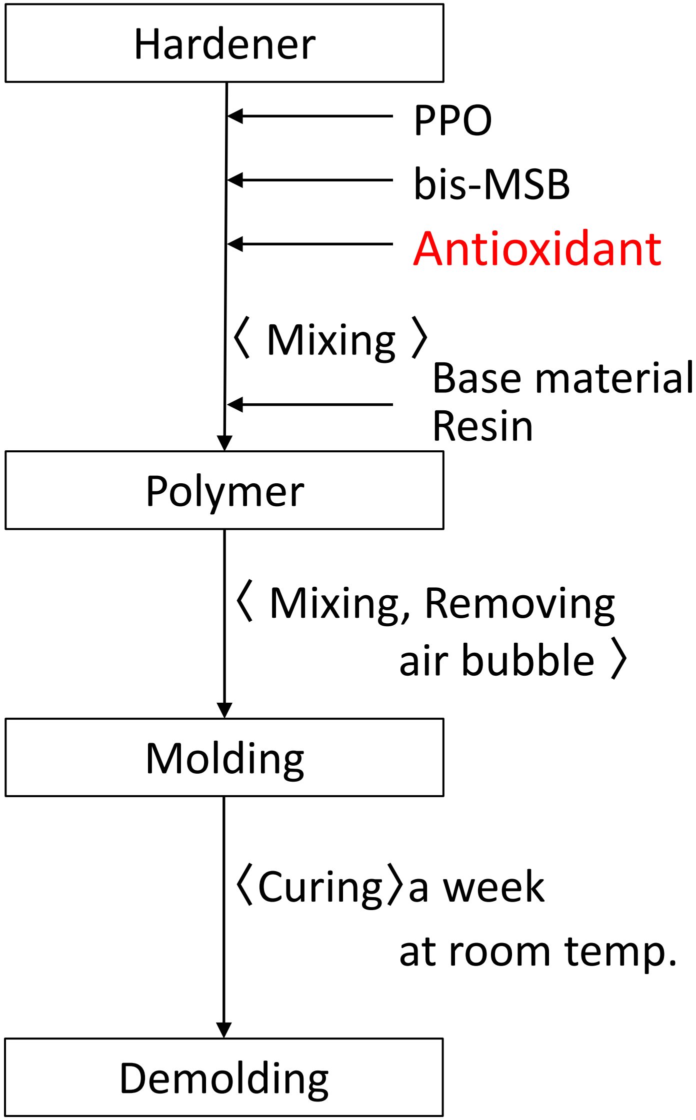
Extend availability of molds

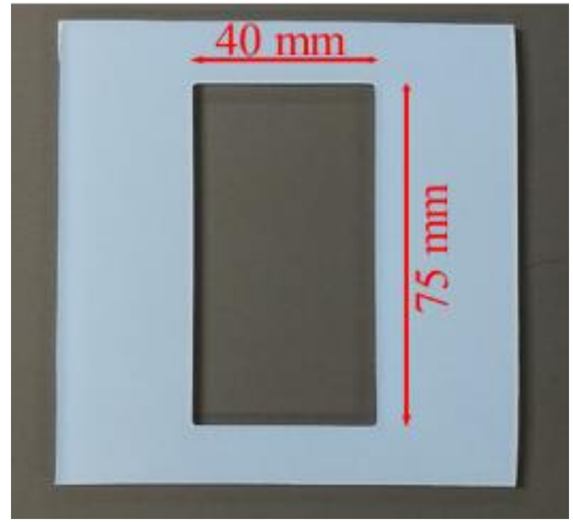
Variety of the additive

For example, functional materials such as gadolinium (Gd) is doped to enhance neutron sensitivity

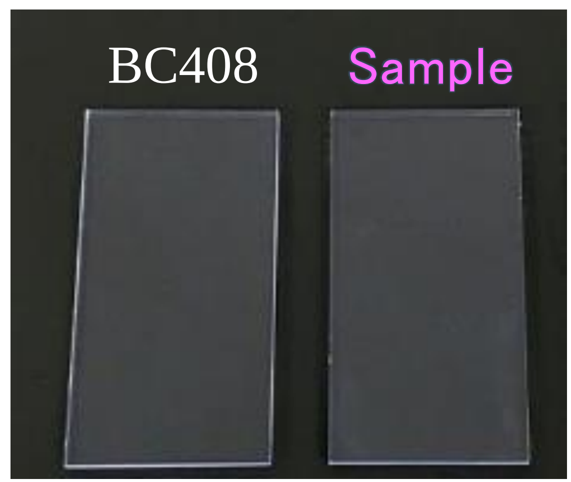
⇒ Suited for mass production.

Materials and methods (2)





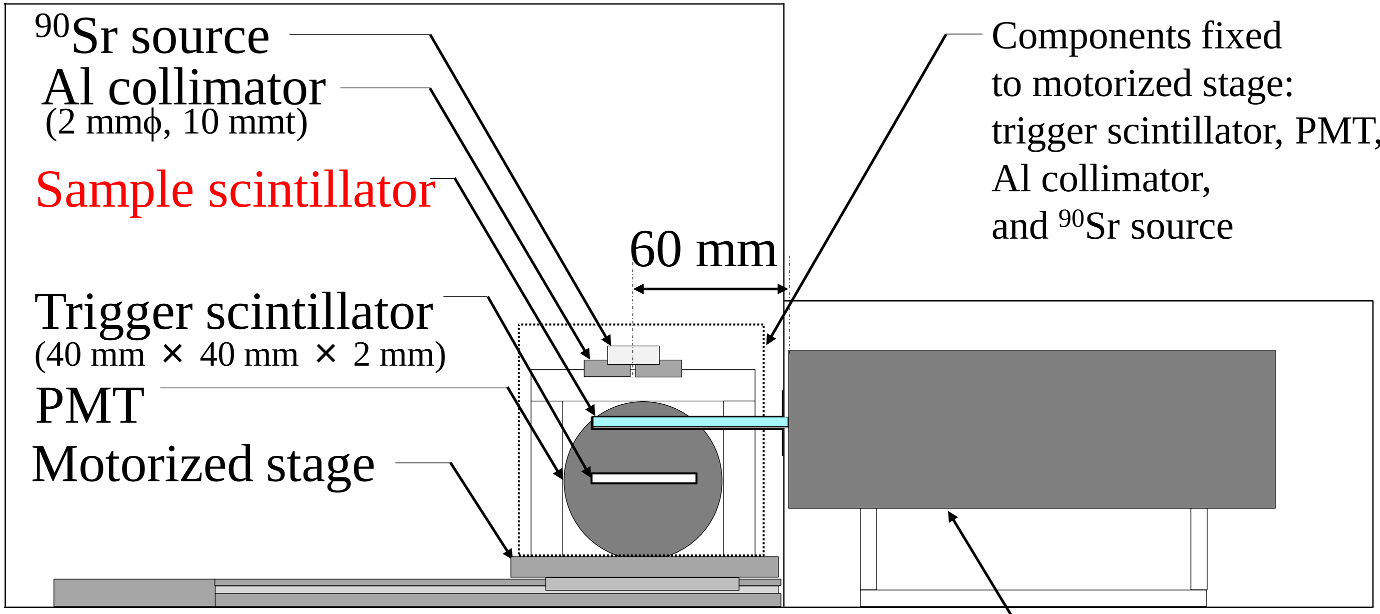
Die-cut silicon rubber sheets (3mmt) are used for the molding.

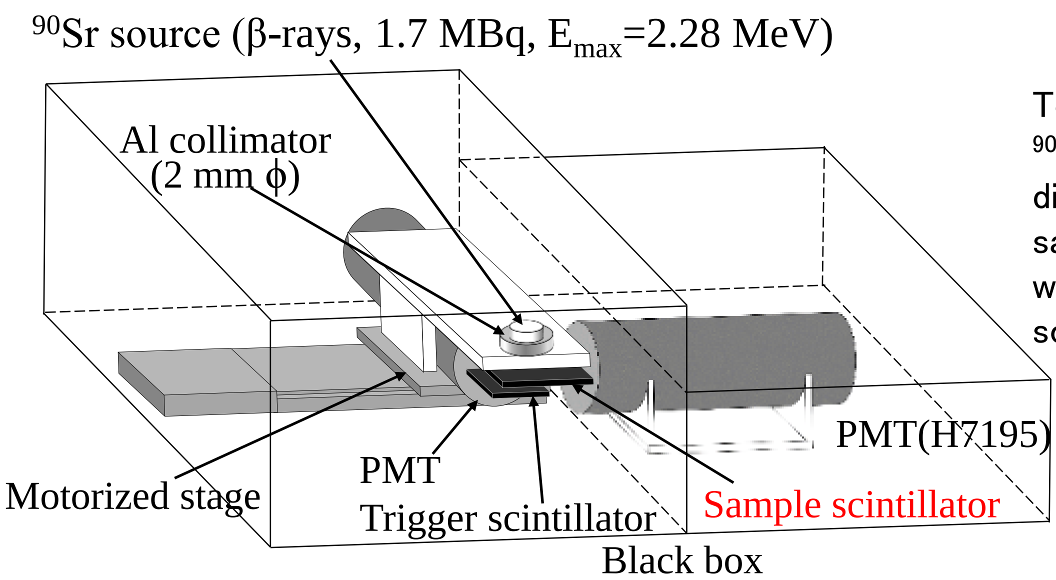


Tested sample size: 75x 40mm, 3mmt

Experimental setup

To select β−rays emitted from ^{90}Sr that penetrated a 2− mm− diameter collimator and the sample scintillator, a trigger was set under the sample scintillator.





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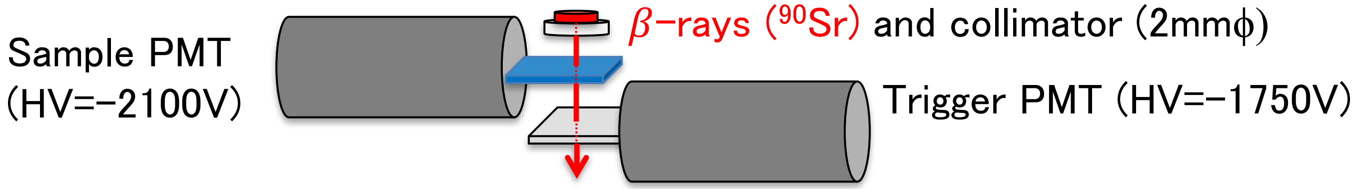
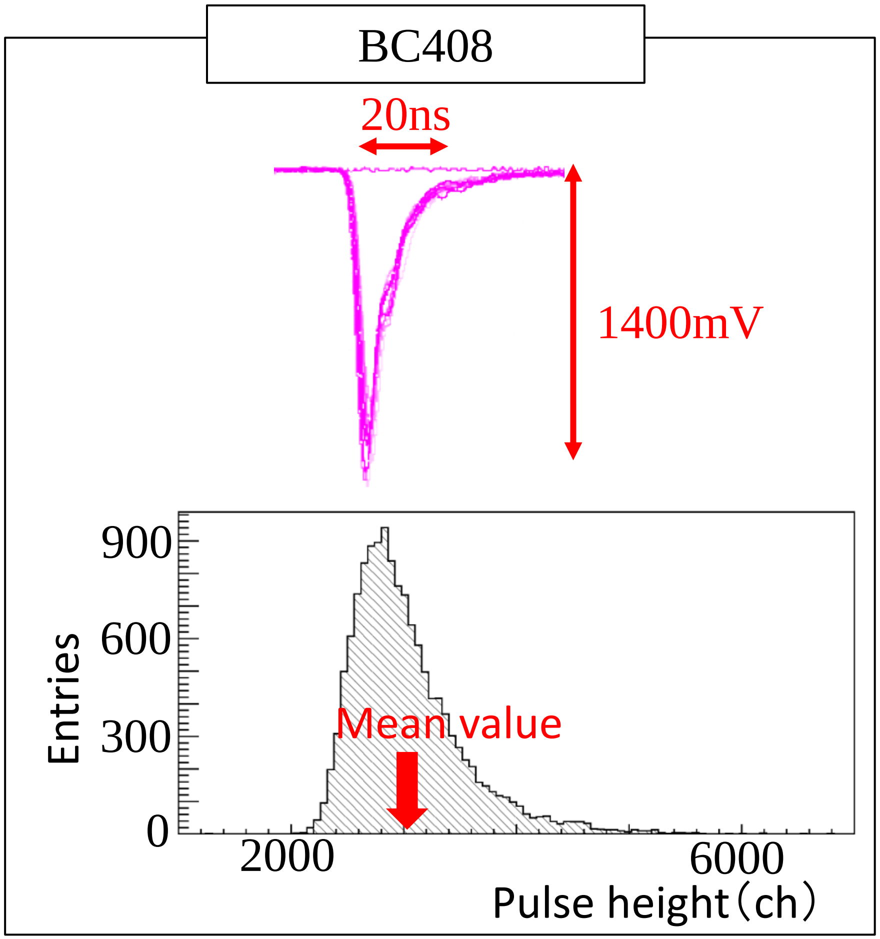
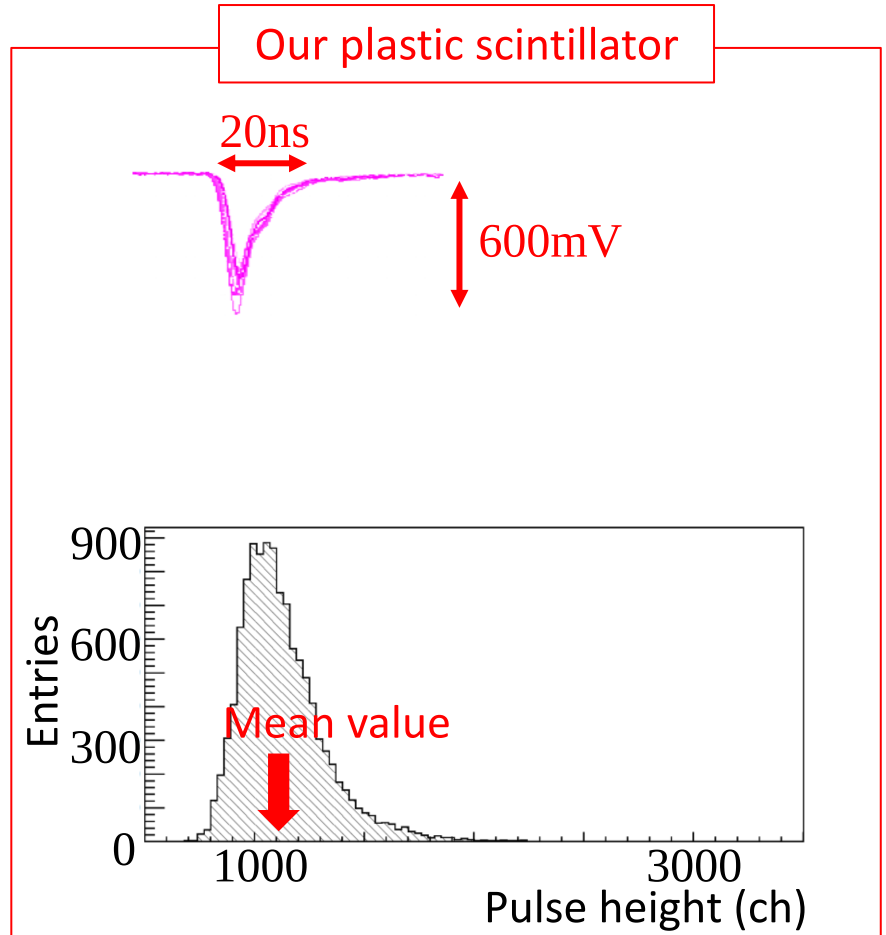
Light yield measurement



Each measurement was 5 min in duration.





Light yields are defined as the mean values (ch/mm).

Light yield measurement (2)

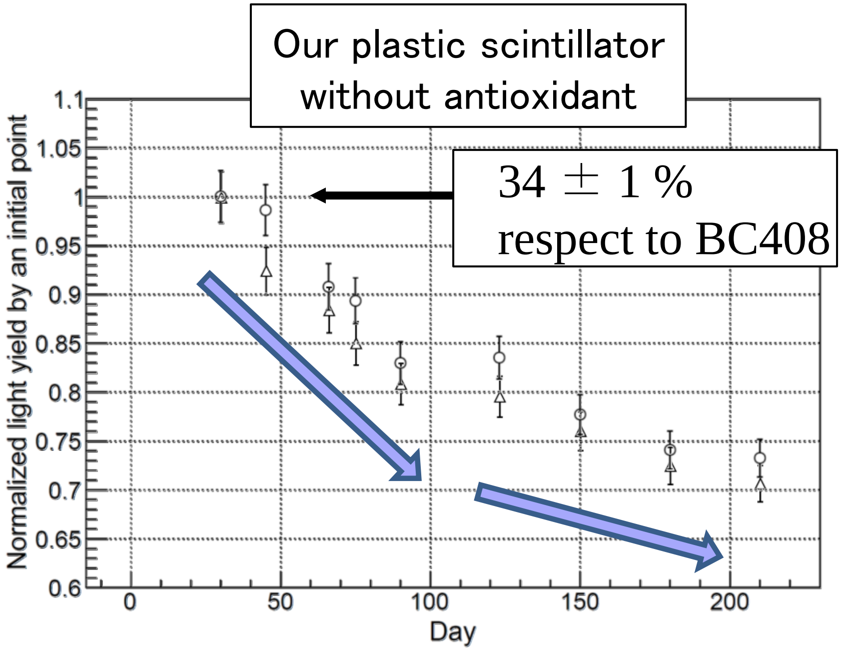
We prepared two scintillator samples for each type.

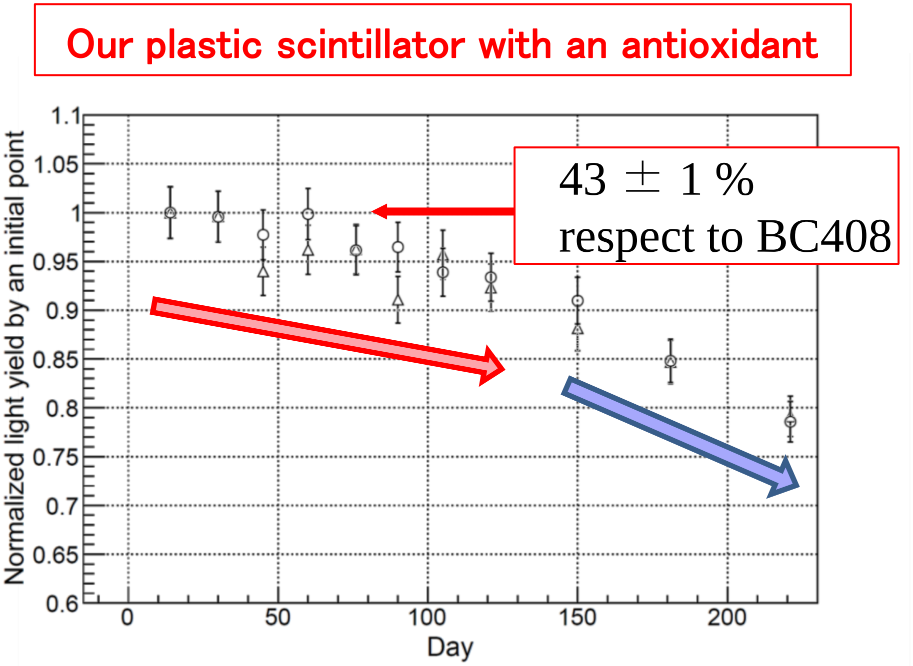
Sample name		Normalized mean (ch/mm)	Mean value respect to BC408 (%)	Thickness (mm)
BC408	1	986 ± 26	100 ± 3	3.073
	2	989 ± 26	100 ± 3	3.116
Our scintillator w/o antioxidant	1	333 ± 9	34 ± 1	2.973
	2	321 ± 8	33 ± 1	3.052
Our scintillator doped antioxidant (1 wt%)	1	421 ± 11	43 ± 1	3.101
	2	405 ± 11	41 ± 1	2.990

About 40% in comparison with BC408

Long-term stability at room temp.

<u>Preserved condition</u>:
shaded and stored in a desiccator
at 20 °C and ordinary pressure.





This indicates that
the antioxidant stabilizes our plastic scintillator.

Our plan: Stabilization

1) To use two type antioxidants

⇒ Lifespan ×2 (Progressing well)

2) To further optimize antioxidants.

⇒ Lifespan ×2

3) To optimize manufacturing method:

① Nitrogen purging (Oxygen removal),

② Complete hardnening, ・・・

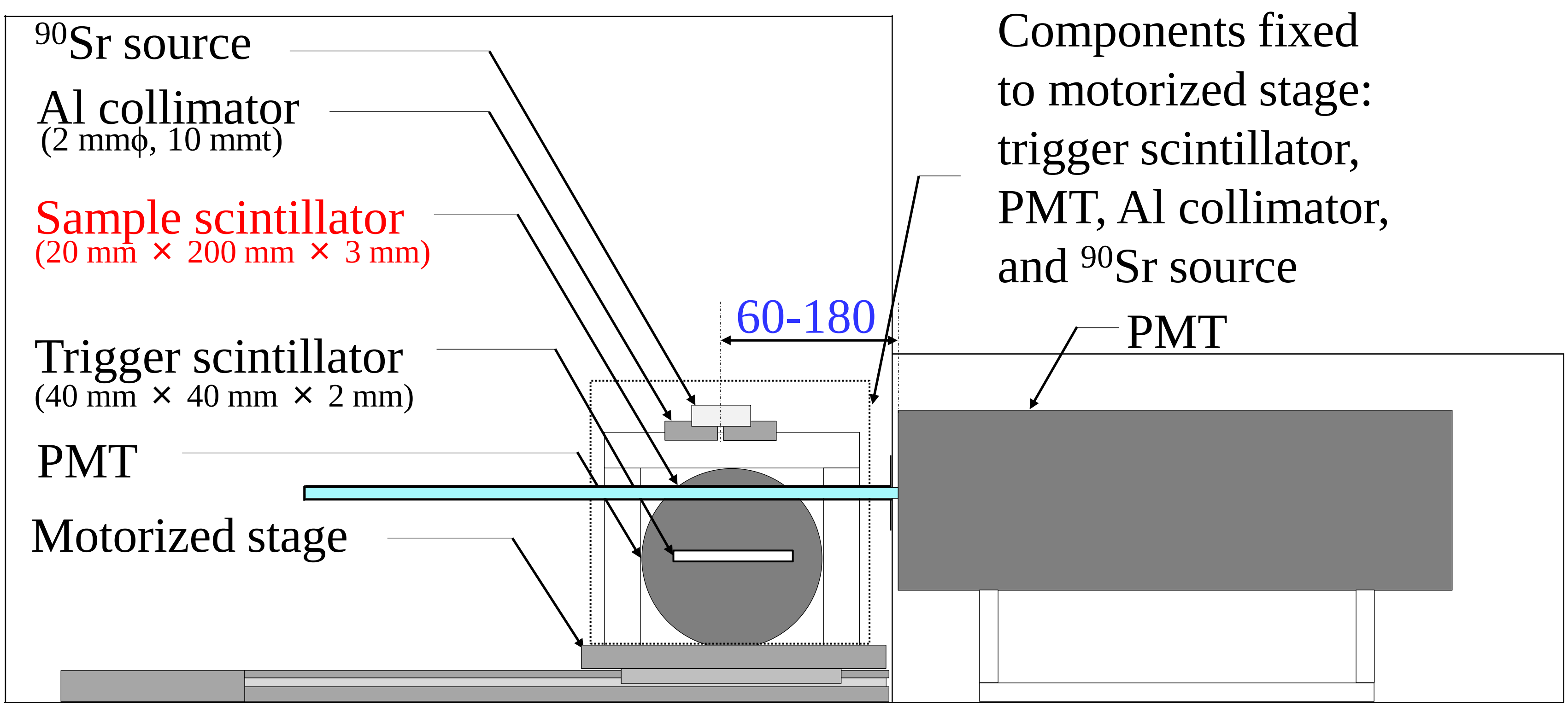
⇒ Lifespan ×2

Attenuation length (1)

Samples :

- BC408 (Saint-Gobain Co.)
- **Our plastic scintillator with antioxidant**

  Size : 200 mm × 20 mm × 3 mm



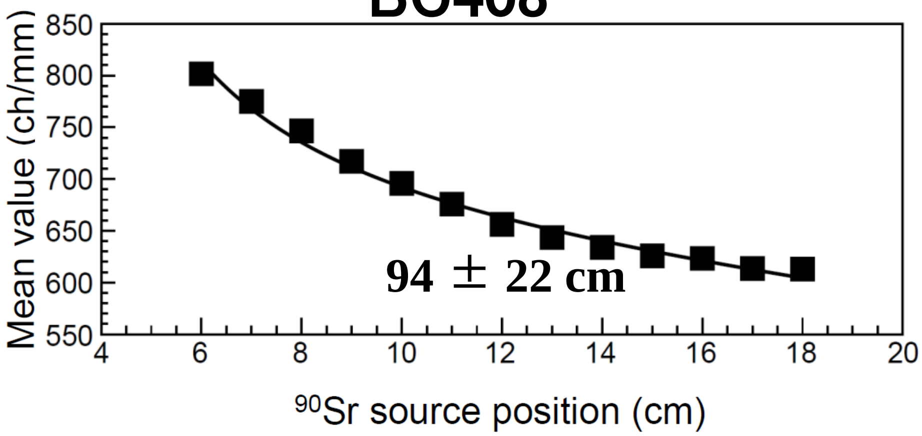
Attenuation length (2)

The mean-value plots of the light yield, which depends on the irradiation position, is fitted with Eq:

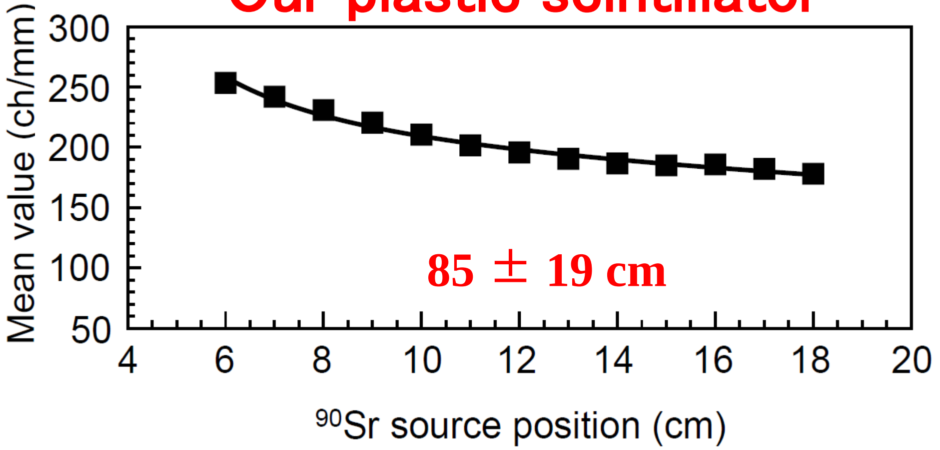
$$f = \left(A + \frac{B}{x^2}\right) \cdot e^{-x/L} ,$$

(A, B: scale parameter, L : attenuation length, x : ^{90}Sr source position)

BC408



Our plastic scintillator



Summary

We developed a plastic scintillator using room-temperature-curable resin.
⇒ **Suited for the mass production.**

In our recent study, the performance of the room-temperature-curable scintillator was evaluated.

1） The Light yield was approximately **40%** respect to BC408.
2) The plastic scintillator containing 1 wt% an antioxidant showed **50% maintenance of the initial value about 1.5 years storage.**
3） The attenuation length showed **85 ± 19 cm as long as BC408.**