Development of beam trigger detector with compact geometry

N. Chiga,[*1] A. Hirayama,[*1,*2] S. Takeuchi,[*1,*2] T. Sumikama,[*1] K. Yoshida,[*1] D. Ahn,[*1] H. Suzuki,[*1] and H. Otsu[*1]

A new scintillation detector used as a focal plane beam trigger detector was developed for the ImPACT experiment. The beam is spread over a wide acceptance of the ZeroDegree spectrometer in the momentum dispersive mode used in this experiment. This scintillation detector was required to cover a large effective area of 240×150 mm^2, which is the same as that of PPAC.[1] The effective area of the present scintillation detector[2] is 120×100 mm^2, which is smaller than that of PPAC. Because the vacuum chamber at F11 of ZeroDegree is not large enough to install a wide scintillator with the present PMT of H7195, the compact PMT of R11265U-200 is used for the new detector. The use of R11265U-200 has the following advantages compared with H7195: the length of 32.5 mm of this PMT is much smaller than that of 215 mm of H7195. The PMT has a transit time of 5.8 ns, which is shorter than that of 40 ns of H7195.

The specifications of the new beam line trigger detector are listed in Table 1. The new detector, which satisfies the requirement of the effective area, is smaller than present detector of 670 mm×100 mm. The new detector can be used at other focal planes on the beam line at BigRIPS, ZeroDegree, or SAMURAI.

Table 1. Specifications of the detector.

Effective area (H × V)	240 × 150 mm^2
Scintillator	EJ-200, 0.2 mm^t
PMT	R11265U-200 ×4
Size of detector (H × D)	524 mm × 100 mm
Requirement of time resolution	less than 100 ps

Figure 1 shows a schematic view of the new detector. Four PMTs of R11265U-200 were attached on the left and right side of the new detector. To ensure that light from the scintillator is effectively collected in the PMT, light guides are used as optical connection between them. The PMTs and light guides were bonded by an optical cement using a dedicated jig to provide a position accuracy within 0.5 mm. The light guides work as a support frame of a thin scintillator. The scintillator was mounted on the light guides using optical grease. It can be easily replaced with a different scintillator. A scintillator with a thickness of 0.1 - 0.5 mm can be mounted.

The new detector successfully worked in the ImPACT experiments in spring and autumn 2016. The time resolution of the difference between left and right timings, which was the average of up and down PMTs for each side, was 43 ps as shown in Fig. 2.

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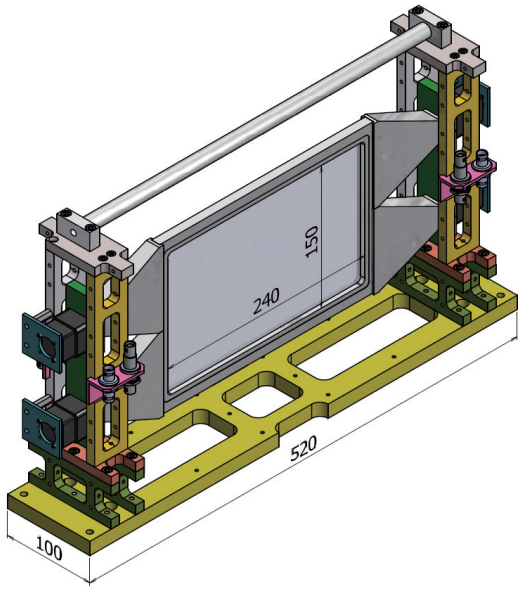

Fig. 1. Schematic 3D-CAD model of the new detector.

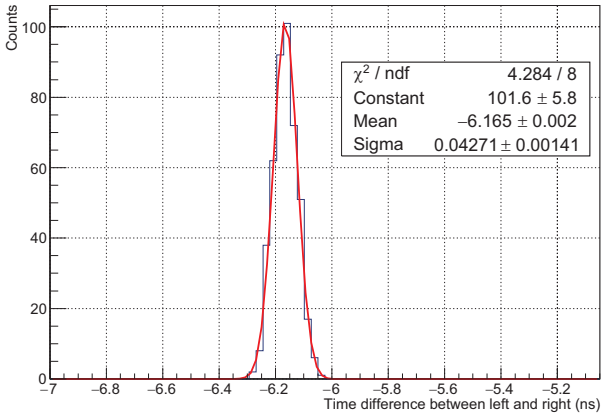

Fig. 2. Time difference between the left and right timings for the secondary beams in the vicinity of ^{93}Zr at 58 MeV/u. The timing average of two PMTs on each side was used.

*1 RIKEN Nishina Center
*2 Department of Physics, Tokyo Institute of Technology

References

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