The Veto Collimator for the SπRIT-TPC

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The Veto Collimator, VC, is an ancillary detector of the SπRIT-TPC[1] (SAMURAI pion Reconstruction Ion-Tracker Time Projection Chamber), the main device used to study the nuclear Equation of State at RIKEN. It is located 22 cm upstream of the target and provides a veto condition for beam particles and upstream reaction products which do not hit the target. The VC consists of four BC408 scintillators with the size of 90×50×6 mm^3. Attached to each scintillator is an MPPC (S10931-100P) which is a new type of a photon-counting device made up of multiple APD (Avalanche PhotoDiode) pixels operating in Geiger mode[2]. The active area of this MPPC is 3×3 mm^2. The BC408 is a premium plastic scintillator with the highest light output and with the maximum emission at the wavelength of 425 nm, which is compatible to the peak sensitivity wavelength of the MPPC[2,3]. The gain of the MPPC amounts to about 2.4×10^6.

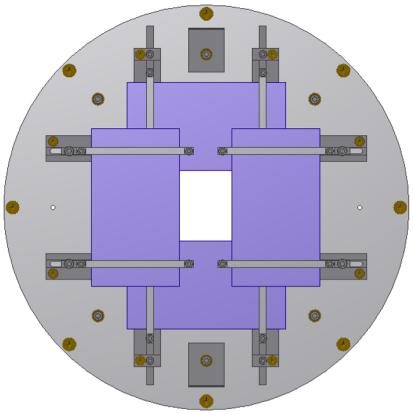

Fig. 1. Mechanical sketch of the veto collimator.

The mechanical sketch of the VC is shown in Fig. 1. Four scintillators, shown in purple, are mounted on adjustable support slots so they form a hole in the center where the beam particles can go through towards the target downstream. To make sure beam particles passing through the hole will hit the target, the size is slightly smaller than the 30×40 mm^2 target.

For each scintillator, the analog signal produced by the MPPC is sent to a preamplifier (same as those used for the KATANA[4] array) and then to the leading edge discriminators of the trigger logic system. Any of the four scintillators firing above the threshold produce a veto signal preventing a trigger for the TPC.

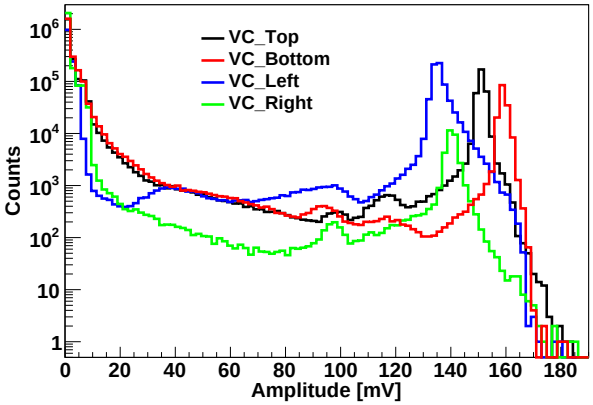

Fig. 2. The energy spectra of fragments hitting the VC.

During the experiment the MPPCs were biased at 71.51, 71.52, 71.41 and 71.40 V and the thresholds were set to 145, 155, 130 and 135 mV for the top, bottom, left and right paddles, respectively. The energy spectra of fragments hitting the four VC paddles are shown in Fig. 2. The presented data come from the commissioning runs of ^{132}Sn at 300 MeV/nucleon, for which the VC was operating in a triggering mode and thus the veto thresholds were not effective. The peaks at high amplitudes are due to the beam particles. The counts at smaller amplitudes correspond to slower and/or lighter upstream reaction products as well as to those backward emitted from the target and from the downstream material. The VC performed well during the two experiments and the commissioning run with the SπRIT TPC in 2016, suppressing upstream reactions and off-target events.

This work is supported by the National Science Foundation of China under Grant No. U1332207, by the U.S. DOE under Grant Nos. DE-SC0004835, DE-SC0014530, DE-NA0002923, US NSF Grant No. PHY-1565546, by the Japanese MEXT KAKENHI grant No. 24105004 and by the Polish NSC Grants UMO-2013/09/B/ST2/04064 and UMO-2013/10/M/ST2/00624.

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