KATANA - a charge-sensitive triggering system for the SπRIT experiment†

P. Lasko,[*1,*2,*5] M. Adamczyk,[*2] J. Brzychczyk,[*2] P. Hirnyk,[*1] J. Łukasik,[*1] P. Pawłowski,[*1,*5] K. Pelczar,[*2] A. Snoch,[*3] A. Sochocka,[*2] Z. Sosin,[*2] J. Barney,[*4,*5] G. Cerizza,[*4,*5] J. Estee,[*4,*5] T. Isobe,[*5] G. Jhang,[*5,*6] M. Kaneko,[*5,*7] M. Kurata-Nishimura,[*5] W.G. Lynch,[*4] T. Murakami,[*5,*7] C. Santamaria,[*4,*5] M.B. Tsang,[*4] and Y. Zhang[*5,*8]

KATANA - the Krakow Array for Triggering with Amplitude discrimiNAtion - has been built and used as a trigger and veto detector for the SπRIT TPC at RIKEN. Its construction allows operating in magnetic field and providing fast response for ionizing particles, giving an approximate forward multiplicity and charge information.

The experiments with the SπRIT TPC at RIKEN were focused on investigation of the central and semi-central heavy-ion (HI) collisions at energies of about 300 MeV per nucleon. The target was located about 3 mm upstream of the entrance field cage window inside the SπRIT TPC, so that the HI beam passed through the chamber. To obtain sufficiently large gas amplification for pions and light charged particles, a high electric field is required inside the chamber. In such conditions the ionization produced by the HI beam would produce an excessive space charge leading to field distortion and could bring a risk of damage: the charge produced by gas ionization could exceed the safe limit for the pad planes of the TPC. For this reason, a gating grid wire plane is mounted below the pad plane[1,2]. The grid was normally 'closed' to keep the detector off until a desired collision occurs. When such an event happens, the opening of the gating grid can occur quickly (in ∼350 ns). Such operation should be performed whenever an incoming projectile reacts violently with the target nuclei.

The KATANA detector, located downstream of the TPC exit window, was designed to produce a logic signal to open the gating grid when a desired event occurs. During the experiment it played a double role: to produce a minimum bias or majority trigger, and to provide a veto signal whenever a beam particle or a fragment heavier than $Z \simeq 20$ passed through the chamber. To fulfill the requirements, the wall has been constructed of two parts: a Veto and a Trigger array. The KATANA-Veto part consisting of 3 thin (1 mm thick) plastic-scintillator paddles with the middle one centered on the beam, has been designed to produce a veto signal for heavy fragments. The KATANA-Trigger array, consisting of 12 thicker (10 mm thick) paddles, arranged on both sides of the beam, has been designed to produce a forward multiplicity trigger.

A technical design of the KATANA detector is presented in Fig. 1. Fifteen scintillators, each 10 cm wide and 40 cm high, are mounted on a rectanglular, aluminum frame. Each scintillator is wrapped in a sheet of a light-reflective, metalized Kapton foil. Three veto plastic bars, marked with dashed lines, are placed in the middle of the frame. Twelve trigger plastics are placed unevenly on both sides of the beam (7 on the left and 5 on the right side) to account for bending of the beam particles in the magnetic field. The Multi Pixel Photon Counter (MPPC) devices from Hamamatsu which are not sensitive to magnetic fields have been used as the light sensors.

During the experimental runs the device perfectly fulfilled its role.

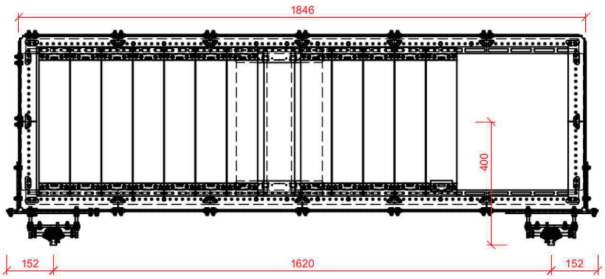

Fig. 1. A technical drawing of the KATANA detector with the external dimensions in mm.

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*1 IFJ PAN, Kraków
*2 Faculty of Physics, Astronomy and Applied Computer Science, Jagiellonian University, Krakw
*3 Faculty of Physics and Astronomy, Wroclaw University
*4 NSCL and Department of Physics and Astronomy, Michigan State University
*5 RIKEN Nishina Center
*6 Department of Physics, Korea University
*7 Department of Physics, Kyoto University
*8 Department of Physics, Tsinghua University