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Pilot production of RPCs for the SHiP experiment

K. S. Lee[1]*,
[1]*Dept. Of Physics and Institute of Basic Science, Korea University, Seoul 02841, Korea*
E-mail: kslee0421@korea.ac.kr

M. Kang[1], Y. Jo[1], S. K. Park[1], S. H. Kim[2], J.-W. Ko[2], K. Y. Lee[2], B. D. Park[2], J. Y. Sohn[2], C. S. Yoon[2], J.-K. Woo[3], Y. G. Kim[4], and K.-Y. Choi[5]
[2]*Dept. of Physics Education & RINS, Gyeongsang National University, Jinju 52828, Korea*
[3]*Dept. of Physics, Jeju National University, Jeju 63243, Korea*
[4]*Dept. of Science Education, Gwangju National University of Education, Gwangju 61204, Korea*
[5]*Dept. of Physics, Sungkyunkwan University, Suwon 16419, Korea*

Two main aims of the SHiP (Search for Hidden Particles) experiment are the observation of hidden particles and high-statistics study of tau neutrino events. These particles can be produced from the decay of charmed particles in a SHiP hybrid target which is composed of a totally 58-cm long series of TZM slabs followed by Tungsten slabs of the same total length. To achieve the physics goals, we carried out a test experiment with the SHiP target replica using CERN SPS 400 GeV/c proton beam at H4 area in July 2018. A major concern for the test experiment is the precise knowledge of the muon flux and the associated charm production cross section. In this test experiment, RPCs will be used for muon identification and their slope measurements. Recently, we have fabricated gas gaps and strip panels to build 5 trigger RPC modules for the present test experiment. In addition, we constructed a prototype RPC to study the fundamental detector performance using cosmic rays. The current construction of the RPC modules is also as a pilot production for the future SHiP experiment in synergy with the present RPC production for the CMS experiment.

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[1]*Speaker

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1. Introduction

The goals of the test experiment performed using the CERN SPS 400 GeV/c protons are to obtain the precise knowledge of the muon flux and the associated charm-production cross section at the beam energy of the SHiP experiment [1, 2].

2. Trigger RPCs of the SHiP experiment

A ShiP trigger RPC is composed of a 2-mm thick gas gap sandwiched by two orthogonal readout strips of a pitch of 10.625 mm. Prior to the test experiment at CERN, we constructed and tested a prototype RPC of a size of 100 × 130 cm^2 to study the fundamental detector performance using cosmic rays.

3. Cosmic-ray Test of the prototype RPC

The left figure in Fig. 1 shows the conceptual design of the ShiP. The right figure shows muon efficiencies ε_μ and mean strip multiplicities $<C_s>$ measured on x (anode) and y (cathode) strips of the SHiP prototype RPC as functions of effective high voltage (HV_{eff}) [3]. The working point (WP) HV_{eff} where ε_μ requiring both x- and y-strip signals exceeds 95% is measured at 9.824 kV. $<C_s>$ at the WP are measured to be about 1.7 for anode (x) and about 2.3 for cathode (y) strips, respectively. The probability of large pulses defined as $C_s > 6$ and the stochastic noise rate at the WP are on the order of 1.5% and 650 Hz m^{-2}, respectively.

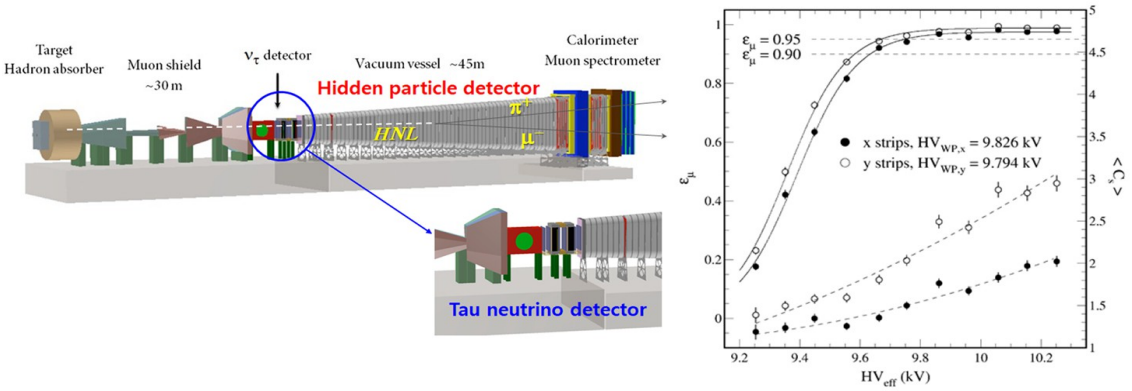

Figure 1. Conceptual design of the SHiP (left) and ε_μ and $<C_s>$ measured on x (anode) and y (cathode) strips of the SHiP prototype RPC as functions of HV_{eff} (left).

4. Conclusions

The detector components, gaps and strips, have been manufactured, tested by the Korean SHiP group, and delivered to CERN for the pilot experiment at CERN SPS. The detector performance of the prototype RPC that appears in the present cosmic-muon test are fairly satisfactory for reliable 2D trigger measurements for the future SHiP.

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