Development of a straw tracker system for COMET experiment at J-PARC

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The COMET experiment at J-PARC aims to search for the charged lepton flavor violating process of neutrinoless μ-e conversion with an improvement of a sensitivity by a factor of 10000 to the current limit, in order to explore the parameter region predicted by most of well-motivated theoretical models beyond the Standard Model [1]. When the μ-e conversion occurs, almost all the energy of the muon mass is carried out by the electron which is expected to have the monochromatic energy of about 105 MeV. The experiment requires to detect such electron with an excellent momentum resolution, better than 200 keV/c, in order to achieve the goal sensitivity. In addition, high rate capability of up to 5×10^9 μ−/s is necessary for accumulation of enough statistics with high power proton driver at J-PARC. Thus the very light material detector which can handle the high intensity beam is indispensable in order to achieve the momentum resolution and to accumulate the enough statistics. On the basis of these requirements, we decided to develop the straw tube tracker system which is operational in the vacuum and constructed by the extremely light material. Then, we have designed the straw tracker system with the simulation and experimental studies, and the prototype straw tracker system has been developed as shown in Fig. 1, which consists of 10 mm diameter tube, longer than 1 m length, with 25 μm thickness Mylar foil and 70 nm aluminum deposition. In this presentation, we report the detail of the design work and the evaluation of the prototype system. The prospect of final detector system is also described.

Fig. 1 Photograph of Straw tracker system prototype. 16 tubes for both X and Y coordinates were installed. The tube consists of 10 mm diameter and longer than 1 m length.

References

[1] Y. Kuno for the COMET collaboration, Prog. Theor. Exp. Phys. 2013 022C01