Preparation status of the J-PARC E16 experiment in 2019

S. Yokkaichi*1 for the J-PARC E16 Collaboration

We have proposed the experiment E16[1] to measure the vector meson decays in nuclei in order to investigate the chiral symmetry restoration in dense nuclear matter. The experiment will be performed at the J-PARC Hadron Experimental Facility. The high-momentum beamline, where the experiment will be conducted, is being constructed by KEK. Its scientific ("stage-1") approval was granted to the experiment E16 by PAC in March 2007. For the full ("stage-2") approval, a technical design report was submitted to PAC in May 2014, and reviewed for the experimental and budgetary feasibility. In the PAC meeting held in Jul. 2017, the stage-2 approval for 40 shifts (320 hours) of a commissioning run was granted. In this run, the background measurement at the new beamline is required. The construction of the beamline and our spectrometer is on schedule for completion in Feb. 2020. Only 20 shifts are allocated in Feb.–Mar. 2020, and another 20 shifts are planned in early 2021.

This experiment aims to systematically study the spectral modification of vector mesons in nuclei, particularly the ϕ meson, using the e^+e^- decay channel with statistics that are two orders larger in magnitude than those of the precedent E325[2] experiment performed at KEK-PS. In other words, it aims to accumulate 1×10^5 to 2×10^5 events for each nuclear target (H, C, Cu, and Pb) and deduce the dependence of the spectral modification on the size of matter and meson momentum.

Our proposed spectrometer has 26 modules. Owing to budget limitations, our first goal of staged construction plan is to construct eight modules, as shown in Fig. 1. With the eight-module configuration, we proposed a physics run, Run-1, with 160 shifts (1280 hours), as described in the previous APR.[3]

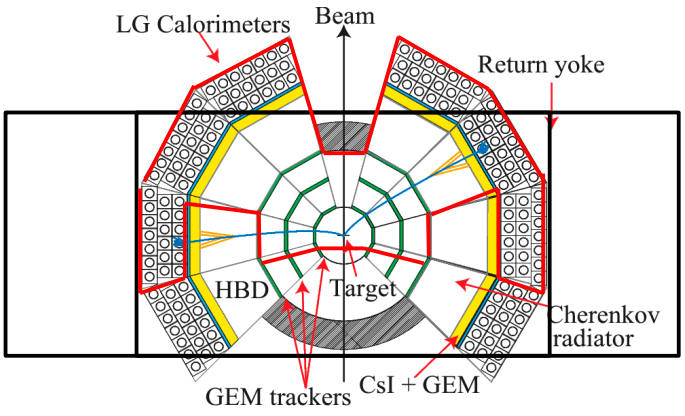

Fig. 1. Plan view of the proposed E16 Spectrometer in the eight-module configuration. The red line shows the constructed parts for the commissioning run in Feb. 2020. The SSD located in the innermost layer is not shown.

*1 RIKEN Nishina Center

Fig. 2. Photograph of the E16 Spectrometer, which is under construction.

The development of detectors and front-end modules has been completed. Field mapping for the spectrometer magnet was performed in Jun.–Jul. 2019. We installed the detectors in the spectrometer magnet in Jul. 2019- Jan. 2020, including three layers of GEM Trackers (GTR) for tracking,[4] Hadron Blind Čerenkov detectors (HBD),[5] and Lead-Glass calorimeters (LG) for electron identification. We joined the RD51[6] collaboration in CERN that aims to develop multi-pixel gas detectors including GEM. One layer of Solid-State Detector (SSD) is introduced between GTR and the target in order to help the tracking under the huge background. The last part of development of trigger electronics,[8] namely, the amp-shaper-discriminator boards to generate the trigger signal at GTR and HBD, were completed in 2019.

We will start the commissioning run with 6 SSD, 6 GTR, 4 HBD, and 6 LG modules, out of eight modules each, as shown in Fig. 1. The installation of detectors has been completed, and shakedown is underway as of Jan. 2020, as shown in Fig. 2.

References

1) S. Yokkaichi *et al.*, J-PARC proposal No. 16, (`http://j-parc.jp/researcher/Hadron/en/pac_0606/pdf/p16-Yokkaichi_2.pdf`); Y. Komatsu *et al.*, JPS Conf. Proc. **12**, (2017), p. 020005; S. Ashikaga *et al.*, JPS Conf. Proc. **26**, (2019), p. 024005.
2) R. Muto *et al.*, Phys. Rev. Lett. **98**, 042501 (2007).
3) S. Yokkaichi, RIKEN Accel. Prog. Rep. **52**, 90 (2019).
4) W. Nakai *et al.*, RIKEN Accel. Prog. Rep. **49**, 195 (2015).
5) K. Kanno *et al.*, Nucl. Instrum. Methods Phys. Res. A **819**, 20 (2016).
6) `http://rd51-public.web.cern.ch/RD51-Public/`.
7) `https://www.psi.ch/drs/drs-chip/`.
8) T. N. Takahashi *et al.*, J. Phys. Conf. Ser. **664**, 082053 (2015); M. Ichikawa *et al.*, IEEE Trans. Nucl. Sci. **66**, 2022 (2019).