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Extinction Measurement at J-PARC MR with Slow-Extracted Pulsed Proton Beam for COMET Experiment

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The COMET experiment aims to search for the neutrinoless conversion of a muon to an electron in muonic atoms. This experiment utilizes a slow-extracted pulsed proton beam at 8 GeV from the J-PARC main ring synchrotron (MR). To achieve a sensitivity of 10^{-17}, an extremely clean pulsed beam is required. In particular, an intensity ratio of leakage protons to the main pulsed beam, called EXTINCTION, must be less than 10^{-10}. This beam is critical in the pursuit of the highest level of sensitivity.
The MR nominally accelerates the protons up to 30 GeV with 600 ns bunch intervals and extracts them slowly after forming the continuous beam. Instead, the COMET requires the acceleration of protons up to 8 GeV with 1.2 μs bunch intervals and slow-extraction with keeping the bunch separations, called bunched slow-extraction (bunched-SX). A 1.2 μs bunch separation is realized by arranging the proton-filled bucket and the empty bucket alternately. Although both buckets are injected into the MR by once excitation of the injection kicker, there are some protons with the extinction of 10^{-6} in the empty bucket at the rapid cycling synchrotron for the MR. To achieve excellent extinction, the injection kicker excitation timing is shifted such that particles remaining in the empty bucket are not injected into the MR. It is essential to measure the extinction with such customized MR operations.
An extinction measurement with a bunched-SX beam was performed with $O(10^{10})$ statistics in May 2021. The extinction was measured by counting all secondary pions of a bunched-SX beam in the K1.8BR secondary beamline in the hadron experimental facility of J-PARC. The result of extinction measurement will be presented.

Working group

WG3

Primary author: NOGUCHI, Kyohei (Kyushu University)

Co-authors: TAMURA, Fumihiko (Japan Atomic Energy Agency); IKEDA, Fumihito (The University of Tokyo); NISHIGUCHI, Hajime (KEK IPNS); YOSHIDA, Hisataka (Osaka University, RCNP); TOJO, Junji (Kyushu University); UENO, Kazuki (KEK IPNS); OISHI, Kou (Imperial College London); TOMIZAWA, Masahito (KEK ACC); SHOJI, Masayoshi (KEK IPNS); HONDA, Ryotaro (Tohoku University, KEK IPNS); MUTO, Ryotaro (KEK ACC); MIHARA, Satoshi (KEK IPNS); IGARASHI, Yoichi (KEK IPNS); FUKAO, Yoshinori (KEK IPNS); HASHIMOTO, Yoshinori (KEK ACC); NAKAZAWA, Yu (KEK IPNS); FUJII, Yuki (Monash University); HIGUCHI, Yuya (Osaka University)

Presenter: NOGUCHI, Kyohei (Kyushu University)

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