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Measurement of structure dependent radiative $K^+ \rightarrow e^+ \nu \gamma$ decays using stopped positive kaons at E36 (12+3)

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The J-PARC E36 experiment is aiming at searching for the lepton universality violation by precisely measuring the ratio of the branching ratio of the $K^+ \rightarrow e^+ \nu (K_{e2})$ to $K^+ \rightarrow \mu^+ \nu (K_{\mu2})$ decays. The E36 experiment was performed at J-PARC employing a stopped K^+ beam in conjunction with a 12-sector iron-core superconducting toroidal spectrometer. Charged particle momenta were calculated by reconstructing the tracks in the spectrometer. Particle discrimination between e^+ and μ^+ was carried out using an aerogel Cherenkov counters and a lead-glass Cherenkov counter, as well as by measuring the time-of-flight between TOF counters.

The peak structure due to the K_{e2} decays was successfully observed in the e^+ momentum spectrum. The structure-dependent radiative $K^+ \rightarrow e^+ \nu \gamma (K_{e2\gamma}^{SD})$ events were selected by requiring one photon hit in the CsI(Tl) calorimeter. The experimental spectra were reproduced by the Monte Carlo simulation, which indicates a correct understanding of the detector acceptance. The $Br(K_{e2\gamma}^{SD})$ value relative to $Br(K_{e2})$ was obtained by calculating the ratio of the $K_{e2\gamma}$ and K_{e2} yields corrected for their detector acceptances. A value of $Br(K_{e2\gamma}^{SD})/Br(K_{e2}) = 1.22 \pm 0.07_{\text{stat}} \pm 0.04_{\text{syst}}$ was obtained, which is significantly larger than the value inferred from a previous experimental result for $Br(K_{e2\gamma}^{SD})/Br(K^+ \rightarrow \mu^+ \nu)$.

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