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# A new results of neutron lifetime measurement with cold neutron beam at J-PARC

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The “neutron lifetime puzzle” arises from the discrepancy between neutron lifetime measurements obtained using the beam method, which measures decay products, and the bottle method, which measures the disappearance of neutrons. To resolve this puzzle, we conducted an experiment using a pulsed cold neutron beam at J-PARC. In this experiment, the neutron lifetime is determined from the ratio of neutron decay counts to $^3$He(n,p)$^3$H reactions in a gas detector. This experiment belongs to the beam method but differs from previous experiments that measured protons, as it instead detects electrons, enabling measurements with distinct systematic uncertainties. By enlarging the beam transport system and reducing systematic uncertainties, we achieved a fivefold improvement in precision. Analysis of all acquired data yielded a neutron lifetime of $\tau_{\rm n} = 877.2 \pm 1.7_{\rm (stat.)}\ ^{+4.0}_{-3.6\,\rm (sys.)}$~s. This result is consistent with bottle method measurements but exhibits a $2.3\sigma$ tension with the average value obtained from the proton-detection-based beam method. We will present about the new results.

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