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The PIONEER experiment for precise measurements of lepton flavor universality

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Recently, several measurement results suggesting a violation of lepton universality in B meson decays have been published, attracting attention as possible evidence of a new physics.

In the PIONEER experiment, the charged pion decay $\pi^+ \rightarrow e^+\nu$ will precisely be measured to obtain the decay ratio $R_{e/\mu} = B(\pi^+ \rightarrow e^+\nu)/B(\pi^+ \rightarrow \mu^+\nu)$ with an accuracy of 0.01%, which is an order of magnitude better than the previous measurements, to verify lepton universality to the limit of theoretical sensitivity. This corresponds to the search for new particles with PeV-scale masses through quantum effects.

In the second stage of the PIONEER experiment, we will also perform a precise measurement of the beta decay $\pi^+ \rightarrow \pi^0 e^+\nu$ of charged pions to verify the CKM unitarity.

The excellent measurement accuracy required for the experiment will be achieved by making full use of the liquid xenon total absorption calorimeter technology developed for the MEG experiment at the University of Tokyo and KEK. In addition, the development of an active target using the latest LGAD technology is underway internationally in order to accurately suppress the reaction near the decay point.

The proposal for the PIONEER experiment was approved by the Paul Scherrer Institute (PSI) in Switzerland in 2022, and is being developed and prepared in international collaboration with Japan, the United States, Canada, Switzerland, Germany, and other countries.

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