

【Grant-in-Aid for Scientific Research (S)】

Broad Section B



Title of Project : Search for new symmetry violation in leptons

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Keyword : Experimental particle physics, lepton, accelerator, particle detectors

【Purpose and Background of the Research】

Although the Standard Model (SM) of particle physics has been established with confirmation of the Kobayashi-Maskawa theory to explain the CP violation and also discovery of the Higgs boson to explain the origin of the mass, there are still mysteries of the Universe: How the anti-matter disappeared? What is the dark matter? What is the dark energy? To solve such mysteries, discovery of New Physics (NP) beyond the SM would be the first step. Here, violation of symmetry or conservation law play important role, and there have been many findings in the quark and neutrino sectors in the past.

In fact, we have found that the B meson prefers decaying to the final state with τ ($D \tau \nu$) rather than those with e ($D e \nu$) or μ ($D \mu \nu$). There are also reported deviations from the SM in rare B meson decays ($B \rightarrow K^{(*)} e^+ e^-$, $B \rightarrow K^{(*)} \mu^+ \mu^-$) and in the anomalous magnetic moment of the muon, $(g-2)_\mu$.

In this research, we will clarify the existence of new symmetry violations in the charged lepton sector, in data taken by SuperKEKB/Belle II experiment and the J-PARC $g-2$ /EDM experiment (E34), and discover New Physics.

【Research Methods】

In the proposed research, we search for lepton universality violations in the tauonic B decays and rare B meson decays, and lepton flavor violation in τ decays. To achieve this goal as early as possible, we will perform R&D to improve the detector performance, and develop computing architecture to process big data samples. Moreover, we will improve the SM prediction of the $(g-2)_\mu$, by precision measurement of the e^+e^- cross section to estimate the contribution of the hadronic loop effect. We also plan to improve the performance of E34 by transferring expertise developed for the Belle II experiment.

【Expected Research Achievements and Scientific Significance】

We plan to accumulate data about 30 times more

than presently available. Together with the detector improvement, we will clarify the lepton universality and lepton flavor violation. In parallel, we try to start the E34 experiment. If deviations are found clearly in some of these measurements, we will be able to claim NP and also elucidate the NP model from correlations.

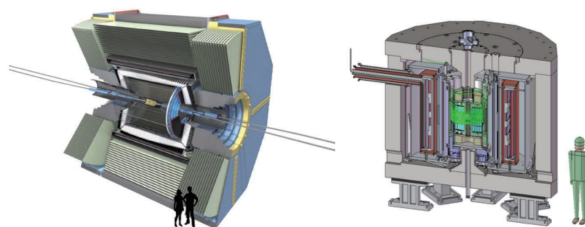


Figure 1 Belle II experiment (left) and J-PARC E34 experiment (right)

【Publications Relevant to the Project】

- "Measurement of the τ lepton polarization and $R(D^*)$ in the decay $B \rightarrow D^* \tau \nu$ ", S. Hirose, T. Iijima, K. Hayasaka et al., Phys. Rev. Lett. 118, 211801 (2017).
- "Measurement of the branching fraction of $B_0 \rightarrow D^* \tau \nu$ relative to $B_0 \rightarrow D^* l \nu$ decays with a semileptonic tagging method", Y. Sato, T. Iijima, K. Hayasaka et al., Phys. Rev. D94, 072007 (2016).

【Term of Project】 FY2018-2022

【Budget Allocation】 147,400 Thousand Yen

【Homepage Address and Other Contact Information】

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