【Grant-in-Aid for Scientific Research (S)】
Science and Engineering (Mathematical and Physical Sciences)

Title of Project： Probing New Physics with Tau-Lepton

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Research Project Number：26220706　Researcher Number：80270396
Research Area：Particle Physics, Nuclear Physics, Cosmic Rays, Astrophysics
Keyword：Particle Physics (experiment), Accelerator, Particle Detectors, Tau-Lepton

【Purpose and Background of the Research】

With the discovery of the Higgs boson at the LHC experiments, particle physics has entered into a new era. The tau-lepton is the heaviest charged lepton in the third generation, and has high sensitivity to the New Physics. At the B-factory experiment, we conducted unique research focusing on the tau-lepton. We searched for the lepton-flavor-violating (LFV) tau decays with the world highest sensitivity, and also obtained constraint on the charged Higgs boson from measurement of B-meson decays with the tau-lepton in the final state (tauonic B decays).

In this research program, we further develop our unique research on the tau-lepton, in the SuperKEKB/Belle II experiment, which aims at 40 times higher peak luminosity than the KEKB/Belle. We search for the tau LFV decays down to the range of $10^{-(9\text{-}10)}$ in the branching fraction, corresponding to 10 to 100 times better sensitivity than the present results. We also aim at improving the precision of tauonic B decays, such as $B \rightarrow \tau \nu$ and $B \rightarrow D \tau \nu$ decays.

【Research Methods】

Experimentally, measurements of particle reactions involving the tau-lepton is challenging, and require maximizing performance of not only the accelerator but also the detector to allow measurements with low enough background even in the high luminosity environment. A large computing system is also necessary.

In the first half period, we aim at establishing the new particle identification detector, called "TOP (Time-Of-Propagation) counter". We will develop reconstruction software, calibration method etc. to maximize the detector performance.

As for computing, we scale up the GRID computing system at Nagoya University, ×30 in CPU and ×15 in Disk, so that intensive physics analyses can be performed at university to deduce results immediately after taking data.

【Expected Research Achievements and Scientific Significance】

The tau LFV search will be performed down to the range of $10^{-(9\text{-}10)}$ in the branching fraction. Tauonic B decays will be measured with 10% accuracy with the Belle II data taken by 2018. Based on these results, we can explore New Physics in TeV region. Other topics include search for tau EDM at the order of 10^{-19} e・cm, precision measurements of tau decay Michel parameters and e^+e^- cross sections, and hadron spectroscopy.

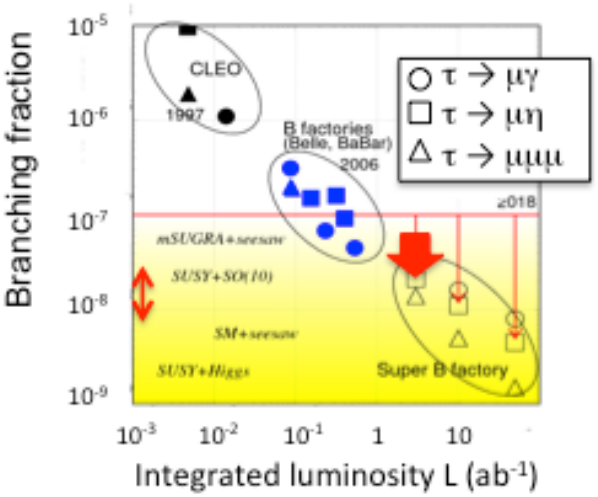

Figure 1　Expected sensitivity for tau LFV decays

【Publications Relevant to the Project】

・"New Search for $\tau \rightarrow \mu \gamma$ and $\tau \rightarrow e \gamma$ decays at Belle", K. Hayasaka, K. Inami, et al. Phys.Lett. B666 (2008) 16-22.
・"Evidence for $B \rightarrow \tau \nu$ with a Hadronic Tagging Method Using the Full Data sample of Belle", K. Hara, Y. Horii, T. iijima et al. Phys.Rev.Lett. 110 (2013) 13, 131801.

【Term of Project】

FY2014-2018

【Budget Allocation】

149,600 Thousand Yen

【Homepage Address and Other Contact Information】

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