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Charged Lepton Flavor Violation searches at the Belle II experiment

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In this talk, we present a brief review of charged lepton flavor violation and lepton number violation results from Belle and discuss prospects with Belle II.
In the standard model (SM), lepton flavors are conserved by accidental symmetries. While the neutrino flavor mixing provides a way for lepton flavor violation (LFV), the observed values of neutrino mixing predicts only very tiny amount of LFV, which is far beyond any realistic expectation of current and future experimental measurements. On the other hand, several new physics models beyond SM predicts sizeable amount of LFV, ranging from $calO(10^{-8})$ to $calO(10^{-10})$.

In the Belle II experiment, the next-generation e^+e^- experiment at KEK using the upgraded SuperKEKB collider, several LFV decays of $\tau^{\pm}$ leptons can be searched for, including $\tau^+ \to l^+\gamma$, $l^+l'^+l'^-$, $l^+h^+h'^-$, where $l,\ l' = e$ or μ and $h,\ h'$ = π or K. In addition, lepton-number-violating (LNV) modes such as $\tau^+ \to l^-h^+h'^+$ can be also searched for. At Belle II, τ decays can be studied in the process $e^+e^- \to \tau^+\tau^-$, which provides a very clean event environment and keeps combinatorial background at a very low level. Moreover, by tagging events with known τ decays on one hemisphere, the absolute branching fraction of rare or exotic τ decays on the other side can be measured, if observed.
In the Belle experiment, these LFV and LNV decays of the τ lepton have been searched for and branching fraction upper limits on the order of a few times 10^{-8} have been obtained. In nearly all modes except for $\tau^+ \to l^+\gamma$, the background level in the signal region is very low, well below one event. Since Belle II aims at accumulating 50 times the total luminosity of Belle, the sensitivity should improve almost linearly with integrated luminosity and predictions by several new physics models can be tested in Belle II.

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