論文の内容の要旨

論文題目

$\mathrm{U}(1)_{\mu-\tau}$ gauge symmetry and its phenomenology

($\mathrm{U}(1)_{\mu-\tau}$ ゲージ対称性と現象論)

氏名　　浅井　健人

$\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge symmetry is one of the possibilities of the extension of the Standard Model (SM). Models extended by the $\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge symmetry contain a corresponding new gauge boson and have often been discussed in the context of the muon anomalous magnetic moment (muon $g-2$). However, the $\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge symmetry can play other important roles and is attractive even without the muon $g-2$. In this thesis, we focus on both the $\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge boson and the $\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge symmetry itself and discuss how they affect the neutrino and dark matter (DM) sectors. First, we discuss relations between neutrino parameters and structure of the neutrino mass matrices derived from the $\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge symmetry in the minimal gauged $\mathrm{U}(1)_{L_\mu-L_\tau}$ model, and find that the neutrino CP phases and the sum of the neutrino masses are determined as functions of the neutrino oscillation parameters, regardless of the $\mathrm{U}(1)_{L_\mu-L_\tau}$-breaking and Majorana mass scales. Second, using the above results, we point out that the successful non-thermal leptogenesis and inflation can be realized simultaneously in the minimal model. Third, we find that if the $\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge symmetry is broken at the electroweak scale, the $\mathrm{U}(1)_{L_\mu-L_\tau}$ gauge boson can successfully contribute to the muon $g-2$ and determination of the light DM abundance simultaneously. Moreover, we explore the indirect detection of such a light DM by neutrino observations and obtain the upper limits from the future HyperKamiokande (HK) sensitivity to the DM annihilation cross section.