Contribution ID: **495** Type: **parallel**

New parameter region in sterile neutrino searches: a scenario to alleviate cosmological neutrino mass bound and its testability at oscillation experiments

Thursday 9 January 2025 14:50 (20 minutes)

Recent high-precision cosmological data tighten the bound to neutrino masses and start rising a tension to the results of lab-experiment measurements, which may hint new physics in the role of neutrinos during the structure formation in the universe. A scenario with massless sterile neutrinos was proposed to alleviate the cosmological bound and recover the concordance in the measurements of neutrino masses. We revisit the scenario and discuss its testability at oscillation experiments. We find that the scenario is viable with a large active-sterile mixing that is testable at oscillation experiments. We present a numerical estimation of the sensitivity reach of the IceCube atmospheric neutrino observation to a sterile neutrino with a mass lighter than active neutrinos for the first time. IceCube shows a good sensitivity to the active-sterile mixing at the mass-square difference with a size of ~ 0.1 eV^2 in the case of the "inverted-mass-ordering sterile neutrino", which is forbidden under the assumption of the standard cosmology but is allowed thanks to the alleviation of the cosmological bound in this scenario.

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Session Classification: Parallel session 7: Beyond The Standard Model (2/2)