

Probing Light Gauge Bosons with Tau Neutrino Experiments

The tau neutrino is probably the least studied particle in the SM, with only a handful of interaction events being identified so far. This can in part be attributed to their small production rate in the SM, which occurs mainly through D_s meson decay. However, this also makes the tau neutrino flux measurement an interesting laboratory for additional new physics production modes. In this study, we investigate the possibility of tau neutrino production in the decay of light vector bosons. We consider four scenarios of anomaly-free $U(1)$ gauge groups corresponding to the $B-L$, $B-L_{\mu}-2L_{\tau}$, $B-L_e-2L_{\tau}$ and $B-3L_{\tau}$ numbers, analyze current constraints on their parameter spaces and explore the sensitivity of DONuT and as well as the future emulsion detector experiments FASERnu, SND@LHC and SND@SHiP. We find that these experiments provide the leading direct constraints in parts of the parameter space, especially when the vector boson's mass is close to the mass of the omega meson.

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