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Neutrino cosmology and trident production at the Deep Underground Neutrino Experiment

New experiments with the possibility to measure the effective number of degrees of freedom in the early universe, such as CMB-S4 or Planck+BAO, can probe the effect of new thermalized light particles and beyond Standard Model interactions involving Dirac neutrinos. The presence of these neutrinos enables the description of different physical phenomena, such as the smallness of neutrino masses and the matter-antimatter asymmetry. Moreover, the presence of right-handed chirality partners for neutrinos allows the calculation of deviations in the effective number ΔN_{eff}. These models, besides addressing the cosmological problems, may also be useful in the description of different phenomena observed on terrestrial experiments involving neutrino oscillations, trident production, and neutrino-electron elastic scattering. We discuss a well-motivated model in which, in addition to right-handed neutrinos, a neutral gauge boson appears. We consider a U(1) anomaly free theory to incorporate these new fermionic and bosonic states, studying the trident production of pairs electron-positron and muon-antimuon at the near detector of DUNE (Deep Underground Neutrino Experiment). We analyze the consequences of having new U(1) interactions in the measurements of $(g-2)_\mu$ anomaly as well as in the leptogenesis mechanism. Finally we consider the sensitivity of DUNE in constraining these models along with the parameter restriction given by measuring ΔN_{eff}, in order to obtain new limits on the effective degrees of freedom that have not yet been reported.

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