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Observing Left-Right Symmetry in the Cosmic Microwave Background

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We have considered the possibility of probing the left-right symmetric model (LRSM) via cosmic microwave background (CMB) by adopting the minimal LRSM with Higgs doublets, also known as the doublet left-right model (DLRM), where all fermions, including the neutrinos, acquire masses only via their couplings to the Higgs bidoublet. There exist additional relativistic degrees of freedom, because of the Dirac nature of light neutrinos, that can thermalize in the early universe through their gauge interactions corresponding to the right sector. We have constrained this model from Planck 2018 bound on the effective relativistic degrees of freedom and also estimate the prospects for planned CMB Stage IV experiments to constrain the model further. We find that W_R boson mass below 4.06 TeV can be ruled out from Planck 2018 bound at 2σ CL in the exact left-right symmetric limit, which is equally competitive as the LHC bounds from dijet resonance searches. On the other hand, Planck 2018 bound at 1σ CL can rule out a much larger parameter space out of reach of present direct search experiments, even in the presence of additional relativistic degrees of freedom around the TeV corner. We also study the consequence of these constraints on dark matter in DLRM by considering a right-handed real fermion quintuplet to be the dominant dark matter component in the universe.

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