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Connection of GeV Dark Matter and Neutrino Floor with $(g-2)_\mu$ Anomaly in $U(1)_{L_\mu - L_\tau}$

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We investigate the impact of recent anomalous $(g-2)_\mu$ measurement with $\sim 4\sigma$ deviation from the SM, probing its effect on a light GeV scale fermionic dark matter (DM). The $(g-2)_\mu$ anomaly can be readily explained in the a beyond the SM (BSM) $U(1)_{L_\mu - L_\tau}$ scenario, where only a portion of hitherto allowed parameter space can explain the anomaly. This constraint impacts the enhancement of the neutrino floor, the neutrino background in the DM direct detection experiments. The GeV scale DM is severely constrained by the $(g-2)_\mu$ result as it restricts the Z' mass in the range of $20-200$ MeV. That restriction results in absence of s-channel resonant annihilation of the GeV scale DM, therefore resulting in over abundance of the DM relic. Even if a t-channel annihilation aided by large couplings can bring the relic density in the observed range, direct detection cross section shoots up. Consequently, super-GeV (with mass $1-10$ GeV) DM gets almost ruled out where as sub-GeV (with mass $0.1-1$~GeV) DM gets severely constrained.

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