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How to rule out $(g-2)_\mu$ in $U(1)_{L_\mu - L_\tau}$ with White Dwarf Cooling

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In recent years, the gauge group $U(1)_{L_\mu - L_\tau}$ has received a lot of attention since it can, in principle, account for the observed excess in the anomalous muon magnetic moment $(g-2)_\mu$, as well as the Hubble tension. Due to unavoidable, loop-induced kinetic mixing with the SM photon and Z, the $U(1)_{L_\mu - L_\tau}$ gauge boson A' can contribute to stellar cooling via decays into neutrinos.
In this work, we perform for the first time an *ab initio* computation of the neutrino emissivities of white dwarf stars due to plasmon decay in a model of gauged $U(1)_{L_\mu - L_\tau}$. Our central finding is that an observation of the early-stage white dwarf neutrino luminosity at the 30% level could exclude (or partially exclude) the remaining allowed parameter space for explaining $(g-2)_\mu$. In this work, we present the relevant white dwarf sensitivities over the entire A' mass range. In particular, we have performed a rigorous computation of the luminosities in the resonant regime, where the A' mass is comparable to the white dwarf plasma frequencies.

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