

Phenomenology 2022 Symposium: From Virtual to Real



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Light Z' and Dirac fermion dark matter at "Lifetime Frontier" Experiments

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We consider a $U(1)_{B-L}$ model with a Z' portal Dirac fermion dark matter (DM) χ of low mass which couples very weakly to the $B - L$ gauge boson Z' . An arbitrary $B - L$ charge $Q \neq \pm 1, \pm 3$ of the DM χ ensures its stability. Motivated by the sensitivity reach of forthcoming "Lifetime Frontier" experiments, we focus on the Z' mass, $m_{Z'}$, in the sub-GeV to few GeV range. We examine both the freeze-out and freeze-in DM scenarios. For the freeze-out scenario, the observed DM abundance is reproduced near the Z' resonance. For the freeze-in scenario, we focus on $m_\chi \ll m_{Z'}$. We show that g_{BL} values roughly scale as $1/Q$ to reproduce the observed DM abundance. For various Q values in the range between 10^{-6} and 10^2 , we show that the gauge coupling values g_{BL} needed to reproduce the observed DM abundance lie in the search reach of future planned and/or proposed experiments such as FASER, Belle-II, LDMX, and SHiP. In the freeze-in case, the Q values to realize observable g_{BL} values are found to be much smaller than that in the freeze-out case.

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