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Riding the dark matter wave: Novel limits on general dark photons from LISA Pathfinder

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I demonstrate the possibility to perform a parametrically improved search for gauged baryon (B) and baryon minus lepton ($B-L$) Dark Photon Dark Matter (DPDM) using auxiliary channel data from LISA Pathfinder. In particular I point out the use of the measurement of the differential movement between the test masses (TMs) and the space craft (SC) which is nearly as sensitive as the tracking between the two TMs. TMs and SC are made from different materials and therefore have different charge-to-mass ratios for both $B-L$ and B. Thus, the surrounding DPDM field induces a relative acceleration of nearly constant frequency. For the case of $B-L$, I show that LISA Pathfinder can constrain previously unexplored parameter space, providing the world leading limits in the mass range $4\cdot 10^{-19}\,\text{eV} < m < 3\cdot 10^{-17}\,\text{eV}$. This limit can easily be recast also for dark photons that arise from gauging other global symmetries of the SM. Furthermore, I comment on possible follow-up ideas.

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