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Searching for Dark Photons at the LHeC and FCC-he

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Extensions of the Standard Model (SM) gauge group with a new $U(1)_X$ predict an additional gauge boson. Through kinetic mixing with the SM photons featured by a coupling ϵ, the ensuing so-called dark photons γ', which acquire mass as a result of the breaking of the gauge group $U(1)_X$, can interact with the SM field content. These massive dark photons can therefore decay to pairs of leptons, hadrons, or quarks, depending on their mass $m_{\gamma'}$. In this work, we discuss searches for dark photons in the mass range around and below one GeV at the LHeC and FCC-he colliders. The signal is given by the displaced decays of the long-lived dark photon into two charged fermions. We discuss the impact of conceivable irreducible (SM and machine-related) backgrounds and different signal efficiencies. Our estimates show that the LHeC and FCC-he can test a domain that is complementary to other present and planned experiments.

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