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Dark photon in parity-violating electron scatterings

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We proposed that the parity-violating electron scattering (PVES) offers a powerful tool to probe the hypothetical dark photon. We calculated the dark photon contributions to PVES asymmetries in both elastic and deep-inelastic scatterings (DIS). These contributions are characterized by the corrections to the standard model couplings C_{1q}, C_{2q}, and C_{3q}.

At low scales, the corrections to C_{1q} and C_{3q} could be as large as 5% were a dark photon to exist. In DIS at very high Q^2, of relevance to HERA or the EIC, the dark photon could induce substantial corrections to C_{2q}, suggesting as large as 10% uncertainties in the extraction of valence parton distribution functions.

We also extract the favoured region of the dark photon parameter space by fitting the experimental data of PVES and atomic parity-violation, which prefers a heavy dark photon with mass above the Z-boson mass.

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