Accessing Derivative Corrections to Heisenberg-Euler in Photon-Laser Collisions

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Measuring vacuum birefringence and real photon-photon scattering for the first time are scientific goals at several current and future high power laser facilities [1]. To describe and calculate signals of this process, the Heisenberg-Euler Lagrangian for a constant field is often employed [2]. We give some examples where this approach fails and instead, the leading contribution arises from derivative corrections to the Heisenberg-Euler Lagrangian [3]. We verify this for the case of a plane wave background by showing the derivative correction exactly reproduces the low-energy limit of photon scattering when calculated with Volkov fermionic wavefunctions and gives the same scaling as low-energy four-photon scattering.

Finally, we give the parameter regime and some example beyond a plane wave where signals described by the derivative-corrected Heisenberg-Euler terms can be measured.

References

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