

Electric Dipole Moments From Missed Dark Matter Scattering

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Axion-like particles are a well-motivated candidate for ultralight dark matter. Because dark matter must be non-relativistic, the effects of its scattering with Standard Model particles are negligible and generally go unnoticed. However, due to the large occupation number of ultralight dark matter, the sum of all scatterings leads to a classical field-like interaction with Standard Model particles. In the case of an axion-like particle, this scattering imparts a parity violating effect. If this collective scattering with axion-like particles is inserted into the one-loop quantum electrodynamics diagram, the parity violation imparted by this scattering will convert the anomalous magnetic moment contribution into an electric dipole moment. This contribution is quite large and leads to a prediction inconsistent with precision measurements of the proton and electron electric dipole moments, unless their couplings to the axion-like particles are very weak. As a result, the constraints on the couplings of axion-like particle dark matter to the electron and proton are improved by as much as eleven and six orders of magnitude, respectively.”

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