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QED Fermions in a noisy magnetic field background

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We consider the effects of a noisy magnetic field background over the fermion propagator in QED, as an approximation to the spatial inhomogeneities that would naturally arise in certain physical scenarios, such as heavy ion collisions or the quark gluon plasma in the early stages of the evolution of the universe. We consider a classical, finite and uniform magnetic field background ⟨⍰(⍰)⟩=⍰, subject to white-noise spatial fluctuations with auto-correlation of magnitude Δ⍰. By means of the Schwinger representation of the propagator in the average magnetic field as a reference system, we used the replica formalism to study the effects of the magnetic noise in the form of renormalized quasi-particle parameters, leading to an effective charge and an effective refraction index, that depend not only on the energy scale, as usual, but also on the magnitude of the noise Δ⍰ and the average field ⍰.

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