

Mini Project: $(g - 2)_\mu$ in QED

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Start from QED Lagrangian of muon (or electron, if you like)

$$\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + \bar{\psi}(i\gamma^\mu\mathcal{D}_\mu - m)\psi, \quad (1)$$

where ψ is the muon field, $F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu$, and $\mathcal{D}_\mu = \partial_\mu - ieA_\mu$. Calculate the so-called “vertex correction diagram” and obtain the anomalous magnetic moment of muon

$$a_\mu \equiv \frac{g_\mu - 2}{2} = \frac{\alpha}{2\pi} \approx 0.0011614, \quad (2)$$

which was first obtained by Schwinger in 1948 and established “quantum field theory” as correct theory. Follow the procedure in [1].

References

- [1] M. Peskin, D. Schroeder, “An Introduction to Quantum Field Theory”, Addison Wesley