Quantum Field Theory 1 – Tutorial 12

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Problem 1: Trace technology

In the evaluation of QED processes we often encounter traces over products of γ matrices. This can be done very efficiently by using the algebraic properties of the γ matrices. Use the anticommutation properties γ matrices and the cyclic property of the trace to show the following identities

$$\mathrm{tr}(\gamma^\mu \gamma^\nu) \;=\; 4\eta^{\mu\nu}\,, \tag{1}$$

$$\mathrm{tr}(\gamma^\mu \gamma^\nu \gamma^\rho \gamma^\sigma) \;=\; 4(\eta^{\mu\nu}\eta^{\rho\sigma} - \eta^{\mu\rho}\eta^{\nu\sigma} + \eta^{\mu\sigma}\eta^{\nu\rho})\,. \tag{2}$$