Midterm 1 Fun Facts

Speed of Light: $c = 1$

Planks constant: $\frac{h}{2\pi} = 1$

$r_{\text{nucleus}} \sim 10^{-15}$ meters.

The mass of the electron is $\sim 10^{-3}$ GeV

The mass of the muon is $\sim 10^{-1}$ GeV

The mass of the tauon is ~ 1 GeV

The mass of the W-boson $\sim$ mass Z-boson ~ 100 GeV

1 TeV = 1000 GeV

$\alpha = 10^{-2}$ $\qquad\qquad$ $\alpha_W \equiv 0.5\alpha$ $\qquad\qquad$ $\alpha_G \equiv G_N m_p^2 = 10^{-39}$

$\text{GeV}^{-1} = 10^{-16}\text{m}$ $\qquad\qquad$ $\text{GeV} = 10^{-27}\text{kg}$ $\qquad\qquad$ $\text{GeV}^{-1} = 6 \cdot 10^{-25}$ s

$\epsilon_L = \frac{1}{\sqrt{2}}\left(0, 1, -i, 0\right)$ and $\epsilon_R = \frac{1}{\sqrt{2}}\left(0, 1, +i, 0\right)$

Cross section: $\sigma \sim \frac{1}{E_1 E_2}|M|^2 d\Pi_{LIPS}$

Decay rate: $\Gamma \sim \frac{1}{E}|M|^2 d\Pi_{LIPS}$

Life-time: $\tau = \frac{1}{\Gamma}$

$d\Pi_{LIPS} = \delta^4(\sum p_i - \sum p_f) \prod_f d\!\!\!/^3 p_f$

$d\!\!\!/^3 p = \frac{d^3 p}{(2\pi)^3 2E_p}$

$$\eta_{\mu\nu} = \begin{cases} 1 & \mu = \nu = 0 \\ -1 & \mu = \nu = 1, 2, 3 \ (i) \\ 0 & \text{otherwise} \end{cases}$$

Physical Observables A can be written as $A = \sum_a a\,|a\rangle\,\langle a|$

$$\mathscr{L}_{scalar} = \frac{1}{2}(\partial_\mu \phi)(\partial^\mu \phi) + \frac{m^2}{2}\phi^2$$

$$\mathscr{L}_{spin1/2} = \bar{\psi}(i\gamma_\mu \partial^\mu - m)\psi$$

$$\mathscr{L}_{spin1} = F_{\mu\nu}F^{\mu\nu} \text{ where } F_{\mu\nu} = \partial_\mu A_\nu - \partial_\mu A_\nu$$