

Elementary Particle Physics: Assignment # 6

Due Tuesday March 8, 11:30

- 1 Using the chiral representation of the 4-spinors given in homework 1, compute the square of the Feynman amplitude generated by QED process for the process $e^+e^- \rightarrow \mu^+\mu^-$ (neglect fermion masses). Compare with the corresponding results you obtained in homework 3 for the Yukawa interaction. Reason the answer.
- 2 An interaction vertex between a muon χ and an electron ψ with the photon

$$\mathcal{L} = -C\psi\gamma^\mu\chi A_\mu + h.c.$$

is allowed by $U(1)$ gauge invariance. If such vertex existed the muon could decay as $\mu^- \rightarrow e^- \gamma$. Compute the decay width for such process (neglect the electron mass) generated by the interaction above.

Such process has not been observed. Use the present experimental constraint on the branching fraction for this process to put a bound on the coupling constant C .

Hint: you can find the value of the total width of the μ (or its life time τ_μ , $\Gamma_\mu = \frac{1}{\tau_\mu}$) and of the bound on the $Br(\mu \rightarrow e\gamma) = \frac{\Gamma(\mu \rightarrow e\gamma)}{\Gamma_\mu}$ in the Particle Data Group webpage.