

Physics 721, Fall 2023

Problem Set 6

Due Monday, October 23.

1. *Practice with gamma matrices*

Show that:

$$\gamma^5 \gamma^\mu \gamma^5 = -\gamma^\mu$$

$$\text{Tr } \not{a} = 0$$

$$\text{Tr } \not{a} \not{b} = 4a \cdot b$$

Similarly, compute $\text{Tr } \not{a} \not{b} \not{c}$, $\text{Tr } \not{a} \not{b} \not{c} \not{d}$, $\text{Tr } \not{a} \gamma^5$, $\text{Tr } \not{a} \not{b} \gamma^5$, $\text{Tr } \not{a} \not{b} \not{c} \gamma^5$, and $\text{Tr } \not{a} \not{b} \not{c} \not{d} \gamma^5$.

The last of these will involve the constant antisymmetric tensor $\epsilon^{\mu\nu\rho\sigma}$. Use only the anticommutation relations of the 4×4 gamma matrices and general properties of the trace (cyclicity, *etc.*). Do not use an explicit representation of the matrices. Recall that $\gamma^5 = i\gamma^0\gamma^1\gamma^2\gamma^3$, $\{\gamma^5, \gamma^\mu\} = 0$, and $(\gamma^5)^2 = \mathbf{1}$.