Physics 325: Elementary Particle Physics
Spring 2010
Problem Set 7

Due: Thu 25 Mar 2010

Reading: Please read the second half of Chapter 7 in Griffiths.

Problems:

7.6. Dirac eigenspinors of $S_z$.

7.11. Lorentz transformation of spinors. In case it is not clear, we want to use

$$\frac{\partial x^0}{\partial x^0'} = \gamma, \quad \frac{\partial x^0}{\partial x^1'} = \gamma\beta, \quad \frac{\partial x^1}{\partial x^0'} = \gamma\beta, \quad \frac{\partial x^1}{\partial x^1'} = \gamma, \quad \frac{\partial x^2}{\partial x^2'} = 1, \quad \frac{\partial x^3}{\partial x^3'} = 1,$$

as follows from the inverse Lorentz transformations

$$x^0 = \gamma(x^0' + \beta x^1'),$$
$$x^1 = \gamma(x^1' + \beta x^0'),$$
$$x^2 = x^2', \quad x^3 = x^3'.$$

7.13. $S$ and its action on $\gamma^0$.

7.17. $\bar{\psi}\gamma^\mu\psi$ transforms as a 4-vector. Let $a^\mu = \bar{\psi}\gamma^\mu\psi$. In the first part of this problem, we want to show that the action $\psi \mapsto \psi' = S\psi$ takes $a^\mu \mapsto a'^\mu$, where

$$a^0' = \gamma(a^0 - \beta a^1),$$
$$a^1' = \gamma(a^1 - \beta a^0),$$
$$a^2' = x^2, \quad a^3' = x^3.$$

7.19. Spatial components of $\sigma^{\mu\nu}$ versus $\Sigma$.

7.20. Maxwell’s equations and the continuity equation.