

Physics 443 Homework #3
Due Tuesday, October 28, 2008

1.)

a) Show by explicit computation the Lorentz invariance of the Dirac Lagrangian, by considering a Lorentz transformation of the fields.

b) Consider the chiral rotation of a massless Dirac field

$$\psi' = \exp[i\alpha\gamma_5]\psi ;$$

find the corresponding Noether current. Show that the corresponding Noether charge measures the total helicity of a collection of massless Dirac particles, and that the addition of a mass term to the Lagrangian violates the symmetry; find an equation that expresses the violation of current conservation by the mass.

c) Find the Noether current related to charge conservation by considering a phase rotation of a Dirac field (of arbitrary mass)

$$\psi' = \exp[i\alpha]\psi .$$

2.) Peskin and Schroeder 3.1

3.) Peskin and Schroeder 3.4; you may omit part (d) – you did it in problem 1.

4.) Peskin and Schroeder 3.7