Massachusetts Institute of Technology

Department of Physics

Course: 8.701 – Introduction to Nuclear and Particle Physics
Term: Fall 2020
Instructor: Markus Klute
TA :   Tianyu Justin Yang

Discussion Problems
from recitation on **September 29th, 2020**

Problem 1: γ-matrices

By considering the three cases $\mu = \nu = 0$, $\mu = \nu \neq 0$, and $\mu \neq \nu$ show that
$\gamma^\mu \gamma^\nu + \gamma^\nu \gamma^\mu = 2g^{\mu\nu}$.

Problem 2:   Negative energy solutions

Consider the $e^+ e^- \to \gamma \to e^+ e^-$ annihilation process in the center-of-mass frame where the energy of the photon is $2E$. Discuss energy and charge conservation for the two cases where:
(a) the negative energy solutions of the Dirac equation are interpreted as negative energy particles propagating backwards in time;
(b) the negative energy solutions of the Dirac equation are interpreted as positive energy antiparticles propagating forwards in time.

8.701 Introduction to Nuclear and Particle Physics
Fall 2020