Physics 570 Homework 9

Due Wednesday, November 29, 2017

Problem 1 (50 points)

Prob. 6.7 of Thomson

Problem 2 (30 points)

Prob. 6.10 of Thomson

Problem 3 (20 points)

In a recent lecture, we showed that the $1 + \cos^2\theta$ angular distribution in the center-of-mass frame for the $e^- + e^+ \to \mu^- + \mu^+$ reaction at high energy can be obtained from the consideration of helcity conservation.

a) If the e^- beam and the e^+ beam both have positive helicity, what would the angular distribution be?

b) Now consider the $\nu_\mu + \bar{\nu}_\mu \to \nu_e + \bar{\nu}_e$ reaction, which proceeds via $\nu_\mu + \bar{\nu}_\mu \to Z^0 \to \nu_e + \bar{\nu}_e$, what would the angular distribution be? Note that ν has negative helicity and $\bar{\nu}$ has positive helcity at high energies.

Note the following values for the rotation matrices:

$$d^1_{1\,1}(\theta) = d^1_{-1\,-1}(\theta) = (1 + \cos\theta)/2; \qquad d^1_{-1\,1}(\theta) = d^1_{1\,-1}(\theta) = (1 - \cos\theta)/2$$