Homework # 4; due Thursday, Sept. 30

Reading: Chapter 4 of Griffiths

14. In lecture, it was mentioned that it is known that the electron is a point particle down to the size scale of 10^{-18} cm. Now, your friend is a middle-school science teacher who has never taken particle physics. Please explain to her how this is consistent with the center-of mass energy of modern colliders.

15. It is tempting to come up with a classical model for the spin of the electron. Consider on such (doomed) attempt, where the angular momentum of the electron is associated with the angular momentum of the electromagnetic field of the electron (the Coulomb field due to the charge, and the magnetic moment). Estimate the size of the electron that would follow from such a picture. For reference, the angular momentum associated with the combination of electric and magnetic fields is:

$$\mathbf{L}_{\mathrm{EM}} = \frac{1}{4\pi c}\int \mathbf{r}\times(\mathbf{E}\times\mathbf{B})\,d^3r$$

16. Review the derivation of the intrinsic parity of the negative pion presented in class. Use similar arguments to figure out the intrinsic parity of the neutral pion from the experimental result that the reaction $d + \pi^- \longrightarrow n + n + \pi^0$ does not occur.

17. Griffiths' problems 4.36

18. Look up the rest-mass difference and the difference in lifetime between the two kinds of neutral kaons, K_L and K_S. Convert the mass difference into angular-frequency units (s^{-1}), and, using the lifetimes, calculate the decay-rate difference in the same units. Compare these two quantities. Is the result surprising?