Physics 370 Homework #12

5 problems

Due by Friday, December 2

▷ **1.**

From the experimental evidence that the force between nucleons has a range of about 1 fm, obtain a rough value (in MeV/c^2 for the mass of the particle exchanged to convey the force, the pion.

▷ **2.**

(a) Show that $\Psi_1(x,t) = Ae^{ikx-i\omega t}$ is a solution of both the Klein-Gordon and the Schrodinger equation.
(b) Show that $\Psi_2(x,t) = Ae^{ikx}e^{i\omega t}$ is a solution of the Klein-Gordon but not of the Schrodinger equation.
(c) Compare the time dependence of $|\Psi|^2$ for Ψ_1 and $\Psi = \Psi_1 + \Psi_2$.

▷ **3.**

Trying to pull two quarks apart would produce more quarks in groups, or hadrons? Suppose that when the separation reaches 1 fm (the radius of a nucleon), the lightest hadron (a π^0) is created. How much force is involved?

▷ **4.**

Draw a Feynman diagram for the interaction

$$\tau^+ \rightarrow e^+ + \nu_e + \bar{\nu_\tau}$$

Prove that the interaction satisfies charge, energy, strangeness, lepton and baryon conservation.

▷ **5.**

Show that the presence of a positive cosmological constant Ω_Λ in Friedmann equation must, as R becomes very large, lead to an exponential expansion of the universe.