

Chapter 3 Assignment

1) Show that the one dimensional Schrodinger equation
$$-\frac{\hbar^2}{2m} \frac{d^2\psi}{dx^2} = i\hbar \frac{d\psi}{dt}$$
 is not covariant.

2) The Klein Gordon equation can be used to describe exotic atoms where an electron is replaced by a spinless π^- meson, ($m_{\pi^-} = 280 m_{\text{electron}}$) One can show the eigenenergies to be given by:

$$E_{n,l} = \frac{mc^2}{\left\{ 1 + (Z\alpha)^2 / \left[n - l - \frac{1}{2} + \sqrt{(l + \frac{1}{2})^2 - (Z\alpha)^2} \right]^2 \right\}^{1/2}}$$

a) Expand E in terms of α^2 up to and including α^4 term.

b) The $3d \rightarrow 2p$ transition for π^- in ^{59}Co has been measured to be $384.6 \pm 1.0 \text{ keV}$. What does theory predict.