Questions 2nd May 2017

Dom Smith

May 2, 2017

Recap

1) By considering the inverse β decay charged-current weak interaction process ν_e d $\rightarrow e^-$u, write the lepton and quark currents.

1i) On the matrix element for the above process, apply a Parity transformation on the scalar product. What terms remain unchanged and what terms do not?

1iii) What is the propagator term of the Weak Interaction?

2) The muon lifetime τ_μ can be written as:

$$\Gamma(\mu^- \rightarrow e^- \nu_\mu \bar{\nu_e}) = \frac{1}{\tau_\mu} = \frac{G_F^2 m_\mu^5}{192\pi^3} \tag{1}$$

How can the muon lifetime be determined experimentally?

The Weak Interaction of Leptons

3) Draw the Feynamn diagram for a muon decay.

3i) How does the additional vertix associated with the muon decay alter Equation 1?

4) What is meant by the Branching Ratio and how is it related to partial decay rates?

5) Write an expression for the tau-lepton lifetime and derive the following equation:

$$\frac{G_F^{(\tau)}}{G_F^{(\mu)}} = \frac{m_\mu^5 \tau_\mu}{m_\tau^5 \tau_\tau} Br(\tau^- \rightarrow e^- \bar{\nu_e} \nu_\tau) \tag{2}$$