

Exp data: $(1.267 \pm 0.023) \times 10^{-4}$

\Rightarrow Triumph for $(V-A)$ theory VII-13

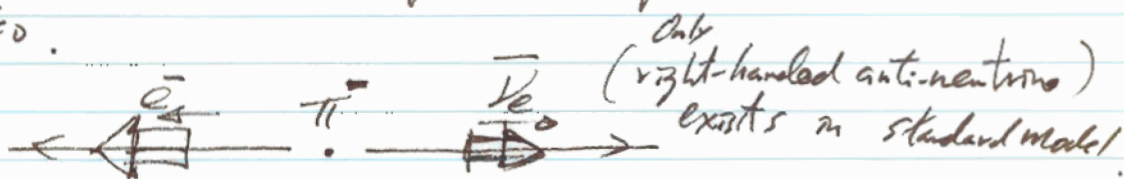
(3)

$$\frac{\Gamma(\pi^- \rightarrow e^- \bar{\nu}_e)}{\Gamma(\pi^- \rightarrow \mu^- \bar{\nu}_\mu)} = \left(\frac{m_e}{m_\mu}\right)^2 \left(\frac{m_\pi^2 - m_e^2}{m_\pi^2 - m_\mu^2}\right)^2 = 1.28 \times 10^{-4}$$

Hence, the branching ratio of $\pi^- \rightarrow \mu^- \bar{\nu}_\mu$ is about 100%.

This can be understood by the conservation of angular momentum.

Since the pion is spinless, the outgoing lepton pair ($e^- \bar{\nu}_e$) must have $J=0$.

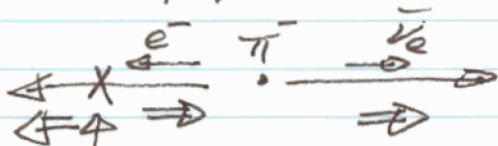


$J=0$ forces

this to be right-handed e^- .

(But, in the limit of $m_e=0$, the weak current only couples to negative helicity electron due to the left-hand current.)

This demands the flip of helicity states.



The "interaction" term $(m_e \bar{e}_R e_L + m_e \bar{e}_L e_R)$ flips the helicity.

Thus, $|\mathcal{M}|^2 \sim m_e^2$.

Similarly, $|\mathcal{M}|^2 \sim m_\mu^2$

Note: μ^- is polarized from π^- decay.