University of Minnesota

School of Physics and Astronomy

2026 Spring Physics 8902
Elementary Particle Physics II

Assignment Solution

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Problem Set 1 Due 11am, Monday, February 2

Question 1

Show that the charge-lowering weak current of the form

$$J^\mu = \bar{e}\gamma^\mu \frac{1}{2}(1 - \gamma^5)\nu_e \tag{1}$$

involves only left-handed electrons (or right-handed positrons). In the relativistic limit $(v \approx c)$ show that the electrons have negative helicity.

Answer

Question 2

Weak decays of leptons

(a) Calculate the muon total decay width, $\Gamma(\mu^- \to e^- \bar{\nu}_e \nu_\mu)$, accounting for the finite mass of the electron.

(b) Use this result to determine the numerical value of the ratio

$$R = \frac{\Gamma(\tau^- \to \mu^- \bar{\nu}_\mu \nu_\tau)}{\Gamma(\tau^- \to e^- \bar{\nu}_e \nu_\tau)}. \tag{2}$$

Compare the theoretical prediction for this ratio with the experimental value.

Answer