Exercise Sheet 6 – Particle Physics – Summer 2016

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hand in: Mo 04.07. (in the lecture)

6.1 Scalar, Pseudo-scalar, Vector, Axial-vector (3 points)

Classify the following quantities as either scalar, pseuso-scalar, vector or axial vector:

- angular momentum $\mathbf{L} = \mathbf{r} \times \mathbf{p}$,
- force $\mathbf{F}$,
- power $P = \mathbf{F} \cdot \mathbf{v}$,
- torque $\mathbf{G} = \mathbf{r} \times \mathbf{F}$,
- electric field $\mathbf{E}$,
- magnetic field $\mathbf{B}$,
- magnetic flux $\phi = \int \mathbf{B} \cdot d\mathbf{S}$.

6.2 Decays of ρ meson (3 points)

Why is the decay $\rho^0 \to \pi^+\pi^-$ allowed, but not the decay $\rho^0 \to \pi^0\pi^0$?
Hint: note the symmetry of the final state ($\pi^0\pi^0$) wave function.

6.3 Kaon weak decays (4 points)

Draw the Feynman diagrams for the following Kaon weak decays:

- $K^+ \to \mu^+\nu_\mu$,
- $K^+ \to \pi^+\pi^0$,
- $K^+ \to \pi^+\pi^-\pi^+$.

6.4 Weak decay of K^+ meson (4 points)

Calculate the ratio R of the Kaon leptonic decay rates

$$R = \frac{\Gamma(K^+ \to e^+\nu_e)}{\Gamma(K^+ \to \mu^+\nu_\mu)}. \tag{1}$$

Compare the result with the experimental value $R_{exp} = (2.488 \pm 0.012) \cdot 10^{-5}$.