Particle Physics, 4th year undergraduate, University of Ioannina

Particle Physics Homework Assignment 8

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Problem 1: Consider an experiment where negative pions, π^- , at rest are being captured by a Hydrogen nuclei.

1) Draw conclusions about the spin of the π^- given that the reaction $\pi^- p \rightarrow n\gamma$ occurs.
2) Can the reaction $\pi^- p \rightarrow n$ occur if the initial state proton is free (not bound in a nucleus) ? What happens if the proton is bound to a nucleus ?
3) Draw conclusions about the parity of the π^0 and π^- provided that the reaction $\pi^- p \rightarrow n\pi^0$ also occurs.
4) Draw conclusions about the π^0 spin provided that it decays into two photons: $\pi^0 \rightarrow \gamma\gamma$

Problem 2: The ρ^0 is a vector boson, that is an 1^- state. Explain why the decay $\rho^0 \rightarrow \pi^+ \pi^-$ is allowed and why the decay $\rho^0 \rightarrow \pi^0 \pi^0$ is forbidden.

Problem 3: The η meson is a 0^- state. Explain why the decay $\eta \rightarrow \pi^- \pi^+$ is forbidden whilst the decay $\eta \rightarrow \pi^- \pi^+ \pi^0$ is allowed via the electromagnetic interaction.

Problem 4:

The decay $^{20}Ne(1^+) \rightarrow {}^{16}O(0^+) + \alpha(0^+)$ proceeds via the strong interaction. The spin and parity assigments of the particles are given in parenthesis. Is this decay allowed or forbidden ?

Problem 5:

The decay $^{20}Ne(1^+) \rightarrow {}^{16}O(3^-) + \alpha(0^+)$ proceeds via the strong interaction. The spin and parity assigments of the particles are given in parenthesis. Is this decay allowed or forbidden ?