NUCLEAR AND PARTICLE PHYSICS
PHY 422/622

ASSIGNMENT II

(1) Given that (K^+, K^0) form an isospin-doublet and $(\Sigma^+, \Sigma^0, \Sigma^-)$ form an isospin-triplet, what are the ratio of cross sections for

$$\begin{aligned}
\pi^- \ + \ p \quad &\longrightarrow \quad K^+ \ + \ \Sigma^- \\
\pi^- \ + \ p \quad &\longrightarrow \quad K^0 \ + \ \Sigma^0 \\
\pi^+ \ + \ p \quad &\longrightarrow \quad K^+ \ + \ \Sigma^+ \\
\pi^+ \ + \ p \quad &\longrightarrow \quad K^0 \ + \ \Sigma^0 \ .
\end{aligned}$$

What are the ratios when the $I = 3/2$ mode dominates?

(2) Consider the bound state of a Dirac fermion and anti-fermion $(f\bar{f})$, such as a meson $(q\bar{q}')$ or positronium(e^-e^+). Assume that the particle and anti-particle have opposite intrinsic parities. Try to argue that this bound state has eigenvalues for parity and charge conjugation

$$\begin{aligned}
P \quad &= \quad -1 \times (-1)^l \\
C \quad &= \quad -1 \times (-1)^{s+1} \times (-1)^l \ .
\end{aligned}$$

l and s, as usual, are the orbital angular momentum and spin quantum numbers of the bound state.

(3) Deduce the most general angular distribution for the decay

$$\Lambda^0 \ \longrightarrow \ p \ + \ \pi^- \ .$$

What happens if *parity* is a good symmetry for the above decay? How was parity-violation experimentally deduced from β-decay of ^{60}Co-nuclei?

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