Lecture Notes Dr. Kuhn

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1 Important Dates

Instead of meeting at our usual time on Tuesday 11/20 we will meet Monday 11/19 at 11:00 a.m. in Room 2108 PSB2 (Nuclear Seminar room).
Tuesday 11/13, Dr. Weinstein will lecture.
Thursday 11/15, Dr. Hattawy will lecture.

2 Summary

2.1 PseudoScalar Octett and Singlet

$J^{P(c)} = 0^{-(+)}$
Octett: π^+, π^0, π^-; η^0; K^+, K^0, $\bar{K}^0$ K^-
Singlet: η'

2.2 Vector Octett and Singlet

$J^{P(c)} = 1^{-(-)}$
Octett: ρ^+, ρ^0, ρ^-, ω^0, K^{+*}, K^{0*}, $\bar{K}^{0*}$,K^{-*}
Singlet: ϕ

2.3 Scalars

$J^{P(c)} = 0^{++} : f_0$

2.4 Exotics

$J^{P(c)} = 1^{-(+)}$ is forbidden for quark anti-quark pairs, and therefore corresponds to exotic states. These exotics states could correspond to tetra quarks or quark-gluon hybrids.

3 Reactions

3.1 Strong Force

$p + n \to \Sigma^+ + K^0$
$\bar{K}^0 + p \to \Sigma^+$ or Σ^{*+}
$K^0 + p \to$ nothing (doesn't interact)
$\eta \to 3\pi$
$\rho \to 2\pi$
$\omega \to 3\pi$ ($\to 2\pi$ is suppressed due to G parity)
$\Delta^{++} \to p + \pi^+ \implies L \geq 1$
$\Delta^+ \to p + \pi^0 \implies$ 3 times more probable
$\Delta^+ \to n + \pi^+$ Not as probable

3.2 Weak Interaction

Weak Interaction is the process responsible for turning protons into nuetrons or vice versa and is responsible for beta decay. The process is essentially changing quark flavor.
Can Λ^0 decay into anything?
$\Lambda \to n + \pi^0$ see Figure 1.

4 WIA

4.1 Quark Level Process

See Figure 2.

4.2 Leptonic Level Process

See Figure 3.

5 WIA in Sun

How does $p + p \to d$ in the sun? Underlying Process: $p + p \to d + e^+ + \nu_e$

6 K0 system

$\frac{1}{\sqrt{2}}|K^0 + \bar{K}^0 >$ is an eigenstate to $CP = +1$, this corresponds to "K short".
$\frac{1}{\sqrt{2}}|K^0 - \bar{K}^0 >$ is an eigenstate to $CP = -1$, this corresponds to "K long".
See Figure 5.

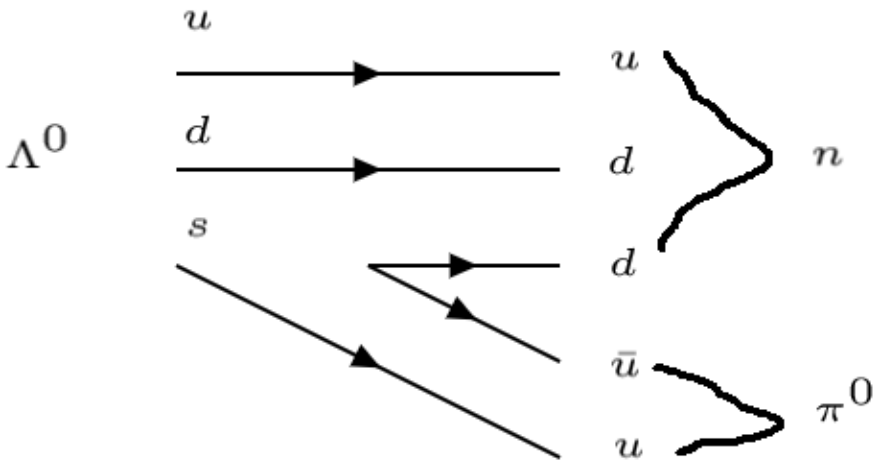

Figure 1: Λ^0 decay into $n + \pi^0$

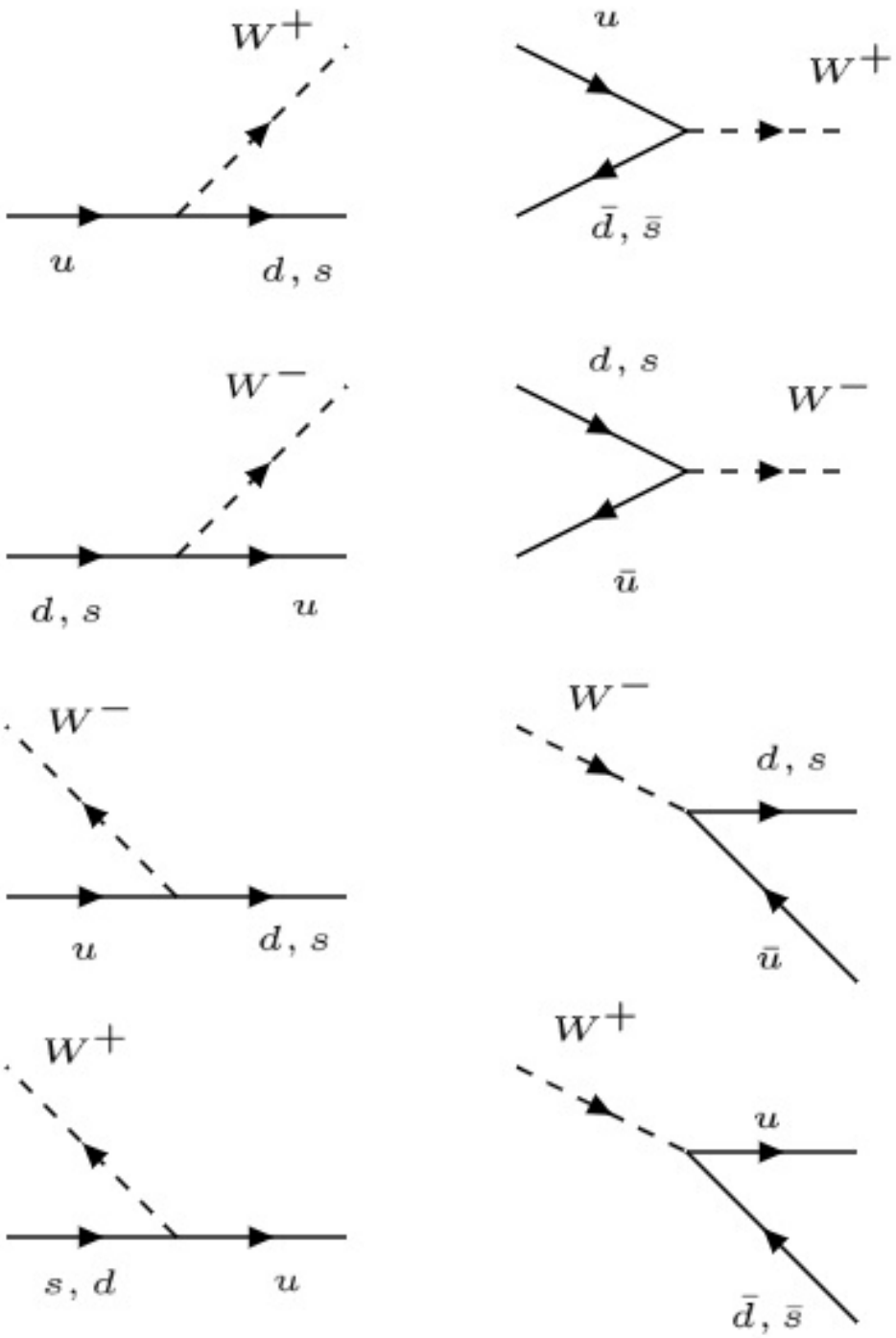

Figure 2: WIA Quark Level Processes

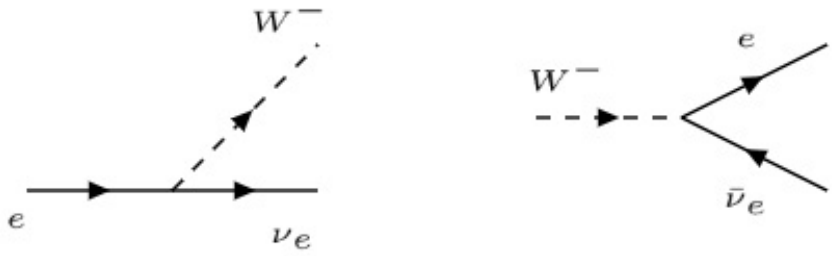

Figure 3: Lepton Level Processes

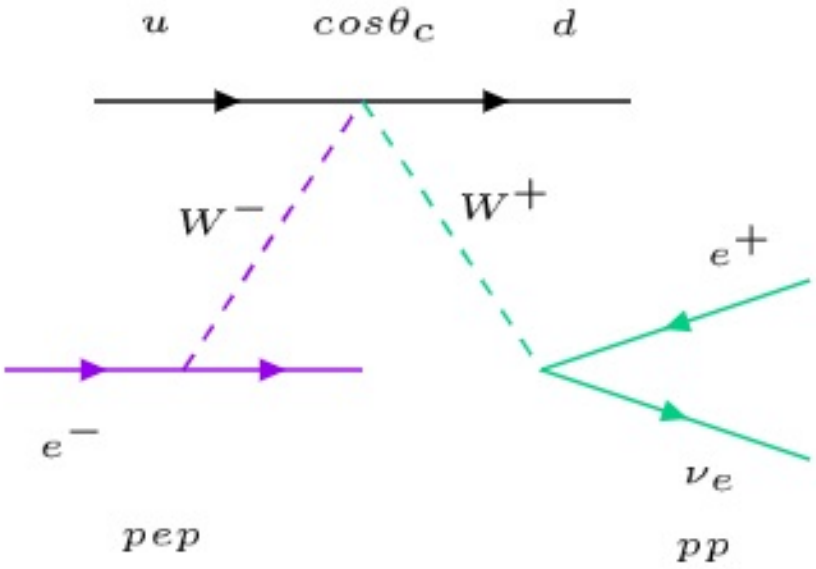

Figure 4: Underlying WIA for $p + p \rightarrow d$

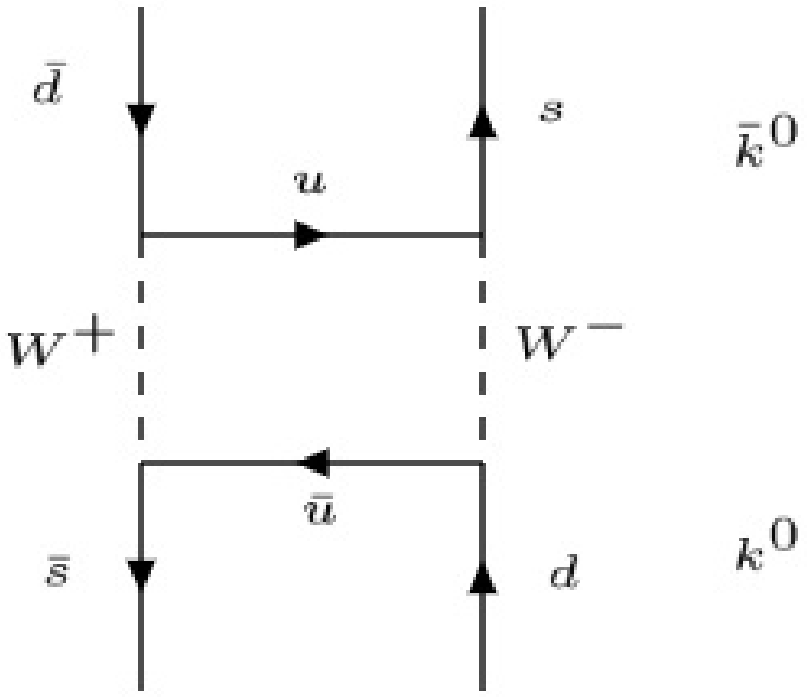

Figure 5: K^0 system