

PHY 493 HW 1

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1 a $\gamma \rightarrow e^- + \mu^+$

$Q: 0 \quad -1 \quad 1$ Conserved

$l_e: 0 \quad 1 \quad 0$ Broken

$l_\mu: 0 \quad 0 \quad -1$ Broken

b $W^+ \rightarrow t + b$

$Q: 1 \quad 2/3 \quad -1/3$ Broken

$B: 0 \quad 1/3 \quad 1/3$ Broken

c $Z^0 \rightarrow \mu^+ + \mu^-$

$Q: 0 \quad 1 \quad -1$ Conserved

$l_\mu: 0 \quad -1 \quad 1$ Conserved

d $t \rightarrow W^+ + b$

$Q: 2/3 \quad -1 \quad -1/3$ Broken

$B: 1/3 \quad 0 \quad 1/3$ Broken

e $\gamma \rightarrow \bar{c}^- + c^+$

$Q: 0 \quad -1 \quad 1$ Conserved

$l_c: 0 \quad 1 \quad -1$ Conserved

f $b \rightarrow c + e^-$

$Q: -1/3 \quad 2/3 \quad -1$ Conserved

$B: 1/3 \quad 1/3 \quad 0$ Broken

$l_e: 0 \quad 0 \quad 1$ Broken

2 a $\Omega^- \rightarrow \Xi^- + \pi^-$

$Q: -1 \quad -1 \quad -1$ broken

$B: 1 \quad 1 \quad 0$ conserved

b $\Sigma^+ \rightarrow \pi^+ + \pi^0$

$Q: 1 \quad 1 \quad 0$ conserved

$B: 1 \quad 0 \quad 0$ broken

c $\pi^0 \rightarrow \mu^+ + e^- + \bar{\nu}_e$

$Q: 0 \quad 1 \quad -1 \quad 0$ conserved

$B: 0 \quad 0 \quad 0 \quad 0$ conserved

$L_\mu: 0 \quad -1 \quad 0 \quad 0$ broken

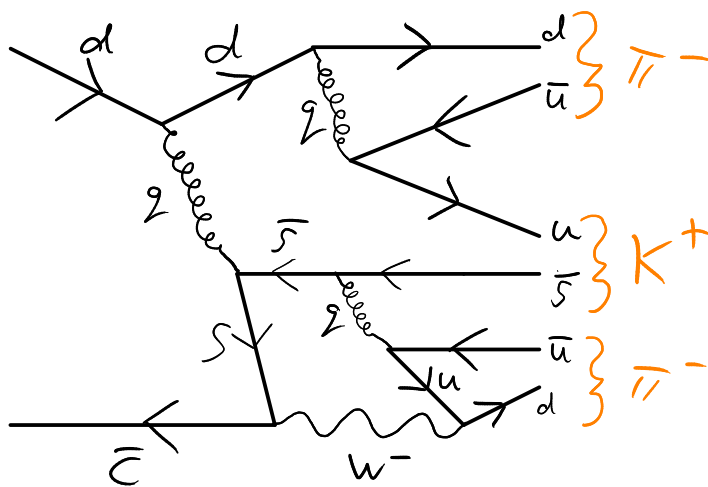
$L_e: 0 \quad 0 \quad 1 \quad -1$ conserved

d $D^- \rightarrow K^+ + \bar{\pi}^- + \pi^-$

$Q: -1 \quad 1 \quad -1 \quad -1$ conserved

$B: 0 \quad 0 \quad 0 \quad 0$ conserved

$\bar{c}d \quad u\bar{s} \quad d\bar{u} \quad d\bar{u}$

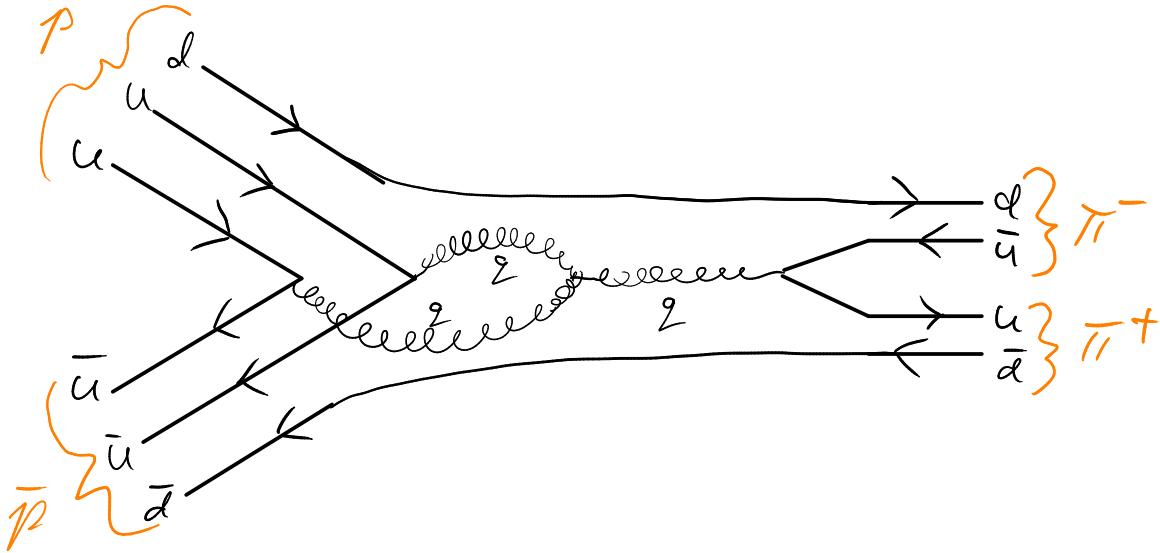


e $p + \bar{p} \rightarrow \pi^+ + \pi^-$

Q: 1 -1 1 -1 conserved

B: 1 -1 0 0 conserved

$u\bar{u}d \quad \bar{u}\bar{u}\bar{d} \quad u\bar{d} \quad d\bar{u}$



f $p \rightarrow e^+ + \gamma$

Q: 1 1 0 conserved

B: 1 0 0 broken

L_e : 0 -1 0 broken

3 $T = 10 \text{ MeV}, \quad Z_{Au} = 2, \quad Z_{Au} = 79, \quad \theta = \pi/4$
 $J = 10^5 \frac{\alpha}{s} \quad t = 0.1 \text{ cm}, \quad r = 100 \text{ cm}, \quad \rho_{Au} = 19.7 \text{ g/cm}^3.$

$$d\Omega = (\sin\theta) d\theta d\phi = \frac{1}{\sqrt{2}} \left(\frac{1 \text{ cm}}{r} \right)^2 = 7.07 \cdot 10^{-5}$$

$$\frac{d\sigma}{d\Omega} = \left(\frac{Z_{Au} Z_{Au} \alpha \hbar c}{4T \sin^2 \frac{\theta}{2}} \right)^2 = 1.50 \cdot 10^3 \text{ cm}^2$$

$$J' = J t \rho_{Au} \frac{N_A}{M_{Au}} \frac{d\sigma}{d\Omega} d\Omega = \boxed{0.64 \text{ } \alpha/s}$$