Master Sciences de la Matière **ENS Lyon**
Année 2013-2014

Travaux Dirigés de Physique des Particules

Some aspects of weak interactions
pion decay, heavy quark decay

The following quark contents will be useful:
pseudoscalars: $\pi^+ = (u\bar{d})$, $D^+ = (c\bar{d})$, $B^+ = (\bar{b}u)$,
vectors: $\rho^0 = (u\bar{u} + d\bar{d})/\sqrt{2}$, $K^{*0}(892) = (\bar{s}d)$
baryons: $p = (uud)$, $\Lambda_c^+ = (cud)$, $\Lambda_b^0 = (bud)$,

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Charmed-meson, bottom-meson, and bottom-baryon decays

1 / Draw the leading Feynman diagram for the following decays, and comment about the relative magnitude of the branching ratios

$$\begin{aligned} D^+ \to \rho^0 + e + \nu_e \quad &= \quad (2.2 \pm 0.4)\, 10^{-3} \ , \\ D^+ \to \rho^0 + \mu + \nu_\mu \quad &= \quad (2.5 \pm 0.5)\, 10^{-3} \ , \end{aligned}$$

2 / Same question for the two above decays and also

$$\begin{aligned} D^+ \to \overline{K}^{\star\, 0}(892) + e + \nu_e \quad &= \quad (3.7 \pm 0.2\, 10^{-2} \ , \\ D^+ \to \overline{K}^{\star\, 0}(892) + \mu + \nu_\mu \quad &= \quad (3.7 \pm 0.3)\, 10^{-2} \ , \end{aligned}$$

3 / Can you predict which of the decays occur most often:

$$\begin{aligned} \Lambda_b^0 \to \Lambda_c^+ + e + \bar{\nu}_e \ , \\ \Lambda_b^0 \to p + e + \bar{\nu}_e \ , \end{aligned}$$

4 / For this latter decay, compute the maximal possible energy for the proton in the Λ_b^0 rest frame, using the masses: 5,6 GeV, 1 GeV, 0,5 MeV et 0.