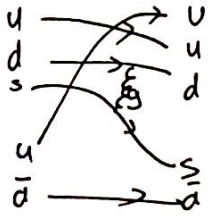
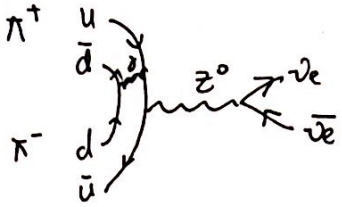
Revision Lecture Notes

- Neutrinos → interact weakly → pick dominant decay for Feynman Diagram
  - ↳ Always in terms of core particles
  - ↳ May cross lines (not preferred)
    - ↳ Strong, requires gluon

$\Lambda_0 + \pi^+ \rightarrow p + \bar{K}^0$





$M_p \simeq 940 MeV/c^2$
$M_\Lambda > M_p$
$M_e \simeq 0.5 MeV/c^2$

Strong: $10^{-22} - 10^{-24}$ s
EM: $10^{-16} - 10^{-21}$ s
Weak: $10^{-7} - 10^{-13}$ s → Depends on Q^5 flavour & available phase space

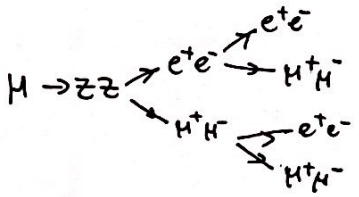
→ Same coding, set proportionally to 5^{th} power $\sim \left(\frac{\hbar c}{m_W}\right)^5$

- Gluons are self mediating, they carry colour charge and form $q\bar{q}$ so self-evident
  The LHC is essentially two gluons colliding at high velocity.

Kinematics

$\sigma_n \sim 20{,}000$ fb

$N = \sigma L$
- Events
- Cross Sectional Area
- Luminosity



→ 4 final branches, multiply out one length by 4. Probabilities add all.

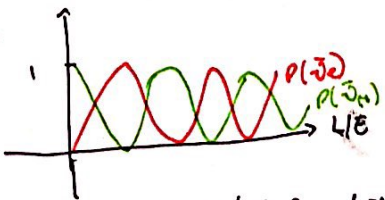
Pion Decay - Helicity

$\pi^+ \rightarrow l^+ + \nu_e$

$l = e, \mu$ → Lepton universality meant we expected the same rate, but π has axial, leptons must be produced back-to-back.
Only left handed neutrinos & charged leptons interact weakly and right handed antineutrinos and right handed anti'leptons interact weakly, so one type of decay is suppressed.
↳ Exceptions Once overtaken, helicity is swapped. Massless particles are difficult to overtake, electron is lighter than muon so is more suppressed as the helicity is more difficult to alter once set.

Neutrino oxillations

$P(\nu_\alpha \rightarrow \nu_\beta) \neq 0$



- Maximum ratio: $\frac{10^5}{10^8} = 10^{-3}$

→ Proportional to the ratios between them.

Bending Ratios: Colour preferred not to leave formations

$K^0 = d\bar{s}$

$\bar{E} = \beta\gamma mc^2$, $L = \beta\gamma c\tau$, $\beta = 1$

→ Energy in rest frame: $M_i = E_{p_1} + E_{p_2}$
Momentum: $p_{p_1} = -p_{p_2} = p$
Then consider individual energies.