WEAK CC interaction

$$\mathcal{L}_I^{CC} = -\frac{g}{2\sqrt{2}}\left(j_\alpha^{CC} + J_\alpha^{CC}\right) W^\alpha + h.c.$$

$$j_\alpha^{CC} = \sum_\ell \overline{\nu}_\ell \gamma_\alpha (1-\gamma_5)\,\ell = v_\alpha^{CC} - a_\alpha^{CC}$$

$$J_\alpha^{CC} = \overline{u}\gamma_\alpha (1-\gamma_5) d' + \ldots = V_\alpha^{CC} - A_\alpha^{CC}$$

with $d' = \sum_q |V_{uq}^{CKM}| q$

Elementary transition amplitude

$$\mathcal{M} = \frac{g^2}{8(M_W^2 + Q^2)} j_\alpha^{CC} J_{CC}^\alpha, \quad \frac{g^2}{8M_W^2} = \frac{G_F}{\sqrt{2}}$$

Nucleon current

$$\langle p'|V_\alpha^{CC}|p\rangle = \overline{u}(p')\left[\gamma_\alpha F_1^{CC} + \frac{i}{2m_N}\sigma_{\alpha\beta}q^\beta F_2^{CC}\right] u(p)$$

$$\langle p'|A_\alpha^{CC}|p\rangle = \overline{u}(p')\left[\gamma_\alpha\gamma_5 G_A + \frac{Q_\alpha}{2m_N}\gamma_5 F_P\right] u(p)$$

$G_F \simeq 1.166 \times 10^{-5}$ GeV^{-2}

$$\frac{G_F}{\sqrt{2}} \frac{4\pi\alpha}{Q^2} \simeq 10^{-4} \frac{Q^2}{\text{GeV}^2}$$