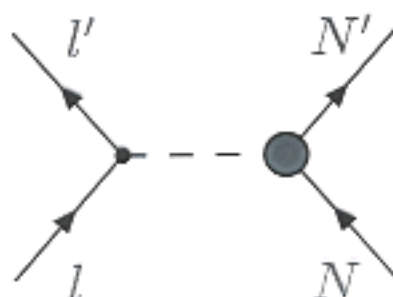


Elementary interactions and currents



For the EM interaction we have

$$\mathcal{L}_I^{em} = -e (j_\alpha^{em} + J_\alpha^{em}) A^\alpha,$$

$$j_\alpha^{em} = \sum_{\ell=e,\mu,\tau} (-1) \bar{\ell} \gamma_\alpha \ell, \quad J_\alpha^{em} = \sum_{q=u,d,\dots} e_q \bar{q} \gamma_\alpha q$$

Elementary transition amplitude

$$\mathcal{M} = -\frac{4\pi\alpha}{Q^2} j_\alpha^{em} J_\alpha^{em}$$

Nucleon current

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