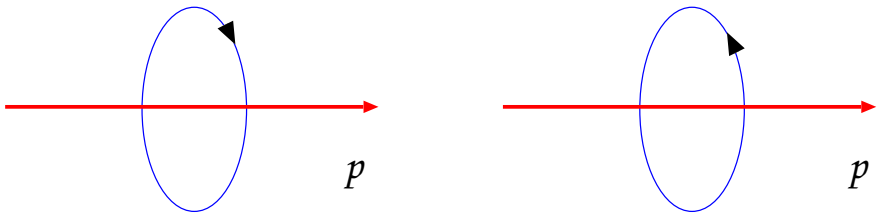
Chiral Symmetry

chiral quark fields:

$$\psi_R = \frac{1+\gamma_5}{2}\psi; \quad \psi_L = \frac{1-\gamma_5}{2}\psi$$



rechtshändig linkshändig

$$\mathcal{L}_{QCD} = i\bar{\psi}_L\gamma^\mu\partial_\mu\psi_L + i\bar{\psi}_R\gamma^\mu\partial_\mu\psi_R - m(\bar{\psi}_L\psi_R + \bar{\psi}_R\psi_L)$$

chiral $SU(2)_L \otimes SU(2)_L$ transf.

$$SU(2)_L: \quad \psi_L \to e^{i\alpha_k \frac{\tau_k}{2}}\psi_L \quad \psi_R \to \psi_R$$

$$SU(2)_R: \quad \psi_R \to e^{i\beta_k \frac{\tau_k}{2}}\psi_R \quad \psi_L \to \psi_L$$

$$Q_k^L = \int d^3r \psi_L^\dagger \frac{\tau_k}{2}\psi_L = \frac{1}{2}(Q_k^V - Q_k^A)$$

$$Q_k^R = \int d^3r \psi_R^\dagger \frac{\tau_k}{2}\psi_R = \frac{1}{2}(Q_k^V + Q_k^A)$$