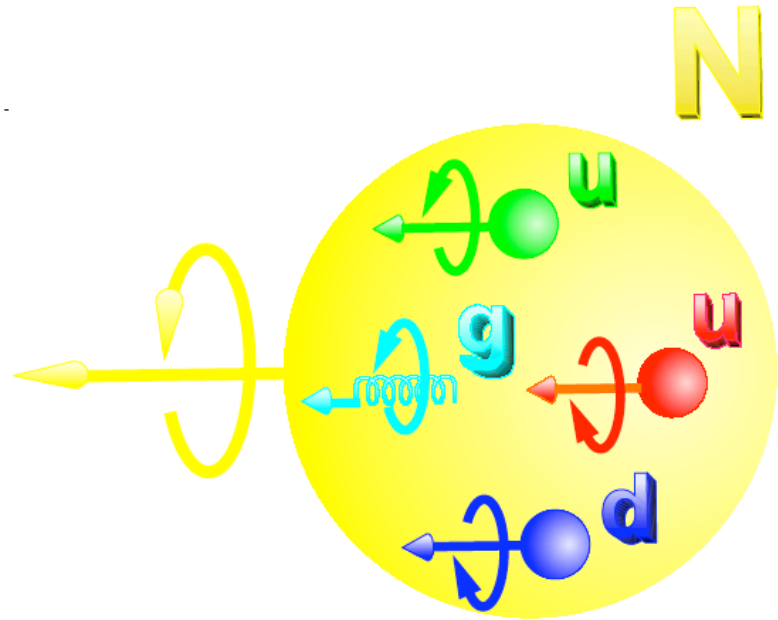
- Today : let's look at spin in QCD

The nucleon, a composite particle with spin



So, what carries the proton spin ?

$$\frac{1}{2} = \langle P, \frac{1}{2}| \, J_3 \, |p, \frac{1}{2}\rangle$$

$$J_i = -\frac{1}{2}\epsilon_{ijk} M^{jk} = \int d^3x \left[\vec{x} \times \vec{T}_{QCD}\right]_i$$

In QCD:

$$J_3 = \int d^3x \Big[\underbrace{\bar{\psi}\gamma^3\gamma_5\psi}_{\sim \text{ quark spin}} + \underbrace{\psi^\dagger \left(\vec{x} \times \left(-i\vec{\mathcal{D}}\right)\right)_3 \psi}_{\sim \text{ quark OAM}} + \underbrace{\left[\vec{x} \times \left(\vec{E}(\vec{x}) \times \vec{B}(\vec{x})\right)\right]_3}_{\sim \text{ total gluon ang. mom.}} \Big]$$

spin + OAM