

Measurement of Sivers quark distribution function with the Polarized Drell-Yan experiments

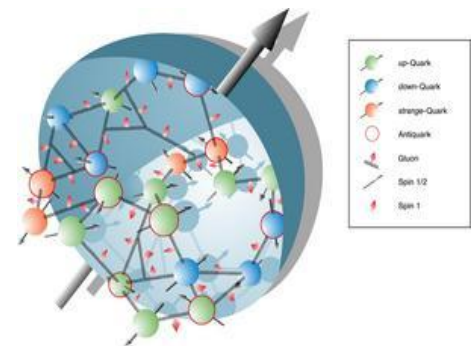
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Structure of proton spin

- Proton spin is $\frac{1}{2}$
- Proton spin was thought to be explained as the sum of the three quark spins
- Experimental results showed that quark spins contribute only 33% of proton spin
- The other elements are gluon spin, orbital angular momenta of gluons and quarks

$$\frac{1}{2} = \boxed{\frac{1}{2} \Delta\Sigma} + \boxed{\frac{1}{2} \Delta G} + \boxed{L_q} + \boxed{L_g}$$

Quark Spin = 33%
Gluon Spin
Orbital angular Momentum of quark
Orbital angular Momentum of gluon



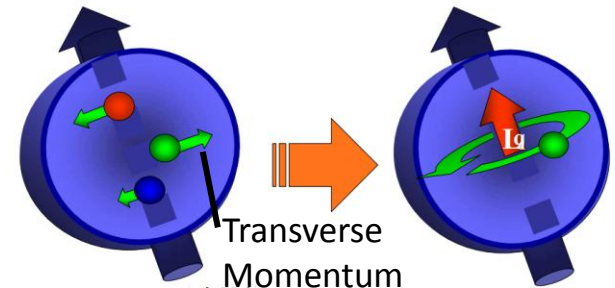
- Several experiments are being conducted for each element

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Sivers quark distribution function $f_{1T}^\perp(x, k_T^2)$

- Needs to be measured with Drell-yan process
- Shows correlation between the proton spin and quark transverse momentum
- Transverse momentum is related to quark orbital angular momentum



$$f_{1T}^\perp(x, k_T^2) \neq 0 \Leftrightarrow L_q \neq 0$$

Polarized Drell-Yan experiments

- A lepton pair is produced by quark annihilation in hadron-hadron scattering in Drell-Yan process
- Polarized proton beam and unpolarized proton target are used in E1027
- Unpolarized proton beam and polarized proton target are used in E1039

