

2. DENSITY MATRIX IN QCD PARTON MODEL

- A FREE SPIN $1/2$ PARTICLE :

$$S_{\text{free}} = \frac{1}{2} (\not{p} + m) (1 + \gamma_5 \not{S}') = \frac{1}{2} (\not{p} + m) (1 + \gamma_5 \not{S}'_{\parallel} + \gamma_5 \not{S}'_{\perp})$$

- EXTENSION TO QCD PARTON MODEL :

$$S_c = \frac{1}{2} (\not{p} + m_q) (q + \Delta q \gamma_5 \not{S}'_{\parallel} + \Delta_T q \gamma_5 \not{S}'_{\perp})$$

- QUARK AS ON-SHELL \Leftarrow E.O.M. $q = 0$

- SPIN OPERATOR IN PARTICLE REST FRAME

$$\Rightarrow S_q \neq S \Rightarrow \text{BOOST}$$

$$S'_{\parallel} = \lambda \left(\frac{P}{m_q} - \bar{\eta}_{\perp} \right) + O(\bar{\eta}_{\perp}^2)$$

$$S'_{\perp} = S_{\perp} + \bar{\lambda}_{\perp} \frac{P}{m_q} + O(\bar{\eta}_{\perp}^2)$$

$\lambda =$ NUCLEON HELICITY

$$\bar{\eta}_{\perp} = \frac{P_{\perp}}{p^+}$$

$$\bar{\lambda}_{\perp} = -\bar{\eta}_{\perp} \cdot S$$

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