Hyperon Polarization in h-h and h-A Collisions and Constituent Quark-Diquark Picture

Tsutomu Tashiro[a], Hujio Noda[b] and Shin-ichi Nakariki[a]

[a]*Department of Computer Simulation, Okayama University of Science, Okayama 700-0005, Japan*
[b]*Department of Mathematical Science, Ibaraki University, Mito 310-8512, Japan*

We discuss the polarization of inclusively produced hyperons in the framework of the constituent quark-diquark picture. It is well known that the leading hyperons produced in unpolarized proton-proton and proton-nucleus collisions are polarized transversely to the production plane[1]. For example, the leading particle Λ^0, with valence quarks in common with the incident proton, is polarized significantly with negative sign, while the $\overline{\Lambda}^0$ is not polarized in the proton fragmentation region. The spin of Λ^0 is measured with respect to the direction $\vec{n} = \vec{p}_{inc} \times \vec{p}_{out} / | \vec{p}_{inc} \times \vec{p}_{out} |$, where $\vec{p}_{inc}$ and $\vec{p}_{out}$ are momenta of the incident beam and the produced particle Λ^0, respectively. Recently the hyperon polarizations in unpolarized reactions are explained by relating them to left-right asymmetries in singly polarized reactions[2]. We assume that the valence diquark in the incident proton tends to pick up a spin down sea quark to form a baryon. Large probabilities $P_{[]}^{\downarrow}$ ($P_{\{\}}^{\downarrow}$) for the spin 0 (spin 1) valence diquarks to combine with a spin down sea quark, explain the polarizations of $\Lambda^0, \Sigma^+, \Xi^-$ in pp and $\Sigma^- p$ collisions qualitatively.

Polarization of Λ^0 produced in $K^- p$ collisions have also large values[3]. The process $qq'^{j_z}_{v} + q''^{\downarrow}_{sea} \to B^{j_z - 1/2}$ is related to the process $qq'^{j_z}_{sea} + q''^{\downarrow}_{v} \to B^{j_z - 1/2}$ by interchanging the roles of valence and sea quarks. Since the normal to the production plane of the baryon B from the valence $q''^{\downarrow}_{v}$ quark is opposite to the direction $\vec{n}$, this process should be read as $qq'^{j_z}_{sea} + q''^{\uparrow}_{v} \to Y^{j_z + 1/2}$. Therefore the above assumption is interpreted as that the spin up valence quark in the incident hadron is preferentially chosen as compared to the spin down valence quark by a sea diquark to form a baryon. The probabilities for the spin up valence quark to recombine with a sea spin 0 (spin 1) diquark are chosen to be equal to $P_{[]}^{\downarrow}$ ($P_{\{\}}^{\downarrow}$). Polarization of Λ^0 produced in K^- beam fragmentation regions are explained by choosing the large probabilities $P_{[]}^{\downarrow}$ and $P_{\{\}}^{\downarrow}$.

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[1] B. Lundberg et al., Phys. Rev. **D40**, 3557 (1989); A. Morelos et al., Phys. Rev. **D52**, 3777 (1995)
[2] Dong Hui, Liang Zuo-tang, Phys. Rev. **D70**, 014019 (2004)
[3] S.A. Gourlay et al., Phys. Rev. Lett. **56**, 2244 (1986)