DIS charged current $\Lambda_c^+/\overline{\Lambda}_c^+$ Production as a Probe of Δs and Δg

Kentarou MAWATARI[a], Toshiyuki MORII[b] and Kazutaka SUDOH[c]

[a] *Graduate School of Science and Technology, Kobe University*
Nada, Kobe 657-8501, JAPAN
[b] *Faculty of Human Development, Kobe University,*
Graduate School of Science and Technology, Kobe University
Nada, Kobe 657-8501, JAPAN
[c] *The Institute of Physical and Chemical Research (RIKEN)*
Hirosawa, Wako, Saitama 351-0198, JAPAN

To determine the polarized s-quark and gluon densities in the proton, we consider the semi-inclusive $\Lambda_c^+/\overline{\Lambda}_c^+$ leptoproduction in charged current DIS;

$$l^+ + \vec{p} \to \bar{\nu} + \vec{\Lambda}_c^+ + X, \quad l^- + \vec{p} \to \nu + \vec{\overline{\Lambda}}_c^+ + X,$$

where arrows attached to particles mean that these particles are polarized.

Since the Λ_c^+ baryon is composed of a heavy c-quark and anti-symmetrically combined light u- and d-quarks in the naive quark model, we can assume the polarization of Λ_c^+ baryon to be that of c-quark. In addition, the Λ_c^+ is dominantly produced by the fragmentation of c-quark which is originated through the t-channel W boson exchange. Therefore, we can expect that the measurement of the spin correlation between the incident proton and the produced $\Lambda_c^+/\overline{\Lambda}_c^+$ gives us information about the behavior of the polarized s-quark and gluon in the proton.

The leading order contribution ($W^+ s \to c$) to this process was studied by Sudoh[1]. In this work, we consider the W boson-gluon fusion process ($W^+ g \to c\bar{s}$) in the next-to-leading order QCD $\mathcal{O}(\alpha_s)$. The contribution of the fusion process is not so small but rather in the high energy region it becomes quite larger than that of the W boson absorption process ($W^+ s \to c$). We can select the contribution of each process effectively by choosing appropriate kinematical regions.

In this calculation, we use typical models of polarized parton distribution function (AAC[2] and GRSV[3] parametrization models) and for the polarized fragmentation function we take two different models; the naive quark model and the jet fragmentation model. We show that our study is very effective to test these model-dependence.

References

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