D Meson Production in Neutrino DIS as a Probe of Polarized Strange Quark Distribution

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In recent years, experimental data for heavy flavor (charm or bottom quark) production and decay are reported by some collaborations. Since the heavy quark mass scale is quite larger than Λ_{QCD}, it is considered that we can treat heavy quarks purely perturbatively. Heavy quarks are produced only at the short distance scale within the framework of a fixed flavor number scheme (FFNS), where only light quarks (*u*, *d*, and *s*) and gluons are considered as active partons, and heavy quarks (*c*, *b*, …) contribution is calculated in fixed order α_s perturbation theory.

The study of heavy flavor production in deep inelastic scattering (DIS) is one of the promising way to access the parton density in nucleon. As is well known, the polarized parton distribution (PDF) plays an important role in deep understandings of the spin structure of nucleon. However, knowledge about the polarized sea quark and gluon distribution remain still poor, and theoretical and experimental ambiguity are rather large. In order to understand the spin structure of nucleon, we need more information about the polarized sea quark and gluon distribution functions.

Charged current (CC) DIS is effective to extract the flavor decomposed polarized PDF's, since $W^{\pm}$ boson changes the flavor of parton. Since there is no initial heavy flavor component in the FFNS, we can identify an initial flavor of parton to study the heavy flavor production in CC DIS.

In this work, to extract the polarized PDF's we studied $D/\overline{D}$ production in CC DIS including $O(\alpha_s)$ corrections in neutrino and polarized proton collision, which might be observed in the forthcoming neutrino experiments. Dominant contribution comes from the following two subprocesses: (1) leading order contribution via *W* boson exchange $W^+ s \to c$ and (2) $O(\alpha_s)$ next-to-leading order contribution via boson-gluon fusion process $W^+ g \to c\bar{s}$. Though there are gluon radiation subprocesses $W^+ s \to cg$ at the same $O(\alpha_s)$ order, the contributions to cross section are not so large.

We have numerically calculated the spin-independent and –dependent cross sections and the spin correlation asymmetry for these processes. The observables strongly depend on the parameterization model of polarized PDF's, and the ambiguity mainly comes from the behavior of polarized strange quark distribution. Therefore, we can directly extract the polarized strange sea quark distribution, if the gluon distribution is determined with high accuracy in RHIC experiment. Also, it might be effective to test the parameterization model of the polarized PDF's.