Charmed Hadron Asymmetries in the Intrinsic Charm Coalescence Model *

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In leading-twist charm production, there is no connection between the spectator and participant partons. However, in higher-twist processes, the interaction between spectators and participants can be strong. These higher-twist processes, such as intrinsic charm, are usually suppressed by $\alpha_s^2(M_{c\overline{c}})/M_{c\overline{c}}^2$ relative to leading-twist production. However, if the transverse distance between the partons is small, they may interact during the time they are near each other, allowing the higher-twist processes to become dominant.

The intrinsic $c\overline{c}$ production cross section, $\sigma_{\rm ic}(hN) = P_{\rm ic}\sigma_{hp}^{\rm in}\mu^2/(4\widehat{m}_c^2)$, extracted from 200 GeV proton- and pion-induced interactions, is $\sigma_{\rm ic}(\pi^-N) \approx 0.5$ μb and $\sigma_{\rm ic}(pN) \approx 0.7$ μb [1]. The probability of finding a $c\overline{c}$ pair in the proton wavefunction was determined from a fit to the EMC charm structure function [2]. Then the total charm production cross section is the sum of leading-twist fusion and higher-twist intrinsic charm, $d\sigma(hN)/dx_F = d\sigma_{\rm lt}/dx_F + d\sigma_{\rm ic}/dx_F$.

There are two ways of producing D mesons from intrinsic $c\overline{c}$ pairs. The first is through standard fragmentation processes. The c quarks can also coalesce with projectile valence spectators to produce leading charmed mesons. Coalescence introduces flavor correlations between the projectile and the final-state hadrons. A critical test of flavor correlations in charm production is the asymmetry between leading and nonleading charm. For example, in $\pi^-(\overline{u}d)$ interactions, the $D^-(\overline{c}d)$ is leading since it has a valence quark in common with the projectile while the $D^+(c\overline{d})$ with no valence quark in common, is nonleading. This observed leading behavior suggests that hadronization at large x_F involves the coalescence of the charmed quarks with projectile spectator quarks.

Here we extended this model to other charmed hadrons. As expected, the asymmetries predicted by the intrinsic charm coalescence model are a strong function of x_F. We find that Λ_c production in the proton fragmentation region ($x_F < 0$ in π^-p collisions) is dominated by the coalescence of the intrinsic charm quark with the ud valence quarks of the proton. The production of $D_s/\overline{D}_s$ and, at $x_F > 0$, $\Lambda_c/\overline{\Lambda}_c$ by coalescence must occur within still higher Fock states such as $|n_V c\overline{c}d\overline{d}\rangle$ and $|n_V c\overline{c}s\overline{s}\rangle$. These states are normalized from a calculation of $\psi\psi$ production from $|n_V c\overline{c}c\overline{c}\rangle$ configurations which allows us to obtain the probability of additional light quark pairs in the Fock states by mass scaling. As more partons are included in the Fock state, the coalescence distributions soften and approach the standard fragmentation distributions. Thus we do not consider $\overline{\Lambda}_c$ production by coalescence at $x_F < 0$ since a minimal nine-parton Fock state is required. Therefore there is no asymmetry in the model for these cases.

[1] R. Vogt and S.J. Brodsky, Nucl. Phys. **B438** (1995) 261; R. Vogt and S.J. Brodsky, Phys. Lett. B349 (1995) 569; R. Vogt, Nucl. Phys. B446 (1995) 149.
[2] B.W. Harris, J. Smith, and R. Vogt, Nucl. Phys. **B461** (1996) 181.

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