A perturbative QCD approach to $\pi^- \; p \to D^- \; \Lambda_c^+$

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We will present results for the pion-induced exclusive process $\pi^- \; p \to D^- \; \Lambda_c^+$. This process is treated by means of a handbag-type mechanism (see Fig. 1).

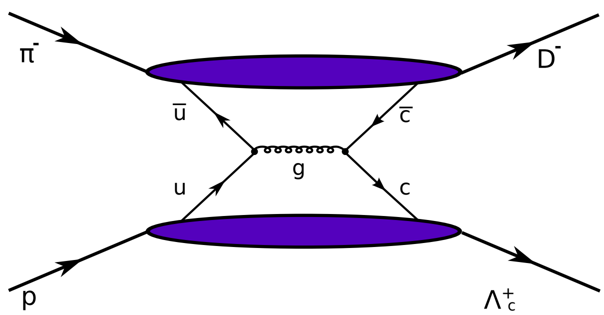

Figure 1: The double-handbag contribution to $\pi^- \; p \to D^- \; \Lambda_c^+$.

Taking the charm-quark mass as a hard scale, we argue that the process amplitude factorizes into one for the perturbatively calculable partonic subprocess $\bar{u} \, u \to \bar{c} \, c$ and hadronic matrix elements that can be parameterized in terms of generalized parton distributions (GPDs). As a next step, these GPDs for the $p \to \Lambda_c^+$ and the $\pi \to D^-$ transitions are modeled by overlaps of (valence-quark) light-cone wave functions for the hadrons involved. In this way we are able to make numerical predictions for unpolarized differential and integrated cross sections as well as spin observables. The approach works well away from the production threshold ($s - (M_{\Lambda_c^+} + M_{D^-})^2 \gtrsim 3 \text{ GeV}^2$) in the forward hemisphere and predicts unpolarized cross sections of the order of nb. This is a finding that could be of interest in view of plans to measure $\pi^- \; p \to D^- \; \Lambda_c^+$, e.g., at J-PARC or COMPASS.

We will also discuss other applications of our model for the $p \to \Lambda_c^+$ transition GPDs, like $\gamma \; p \to \bar{D}^0 \; \Lambda_c^+$ or $p \; \bar{p} \to \Lambda_c^+ \bar{\Lambda}_c^-$. Whereas our cross sections for all these exclusive charm-production processes are typically of the order of nb, other approaches based on QCD sum rules, exchange of Regge trajectories, or unreggeized hadron exchange, may lead to cross sections which are one to three orders of magnitude larger. This discrepancy could perhaps be explained by a sizable amount of intrinsic (non-perturbative) charm in the proton, which has been neglected in our approach and has also not yet been verified experimentally.