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Heavy-Quark Spin Symmetry Violation effects in Charmed Baryon Production

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In this work, we investigate an effective Lagrangian that describes the interactions between D mesons, charmed baryons (Y_c), and nucleons within the framework of Heavy-Quark Spin Symmetry (HQSS). Using the super-multiplet formalism, we systematically construct the three-point interaction terms. As a result, by considering the minimal sets of the effective Lagrangian in the HQSS construction, there are two effective Lagrangians that are invariant under HQSS whereas we find two minimum terms of the Lagrangian that violate the HQSS transformation. To reveal the phenomenological consequences of HQSS-breaking pattern, we compute the differential cross-sections for exclusive charmed baryon pair production in proton-antiproton collisions, $p\bar{p} \to Y_c \bar{Y}_c'$, with $Y_c, Y_c' \in \{\Lambda_c, \Sigma_c, \Sigma_c^*\}$. We demonstrate that the production rates of these channels can be used as a sensitive probe of the HQSS-violating dynamics. Our framework provides predictions for these observables, which are of crucial importance for the upcoming PANDA experiment at the Facility for Antiproton and Ion Research (FAIR).

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