Heavy Flavor Production in Polarized pp Collisions

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Due to the dominance of the gluon-gluon-fusion mechanism, heavy flavor production in polarized pp collisions is one of the most promising tools to extract the polarized gluon density Δg in the future. However, for a reliable determination of Δg the knowledge of the next-to-leading order QCD corrections is indispensable. We sketch the general outline of such a calculation[1], in particular the decomposition of the one-loop integrals into a set of scalar integrals, the phase space 'slicing' method used in the calculation of the 'real' corrections, and the subtleties due to the appearance of γ_5 in n dimensions. We discuss the behaviour of the total partonic gg cross section near threshold and at high energies. Furthermore, it is demonstrated that the dependence on unphysical factorization and renormalization scales, μ_f and μ_r, respectively, is largely reduced when going from the LO to the NLO of QCD. The unknown precise value of the heavy quark mass appears to be the major uncertainty in the calculation of heavy flavor cross sections. Theoretical estimates of heavy quark rates and spin asymmetries must include a simulation of the heavy quark decay into experimentally observed particles, usually muons, as well as the detector acceptance which can be rather limited. This can be achieved by taking the probability that a heavy quark in a given (p_T, η)-bin is actually detected from a Monte-Carlo generator, e.g., from `PYTHIA`. Finally, we present a general technique based on Mellin-moments[2] for implementing in a fast way, and without any approximations, higher-order calculations of partonic cross sections into global analyses of parton distribution functions. A case study for such an analysis is presented using a set of fictitious data for the transverse momentum distribution of "prompt" photons in polarized pp collisions.

[1] Work done in collaboration with I. Bojak.
[2] Work done in collaboration with W. Vogelsang; `hep-ph/0107064`.