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Modeling spin effects in electron-positron annihilation to hadrons

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We present a recursive quantum mechanical model for the polarized fragmentation process of a string stretched between a quark and an antiquark with entangled spin states. The quarks are assumed to be produced in the e^+e^- annihilation process and are described by a joint spin density matrix that implements the correlations between their spin states. The string fragmentation process is formulated at the amplitude level by using the splitting matrices of the recent string+$^3P_0$ model of polarized quark fragmentation, and accounts for the systematic propagation of the spin correlations in the fragmentation chain. The model is written as a recursive recipe suitable for a Monte Carlo implementation and it is applied to the production of two back-to-back hadrons in e^+e^- annihilation, showing analytically that it reproduces the expected azimuthal distribution of the hadrons. To obtain more quantitative predictions, the model is implemented in the Pythia 8 Monte Carlo event generator allowing for the first time to simulate the e^+e^- annihilation process to hadrons with quark spin effects and to study important observables such as the Collins asymmetries and the Artru-Collins asymmetries. The main simulation results as well as the comparison with the available e^+e^- data on the Collins asymmetries are presented.

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