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Inclusive and semi-inclusive production of spin-3/2 hadrons in e+e− annihilation

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We investigate the inclusive and semi-inclusive productions of spin-3/2 hadrons, such as Ω, in unpolarized e^+e^- annihilation. We derive a complete definition of quark transverse momentum dependent (TMD) fragmentation functions (FFs) to spin-3/2 hadrons for the first time from the decomposition of the quark-quark correlation matrix at leading twist, 14 of which are newly defined corresponding to rank-3 tensor polarized hadron. The collinear FFs are obtained by integrating over quark transverse momentum, and only two TMD FFs with rank-3 tensor polarization have nonvanishing collinear counter parts. Then we perform a leading order calculation of the unpolarized differential cross sections. In the single-hadron inclusive production, only two structure functions are found nonzero and none of the rank-3 tensor polarized FFs contributes. For the nearly back-to-back two-hadron production, half of the 48 structure functions are found nonzero even if the spin of the second hadron is not analyzed, and ten of the rank-3 tensor polarized TMD FFs contribute. Therefore, one can study the rank-3 tensor polarized FFs via the production of a spin-3/2 hadron and an unpolarized hadron in unpolarized e^+e^- collision experiments. These newly defined FFs can be further applied in semi-inclusive deep inelastic scattering processes for the study of nucleon structures.

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