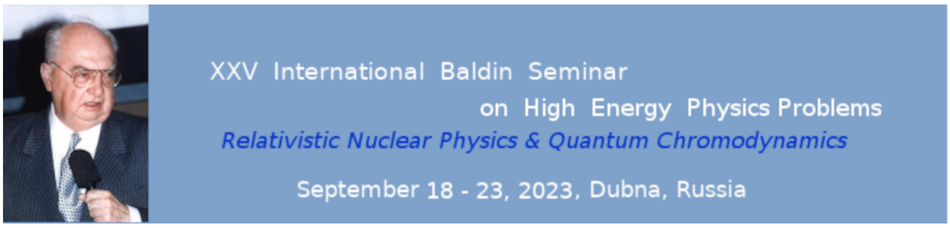

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Invariants for angular distributions in lepton pair production

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The study of the angular distribution of lepton pairs in hadronic collisions has allowed us to test the Drell-Yan mechanism[1, 2], as well as the interaction of vector W and Z bosons. However, rotationally invariant polarization expressions can provide more accurate measurements, improving the quality of comparisons between measurements and theoretical predictions [3, 4]. In all reference frames the angular coefficients are measured in the rest frame of the lepton pair. The angular distribution of the decay is determined by the choice of the polarization axis, i.e., by the choice of the direction of the ⊠-axis of the rest frame of the ⊠-boson. The reference frames differ only in the definition of the direction of the ⊠-axis. In the literature, the Collins-Soper reference frame is most often used. In this paper we analyze the dependences of the rotational invariants on the transverse momentum ⊠⊠ in the Collins-Soper [5], Gottfried-Jackson [6], ⊠–channel [7] reference frames. Leptons are produced in decays of ⊠ ⟶ ⊠–⊠+ gauge bosons born in proton-proton collisions in the Drell-Yan process. The measurement of lepton angular distributions allows us to study in detail the Drell-Yan process, in which a quark of one hadron and an antiquark of another hadron annihilate and, through the exchange of a ⊠-boson or virtual photon ⊠*, create a pair of oppositely charged leptons ⊠–⊠+.

To estimate the errors of the rotational invariants it is necessary to calculate their standard deviation ⊠ [8], for this purpose we used the characteristics of the coefficients ⊠, ⊠, ⊠, whose functions are the rotational invariants.

The calculations were performed on the basis of data from the E615 experiment on the scattering of ⊠–-mesons with energy 252 GeV on a fixed tungsten target. The result of checking the rotational invariants is their good agreement with the theory: the invariants are qualitatively closer than the coefficients of the angular distributions in different reference frames and lie within one standard deviation. We also analyze the rotational invariants with a zero coefficient ⊠, the result of which is the appearance of a scatter of values of the rotational invariants, i.e., we can conclude about the non-zero value of this coefficient.

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