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High Energy Physics - Phenomenology

Quark Wigner Distributions and Orbital Angular Momentum

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(Submitted on 1 Jun 2011)

We study the Wigner functions of the nucleon which provide multidimensional images of the quark distributions in phase space. These functions can be obtained through a Fourier transform in the transverse space of the generalized transverse-momentum dependent parton distributions. They depend on both the transverse position and the three-momentum of the quark relative to the nucleon, and therefore combine in a single picture all the information contained in the generalized parton distributions and the transverse-momentum dependent parton distributions. We focus the discussion on the distributions of unpolarized/longitudinally polarized quark in an unpolarized/longitudinally polarized nucleon. In this way, we can study the role of the orbital angular momentum of the quark in shaping the nucleon and its correlations with the quark and nucleon polarizations. The quark orbital angular momentum is also calculated from its phase-space average weighted with the Wigner distribution of unpolarized quarks in a longitudinally polarized nucleon. The corresponding results obtained within different light-cone quark models are compared with alternative definitions of the quark orbital angular momentum, as given in terms of generalized parton distributions and transverse-momentum dependent parton distributions.

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