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Light-front transverse momentum distributions for $J = 1/2$ hadronic systems in valence approximation

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The semi-inclusive correlator for a $J = 1/2$ bound-system, composed by A spin-$1/2$ fermions, is linearly expressed in terms of the light-front Poincare' covariant spin-dependent spectral function, in valence approximation. The light-front spin-dependent spectral function is fully determined by six scalar functions that allow for a complete description of the six T-even transverse-momentum distributions, suitable for a detailed investigation of the dynamics inside the bound system. The application of the developed formalism to a case with a sophisticated dynamical content, like ^{3}He, reaches two goals: (i) to illustrate a prototype of an investigation path for gathering a rich wealth of information on the dynamics and also finding valuable constraints to be exploited from the phenomenological standpoint; (ii) to support for the three-nucleon system a dedicated experimental effort for obtaining a detailed 3D picture in momentum space. In particular, the orbital-angular momentum decomposition of the bound state can be studied through the assessment of relations among the transverse-momentum distributions, as well as the relevance of the relativistic effect generated by the implementation of macrocausality. A fresh evaluation of the longitudinal and transverse polarizations of the neutron and proton is also provided, confirming essentially the values used in the standard procedure for extracting the neutron structure functions from both deep- inelastic scattering and semi-inclusive reactions, in the same kinematical regime.

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