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Minkowskian three-body model of the proton and Ioffe-time imaging

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Understanding the structure and dynamics of the proton constitute one of the most important challenges in hadron physics. From the theoretical point of view, one of the challenges is to extract from Lattice QCD calculations, performed in Euclidean space, Minkowskian quantities such as the proton parton distribution function. Due to the inherent difficulties associated with the mapping of Euclidean quantities to the corresponding Minkowskian ones, it is advantageous to have a solution defined directly in Minkowski space for calculations of dynamical observables such as momentum distributions.

In this contribution we present results for the proton calculated using a simple but dynamical model defined in Minkowski space [1]. Our starting point is the Bethe-Salpeter-Faddeev equation for a system of three spinless bosons interacting through a contact interaction. Recently, the solution to this equation was studied in great detail by us in the papers [2, 3, 4]. In this work, the equation is solved in the valence approximation and the parameters of the model are set by comparing the calculated Dirac form factor with experimental data. The single- and double parton distributions of the proton are then computed. The proton image on the null plane in the space given by the transverse coordinates and the Ioffe times \tilde{x}_{1,2} is also studied, by performing numerically the Fourier transformation of the distribution amplitude.

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