Contribution ID: **245** Type: **Poster contribution**

Structure and dynamics of the proton using light-front dynamics

Understanding the structure and dynamics of the proton constitute an important remaining challenges in hadron physics. From the theory side, one of the challenges is to extract from Lattice QCD calculations, performed in Euclidean space, Minkowskian quantities such as the proton parton distribution function. It is difficult to do the inversion of Euclidean quantities back to the corresponding Minkowskian ones, and thus important to have a solution defined directly in Minkowski space for calculations of dynamical observables such as momentum distributions.

We present results for the proton calculated using a simple although dynamical model defined in Minkowski space [1]. Our starting point is the Bethe-Salpeter-Faddeev equation for a system of three spin-less bosons interacting through a contact interaction. Recently, the general properties of the solution to this equation was studied in great detail in the papers [2, 3, 4]. In the present work, the equation is solved in the valence approximation (i.e. only the first Fock component is kept) 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 in coordinate space in terms of 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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Track Classification: Structure of hadrons