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Pion calculation observables with the Minkowski space pion model

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The pion structure in Minkowski space is described in terms of an analytic model of the Bethe–Salpeter amplitude combined with Euclidean Lattice QCD results.
The model is physically motivated to take into account the running quark mass, which is fitted to Lattice QCD data. In the present work, we extend the an previus work, with the present model utilized to calculated the pion observables, in order to test the parameters dependence and the consequences for the pion observables, and, see the limits of the model presented in terms of the initial parameters. The model is build in order to fit quark propagator in the space-like region, from the lattice calculations with the Landau gauge, that choice preserve the Lorentz invariance of the QCD. The Lattice calculation utilized here, have two degenerate light quarks, u and d, and, also the heavy s quark. The pion pseudoscalar vertex is associated to the quark mass function, as dictated by dynamical chiral symmetry breaking requirements in the limit of vanishing current quark mass. The quark propagator is analyzed in terms of a spectral representation, and it shows a violation of the positivity constraints. The pion Bethe–Salpeter amplitude is also built in terms of a integral representation. The pion space-like electromagnetic form factor is calculated with a quark electromagnetic current, which satisfies the Ward–Takahashi identity to ensure current conservation. The results for the form factor and weak decay constant are found to be consistent with the experimental data.

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