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Exploring the Dyson-Schwinger equation in Minkowski space

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In recent years, many efforts have been developed to formulate and solve the Bethe-Salpeter and Dyson-Schwinger equations (DSE) directly in Minkowski space, in contrast to the usual procedure of formulation in the Euclidean space and subsequent extension to Minkowski space, which is the approach used in lattice gauge theories. In this work, the fermion self-energy is calculated from the rainbow-ladder truncation of the DSE in quantum electrodynamics (QED) for timelike and spacelike momenta using the Nakanishi integral representation of the fermion propagator. These solutions are in very good agreement with the ones obtained in the Euclidean space in different gauges. We show that this very simple model offers the possibility of the exploration of many different physical problems, such as the chiral symmetry breaking region and could provide a phenomenological model for the pion and its momentum distributions.

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