



Contribution ID: 20

Type: not specified

CANCELLED: Excited states from the Bethe-Salpeter equation in Minkowski space

We compute for first time the spectrum of the Bethe-Salpeter equation, for a system composed of two bosons exchanging a massive scalar. The ladder approximation for the kernel is used. This study is performed directly in the Minkowski space by using the Nakanishi representation of the Bethe-Salpeter amplitude and the projection onto the null plane or light-front projection. The eigenvalues, momentum space light-front wave function, transverse momentum amplitudes and 3D structure of impact parameter space wave function are computed for the first excited state. The latter is an important dynamical ingredient for evaluating parton transverse-momentum distributions, which depend upon both the Bjorken momentum fraction and the transverse components of parton momentum, or parton density distributions in impact parameter space. Also, a comparison of the eigenvalues and transverse-momentum distributions with the Euclidean space show a great agreement within our numerical the accuracy. The results show the reliability of our method, allowing to extend it to real systems, composed by fermions and kernels beyond of the the ladder one, which are topics in current research in hadron physics.

Summary

We provide a new approach to obtain solutions of the Bethe-Salpeter equation in Minkowski space. This relativistic equation allows to study bound states in nuclear and hadron physics where relativistic effects are large and the full relativistic description is required. As a natural extension of the previous calculation where the ground state was studied, here we show results for the excited states. Finally, perspectives of this approach are also presented.

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Session Classification: Section B

Track Classification: Section B: Light Quarks