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Towards TMDs with contour deformations

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Hadrons are strongly interacting particles composed of quarks and gluons and described by Quantum Chromodynamics (QCD). Their internal structure can be described in terms of structure functions that encode, for example, the momentum and spin distributions of their constituents. Parton distribution functions (PDFs) and Transverse Momentum Distributions (TMDs), for example, describe the quark and gluon momentum distributions inside a hadron. These distribution functions are, however, not easy to calculate, because they are defined on the light front, whereas most hadron calculations are performed in a Euclidean metric. The main problem is then to go from Euclidean onto the light front.

We are developing a new method to compute the parton distributions (TMDs and PDFs) from hadronic matrix elements needed contour deformations, which we illustrate for a simple system of two interacting scalar particles of equal mass, using an handbag approximation to the matrix element, that includes the two-body Bethe-Salpeter amplitude as input (calculated from its Bethe-Salpeter Equation). Afterwards, the projection onto the light front is done through a combination of contour deformations and analytic continuation methods. We then explore ways of extending the handbag approximation by adding "quark-quark" interactions via the introduction of the four-point function in the diagram, which, in turn, is calculated self-consistently, from its own scattering equation.

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