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The Correlated Spatial Structure of the Proton: Two-body densities as a framework for dynamical imaging

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The Fourier transforms of generalized parton distributions (GPDs) give single-particle spatial densities of the quarks and gluons inside the proton. The average radius of each partonic component of the nucleon as well as the charge and matter densities of the nucleons are among physical quantities to which GPDs provide insight. However, to obtain a fuller dynamical picture of the proton's internal structure, information on the relative positions between partons is crucial. Such information is not directly contained in the single-particle densities, but we propose that two-particle densities can capture such correlations between the quarks and gluons in the transverse plane. Connecting the two-body densities to the observables for exclusive experiments, we show that two-particle densities can be defined in QCD with generalized double parton distributions (GDPDs).

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