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Tomography and gravitational radii for hadrons by three-dimensional structure functions

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Tomography and gravitational radii for hadrons by three-dimensional structure functions
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Hadron tomography can be investigated by three-dimensional structure functions such as generalized parton distributions (GPDs), transverse-momentum-dependent parton distribution (TMDs), and generalized distribution amplitudes (GDAs). The GPDs and GDAs contain information on spacelike and timelike transverse form factors of the energy-momentum tensor, so that they probe gravitational-interaction radii of hadrons [1]. Although charge radii of the nucleons are determined, mass radii have not been measured for any hadrons.

Here, we extract the GDAs, which are s-t crossed quantities of the GPDs, from cross-section measurements of hadron-pair production process gamma+gamma^* to h+hbar [1]. The GDAs are expressed by a number of parameters and they are determined from pion-pair production data of KEKB. We discuss the dependence on parton-momentum fraction z in the GDAs and also time-like form factor of the energy-momentum tensor [1]. Our studies should be valuable for probing three-dimensional structure of hadrons, especially for applications to exotic hadron candidates which cannot be used as fixed targets for GPD and TMD measurements [2]. In addition, the results indicate the gravitational-interaction radius for the pion [1]. The GDA studies are also possible by the two-photon process into a hadron pair by ultra-peripheral collisions at LHC and RHIC. In future, there is a possibility to investigate the GPDs at J-PARC for nucleon tomography [3].

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