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Gravitational form factors on the lattice

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Hadronic matrix elements of the QCD energy-momentum tensor can be parametrized in terms of gravitational form factors (GFFs) which, through their dependence on momentum transfer and decomposition into quark and glue contributions, encode information about the distributions of energy, angular momentum, pressure, and shear forces within a hadron spatially and amongst its constituents. GFFs can be constrained indirectly by experiments through their relation with generalized parton distributions, but they are directly and straightforwardly accessible to lattice calculations. We present the results of a recent lattice calculation at unphysically heavy pion masses of the gluonic contributions to the GFFs (and various densities derived from them) of the rho meson and delta baryon, which are as yet unconstrained by experiment, extending previous studies of the gluon GFFs of the pion and nucleon. We discuss further progress in an ongoing program of lattice calculations to determine the GFFs of the physical proton with full control over uncertainties, including both quark and glue contributions, providing access to the physical energy, spin, pressure, and shear force densities.

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