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Gravitational form factor, transverse spin sum rule and longitudinal momentum density in the transverse plane in a light front quark-diquark model of nucleons

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In lightcone framework, longitudinal angular momentum operator is kinematical but the transverse angular momentum operator is dynamical and thus
understanding the transverse spin and transverse angular momentum of the proton is more complicated than longitudinal spin and angular momentum and frame dependent.
Here, we evaluate the gravitational form factors for a transversely polarized proton from the energy momentum tensor and evaluate the Pauli-Lubanski operator to verify a sum rule for the transverse spin in a light front scalar quark-diquark model with the light front wave functions constructed from a soft-wall AdS/QCD model.
Further, the Fourier transform of the gravitational form factor $A(Q^2)$ in the impact parameter space gives the longitudinal momentum density in the transverse impact parameter space.
The longitudinal momentum densities in the transverse impact parameter space are discussed for both unpolarized and transversely polarized nucleons in the quark-diquark model. For the unpolarized nucleon, the distribution is axially symmetric whereas for the transversely polarized nucleon the distribution becomes distorted and our analysis shows that the distortion is dipolar in nature.

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