Equivalence Principle and Partition of Angular Momenta in the Nucleon

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The partition of nucleon spin between total angular momenta of quarks and gluons Is controlled by the gravitational formfactors related to the moments of Generalized Parton Distributions.

The Ji sum rules resulting from the conservation laws correspond to the new manifestation of equivalence principle, complementary to the most well-known one, being the equality the inertial and gravitational masses. This Post-Newtonian manifestation, appearing wnen spin-gravity interaction is considered. Ieads to the nullification of gravitational analog of anomalous magnetic moment and is not yet tested experimentally. The possible experiments with storage rings and cold neutrons are suggested and discussed. The relevance of gravitational formfactors are for the search of extra-dimensional gravity in diffraction at LHC is stressed.

The validity of equivalence principle separately for quarks and gluons is conjectured, resulting in Exact Equipartition of momenta nad total angular momanta, which is violated in perturbative QCD but may be restored beyond the perturbation theory. The new arguments in favor of this conjecture based on the QCD sum rules calculations for vector mesons are presented.

The relation between orbital and spin angular momenta resulting from relocalization (Belinfante) invariance are considered. It is shown that this invariance provides the unique way of derivation of angular momentum sum rules. The transverse spin sum rule involves, generally speaking, only chiral-even operators, while Bakker-Leader-Trueman sum rule implies model relations between chiral-even and chiral-odd structures.. The relocalization invariance imples also the absence iof massless pole in the matrix elements of singlet axial current in the chiral limit, manifesting another relation of nucleon spin structure and nonperturbative QCD