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Towards solving the proton spin puzzle (12'+3')

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The fact that the spins of the quarks in the proton, as measured in deep inelastic lepton scattering, only add up to about 30% of the spin of the proton is still not understood after 30 years. We show that our newly developed model for the quark and gluon momentum distributions in the proton, based on quantum fluctuations of the proton into baryon-meson pairs convoluted with Gaussian momentum distributions of partons in hadrons, can essentially reproduce the data on the proton spin structure function $g_1(x)$ and the associated spin asymmetry. A further improved description of the data is achieved by also including the relativistic correction of the Melosh transformation to the light-front formalism used in deep inelastic scattering. However, this does not fully resolve the spin puzzle, including also the neutron spin structure and the spin sum rules. These aspects can also be accounted for by our few-parameter model if the conventional SU(6) flavor-spin symmetry is broken, giving new information on the non-perturbative bound-state nucleon.

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