Spin Structure of the Proton in Correlated Quark Model

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We describe the spin of the proton as arising from the orbital momentum of quark and gluon condensate circulating around valence quarks. Considerations are performed in the frame of proposed by the author StronglyCorrelated Quark Model **(**SCQM**)**. The model leads to the representation of constituent quarks as solitons. Quarks inside hadrons can be described by "breather" mode solution of sine-Gordon equation for scalar field: the quark and antiquark in mesons and three valence quarks in nucleons oscillate around the origin in correlated motion. Derived interquark potential explicitly demonstrates that relativistic (current) valence quark configurations are located at the origin of oscillation and nonrelativistic constituent quarks are at maximal distances, correspondingly. In intermediate region there is a transition from current to constituent quarks with constituent mass generation. This transition is an explicit manifestation of chiral symmetry breaking.

Inclusion of spin brings to spinning quarks – solitons or extended vortex representation of constituent quarks. It is shown that the dominating contribution to proton spin comes from orbital angular momentum of gluons and sea quark – antiquark pairs circulating around the oscillating valence quarks. We assume that the spin of constituent quark is entirely analogous to the angular momentum carried by the classical circularly polarized wave:

$$\mathbf{s}_Q = \mathbf{J}_Q = \mathbf{J}_g = \int_a^\infty d^3 r \left[\mathbf{r} \times (\mathbf{E} \times \mathbf{B})\right],$$

were **E** is chromoelectric and **B** is chromomagnetic fields around the valence quark. Circulating around the valence quark the flow of gluons and sea quark – antiquark pairs is associated with the hadronic matter current. In this model the sea quarks are not polarized. So there is no room for polarized strange quarks in proton in our approach. Our model gives an alternative solution of spin crisis. We analyze the known polarization phenomena in the framework of our approach.