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THE ROLE OF QUARKS IN FORMATION OF NUCLEAR STRUCTURE: SUPER-HEAVY NUCLEI

We propose a quark model of nuclear structure where quark correlations lead to nucleon-nucleon correlations and arrangement of them into lattice–like structure. The model is based on the quark model of nucleon structure in which valence quarks are strongly correlated within a nucleon (SCQM) [1]. Nuclei are built by junctions of SU(3) color fields of two quarks of neighboring nucleons. Application of the model to larger collections of nucleons reveals the emergence of the face-centered cubic (FCC) symmetry at a nuclear level where nucleons are arranged in alternating spin–isospin layers [2]. The model of nuclear structure becomes isomorphic to the shell model and, moreover, composes the features of the liquid drop and cluster models. In difference with the shell model, protons and neutrons in our model are strongly correlated. Binding of nucleons in bound nuclei are provided by quark loops which result in three and four nucleon correlations [3]. It turns out that building blocks of the nuclear structure are three-nucleon (triton and 3He) and four-nucleon (4He) like configurations which form inside nuclei virtual triton/3He and 4He clusters. These configurations are responsible for pairing effect and symmetry energy. We demonstrate applicability of the model constructing nuclei starting from heavy (near Pb) through super-heavy ones up to Z=126. The model used to calculate the deformation parameter of nuclei, to estimate the optimal value of neutron to proton ratio in super-heavy nuclei. We analyze magic numbers for heavy and super-heavy nuclei and possibility of the "island of stability" .

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Section

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