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FROM QUARK AND NUCLEON CORRELATIONS TO NUCEAR DRIP LINE

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We propose a quark model of nuclear structure, where quark correlations lead to nucleon–nucleon correlaions and arrangement of them into lattice–like structure.
The model is based on the quark model of nucleon structure, Strongly Correlated Quark Model (SCQM), in which valence quarks
are strongly correlated within a nucleon. Nuclei are constructed due to junctions of SU(3) color fields of quarks of neighbor nucleons [1]. At any junction two quarks should be of different color (r,g,b), different flavor (u,d), and have parallel spins.
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. Binding of nucleons in stable nuclei are provided by quark loops which form three and four nucleon
correlations. On a quark level the nuclear shell closures correspond to the octahedral or truncated tetrahedral symmetry. Thus all nuclei even with closed shells are non-spherically symmetric. The quark loop that can be identified with three nucleon force results in a pairing” effect andhalo” nuclei. And namely quark loops leading to four-nucleon correlations are responsible for the binding energy enhancement in even-even nuclei which are formed by virtual alpha-clusters. Closure of a subsequent shells (\emph{p-, d-, f-, …}) rearranges the previous shells
(\emph{s-, p-, d-, f-, …}) in such a way, that nucleons of the previous shell become the common ones for neighbour virtual alpha-clusters. At the same time, the common nucleons become binding between pairs of virtual alpha-clusters [3]. According to the model For medium and heavy nuclei the arrangement of nucleons is modified by Coulomb repulsion of protons. This effect together with quark/nucleon correlations leads to deviation from the shell model expectations. The model can predict the boundary of the maximal numbers of proton and neutron excess, i.e. proton and neutron drip lines.

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