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Short Range Correlations in Nuclei and Their Implications for the Structure of Dense Nuclear Matter[1]

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Novel processes probing the decay of nucleus after removal of a nucleon with momentum larger than Fermi momentum by hard probes finally proved unambiguous evidence for long sought presence of short-range correlations (SRCs) in nuclei. Analysis of these processes in combination with the analysis of the scaling properties of the ratios of the cross sections of large Q^2, A(e,e')X processes at $x > 1$ allows us to conclude that (i) practically all nucleons with momenta ≥ 300 MeV/c belong to SRCs, consisting mostly of two nucleons, ii) probability of such SRCs in medium and heavy nuclei is $\sim 25\%$, iii) a fast removal of such nucleon practically always leads to emission of correlated nucleon with approximately opposite momentum, iv) proton removal from two-nucleon SRCs in 90% of cases is accompanied by a removal of a neutron and only in 10% by a removal of another proton. We explain that observed absolute probabilities and the isospin structure of two nucleon SRCs confirm the important role that tensor forces play in internucleon interactions. We find also that the presence of SRCs requires modifications of the Landau Fermi liquid approach to highly asymmetric nuclear matter and leads to a significantly faster cooling of cold neutron stars with neutrino cooling operational even for $N_p/N_n \leq 0.1$. We also outline directions for future theoretical and experimental studies of the nucleonic and quark-gluon structure of two and three nucleon SRCs at high energy electron and hadron facilities.

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