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Extended Brueckner-Hartree-Fock theory and role of pions in nuclei

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We present an extended Brueckner-Hartree-Fock (EBHF) theory for understanding the nuclear structure as a consequence of bare interaction among the constituent particles in medium and heavy nuclear system. The nuclear force is characterized by the strong tensor force induced by pion exchange interaction. To handle the strong tensor force based on the single-particle picture, the Hartree-Fock variational model space is extended to include 2-particle 2-hole (2p-2h) states with all possible configurations, which are able to describe the high momentum components originating from pseudo-scalar nature of pion. We take a variational principle of the total energy in this extended model space. We obtain an equation for the single-particle states in the Fermi sea with inclusion of an effect of the pion exchange and short-ranged repulsive interaction. We elucidate the nature of the EBHF theory by comparing with the Brueckner-Hartree-Fock (BHF) theory and the Feshbach projection operator method. This framework has a similar structure with the EBH theory except for including the concept of the energy of the total system. The Feshbach projection operator method is entirely agree with our framework when the P-space projection corresponds to the Hartree-Fock states and the Q-space projection corresponds to the 2p-2h states.

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