New generation of relativistic approach for nuclear structure

Jie Meng
School of Physics, Peking University

During the last decades, the covariant density functional theory (CDFT) in Hartree level with either meson exchange or point coupling version including both density-dependent and nonlinear couplings allows a very successful description of nuclear ground state as well as excited state properties all over the nuclear chart.

The CDFT in Hartree-Fock level with density-dependent σ, ω, ρ and π meson-nucleon couplings provides not only an equally good description for nuclear properties but also better understanding for the nucleon effective mass and its isospin and energy dependence in nuclear matter. Based on the density-dependent relativistic Hartree-Fock (RHF) approach, a fully self-consistent charge-exchange RPA has been established and the Gamow-Teller excitation energies and their strengths can be reproduced while maintaining g' =1/3 in the contact counter-term.

With the success of CDFT in both Hartree and Hartree-Fock level and the *ab initio* calculation for infinite nuclear matter, it is feasible to calculate the finite nuclei with *ab initio* method in CDFT framework. The *ab initio* calculation for finite nuclei has been realized with the full Relativistic Brueckner-Hartree-Fock (RBHF) theory through the Harmonics Oscillator (HO) basis expansion method. With the G-matrix of Brueckner theory for Bonn A, the RHF equation has been solved in HO basis. The *ab initio* description of finite nuclei in CDFT has been realized and good description for doubly magic nuclei including ^{14}C, ^{16}O, ^{40,48}Ca and ^{56}Ni has been achieved.