Regularization and renormalization in nuclear matter with zero-range effective interactions.

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Résumé

The binding energy per nucleon for nuclear matter at beyond the mean-field level approximation is derived with zero-range effective interactions. Due to the zero-range character, momentum integrals diverge and regularization schemes, such as momentum cutoff and dimensional regularization DR, are employed. Moreover, the renormalization of infinities is performed through a fitting procedure to absorb the divergence, in the case of finite-cutoff, and through a minimal-subtraction scheme (MS) in DR. First, we analyze this problem with the simplified "t0 – t3 " Skyrme model consisting of a Dirac delta function that gives rise to an ultraviolet divergence. We have found that for every physical value of the cutoff it is possible to refit the interaction parameters so that the "Skp[35]" mean-field equation of state is recovered. After that, we extend our work to the case of the Skyrme full interaction, consisting of a Dirac delta function plus the derivative squared. We show that, for every value of the cutoff, a unique set of refitted parameters is obtained so that the equation of states for both symmetric and nuclear matter, with different neutron-proton asymmetry, are reproduced.

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