Finite amplitude method in covariant density functional theory

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Nuclear density functional theory (DFT) with a minimal number of parameters allows a very successful description of ground-state and excited-state properties of nuclei all over the nuclear chart. In particular, its covariant version (CDFT) takes the Lorentzian symmetry into account, which puts stringent restrictions on the number of parameters without reducing the quality of the agreement with experimental data.

While the self-consistent random phase approximation (RPA) is one of the leading theories applicable to both low-lying excited states and giant resonances, its calculations in the conventional matrix form face to big computational challenges in the two- or three-dimensional deformed cases. In recent years, the so-called finite amplitude method (FAM) [1] has been developed, which provides a promising way for solving the RPA equations when the dimension of the matrix is huge. Its feasibility, accuracy, and efficiency have been demonstrated in the non-relativistic framework (see review [2] and references therein).

In the present study, we devote to combining the advantages of both CDFT and FAM, i.e., to develop the self-consistent relativistic RPA with FAM. Its feasibility has been demonstrated [3]. In addition, it is shown that the effects of Dirac sea can be taken into account implicitly in the **r**-space representation and the rearrangement terms due to the density-dependent couplings can be treated practically without extra computational costs.

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