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A coupled-channel approach to Hartree-Fock-Bogoliubov mean-field theory for deformed neutron rich nuclei

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The coordinate-space Hartree-Fock-Bogoliubov (HFB) method plus the continuum quasi-particle random phase approximation (QRPA)[1] is useful schemes to describe nuclei close to the neutron drip line as the methods allows us to treat properly the asymptotic behaviours of quasi-particle wave functions of weakly bound and unbound orbits. However, no complete formulation has been given once nuclear mean-field is deformed. Attempting to formulate a continuum QRPA for deformed nuclei, we investigate in the present work the coupled-channel formalism of the deformed HFB[2][3], where the quasi-particle states are represented as a coupled radial wave functions for channels with different quantum numbers ljm. Using a deformed Woods-Saxon potential and the density-dependent delta-type pair interaction, we succeeded for the first time in obtaining the self-consistent pair potential and the associated quasi-particle states. We confirm that the exponential tail of the density and pair density is accurately described. This is because the coupled-channel representation allows us to adopt a very small discretization $\Delta r = 0.2$ fm for the radial wave functions. It is straightforward to implement out-going wave boundary condition using a closed form construction of the HFB Green function for the coupled channels.
References:
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