From Gogny force to shell-model calculations

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In shell-model calculations, one of the most crucial tasks is how to calculate effective *NN* interaction matrix elements. One can start from a realistic bare *NN* interaction, and make necessary renormalizations for shell-model calculations. However, such calculations are usually limited to a light mass region (mostly A≤12 at present) if one wants to do *ab-initio* calculations. For heavier mass region, one has to make a cut-off of the model space, and further renormalizations are normally needed to include contributions from excluded space (including core polarization). The renormalizations would bring further restrictions on calculations. For example, the renormalization using the folded diagram expansion restricts shell-model calculations to be performed within one shell. This means that the model space cannot include configurations from different shells due to perturbation approximation used [1]. As another method, one can use phenomenological interaction matrix elements which are obtained by fitting to experimental data, e.g., the USD interaction for the *sd* shell [2]. However, such phenomenological method involves a big number of parameters to be determined by fitting to data. This is a big task in fitting, particularly for heavy mass regions, and also requires enough experimental data available.

We use the well-known Gogny force [3] to calculate the effective interaction matrix elements. The Gogny force has been widely used for mean-field calculations, involving only 12 parameters. As the first step of our work, we simply adopt the existing values of the parameters (determined by mean-field calculations), and calculate the effective interaction matrix elements. Our preliminary calculations show that the matrix elements obtained thus can lead to reasonable results for the excited spectra of nuclei. We will show some of calculations for the *sd* mass region including exotic nuclei near drip lines. As further work, we should readjust the parameter values of the Gogny force especially for shell-model calculations with a given model space, because the effective interaction matrix elements would be model-space-dependent. Using the existing mean-field parameters of the Gogny force, we will also test no-core shell-model calculations, to see whether the Gogny parameters are unified for both mean-field and shell-model calculations.

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