Hybridization of tensor-optimized and high-momentum antisymmetrized molecular dynamics for light nuclei with bare interaction

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The *ab initio* studies using bare interaction provide ultimate solution for the nuclei. It is also the only method to verify many fundamental laws in nuclear physics, such as the degree of freedom in nucleon-nucleon interactions. The great challenge in *ab initio* calculation of nuclei is the correct description of nucleon-nucleon correlations.

We formulate a new framework "HM-TOAMD". In this framework, we hybridize the "HM-AMD" which is proposed recently [1] with the well formulated framework "TOAMD" [2] to balance between the explicitness from the TOAMD approach and the analytical simplicity from the HM-AMD approach. We perform the first *ab initio* calculation with this HM-TOAMD method for the ^{3}H nucleus [3]. We discuss first the effect of the imaginary shift $\vec{D}$ on the total energy and tensor matrix element for ^{3}H, and observe local minima around $D_z = 4$ fm and $D_z = 10$ fm corresponding to tensor and short-range correlations, respectively. With the bare nucleon-nucleon interaction AV8′, we accurately reproduce the energy and radius of this nucleus, as shown in Fig. 1.

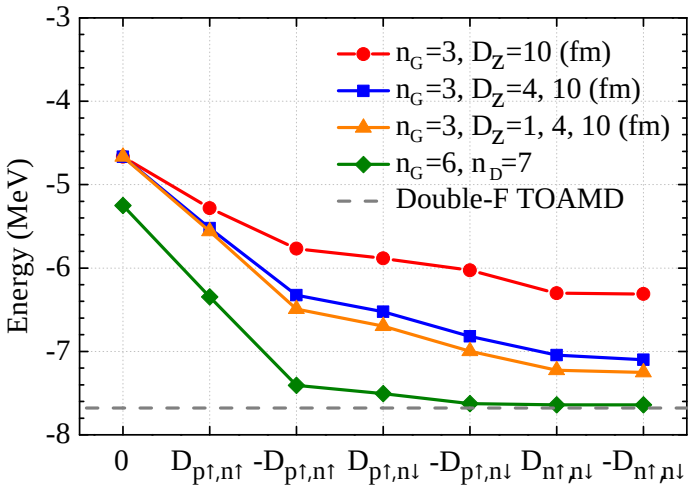

Figure 1: Energy of the ^{3}H nucleus calculated with HM-TOAMD using the bare interaction AV8′ with successively adding the various kinds of high-momentum pairs. $n_{\rm G}$ is the number of gaussian expansions in the TOAMD correlation function for each channel. All the imaginary shifts $\vec{D}$ are adopted to be parallel with the z-axis. $n_{\rm D}$ is the number of imaginary shifts $\vec{D}$ in $\pm z$-direction for each pair. $\pm D$ denote different high-momentum pair shifts. Label of each line denotes the values of $|\vec{D}|$ superposed.

In this study, nucleon-nucleon correlations that are invoked by the strong tensor force and short-range repulsion in the bare interaction are precisely described by our new framework. The flexibility of the model space is found to be promising for future *ab initio* calculations of p-shell nuclei and heavier clustering nuclei.

References

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