Shell-Model Description of $^{16}_{\Lambda}$O with Σ Degrees of Freedom

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Shell-model calculations in a large model space are performed for $^{16}_{\Lambda}$O. Effective interactions and single-particle energies with degrees of freedom of Σ in addition to Λ and nucleon used in the calculations are microscopically derived within the framework of the unitary-model-operator approach (UMOA) [1], starting from the bare interaction given in free space.
Recently, a high-resolution γ-ray spectroscopy experiment for $^{16}_{\Lambda}$O has been performed at BNL. Two γ-transitions from the first-excited 1^- state to the ground-state doublet, the 0^- and 1^- states, are expected to be observed. From these the magnitude of the splitting of the ground-state doublet would be determined. In order to investigate effects of the Σ degrees of freedom on the ground-state doublet, we show the dependence of the calculated energy levels on the size of the model space, especially, that for the ΣN channel.
As for the 0^+ and 2^+ states in $^{16}_{\Lambda}$O which are $1\hbar\omega$ excited states from the ground state, it has been discussed that effects of the parity-mixing intershell coupling should be incorporated in the structure calculation to investigate relative positions quantitatively [2]. As a unique feature of the structure of Λ hypernuclei, negative- and positive-parity nuclear core states can couple through a transition of Λ states such as the $0p_{1/2}$ state to the $0s_{1/2}$ state in a same energy region. In our approach, such a configuration is automatically included in the large model space. We discuss the effects of the parity-mixing intershell coupling on these states by examining the probability of configurations for each state.
In the calculations, some versions of the Nijmegen soft-core potentials are used as the YN interaction. As for the NN interaction, the Paris potential is employed. The dependence of the calculated results on the YN interactions are also investigated.

References

[1] S. Fujii, R. Okamoto, and K. Suzuki, Prog. Theor. Phys. **104** (2000) 123.
[2] T. Motoba, Nucl. Phys. **A639** (1998) 135c.