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Renormalization of Operators s and τs in Nuclei with an *LS* Doubly Closed Shell Plus or Minus One Nucleon*

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Observed matrix elements of the Gamov-Teller interaction in nuclei with an *LS* doubly closed shell are very much reduced from the shell model values. Because mesonic processes do not seem to contribute so much, the reduction should be due to nuclear many body correlations.

Since the effect of configuration mixing (or core polarization) vanishes in first order perturbation, it is evaluated in second order. All excited intermediate states with $2\hbar\omega$ excitation energy in the harmonic oscillator shell model are taken into account. Kuo's *G*-matrix elements[1] are used as an effective interaction.

In this calculation, we find that the tensor part in Kuo's matrix elements produces the largest effect. We therefore take into account only the tensor force in the Hamada-Johnstone potential beyond $2\hbar\omega$ excitation. The second order effect of configuration mixing due to the tensor force is evaluated up to $10\ \hbar\omega$ excitation energy. The contribution from states higher than $10\ \hbar\omega$ excitation is estimated by the use of extrapolation. We assume 0.5 $(\hbar/m_\pi c)$ as a cut-off radius and 14.6 MeV for mass 16 region and 10.9 MeV for mass 40 region as $\hbar\omega$.

Table I shows the numerical results which are in a good agreement with observations. Higher excited states than $2\hbar\omega$ contribute very much.

There is an important question. How large a modification is produced by the admixture of a core deformed state? We use the Gerace-Green wavefunction of ^{41}Ca[2] to estimate this effect. The correction $\delta\langle\tau s\rangle$ due to the core deformed state is found to amount to be 0.05. We, however, cannot sum up this value and $\delta\langle\tau s\rangle$ given in Table I, because the core deformed state is a part of $2\ \hbar\omega$ excited states and is partially taken into account in second order perturbation.

Gerace and Green assumed that the isospin of the three particles in the core deformed state is 1/2. We find, however, that there is a large cancellation which comes from an interference between the core deformed state and other three particle-two hole states with $T = 3/2$. This cancellation reduces very much the contribution from the core deformed state.

The renormalization of τl is very tedious to calculate it beyond $2\ \hbar\omega$ excitation. The second order corrections up to $2\ \hbar\omega$ are -0.063, -0.239, 0.633 and -0.567 for ^{15}N, ^{17}O, ^{39}K and ^{41}Ca.

References

1) T. S. Kuo: private communication.
2) W. J. Gerace and A. M. Green: Nuclear Phys. **A93** (1967) 10.

Table I.

A		Kuo ($2\hbar\omega$) $\delta\langle s\rangle$	$\delta\langle\tau s\rangle$	Tensor ($HJ\infty\hbar\omega$) $\delta\langle s\rangle$	$\delta\langle\tau s\rangle$	obs† $\delta\langle s\rangle$	$\delta\langle\tau s\rangle$
15	$0p_{1/2}^{-1}$	0.044	−0.004	0.126	−0.034	0.08	−0.015
17	$0d_{5/2}$	−0.013	−0.019	−0.117	−0.061	−0.06	−0.06
39	$0d_{3/2}^{-1}$	0.057	−0.017	0.200	−0.072		−0.075
41	$0f_{7/2}$	−0.018	−0.026	−0.131	−0.070		−0.10

†K. Sugimoto: Phys. Rev. **182** (1969) 1051
$\langle\tau s\rangle$ is referred to $\tau_z = 1/2$ states.

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