Measurement of Ground State Magnetization Densities and the Excitation of High Multipolarity Magnetic Excitation of Single Particle

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ABSTRACT

This topic deals in the study of correlation of ground and excited states of even nuclei like 160 and 4He. The main objective of present work is to develop more theoretical techniques applicable in nuclear physics. The work is also extended to discrete excited states as well as odd even nuclei. The work is useful for the calculation of nuclear many body problems for spherically symmetric nuclear quantization representation. The ground state calculation of 160 and 4He are done using G. matrix, which also help in calculation of ground state binding energy and one body two body densities.

Key words - *Excited states. discrete excited states, odd even nuclei*

1. INTRODUCTION

Many attempts have already been made to understand complex behavior of even nuclei and to propose a suitable model based on certain approximation and to calculate various parameters of these nuclei. Present attempt is not only advancement of these attempts but also knock out reaction to discrete states all have in same way supported the mean field approach, as the lowest order in the description of nuclear structure. The form factor for the excitation of high single particle stated in 208 Pb were described extremely, well in shape be mean field wave function. general conclusion of observables e.g. binding energy, one body density or two body densities. They do not change actual shape of the wave function but simply modify the strength due to deoccupation of orbits below the fermi surface and partial occupation of orbits above the fermi surface. Therefore, we have to take into account the correlation largely due to hard repulsive core of nucleon nucleon interaction.

To account for the correlation, there are different ways. One way is to introduce correlation function in many body wave functions in real space. It has been quite successful for small nuclei [13] and has resulted in reasonable description of 16 O. Another approach is added in configuration space to the uncorrelated ground state multipartite multimode configurations. These two approaches can be related to each other.

2. THEORY

In the present study the exp(s) method also known as coupled cluster expansion to generate the complete ground state correlations due to the nucleon nucleon interaction is used. To solve G-matrix inside the nucleus, there are two types of functions one is uncorrelated and other is correlated.

The quantities to be compared to experiment are calculated be evaluating the mean value of corresponding operators fixed at the minimum of the energy function.

Here Q is indicated as generic operator associated to on observable.

$$(Q) = \frac{<Ø_0 | F^* QF | Ø_0>}{<Ø_0 | F^* F | Ø_0>}$$

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3. UNCORRELATED FUNCTION

An uncorrelated ground state can be constructed as a single slater determinant which indicates all the occupied orbits and is written as |o >. It is introduced as the vacuum of reference state of the many body system. The vacuum must play [10] the basic role of cycle victor, with respect to which may be defined two mutually communicating sub algebras called Abelion. There are multi configurational creation operator Cn* and their Hermition adjoint destruction operator Cn. Therefore

$$|\tilde{\Psi}< = \Sigma \quad n\, C^{*}_{n} |0>$$

$$\text{and} < \quad | = \Sigma \quad n< 0 | C_{n}$$

Where n is set index, a general multiparticle cluster configurations.

4. CORRELATED FUNCTIONS

Correlated function can be obtained using variation approach and shall further assume that there exist at least one set of wave function. This set is the set of single particle mean field wave functions. With that basis lowest order or correlation are the two particle tow hole (2p2h) correlated. A variation $\delta|\tilde{o}>$ orthagonal to the correlated ground state can be constructed from any operator C^{*}_{n} representing any npnh excitation as

$$\delta|\tilde{o} >= e^{-s}C^{*}\, e^{-s^{*}}|\tilde{o} > = e^{-s}\, C^{*}_{n}|\tilde{o} >$$

According to the variatial prinipale the Hamiltonian between ground state and such a variation vanishes. So we have

$$<\tilde{o}|HS|\tilde{o}> = < o|e^{-s}He^{-s}\, C^{*}_{n}|o >=$$

the term $e^{s}He^{-s}$ represents effective Hamilatonian

All the individual components of S Commute with each other, so that each element of S is linked directly, to the Hamilatonian.

5. EVALUATION OF GROUND STATE OF 16 O

In the present study coupled cluster exp (s) method is used to calculate the ground state of 16O. The equation is solved so it determines the 2p2h amplitude and thus essentially the ground state G-matrix for 16 O is a space of 35hw with a harmaric oscillater length parameter b= 0.8 fm, excluding those orbits with l£13. Further correlation for 3p3h as correction are included in a reduced space of 30hw ans l£6. In the last correctors due to 4p4h corrections are included in full space.

6. BINDING ENERGY

To apply the above formalism to ground state binding energy; let us first evaluate the ground state expectation values for arbitrary operators. Which can be evaluated by introducing the operator * which is defined by Its decomposition in terms of ph-creation operators.

$$\tilde{s}^{*} = ?\, \frac{1}{n!}\, \tilde{s}\, C^{*}_{n}$$

Bragrand state wave function is given as

$$<\tilde{o}| = < o|\tilde{s}\, e^{-s^{*}}$$

Now we shall apply this procedure to ghe ground state binding energy. the expectation value of Hamiltaion can be written as

$$<E>= <o|e^{s}He^{-s}(1+S^{*})|o>$$

the term invaling * vanishes and energy becomes

$$<E>= <o|e^{s}He^{-s}|o>$$

Assuming that H is almost two body operator and taking in to account that S, Vanishes, we write this as

$$<E>= <o|H|o> + < o|S_{2}\, V_{2}\, o|o >$$

When expectation value of operator H is evaluated in the above eqation, it is considered that the whole orbits are not diagmal with respect to only of these operators. Also, this expression needs to be modified if three nucleon interactions are preset. This expression does not give the upper limit of th e ground state of the energy unless it is exactly at the mi nimum.

Table -1

7.1 Strength parameter of various three nucleon interactions of the urbana series

Sl. No.	Potential	Two pion exchange	Short range potential
1.	Urbana –V	- 0.0333	0.0030
2.	Urbana –VII	- 0.0333	0.0038
3.	Urbana –VIII	- 0.0280	0.0050
4.	Urbana –IX	- 0.0293	0.0048

Where $A^{*}{}_{2} = \left[ff^{*} \frac{m\pi}{12\pi} \right]^{2} \frac{}{9E_{av}}$

f and f* are π NN and π N" cou pling constant E_{av} is the mean energy.

Table -2

7.2 Resulting binding energy (E), r.m.s. charge radii (r) and occupation probabilities

Sl. No.	Potential	Binding energy (E) (Mev/nucleon)	r.m.s charge radii (r)(fm)	$1d_{S/2}$ %	$2S_{1/2}$ %
01	V_8	- 6.44	2.843	2.08	4.26
02	V_{14}	- 5.66	2.839	1.86	4.98
03	V_{18}	- 4.79	2.840	1.77	3.83
04	V_{14}+urbanaV	- 7.00 (+0.27)	2.832	2.40	7.33
05	V_{18}+urbana IX	- 5.90 (+0.27)	2.805	2.65	6.57
06	Experimental	- 8.0	2.73	2.27	1.78
			$\pm$0.025	$\pm$0.12	$\pm$0.36

8. CONCLUSION

A reasonable description of th e ground that of 16 O that explicitly accounts for realistic correlations. we use the coupled cluster expans ion (exp (S) method) to solve the many body Schrödinger equations in configuration space. While the coupled cluster expansion is exact it carried out to all orders, the present result are obtained wi th truncations. our efforts are current direction in two d irects. First we intend to apply the procedure described in the this paper for more realistic interaction. Second we shall use the equality of motion Technique t o calculate excited states of 16 O nuleus.

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