Calculation of Energy Levels of ^{205}Hg by using Nuclear Shell Model and (OXBASH) Program

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Abstract

We deal with the energy levels of ^{205}Hg by applying the nuclear shell model and (oxbash) program , to calculate (TBME) the effective interaction (khhe) is used , it has been found that the energy levels are identical with the practical results available for the first band , and it is expected that them would be identical energy levels and identical spin in the second ,third , fourth , and fifth band .

1. Introduction

It is expected that there is about 6000 nucleus in the nuclear table cited between the Drip lines of the protons and the neutrons. Till now, only 3600 are really discovered , 198 of them are stable inactive and their ages is close to half age of the earth [Al_Khalili and Roceckl 2004]. The fact that most of the famous nuclei are unstable help proving a great deal of in formation about the nucleus through nuclear fission.

The progress in the nuclear characteristics represented by the number of protons and neutrons is the most important aspects in the nuclear physics [Klimkiewicz 2007] . The ^{205}Hg is rich of neutrons n=125 , however the information about it is very less because defecate product this nuclear [Jungclaus 2007] [Dillmann 2003].

2. Theoretical part

The practical calculations about th e nuclear shell model proves the theoretical expectation , and allows to calculate the energy levels , nuclear density , nuclear component structure . The Hamionin which governs the neutrons dynamics on the part of the nuclear shell model is represented by the following formula [Honma 2002] :

$$H = \sum_i E_i a_i + \sum_{ijkl} V_{ijkl} a_i^\dagger a_j^\dagger a_i a_j \quad \text{---------- (1)}$$

Where *E*i : stands for the energy of the single (SPE) particle of the orbit i its value can be found from the closed shell side of the mass number A= closed core + 1 , ni , stand for the busy space in orbit i .

V_{ijkl} : is known as the two body matrix element (TBME) of the interaction between nucleon of the orbits (i , j , k , l) , and it can be calculated by A= closed core +2

$a_j^+ a_i^+$: reactive effects (to generate a couple of phermons) .

$a_j\, a_i$: decline effects (to decline acouple phermons).

The element matrixes for duboul Particals (TBME) can be write as follow .

$$V^{T}{}_{J,J'} = \left(\frac{\sum_{J} (2J+1) \langle JJ' | V | JJ' \rangle_{JT}}{\sum_{J} (2J+1)} \right)^{2}$$

And the calculation is achieved by employing the affective interactions.

The calculate the shell model by using (oxbash) program , is it proposed that the levels which are rich of protons and neutrons , i.e (closed shell) are the magic number that stand for the inert core , and the nucleons in the next shell are the magic number that stand for valence nucleons [kranel 1988] the orbital between two magic number represent the valence shell named the main shell such as ($1h_{9/2}$, $2h_{7/2}$, $2f_{5/2}$, $3p_{3/2}$,$3p_{1/2}$, $1i_{13/2}$) the main shell between two magic number (126) and (82) is called single particle space (sps) according to the effective interaction . [Honma ,2004] .

Calculation and discussion

The nuclear shell model ia applied to calculate the energy levels of ^{205} Hg which is multi _single nuclear , whose mass number A= 205 , P= 80 , and N=125 , and it is positioned in the shell (khh) , according to the shell model the closed shell occurs , at the magic number P= 50 , N=82 . the valence nucleons , of P=30 , and N=45 , their summation is 75 particles out of the closed shell in the folloing shell :

P= $1g_{7/2}$, $2d_{5/2}$, $2d_{3/2}$, $3s_{1/2}$, $1h_{11/2}$

N= $1h_{9/2}$, $2f_{5/2}$,$3p_{3/2}$, $3p_{1/2}$, $1i_{13/2}$

To make calculation on ^{205} Hg , the closed shell at 208 is selected whose P=82 , N= 126 , and where it is possible to use the number of gaps instead of the valence particles , i.e the number of nucleons is a 3 gaps instead of 75 particles to close the shell at the magic number P= 82 , N= 126 In the shell area ($1H_{11/2}$) , there is two proton gaps and one neutron gap in shell ($1I_{13/2}$) . The (oxbash) program is used to calculate the energy levels and the band .The obtained values are compared th those of the international standards as it is shown in fig (1) and (2) [Grory and Kuol 1975] .

It can be noticed fig (1) , (2) that the energy levels on earth land obtained on the level 1/2 , are identical with the practical valuesw -1/2 , by the same token , the practical and theoretical values in the first band are all identical ($9/2_1^-$, $7/2_1^-$, $3/2_1^-$, $5/2_1^-$) we also get new values that do not have been compared to the practical values as the later are not available , these value are ($1/2^+$, $11/2^-$, $3/2^+$, $5/2_1^+$, $11/2_1^+$, $9/2_1^+$) in the first band . Identical energy levels and spin are also expected in the other bands levels [www.nndc.2011].

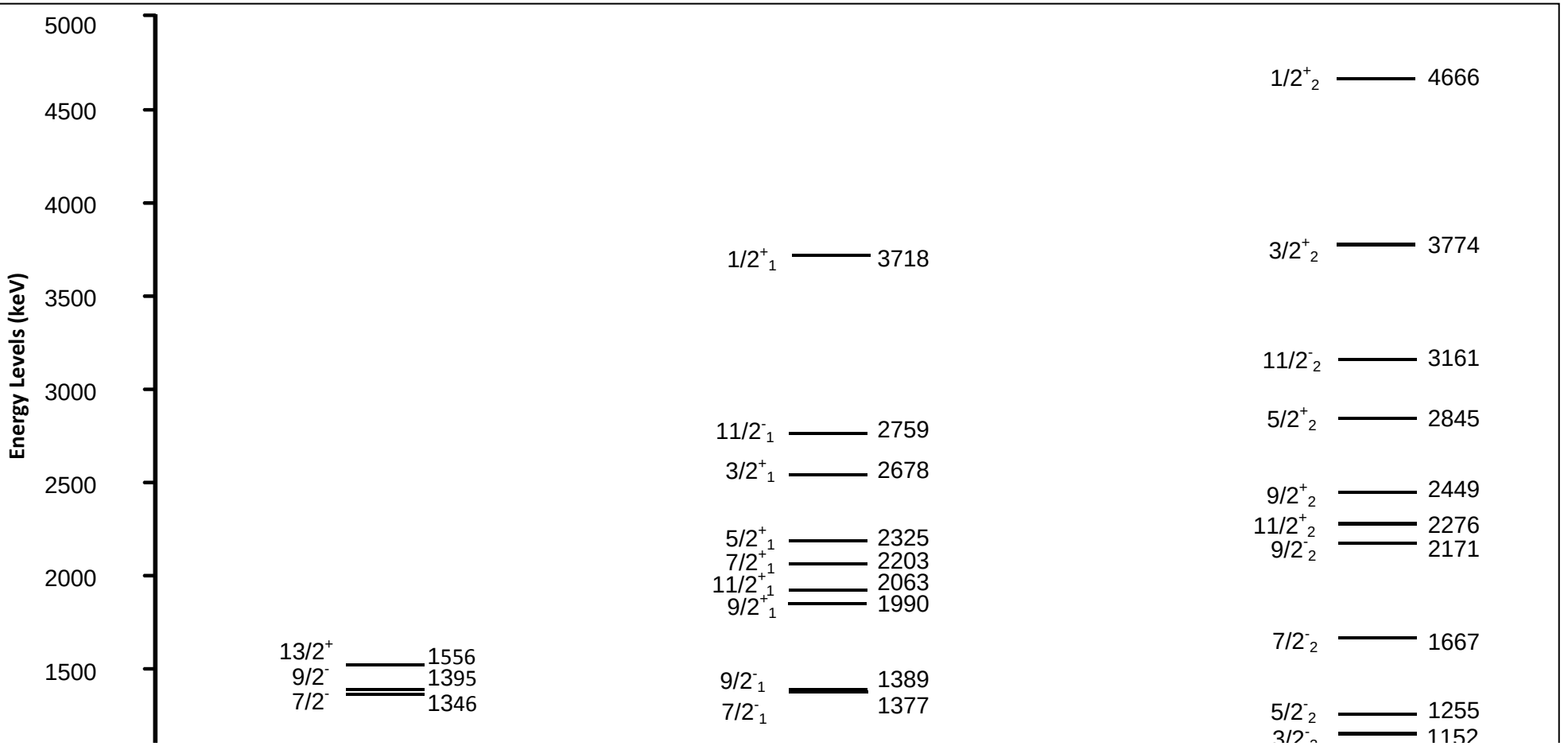
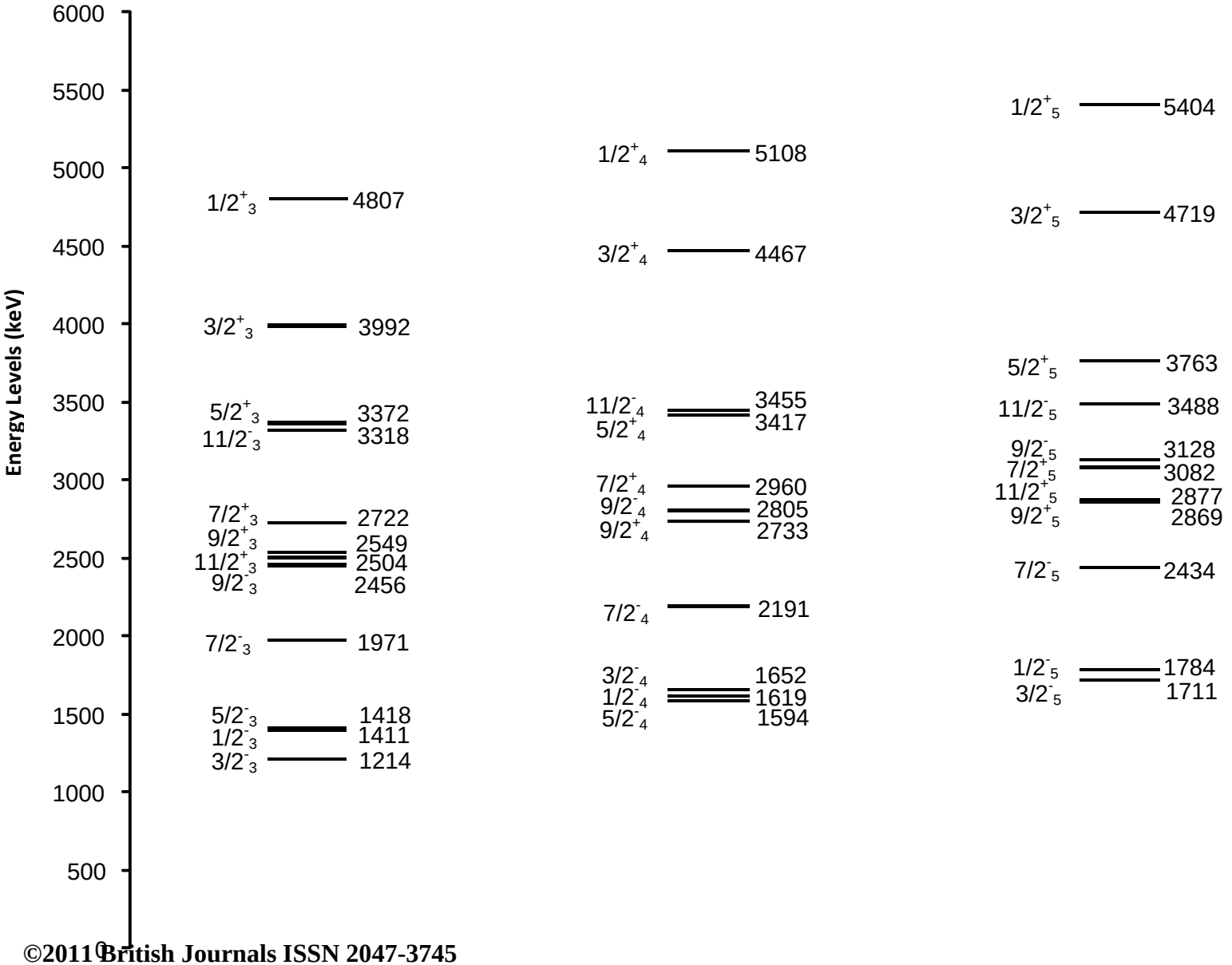


Fig (1) Shows the energy levels compared with theoretically calculated to isotopes (^{205} Hg) with practical results

Exp[www.nndc .com] P.W.



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4. Conclusions

The application of the nuclear shell model using the (Oxbash) nuclied ^{205} Hg and the expline of following below .

1- Been confirmed theoretical values of energies (0 , 377 , 485 , 1377 , 1389) are well defined angular momentum and replicate ($9/2_1^-$, $7/2_1^-$, $3/2_1^-$, $5/2_1^-$, $1/2^-$) with practical values.
2- Been identified similar levels of momentum and energy have not been identified in practice (1/2+ , 11/2- , 3/2+ , 5/21+ , 7/21+ , 11/21+ , 9/21+) .
3- The effectiveness of file effective interaction in the calculations of neutron-rich regions of the nuclear shell .

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