Nuclear Structure of $^{44-46}$Ti isotopes using shell model by OXBASH code

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Abstract

Studying 44-46 Ti nuclei's nuclear composition in the shell model's framework was a key to understand the electronic transition at one orbital (1f7/2) and Even-even nucleus. Furthermore 40Ca shell is considered to be closed. The explanation nucleus's excited states of 44-46 Ti with neutrons (N=22,24) with 4 to 6 nucleons outside of closed shell. The energy levels were calculated using the shell model and decrease in the probability of the electric quadruple transition B (E2) for the 44-46 Ti isotopes by utilizing the OXBASH code included within the f7 shell in conjunction with the F7MBZ& F742, The findings were analyzed and contrasted with certain previous experimental values. It was determined that the obtained theoretical results and the experimental data agree. There were a good agreement with theoretical and experimental results which paved the rode for more applications. Ultimately, through this study, the best effective effort was reached, which is F7MBZ .

Keywords: *Energy levels; Shell model; OXBASH code, B (E2).*

1. INTRODUCTION

The Shell model's calculations, implemented in a model space where the nucleons are constrained to occupy more than a few orbits without the need for scaling factors in order to replicate the recorded static moments or transition strengths are capable of reproducing observed static moments and transition strengths. Traditionally, Transition density models have undergone extensive testing by comparing computed and measured form factors of longitudinal electron scattering. Nuclear excitations have been studied using a variety of microscopic and macroscopic theories. [1]. The structure of neutron-rich nuclei has recently been the topic of substantial theoretical and experimental investigation. The current study is based on the notion that nuclei with a large neutron excess can suffer major alterations to their fundamental shell structure [2] . With the nuclear shell model SM in mind, Talmi used SDI to investigate the surface delta relationship. to compute the properties of closed core nuclear scenarios involving few particles [3]. Computations in the well-known shell-model approach are carried out in a reduced Hilbert space, the so-called model space, and only particles outside a core made up of filled shells (valence particles) are considered active [4]. The purpose of this research is to look into the decreased transition probabilities and level schemes for 44Ti, 46Ti, and even isotopes, use the most recent OXBASH for Windows version the energy levels of some 44Ti states and 46Ti Compared to the most recent data, the figures calculated in this paper show [2].

2. Theory

The force that created by collision of two nucleons is known as the residual interaction and the Hamiltonian operator perturbation that causes this interaction. The potential energy of two particles is equal to their sum then use the equation to symbolize the Hamiltonian operator in the state of perturbation [3].

$$H = H_\circ + \sum_{i<j} V_{ij} \quad \ldots\ldots\ldots (1)$$

H°: is an unperturbed Hamiltonian , V_ij: remains of the two-body interaction [5]. In a D-dimensional Hilbert space[6], Schrödinger equation can be expressed in writing.

$$H = |\psi_n\rangle = E_n |\psi_n \quad \ldots\ldots(2)$$

Where

$$H = H_o + H_1 \quad \ldots\ldots\ldots(3)$$

$$H_o = \sum_{i=1}^{A} (T_o + U_i) \quad \ldots\ldots\ldots(4)$$

$$H_o = \sum_{i<j}^{A} (V_{ij}^{NN} - \sum_{i=1}^{A} U_i) \quad \ldots\ldots\ldots(5)$$

To disentangle [3] the nuclear Hamiltonian one-body potentials have been proposed as the integral of one-body terms. Which characterizes the nucleons' free-moving nature plus the interaction H_(1). When solving the Schrodinger equation for a central potential, the energy of individual nucleons are given by the SPE . As shown in the states of a single particle, Whether it be a particle or a hole outside of a nucleus with a doubly-closed shell (DCS) in its neighbors (DCS ±1) [7] . Lastly, by choosing the desired interaction the formation of the Hamiltonian, and after that, the calculations are carried out [8].

3. Calculations and Discussion

Titanium isotope structure is examined using the shell model employing the OXBASH system For the calculations , different discussions are possible for the level of energy decreased likelihood of E2 transitions , The 44-46 Ti isotopes have 22 and 22 (or 24) proton, and neutron respectively and The core is considered as 40 Ca for 44Ti with 4 nucleons outside core and for 46Ti with 6 nucleons outside core.

The OXBASH code has been implemented by us in m-scheme as well as jj-coupling respectively. This study seeks consists of determining energy levels and lowered electric quadrupole transition probability B (E2).

3.1. Energy levels

The purpose of this investigation is to Determine the nuclei that are in close proximity to 44Ti because of the significant role that these nuclei play in recent developments in astrophysical applications .The determined energy levels and presented low-lying state experimental results for even-even nuclei .However, On the left, you can see the results of our calculations and right-hand experimental info for any band [9].

3.1.1 Energy levels of 44 Ti

For 44Ti isotope using (F7MBZ) interactions is shown in the table1 . When measured against the experimental data that is presented . Both of the parity and angular momentum are found to be identical to the ground state of level 0+. A good agreement was obtained for the values of the practical energies (1.08306, 2.45433 , 4.01531 ,7.670 ,9.100) MeV corresponding to the angular momentum (2+1 , 4+1, 6+ 1,6+ 2,4+5) when compared with the calculated theoretical values , The total momentum and parity of the unconfirmed practical energies (6.5085, 6.810 , 7.6711 , 8.0399 ,9.361 ,9.713 , 10.460) MeV was confirmed for the angular momentum (8+1 , 0+2, 10+1 ,12+1 ,2+ 3, 4+4, 0+3) are confirmed when compared with the calculated theoretical values , And The experimental energy value(5.1511 ,10.113) MeV was confirmed for angular momentum (6-2 ,3-2) with positive parity In our calculations , We expect that practical values (6.959, 6.5718 , 8.984) MeV whose angular momentum is uncertain (4+ , 8+, 10+) have angular momentum (3+1 , 7+1, 9+1) , We found the values of energies for a specific angular momentum close to the values of the practical energies (7.634 ,8.067 , 8.318 ,9.030 ,9.280 ,9.542 ,9.668 , 9.895 ,10.520) that have no specific angular momentum, and thus we expect that its angular momentum is the theoretically calculated momentum (4+3 , 8+2, 5+2 , 6+4, 8+3, 2+4, 7+2 , 10+2, 6+5). Through our calculations, we noticed that there are three levels with total angular momentum and parity that were not matched by any available practical value. For 44Ti isotope using (F742) interactions is shown in the table2 . When measured against the experimental data that is presented , The parity and angular momentum are determined to be similar to the level 0+ ground state.. A good agreement was obtained for the values of the practical energies (1.08306, 2.45433 , 4.01531 ,7.458 ,7.670) MeV corresponding to the angular momentum (2+ 1, 4+1, 6+1 ,8+2 ,6+4) when compared with the calculated theoretical values , confirmed The total momentum and parity of the unconfirmed practical energies (4.8031, 6.5718 , 6.959 , 6.84884 ,7.6711 ,8.0399 , 8.180 ,8.947 ,9.143 ,8.984) MeV corresponding to the angular momentum (6+2, 8+1, 4+3 ,6+3 ,10+1 , 12+1, 2+3 , 4+5 , 0+3 , 10+2) when compared with the calculated theoretical values , And The experimental energy value(5.6706 ,8.534) MeV was confirmed for angular momentum (7-1 ,3-2) with positive parity In our calculations , A good agreement was obtained for the practical energy values (5.055 ,5.250) corresponding to the angular momentum (3-1,5-1) but with negative parity , We found the values of energies for a specific angular momentum close to the values of the practical energies (4.7922 ,8.067 , 8.318 ,9.180) that have no specific angular momentum, and thus we expect that its angular momentum is the theoretically calculated momentum (2+2 , 4+4, 7+2 , 6+5). Through our calculations, we noticed that there are six levels with total angular momentum and parity that were not matched by any available practical value.

Table (1): Excitation energy predicted by (F7MBZ) interactions and observed excitation energies[10] for the 44Ti nucleus are compared

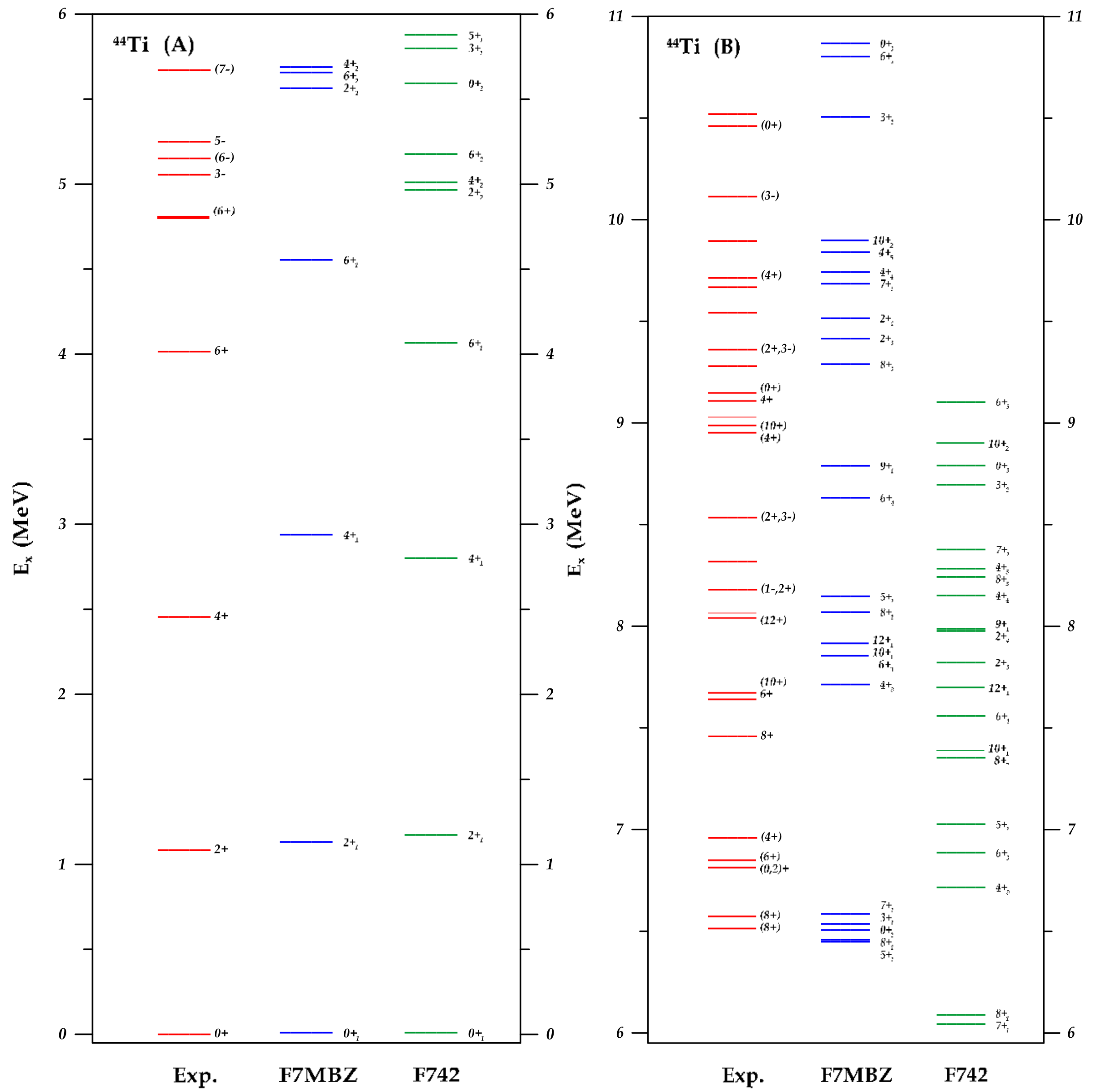
F7MBZ (Theoretical values)		**Experimental values**			**Theoretical values for F7MBZ**		**Experimental values**	
$J^{\pi+}$	**E (MeV)**	**E (MeV**	J^{π}		$J^{\pi+}$	**E (MeV)**	**E (MeV**	J^{π}
0_1	0	0	0+		12_1	7.905	8.0399	(12+)
2_1	1.121	1.08306	2+		8_2	8.061	8.067	-----
4_1	2.929	2.45433	4+		5_2	8.139	8.318	-----
6_1	4.545	4.01531	6+		6_4	8.624	9.030	-----
2_2	5.554	4.7922	-----		9_1	8.781	8.984	(10+)
6_2	5.647	5.1511	(6-)		8_3	9.281	9.280	-----
4_2	5.680	-----	-----		2_3	9.407	9.361	(2+,3-)
5_1	6.440	-----	-----		2_4	9.507	9.542	-----
8_1	6.449	6.5085	(8+)		7_2	9.677	9.668	-----
0_2	6.497	6.810	(0,2)+		4_4	9.734	9.713	(4+)
3_1	6.528	6.959	(4+)		4_5	9.832	9.100	4+
7_1	6.577	6.5718	(8+)		10_2	9.891	9.895	-----
4_3	7.705	7.634	-----		3_2	10.497	10.113	(3-)

6_3	7.842	7.670	6+		6_5	10.794	10.520	-----
10_1	7.845	7.6711	(10+)		0_3	10.859	10.460	(0+)

Table (2): Excitation energy predicted by (F742) interactions and observed excitation energies[10] for the 44Ti nucleus are compared.

F742(Theoretical values)		**Experimental values**			**F742(Theoretical values)**		**Experimental values**	
$J^{\pi+}$	**E (MeV)**	**E (MeV)**	J^{π}		$J^{\pi+}$	**E (MeV)**	**E (MeV)**	J^{π}
0_1	0	0	0+		8_2	7.345	7.458	8+
2_1	1.163	1.08306	2+		10_1	7.380	7.6711	(10+)
4_1	2.791	2.45433	4+		6_4	7.551	7.670	6+
6_1	4.057	4.01531	6+		12_1	7.689	8.0399	(12+)
2_2	4.956	4.7922	-----		2_3	7.813	8.180	(1-,2+)
4_2	5.001	-----	-----		2_4	7.968	-----	--------
6_2	5.167	4.8031	(6+)		9_1	7.979	--	-----
0_2	5.583	-----	-----		4_4	8.143	8.067	-----
3_1	5.788	5.055	3-		8_3	8.234	-----	-----
5_1	5.868	5.250	5-		4_5	8.275	8.947	(4+)
7_1	6.035	5.6706	(7-)		7_2	8.369	8.318	-----
8_1	6.080	6.5718	(8+)		3_2	8.688	8.534	(2+,3-)
4_3	6.707	6.959	(4+)		0_3	8.782	9.143	(0+)
6_3	6.878	6.84884	(6+)		10_2	8.891	8.984	(10+)
5_2	7.018	-----	-----		6_5	9.094	9.180	-----

Fig.1. A comparison between theoretical energy levels for two interaction and the experimental data for 44Ti.



3.1.2 Energy levels of 46Ti

For 46Ti isotope using (F7MBZ) interactions is shown in the table3 . When measured against the experimental data that is presented, Both the parity and angular momentum are found to be identical to the ground state of level 0+. A good agreement was obtained for the values of the practical energies (0.889286, 2.009846 , 2.9618 ,3.29886 ,3.2357 ,3.731 ,4.8969 ,5. 794 , 6.2004 ,6.2419 , 7.9418 ,8.283 , 8.2175 ,9.170 , 9.615 ,10.180 ,) MeV corresponding to the angular momentum (2+1 , 4+1, 2+2 , 6+1,2+3 ,1+1 , 8+1 , 4+4, 8+ 2,10+1 ,11+1 , 10+3,12+1 , 1+3 , 2+10 , 1+4) when compared with the calculated theoretical values , confirmed The total momentum and parity of the unconfirmed practical energies (3.849, 4.398 , 4.527 , 5.604 , 5.992 ,5.872) corresponding to the angular momentum (4+1 , 6+2, 6+3 , 2+4,4+3 , 2+5) when compared with the calculated theoretical values , And The experimental energy value(5.409,5.530 ,6.8303,7.019) MeV was confirmed for angular momentum (3-2 , 3-3,9-1 , 3-4) with positive parity In our calculations , We expect that practical values (9.168, 9.205) MeV whose angular momentum is uncertain (4+ , 6+) have angular momentum (3+8 , 7+7) , We found the values of energies for a specific angular momentum close to the values of the practical energies (3.213 , 3.7715 , 4.003 , 5.117 ,5.154 , 5.811 ,6.025 ,6.021, 6.251 , 6.266 , 6.305 ,6.574 ,6.616 , 6.794 , 6.851 ,6.974 , 7.101 ,7.147 , 7.172 ,7.201 , 7.288 ,7.350 , 7.472 , 7.558 , 7.584 , 7.608 ,7.735 ,7.788 ,7.849 ,7.874 , 7.937 ,8.013 ,8.040 , 8.088 ,8.134 ,8.230 ,8.2939 ,8.384,8.467 ,8.530 ,8.621, 8.701 ,8.761 ,8.808 ,8.940 ,8.984 ,9.070, 9.141 ,9.253 , 9.345 , 9.572 ,9.649 ,9.761 ,9.790, 9.852 , 9.864 ,10.038 , 10.212 ,10.441 , 10.602 ,10.730 ,10.866 , 10.938 , 10.980 , 10.051 ,11.299 , 11.426 , 12.974) that have no specific angular momentum and thus we expect that its angular momentum is the theoretically calculated momentum (4+2 , 3+1, 5+1 , 0+2, 5+2, , 7+1, 7+2, 4+6 , 5+ 3, 6+4, 6+5 , 7+3, 5+4, 1+2, 6+6 , 8+3, 0+ 3, 2+6, 4+7,6+7 , 4+8, 5+5, 10+2, 8+4 , 4+9, 7+4, 8+5 , 5+6, 9+2 , 6+8, 2+7, 7+5, 9+3, 3+6, 4+10,6+9, 5+7, 3+7, 8+6, 2+8, 2+9 , 5+8, 8+7 , 7+6, 6+10, 5+9, 9+4 , 5+10 ,0+4 , 8+8, 8+9, 9+5, 7+8 , 11+2, 3+9 , 10+5, 10+6, 7+9, 8+10 , 12+2, 13+1,3+10 , 14+1, 9+6, 7+10, 11+3, 0+5 ,10+7). Through our calculations, we noticed that there are three levels with total angular momentum and parity that were not matched by any available practical value.

Table (3): Excitation energy predicted by (F7MBZ) interactions and observed excitation energies[10] for the 46Ti nucleus are compared.

F7MBZ (Theoretical values)		Experimental values			Theoretical values F7MBZ		Experimental values	
$J^{\pi+}$	E (MeV)	E (MeV)	J^{π}		$J^{\pi+}$	E (MeV)	E (MeV)	J^{π}
0_1	0	0	0+		9_2	7.863	7.849	-----
2_1	1.101	0.889286	2+		6_8	7.884	7.874	-----
4_1	2.174	2.009846	4+		2_7	7.932	7.937	-----
2_2	2.769	2.9618	2+		7_5	8.028	8.013	-----
4_2	3.218	3.213	-----		9_3	8.051	8.040	-----
6_1	3.267	3.29886	6+		3_6	8.064	8.088	-----
2_3	3.690	3.2357	2+		4_{10}	8.190	8.134	-----
3_1	3.747	3.7715	-----		6_9	8.226	8.230	-----
4_3	3.901	3.849	(4+)		10_3	8.228	8.2839	10+,11+,12+
1_1	3.996	3.731	1+		5_7	8.277	8.293	-----
5_1	4.022	4.003	-----		12_1	8.292	8.2175	12+
6_2	4.190	4.398	(5-,6+)		3_7	8.431	8.384	-----
6_3	4.888	4.527	(6+)		8_6	8.452	8.467	-----
8_1	4.986	4.8969	8+		2_8	8.499	8.530	-----
0_2	5.193	5.117	-----		2_9	8.674	8.621	-----
5_2	5.202	5.154	-----		5_8	8.721	8.701	-----
4_4	5.208	5.794	4+		8_7	8.778	8.761	-----
3_2	5.470	5.409	3-		7_6	8.915	8.808	-----
2_4	5.493	5.604	(2+)		6_{10}	8.939	8.940	-----
4_5	5.633	5.992	(4+)		5_9	8.953	8.984	-----
3_3	5.672	5.530	3-		9_4	9.067	9.070	-----
7_1	5.700	5.811	-----		5_{10}	9.156	9.141	------
2_5	5.794	5.872	(2+)		10_4	9.173	----	-----
8_2	5.938	6.2004	8+		3_8	9.226	9.168	4+

7_2	5.945	6.025	-----		7_7	9.235	9.205	6+
4_6	6.094	6.021	-----		0_4	9.241	9.253	-----
5_3	6.132	6.251	-----		1_3	9.319	9.170	1+
6_4	6.266	6.266	-----		8_8	9.348	9.345	-----
10_1	6.438	6.2419	10+		8_9	9.534	9.572	-----
6_5	6.443	6.305	-----		9_5	9.644	9.649	-----
7_3	6.588	6.674	-----		2_{10}	9.740	9.615	2+
5_4	6.657	6.616	-----		7_9	9.747	9.761	-----
1_2	6.860	6.794	-----		11_2	9.822	9.790	-----
6_6	6.912	6.851	-----		3_9	9.866	9.852	-----
9_1	6.921	6.8303	9-		10_5	9.883	9.864	-----
8_3	6.983	6.974	-----		10_6	10.140	10.038	-----
3_4	7.051	7.019	(3-,4+)		7_9	10.208	10.212	-----
0_3	7.111	7.101	-----		1_4	10.327	10.180	1+
2_6	7.117	7.147	-----		8_{10}	10.445	10.441	-----
4_7	7.186	7.172	-----		12_2	10.638	10.602	-----
6_7	7.255	7.201	-----		13_1	10.749	10.730	-----
4_8	7.406	7.288	-----		3_{10}	10.840	10.866	-----
5_5	7.433	7.350	-----		14_1	10.900	10.938	-----
10_2	7.459	7.472	-----		9_6	10.912	10.980	-----
3_5	7.576	7.534	(3-)		7_{10}	10.954	11.051	-----
8_4	7.593	7.558	-----		11_3	11.271	11.299	-----
4_9	7.594	7.584	-----		0_5	11.438	11.426	-----
7_4	7.619	7.608	-----		12_3	11.841	-----	-----
8_5	7.771	7.735	-----		9_7	12.200	-----	-----
11_1	7.774	7.9418	11+		10_7	12.351	12.974	-----
5_6	7.804	7.788	-----					

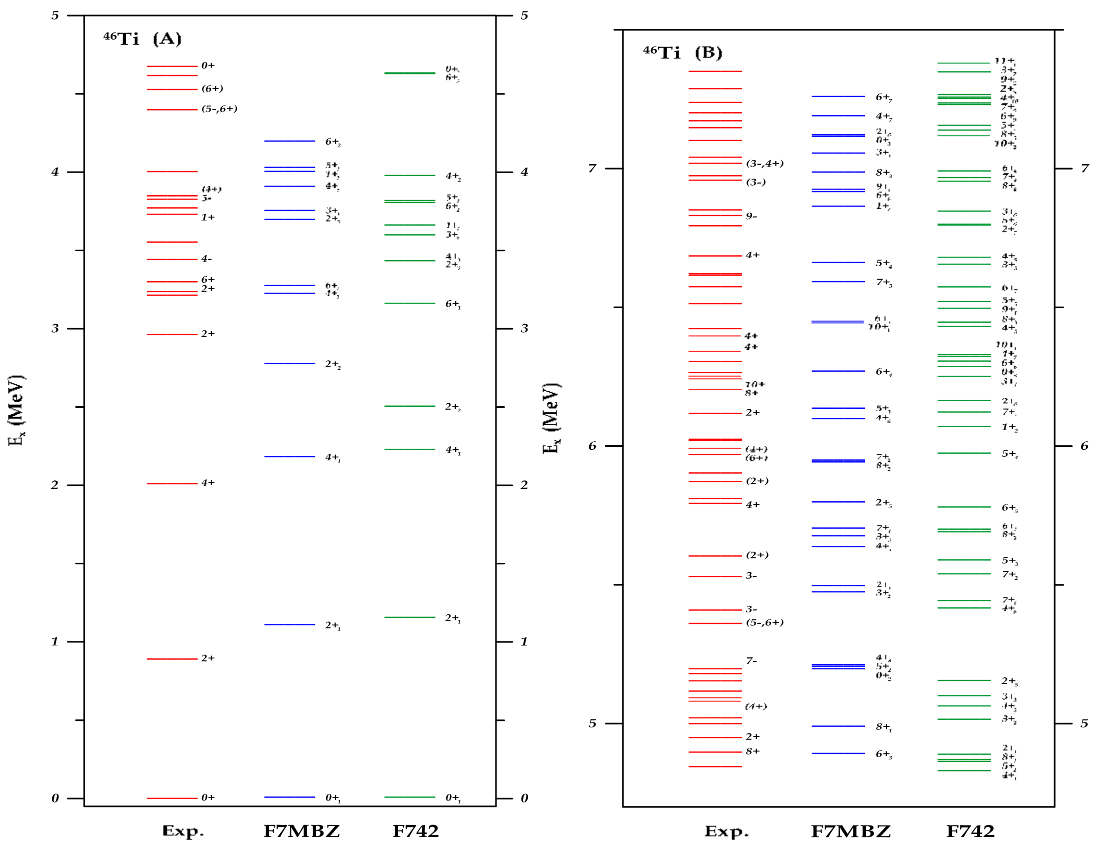
For 46Ti isotope using (F742) interactions is shown in the table4 . When measured against the experimental data that is presented, Both the parity and angular momentum are found to be identical to the ground state of level 0+. A good agreement was obtained for the values of the practical energies (0.889286, 2.009846 , 2.9618, 3.29886,3.2357, 3.731,4.675 ,4.8969 ,4.950 ,6.2004,6.118 ,6.338 ,6.2419,6.395,6.685 ,7.9418 , 8.2175) MeV corresponding to the angular momentum (2+1 , 4+1,2+2 , 6+1 , 2+3,1+1, 0+2,8+1 ,2+4 , 8+2 , 2+6, 4+7, 10+1 ,4+8 , 4+9,11+1,12+1) , when compared with the calculated theoretical values , confirmed The total momentum and parity of the unconfirmed practical energies (4.527, 5.079, 6.361, 5.965, 7.019 ,8.020) corresponding to the angular momentum (6+3, 4+5 , 6+4, 6+5, 4+10, 0+4) when compared with the calculated theoretical values , And The experimental energy value(3.82643 ,6.958) MeV was confirmed for angular momentum (5-1 ,3-6) with positive parity In our calculations , A good agreement was obtained for the practical energy values (3.44139 ,3.826, 5.1976) corresponding to the angular momentum (4-3,5-1,7-4) but with negative parity, We found the values of energies for a specific angular momentum close to the values of the practical energies (3.213 , 3.551 , 3.7715 , 4.617, 4.845 ,5.000 , 5.094 , 5.117 , 5.154 , 5.180 , 5.811 , 5.903 , 6.025 , 6.021 , 6.251 , 6.266 , 6.305 ,6.424, 6.513 , 6.574 , 6.616, 6.794 , 6.851 , 6.974 , 6.041 , 7.101 ,7.147 , 7.172 ,7.201 , 7.238 ,7.288 , 7.350 , 7.472 ,7.558 , 7.660 , 7.710 , 7.730 , 7.735 , 7.788 , 7.849 ,7.874 ,7.917, 7.979 , 8.013 , 8.182 , 8.230 ,8.346 , 8.384 , 8.467 , 8.530 ,8.574 ,8.621 , 8.662 , 8.701 ,8.984 , 9.070,9.111 ,9.141 ,9.253 , 9.304 , 9.345 , 9.474 , 9.761 , 9.864 , 10.038 , 10.212 , 10.441 , 10.602 , 10.866 , 10.980) that have no specific angular momentum and thus we expect that its angular momentum is the theoretically calculated momentum (4+2 , 3+1 , 6+2 , 4+4, 5+2, 3+2, 3+3, 2+5, 4+6 , 7+1, 5+3, 5+4 , 1+2, 7+3, 3+4 , 0+3, 6+6, , 8+3, 5+5 , 6+7 , 3+5, 2+7, 5+6, 8+4, 7+4, 6+8,10+2, 8+5, 5+7, 6+9, 7+5, 3+7, 9+3 , 2+9, 5+8, 8+6, 10+3 , 8+7 ,1+3 , 5+9, 3+8, 6+10, 7+6, 5+10, 7+7 , 2+10, 9+4, 3+9, 10+4 , 8+8, 7+8 ,8+9 , 1+4, 9+5, 7+9, 3+10,10+5 , 11+2 ,8+10 , 10+6 , 0+5 , 7+10 , 9+6 , 122 , 13+1 , 11+3 , 14+1 , 9+7 , 12+3 , 10+7). Through our calculations, we noticed that there are three levels with total angular momentum and parity that were not matched by any available practical value.

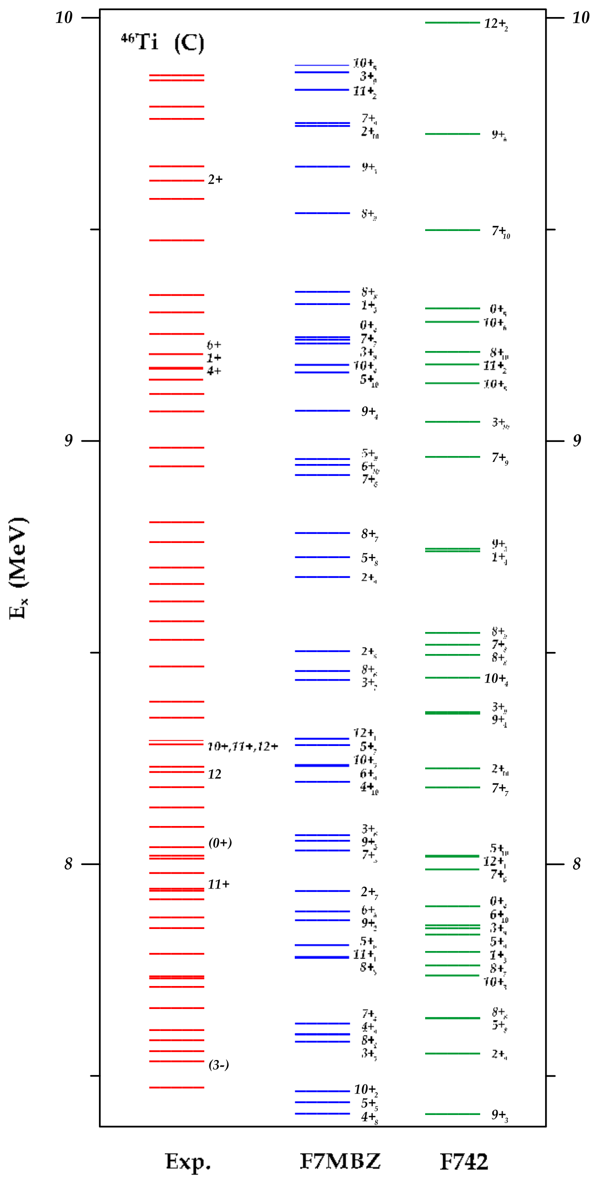
Table (4): Excitation energy predicted by (F742) interactions and observed excitation energies[10] for the 46Ti nucleus are compared.

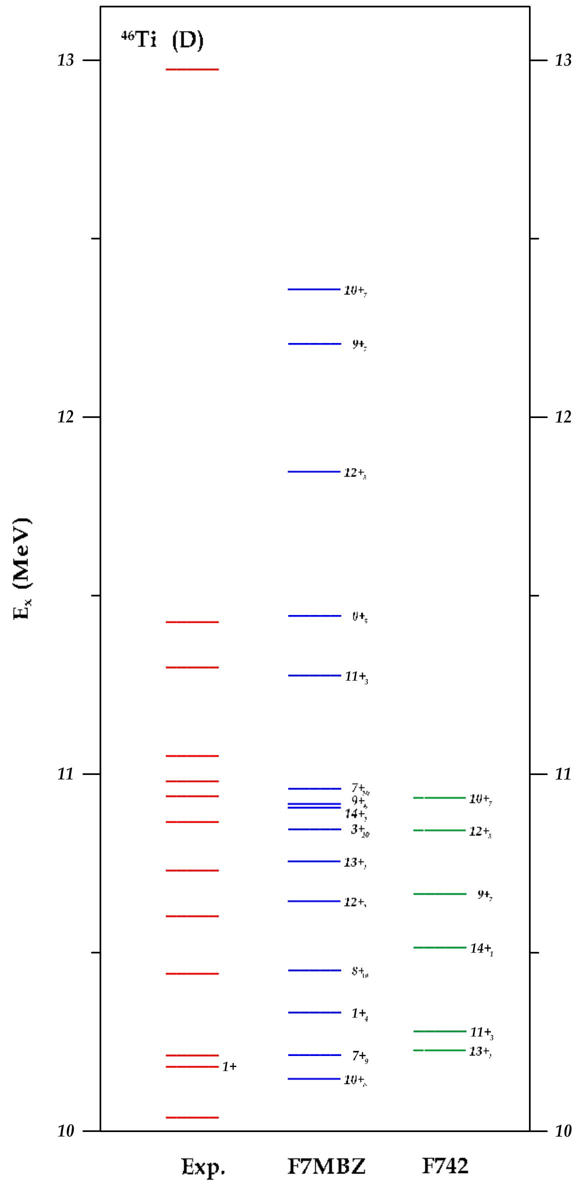
F742(Theoretical values)		**Experimental values**			**F742Theoretical values**		**Experimental values**	
$J^{\pi+}$	**E (MeV)**	**E (MeV)**	J^{π}		$J^{\pi+}$	**E (MeV)**	**E (MeV)**	J^{π}
0_1	0	0	0+		8_5	7.134	7.147	-----
2_1	1.148	0.889286	2+		5_7	7.151	7.172	-----
4_1	2.221	2.009846	4+		6_9	7.226	7.238	-----
2_2	2.497	2.9618	2+		7_5	7.232	7.288	-----
4_2	3.970	3.213	-----		4_{10}	7.248	7.019	(3-,4+)
6_1	3.154	3.29886	6+		2_8	7.253	-----9_2	---------
4_3	3.426	3.44139	4-2+			7.262	-----10_2	---------
2_3	3.426	3.2357	-----			7.110	7.172 3_7	--11+
3_1	3.591	3.5531	1+			7.344	7.350 11_1	---------
1_1	3.654	3.731	-----			7.377	7.9418 9_3	---------
6_2	3.797	3.7715	5-			7.405	7.472 2_9	---------
5_1	3.810	3.82643	(6+)			7.548	7.558 5_8	---------
6_3	4.620	4.527	0+			7.631	7.660 8_6	---------
0_2	4.625	4.675	-----			7.632	7.710 10_3	-----
4_4	4.826	4.617	-----			7.729	7.730 8_7	(0+)
5_2	4.859	4.845	8+			7.756	7.735 1_3	-----12
8_1	4.866	4.8969	2+			7.788	7.788 5_9	-----
2_4	4.885	4.950	-----			7.829	7.849 3_8	-----
3_2	5.011	5.000	(4+)			7.844	7.874 6_{10}	-----
4_5	5.059	5.079	-----			7.851	7.917 0_4	-----
3_3	5.096	5.094	-----			7.896	8.020 7_6	-----
2_5	5.151	5.117	-----			7.980	7.979 12_1	-----
4_6	5.412	5.154	-----			8.013	8.2175 5_{10}	-----
7_1	5.439	5.180	7-			8.015	8.013 7_7	-----
7_2	5.535	5.1976	-----			8.177	8.182 2_{10}	
5_3	5.585	5.811	8+			8.222	8.230 9_4	-----
8_2	5.686	6.2004	(5-,6+)			8.351	8.346 3_9	-----
6_4	5.696	5.361	(6+)			8.355	8.384 10_4	----
6_5	5.776	5.965	---------			8.436	8.467 8_8	-----
5_4	5.970	5.903	------2+			8.490	8.530 7_8	----
1_2	6.066	6.025	-----			8.514	8.574 8_9	
7_3	6.118	5.021	-----			8.542	6.621 1_4	
2_6	6.160	6.118	-----			8.735	8.662 9_5	
3_4	6.247	6.251	4+			8.741	8.701 7_9	
0_3	6.282	6.266				8.958	8.984 3_{10}	
6_6	6.302	6.305				9.041	9.070 10_5	
4_7	6.319	6.338				9.131	9.111	

10_1	6.325	6.2419	10+		11_2	9.175	9.141	----
4_8	6.426	6.395	4+		8_{10}	9.206	9.253	----
8_3	6.442	6.424	-----		10_6	9.275	9.304	-----
9_1	6.492	-----	-----		0_5	9.309	9.345	-----
5_5	6.516	6.513	-----		7_{10}	9.494	9.474	-----
6_7	6.569	6.574	-----		9_6	9.721	9.761	-----
3_5	6.651	6.616	-----		12_2	9.984	9.864	-----
4_9	6.676	6.685	4+		13_1	10.220	10.038	-----
2_7	6.792	6.794	-----		11_3	10.274	10.212	-----
5_6	6.795	6.851	-----		14_1	10.509	10.441	-----
3_6	6.842	6.958	(3-)		9_7	10.659	10.602	-----
8_4	6.950	6.974	-----		12_3	10.836	10.866	-----
7_4	6.963	7.041	-----		10_7	10.927	10.980	-----
6_8	6.987	7.101	-----					

Fig.2. A comparison between theoretical energy levels for two interaction and the experimental data for 46Ti.







3.2 B(E2) Calculations :

3.2.1 B(E2) for 44Ti

Within the nuclear shell model, (F7MBZ & F742) projected that the chance of an electric quadruple transition B (E2) for 44Ti would be lower. The transition probability was determined for each in-band transition assuming a pure E2 transition by using the harmonic oscillator potential (HO, b), Where b< 0. Core polarization effects have been taken into account by selecting the effective charges for the proton (ep=1.46e) and the neutron (en=0.5e). Table 5 44Ti was calculated with the help of the efficient interactions of F7MBZ and F742. Over all, there appears to be a fair amount of concordance between the computed results and the available experimental data.

Table 5: the B (E2) values for 44Ti ground-state band. They use e2fm4 units, which match the experimental results.

J_i^+	→	J_f^+	Theory B(E2) (e^2 fm^4)		Exp. B(E2) (e^2 fm^4) e_p = 1.46e , e_n = 0.5e b =1.888 fm
			F7MBZ	F742	
2_1	→	0_1	119.9	119.8	119.95
0_2	→	2_1	7.257	14.03	3137.152
2_2	→	2_1	21.55	27.96	64.588
2_2	→	0_2	12.77	12.64	212.219
2_2	→	0_1	1.285	1.029	1.384
2_3	→	0_1	0.03518	0.0005722	5.259
2_3	→	0_2	0.02539	13.38	55.362
2_4	→	0_1	0.06678	0.03225	1.199
4_1	→	2_1	154.7	150.5	276.808
4_2	→	2_1	2.295	6.207	24.913
4_2	→	2_2	28.96	28.03	193.765
4_3	→	2_1	0.007912	0.09484	4.152
4_3	→	2_3	0.02051	5.635	258.354
6_1	→	4_1	89.09	65.62	156.858

3.2.2 B(E2) for 46Ti

Within the nuclear shell model, (F7MBZ & F742) projected that the chance of an electric quadruple transition B (E2) for 46Ti would be lower. The transition probability was determined for each in-band transition assuming a pure E2 transition by using the harmonic oscillator potential (HO, b), Where b< 0. Core polarization effects have been taken into account by selecting the effective charges for the proton (ep=1.157e) and the neutron (en=0.771e). Table 6 46Ti was calculated with the help of the efficient interactions of F7MBZ and F742. Over all, there appears to be a fair amount of concordance between the computed results and the available experimental data.

Table 6: the B (E2) values for 46Ti ground-state band. They use e2fm4 units, which match the experimental results

J_i^+	→	J_f^+	Theory B(E2) (e^2 fm^4)		Exp. B(E2) (e^2 fm^4) e_p = 1.57e , e_n = 0.771e b =1.902 fm
			F7MBZ	F742	
2_1	→	0_1	120.1	119.6	------
4_1	→	2_1	125.5	121.9	489.516
0_2	→	2_1	13.69	20.78	50.910
2_2	→	2_1	50.3	41.96	

2_2	→	0_1	11.05	12.49	0.627
2_3	→	0_1	4.476	3.012	8.713
6_1	→	4_1	125	108.2	160.561
0_4	→	2_1	0.08582	0.00218	21.245
8_1	→	6_1	133.2	124.1	110.631
10_2	→	8_1	66.48	69.85	152.729

4. Conclusions

All figures show , success in reaching an agreement nearly all energy levels of the isotopes of Titanium, and a proper reproduction of the level arrangement is made . We can evaluate practically any calculations in relation to (F7MBZ & F742) data . Met with some success in replicating the level structure exhibited. Generally speaking , the greatest and most thorough results possess the biggest model space while performing calculations in the infinite sphere . In OXBASH, the model space is described based on the nucleon valence orbits that are now excited together with the outcomes of our calculations are often in agreement with experimental findings

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