Nuclear Structure of ⁴⁴⁻⁴⁶Ti isotopes using shell model by OXBASH code

Ali K. Hasan

Physics Department, College of Education for Girls, University of Kufa, Najaf, Iraq, alikh.alsinayyid@uokufa.edu.iq

Hanan K. Chyad

Physics Department, College of Education for Girls, University of Kufa, Najaf, Iraq, myid6552@gmail.com

Abstract

Studying 44-46 Ti nuclei's nuclear composition in the shell model's framework was a key to understand the electronic transition at two orbitals (1d3/2 and 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 theoretical and experimental substantial 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° : 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.

Where

$$H = H_o + H_1 \qquad \dots \dots \dots (3)$$
$$H_o = \sum_{i=1}^{A} (T_o + U_i) \qquad \dots \dots \dots (4)$$
$$H_o = \sum_{i \le i}^{A} (V_{ii}^{NN} - \sum_{i=1}^{A} U_i) \qquad \dots \dots \dots (5)$$

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 eveneven nuclei .However, On the left, you can see the results of our calculations and righthand 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 with positive (6-2, 3-2) 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.

F7MBZ	(Theoretical	Experimental values		Theoreti	cal values for	Experimental values	
values)				F7MBZ			
J^{π_+}	E (MeV)	E (MeV	J ^π	J^{π_+}	E (MeV)	E (MeV	J^{π}
01	0	0	0+	121	7.905	8.0399	(12+)
21	1.121	1.08306	2+	82	8.061	8.067	
41	2.929	2.45433	4+	52	8.139	8.318	
61	4.545	4.01531	6+	64	8.624	9.030	
2_{2}	5.554	4.7922		9 ₁	8.781	8.984	(10+)
62	5.647	5.1511	(6-)	83	9.281	9.280	
42	5.680			23	9.407	9.361	(2+,3-)
51	6.440			24	9.507	9.542	
81	6.449	6.5085	(8+)	72	9.677	9.668	
02	6.497	6.810	(0,2)+	44	9.734	9.713	(4+)
31	6.528	6.959	(4+)	45	9.832	9.100	4+
71	6.577	6.5718	(8+)	102	9.891	9.895	
43	7.705	7.634		32	10.497	10.113	(3-)

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

63	7.842	7.670	6+	65	10.794	10.520	
101	7.845	7.6711	(10+)	03	10.859	10.460	(0+)

Table (2):	Excitation	energy	predicted	by	(F742)	interactions	and	observed	excitation
energies[10] for the 44	Ti nucle	us are com	par	ed.				

F742(Theoretical values)		Experimental values			F742(Th	eoretical values)	Experimental values	
J^{π_+}	E (MeV)	E (MeV)	J ^π		J^{π_+}	E (MeV)	E (MeV)	J ^π
01	0	0	0+		82	7.345	7.458	8+
21	1.163	1.08306	2+		101	7.380	7.6711	(10+)
41	2.791	2.45433	4+		64	7.551	7.670	6+
61	4.057	4.01531	6+		121	7.689	8.0399	(12+)
22	4.956	4.7922			23	7.813	8.180	(1-,2+)
42	5.001				24	7.968		
62	5.167	4.8031	(6+)		9 ₁	7.979		
02	5.583				4_{4}	8.143	8.067	
31	5.788	5.055	3-		83	8.234		
51	5.868	5.250	5-		4 ₅	8.275	8.947	(4+)
71	6.035	5.6706	(7-)		72	8.369	8.318	
81	6.080	6.5718	(8+)		32	8.688	8.534	(2+,3-)
43	6.707	6.959	(4+)		03	8.782	9.143	(0+)
63	6.878	6.84884	(6+)		102	8.891	8.984	(10+)
52	7.018				65	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 , And The experimental energy values 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 9.205) MeV (9.168, 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 (7	Theoretical values)	Experimental	values	Theoret	ical values F7MBZ	Experimental values	
J^{π_+}	E (MeV)	E (MeV)	J ^π	J ^{<i>π</i>+}	E (MeV)	E (MeV)	J ^π
01	0	0	0+	92	7.863	7.849	
21	1.101	0.889286	2+	68	7.884	7.874	
41	2.174	2.009846	4+	27	7.932	7.937	
2_{2}	2.769	2.9618	2+	75	8.028	8.013	
42	3.218	3.213		9 ₃	8.051	8.040	
61	3.267	3.29886	6+	36	8.064	8.088	
23	3.690	3.2357	2+	410	8.190	8.134	
31	3.747	3.7715		69	8.226	8.230	
43	3.901	3.849	(4+)	103	8.228	8.2839	10+,11+,12+
1_{1}	3.996	3.731	1+	57	8.277	8.293	
51	4.022	4.003		121	8.292	8.2175	12+
62	4.190	4.398	(5-,6+)	37	8.431	8.384	
63	4.888	4.527	(6+)	86	8.452	8.467	
81	4.986	4.8969	8+	2_{8}	8.499	8.530	
02	5.193	5.117		29	8.674	8.621	
52	5.202	5.154		58	8.721	8.701	
44	5.208	5.794	4+	87	8.778	8.761	
32	5.470	5.409	3-	76	8.915	8.808	
24	5.493	5.604	(2+)	610	8.939	8.940	
45	5.633	5.992	(4+)	59	8.953	8.984	
33	5.672	5.530	3-	94	9.067	9.070	
71	5.700	5.811		510	9.156	9.141	
25	5.794	5.872	(2+)	104	9.173		
82	5.938	6.2004	8+	38	9.226	9.168	4+

72	5.945	6.025		77	9.235	9.205	6+
46	6.094	6.021		04	9.241	9.253	
53	6.132	6.251		13	9.319	9.170	1+
64	6.266	6.266		88	9.348	9.345	
101	6.438	6.2419	10+	89	9.534	9.572	
65	6.443	6.305		95	9.644	9.649	
73	6.588	6.674		210	9.740	9.615	2+
54	6.657	6.616		79	9.747	9.761	
12	6.860	6.794		112	9.822	9.790	
66	6.912	6.851		39	9.866	9.852	
91	6.921	6.8303	9-	105	9.883	9.864	
83	6.983	6.974		106	10.140	10.038	
34	7.051	7.019	(3-,4+)	79	10.208	10.212	
03	7.111	7.101		14	10.327	10.180	1+
26	7.117	7.147		810	10.445	10.441	
47	7.186	7.172		122	10.638	10.602	
67	7.255	7.201		131	10.749	10.730	
48	7.406	7.288		310	10.840	10.866	
55	7.433	7.350		141	10.900	10.938	
102	7.459	7.472		9 ₆	10.912	10.980	
35	7.576	7.534	(3-)	710	10.954	11.051	
84	7.593	7.558		113	11.271	11.299	
49	7.594	7.584		05	11.438	11.426	
74	7.619	7.608		123	11.841		
85	7.771	7.735		97	12.200		
111	7.774	7.9418	11+	107	12.351	12.974	
56	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)

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(Tł	neoretical values)	Experimental	values	F742Tł	neoretical values	Experimental values		
J^{π_+}	E (MeV)	E (MeV)	J ^π	<i>J</i> ^{π+}	E (MeV)	E (MeV)	J ^π	
01	0	0	0+	85	7.134	7.147		
21	1.148	0.889286	2+	57	7.151	7.172		
41	2.221	2.009846	4+	69	7.226	7.238		
22	2.497	2.9618	2+	75	7.232	7.288		
42	3.970	3.213		410	7.248	7.019	(3-,4+)	
61	3.154	3.29886	6+	28	7.253			
43	3.426	3.44139	4-	92	7.262			
23	3.426	3.2357	2+	102	7.110	7.172		
31	3.591	3.5531		37	7.344	7.350		
11	3.654	3.731	1+	111	7.377	7.9418	11+	
62	3.797	3.7715		93	7.405	7.472		
51	3.810	3.82643	5-	29	7.548	7.558		
63	4.620	4.527	(6+)	58	7.631	7.660		
0_{2}	4.625	4.675	0+	86	7.632	7.710		
44	4.826	4.617		103	7.729	7.730		
52	4.859	4.845		87	7.756	7.735		
81	4.866	4.8969	8+	13	7.788	7.788		
24	4.885	4.950	2+	59	7.829	7.849		
32	5.011	5.000		38	7.844	7.874		
45	5.059	5.079	(4+)	610	7.851	7.917		
33	5.096	5.094		04	7.896	8.020	(0+)	
25	5.151	5.117		76	7.980	7.979		
46	5.412	5.154		121	8.013	8.2175	12	
71	5.439	5.180		510	8.015	8.013		
72	5.535	5.1976	7-	77	8.177	8.182		
5 ₃	5.585	5.811		210	8.222	8.230		
82	5.686	6.2004	8+	94	8.351	8.346		
64	5.696	5.361	(5-,6+)	39	8.355	8.384		
65	5.776	5.965	(6+)	104	8.436	8.467		
54	5.970	5.903		88	8.490	8.530		
12	6.066	6.025		78	8.514	8.574		
73	6.118	5.021		89	8.542	6.621		
26	6.160	6.118	2+	14	8.735	8.662		
34	6.247	6.251		95	8.741	8.701		
03	6.282	6.266		79	8.958	8.984		
66	6.302	6.305		310	9.041	9.070		
47	6.319	6.338	4+	105	9.131	9.111		

101	6.325	6.2419	10+	112	9.175	9.141	
48	6.426	6.395	4+	810	9.206	9.253	
83	6.442	6.424		106	9.275	9.304	
91	6.492			05	9.309	9.345	
5 ₅	6.516	6.513		710	9.494	9.474	
67	6.569	6.574		9 ₆	9.721	9.761	
35	6.651	6.616		122	9.984	9.864	
49	6.676	6.685	4+	131	10.220	10.038	
27	6.792	6.794		113	10.274	10.212	
56	6.795	6.851		141	10.509	10.441	
36	6.842	6.958	(3-)	9 ₇	10.659	10.602	
84	6.950	6.974		123	10.836	10.866	
74	6.963	7.041		107	10.927	10.980	
68	6.987	7.101					

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



⁴⁶Ti (D)





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.

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			Theory B(E2) (e^2	fm ⁴)	Exp. B(E2) (e^2 fm ⁴)
J_{i}^{+}	\rightarrow	$J_{\rm f}{}^+$			$e_p = 1.46e$, $e_n = 0.5e$ b
			F7MBZ	F742	=1.888 fm
21	\rightarrow	01	119.9	119.8	119.95
02	\rightarrow	21	7.257	14.03	3137.152
22	\rightarrow	21	21.55	27.96	64.588
22	\rightarrow	02	12.77	12.64	212.219
22	\rightarrow	01	1.285	1.029	1.384
23	\rightarrow	01	0.03518	0.0005722	5.259
23	\rightarrow	02	0.02539	13.38	55.362
24	\rightarrow	01	0.06678	0.03225	1.199
41	\rightarrow	21	154.7	150.5	276.808
42	\rightarrow	21	2.295	6.207	24.913
42	\rightarrow	22	28.96	28.03	193.765
43	\rightarrow	21	0.007912	0.09484	4.152
43	\rightarrow	23	0.02051	5.635	258.354
61	\rightarrow	41	89.09	65.62	156.858

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

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

			Theory B(E2) (e^2	fm ⁴)	Exp. B(E2) (e^2 fm ⁴)
J_i^+	\rightarrow	J_{f}^{+}	F7MBZ	F742	$e_p = 1.57e$, $e_n = 0.771e$ b = 1.902 fm
21	\rightarrow	01	120.1	119.6	
41	\rightarrow	21	125.5	121.9	
02	\rightarrow	21	13.69	20.78	489.516
22	\rightarrow	21	50.3	41.96	50.910

22	\rightarrow	01	11.05	12.49	0.627
23	\rightarrow	01	4.476	3.012	8.713
61	\rightarrow	41	125	108.2	160.561
04	\rightarrow	21	0.08582	0.00218	21.245
81	\rightarrow	61	133.2	124.1	110.631
102	\rightarrow	81	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 а 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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