الحسابات التظرية لإمكانية الحصول على نضائر أيزمرية لعنصري الازيميوم والاريديوم في النطاق الكتلي (من 190 - 200)

✍.أ. أبراهيم محمد الأطرش
كلية الآداب الزنتان

مستخلص:

نتناول في هذه الورقة إمكانية إنتاج نظائر أيزُمرية لها متوسط عمر طويل يمتد من ثوان إلى آلاف السنين لعنصري الايزميوم والاريديوم في النطاق الكتلي (190- 200) .

الأيزُمرات هي نظائر متواجدة في مستويات طاقة عالية، وهي عبارة عن حالات مثارة مؤقتة الثبات لبعض أنوية العناصر، وهذه الأيزُمرات يمكن أن تفقد طاقة إثارتها بطرق مختلفة مثل انحلال ألفا ، بيتا ، جاما والتحول الداخلي طبقاً لطاقة وطبيعة هذا الأيزُمر.

إنَّ هذا البحث يمكننا من التنبؤ عن إمكانية تصنيع هذه النظائر الأيزُمرية في مستويات طاقة عالية، حيث يصل متوسط عمر البعض منها إلى آلاف السنين، وهذا يمكننا من استغلال هذه النظائر كخزانات للطاقة حيث إنَّها لا تحتاج إلى حيز كبير للتخزين، ويتم حالياً تصنيع نظير الهافنيوم(178) بكميات محدودة في الولايات المتحدة، وبذلك يمكن استخدام هذه الطاقة النظيفة سلمياُ وعسكرياً.

Theoretical calculations of the possibility of obtaining isomeric pisotopes of osmium and iridium in the mass range (190-200)

Ibrahim Mohammad Masoud Alatrash

Alzentan University, College of Education, Yafren, Physics Department

Abstract:

In this paper, we discuss the possibility of producing isomer isotopes with a long life expectancy of seconds to thousands of years for the elements osmium and iridium in the mass range (190-200).

Isomers are isotopes present at high energy levels, which are temporary excited states of some nuclei of elements, and these isomers can lose their excitation energy in various ways such as alpha, beta and gamma decay and internal transformation according to the energy and nature of this isomer.
This research enables us to predict the possibility of manufacturing these isomer isotopes at high energy levels, where the average age of some of them reaches thousands of years, and this enables us to exploit these isotopes as energy tanks as they do not need much space for storage, and the hafnium isotope (178) is currently manufactured in limited quantities in the United States, so this clean energy can be used peacefully and militarily.

Keywords: Isomers, Quasi-particles, (BCS) Theory, Asymptomatic quantum numbers

1- Introduction

The name isomer came from chemistry, where this name means chemical compounds that different from each other in physical and chemical properties, and consist of the same number and type of atoms.

In The nuclear physics, isomers are temporarily triggered states of atomic nuclei, and these isomers can lose their excitation by one or more known radioactive decay methods depending on the nature and energy of this isomer.

2- Reasons for the occurrence of the phenomenon:

There was a sharp contrast between the view that the nucleus of an atom is made up of clusters of strongly bonded particles, and the vision that sees nucleons encapsulated in orbits with known definite angular momentum amounts. The dispute was resolved by combining wave mechanics with Pauli's principle.

It is therefore possible to imagine the nucleus shaking, swaying and rotating its society at the same time as if its nucleon components had mathematically precisely effective quantized shells. But the excitation of single, combined particles is often completely inseparable.

Most isomers are formed at the lowest value of spin between the motion of single particles and the clustered particles, and this can be applied to:

1- Spherical nuclei near closed shells as long as there are few nucleons, in such a way the excitation of decoupling mating can generate high angular momentum moment at low energy.
2- Severely deformed nuclei with active nucleons (close to Fermi's neutron and proton levels).

3- Energy storage in isomers:

Highly twisted isomers, especially long-lived ones, are particularly important, as they act as energy tanks, and constantly decomposition β we have some kind of extended energy use while electromagnetic decomposition (γ rays, internal transformation or both) significantly induces the isomer to decomposition. When exercising an external stimulus, the release of energy is possible either rapidly (gamma rays) or in the form of gamma lasers.

4- The extent of the spread of isomers:

Nuclear isomers are scattered irregularly between nuclei with different mass numbers. Note that the largest number of nuclear isomers in regions following the numbers of protons or neutrons in the structure of nuclei (from 39 to 49, from 69 to 81 and from 111 to 125).

5- Isomer traps:

As shown in it formed in different ways The nuclear isomers known so far are is difficult for the isomer to change its geometric shape, as show in Figure (1) when it dissolves to the change of twirl is subject, the change of the state of its twirl' different state as well as it may not be possible to change the direction of the rules of choicet all of which are factor that help in the twirl relative to the axis of symmetry formation of the isomer state.

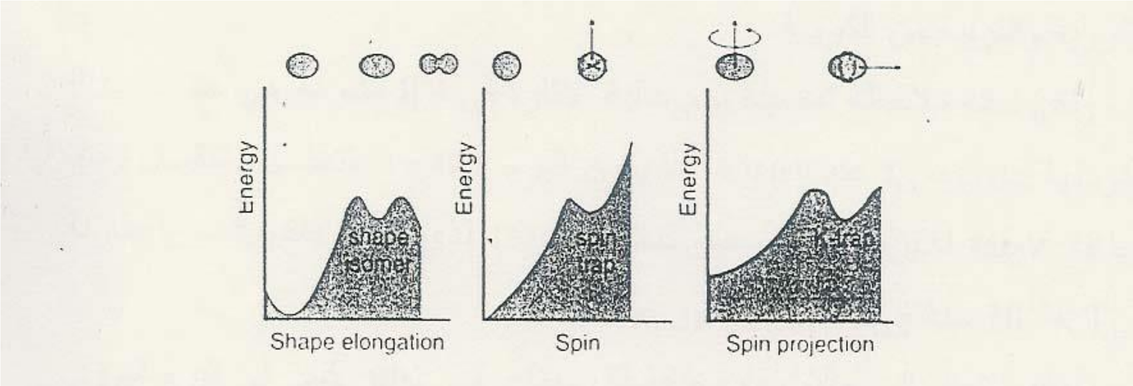

Figure (1) :shows the different methods of forming known nuclear isomers.

5-1 Isomers resulting from the geometric shape (Shape Isomers):

Isomers occur in this case as a result of the presence of a second minor endpoint in energy as a result of the elongation of the nucleus (the first minor endpoint is caused by the minimum energy level), and one of the most important examples of fissionable isomers in heavy nuclei is americium ^{242}Am This isomer is caused by the elongation of the nucleus so that the ratio of its primary axis (main) to secondary (sub) (2:1), and this isomer dissolves by fission with a half-life period equal to (14ms), and this is the longest half-life of an isomer of this type known to date.

5-2 Spin Trap:

In general, the excitation of single particles in the nucleus (the shell model of a single particle) will lead to excited states with different angular momentum quantities, and isomer states may exist as an inevitable consequence. Von Weissäcker [4] also observed that angular momentum changes are the bioreceptor of spin traps. If the change of total angular momentum (or spin) by 1 unit (λ=1) will be the preferred path of decay (where λ is the difference in spin between the initial and final states).

5-3 (K-trap):

This type of isomer is known as a K-trap and is a type of twist trap whose presence depends not only on the magnitude of the nuclear twist vector, but also on its direction.

where (K) is a quantum number representing the projection of the total nuclear spin on the axis of symmetry of the nucleus, this type of isomer arises only in distorted nuclei with axial symmetry, that are located very far from closed shells that favor spherical shape.

6- Production of isomers using the (K-Trap):

Considering the partial level to $^{178}{}_{Hf}$ shown in Figure 2, the cases were arranged in three groups of role intention. The twist constant of motion on the axis of symmetry is zero, and in the lowest energy set (beam) dependent on the value (I=1) of the base state for each state of rotation is (K=0). In the right-hand part of the diagram is an isomer (I = 8) formed when a nucleon pair is broken, and these unpaired nucleons generate 8 units of the spinning matrix on the axis of symmetry for each rotational range (K = 8), (K spin presenter set). An isomer with a (I=8) half-life of 4 seconds is decomposed by a transition with (λ=1) which must change the value of the rotation vector (I=8) within 90 degrees from being parallel to the axis of symmetry (K=8) to perpendicular (K=0). According to the simple rules of angular momentum, a transition with (λ=1) is not possible and is called a (Forbidden transition K) and the isomer is called a trap (K).

Applying the same logic to its isomer (K=16), (T1/2 =31years) as in Figure (2) the isomer decomposes into (I=12) for it (K=8) by moving to it (E=13KeV), (λ=16-12=4) and a coefficient of prevention υ= λ-kΔ = (16-8) - 4 = 4, this isomer called (λ=4).

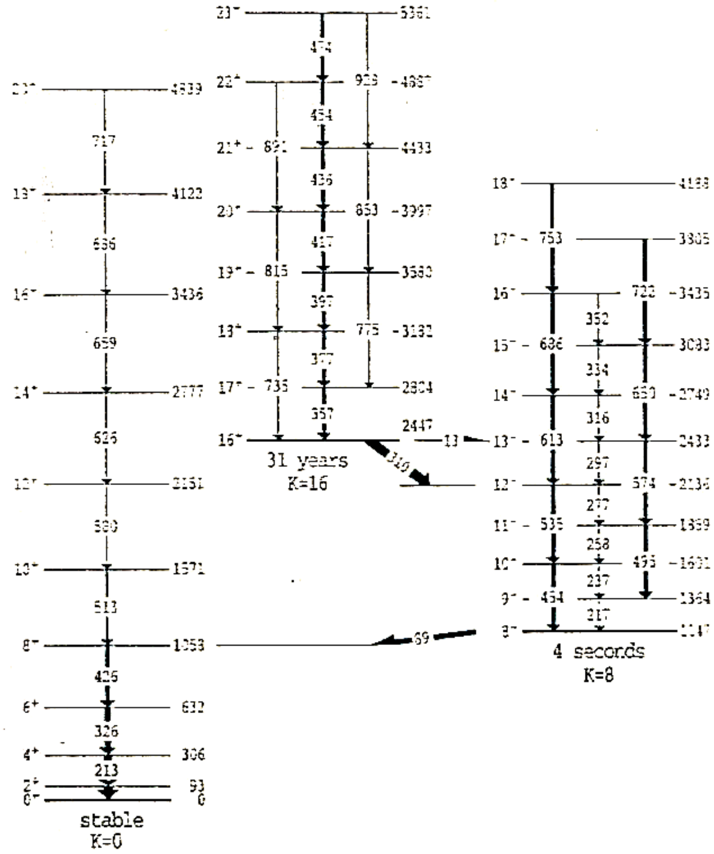

Figure 2: the partial level of hafnium ^{178}Hf shows the rotational beams K=0, K = 8 and K=16. Level energies and transitions are given in KeV.

6-1 Fusion reactions:

Heavy nuclei are necessary for the formation of high-spin isomers with fusion-evaporation reactions of the type shown in Figure (3-a) as a K trap created by the collision of ^{48}Ca with ^{130}Te after fusion which is ^{178}Hf the heaviest isotope of hafnium.

6-2 Partial fusion reactions:

Partial fusion reactions figure (3-b) can contribute to a decrease in an increase in the units of angular momentum, or in some spin states. As an example, ^{178}HF can be studied by extrusion of ^{176}Yb to ^{9}Be. Sometimes the Latter may evaporate in the field of the former, and α particles are volatilized while the unstable residue (^{5}He) merges with the target.

6-3 Scattering reactions:

Figure (C-3), explain the scattering method that recently led to discovery of new (trap-k). Successful technology includes deformed heavy nuclei as target .(H_f), and use ^{238}U deformed heavy nuclei.

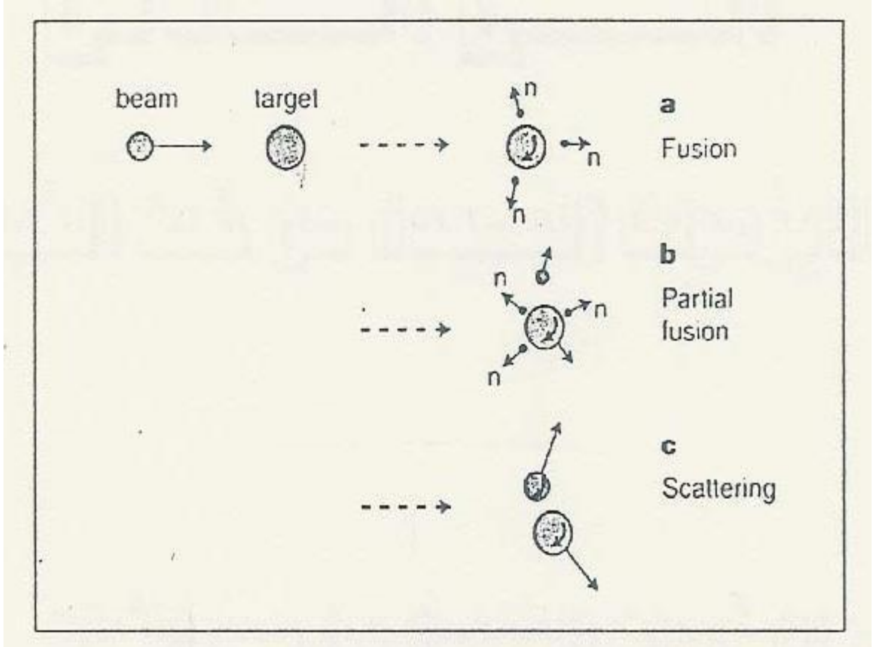

Figure (3): Some possibilities resulting from the collision of a beam of nuclei with a nuclear target.

A) Fusion – evaporation of some neutrons in 10^{-19} seconds
B) Partial fusion with evaporation of some neutrons.
C) Scattering, in all cases specific nuclei resulting from the excitation energy to 10Mev that can be dispensed with gamma radiation.

7- DECAY of β and selection rules:

An excited nucleus can get rid of its excess energy by beta rays. Beta rays are electrons emitted from the nucleus, it releases electrons (β^{-}) rays contains an excessive number of neutrons, it releases positrons (β^{+}) rays contains an excessive number of protons.

$$n \rightarrow p + e^{-} + \nu^{-} \qquad (1)$$

Where ($^{-}$√) anti neutrino.

where the excess proton ، raysβ^{+} If the nucleus contains more protons, it emits turns into a neutron according to the equation:

$$p \rightarrow n + e^{+} + \nu \qquad (2)$$

Where √ netrin0

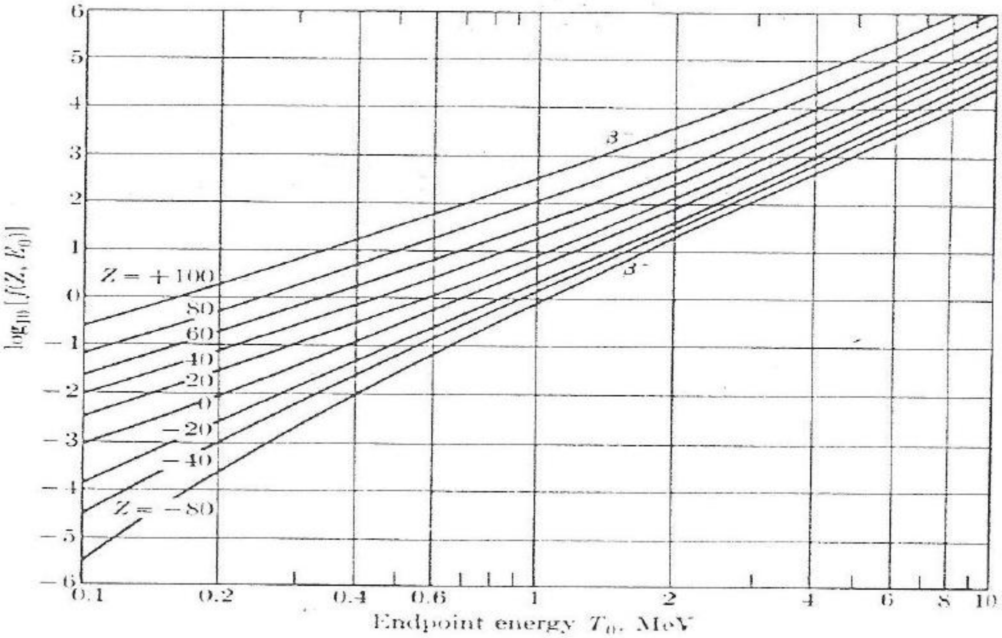

Figure (4): Fermi function as a function in T_{max} and Z for both β^{-} and β^{+}

7.1 Selection rules for beta decay:

Beta decay can be classified by the orbital angular momentum that can be carried by both the electron and the neutrino, and by the change in parity, addition, beta decay can be distinguished in terms of self-twisting of electrons and neutrino bodies, which can be :

1 - Parallel (Gamo-Teller decay)

Where: S=1

2- Non-parallel (Fermi decay) .
Where: S=0

The selection rules for angular momentum can be summarized in the following table:

Table (1): Selection rules for beta (β) decay

log(ft1/2)	Jammu-Teller Transmission		Fermi transmission			Transition
	Δπ	ΔI	Δπ	ΔI	L	
3.5 ± 0.5			No	0,1	0	Supper allowed
5.5 ± 0.5	No	1,0				Allowed
7.5 ± 0.5	Yes	1,2	Yes	0,1	1	Forbidden from the first degree
12	No	2,3	No	1,2	2	Forbidden from the second degree
16	Yes	3,4	Yes	2,3	3	Forbidden from the third degree
21	No	4,5	No	3,4	4	Forbidden from the fourth degree

. Table(2) : Asymptotic numbers and value of $Log_{10}(ft)$

$4.5\langle Log_{10}(ft)\langle 5.0$	At
$6.0\langle Log_{10}(ft)\langle 7.5$	Ah
$5.5\langle Log_{10}(ft)\approx 7.5$	1 hour
$7.5\langle Log_{10}(ft)\langle 8.5$	1 hour

(A) Allowed, (u) not disabled, (h) disabled, (1) forbidden from the first degree.

8 - Isomers far from the line of stability:

Isomers of elements far of the stability line and so, can be easily identified and detected (These elements only exist in an isomeric state), far the longest measured life time of a polysomite hafnium isomer, (^{178}Hf).

Calculations deformed shell model for nuclei that are not available for experimental observations (They do not exist in nature) predict are isomers specifically at the number of neutrons (orbit or energy level) shells (N=114-116) and deformed about $\beta_2 \cong 0.20$ (β_2 deformed quadrupole) where there are orbits ($\Omega = 9/2\,, 11/2$) in neutron Fermi level (where the excitation energy is simple)as Figure (6). Thus is ($^{186-188}Hf$) a prime candidate for future practical studies.

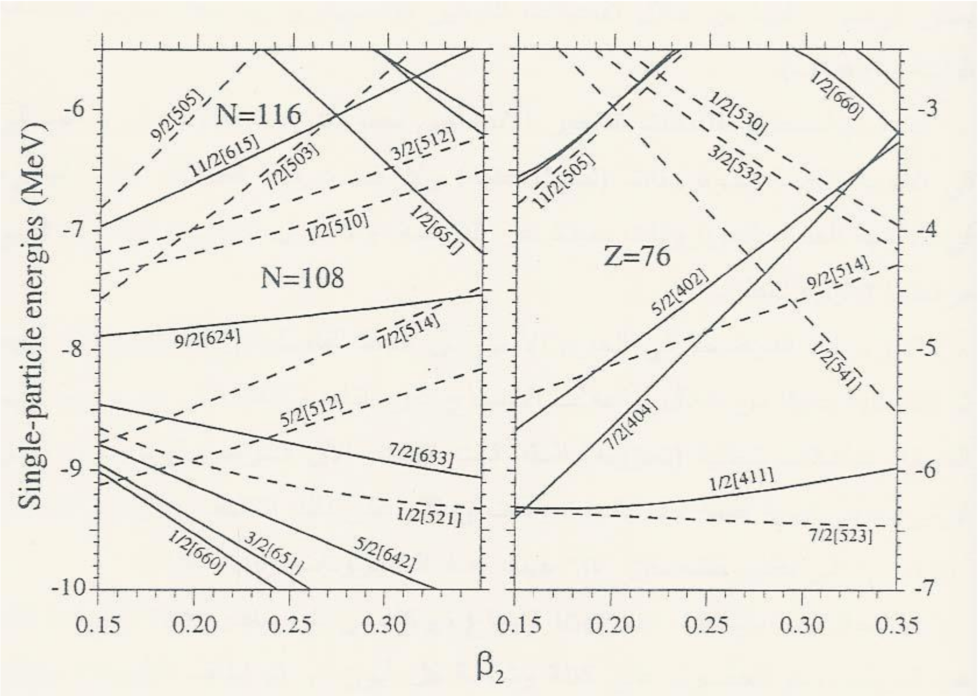

Figure (6): Nelson's orbits near Z=76 and N=108,116

8-1 Methods of production of these isomers:

Shows the isomers discovered through in completed fusion as Figure (7), to the north of the dividing line, it shows the quaternary and pentameric isomers that were studies in this way to produce reactions $^{130}Te\ (^{48}Ca\ ,3n)^{175}Hf$ that enable study ^{175}Hf at high spin, where found many isomers resulting from the formation of quasi-particles, isomer is practically observed (K) has (nine quasi-particles) (K=57/2) the presence of ^{175}Hf this is isomer has (nine quasi-particles) because the isomers contain many isomers exist in isotopes that have neutrons with high quantum numbers and these cannot be accessed through fusion evaporation reactions (by fixed beams and targets), while used inelastic reactions in depth to study spin state in deficient nuclei-neutron.

The isomers shown in the right part in Figure (7), were all recently discovered through in complete fusion reaction and inelastic reactions

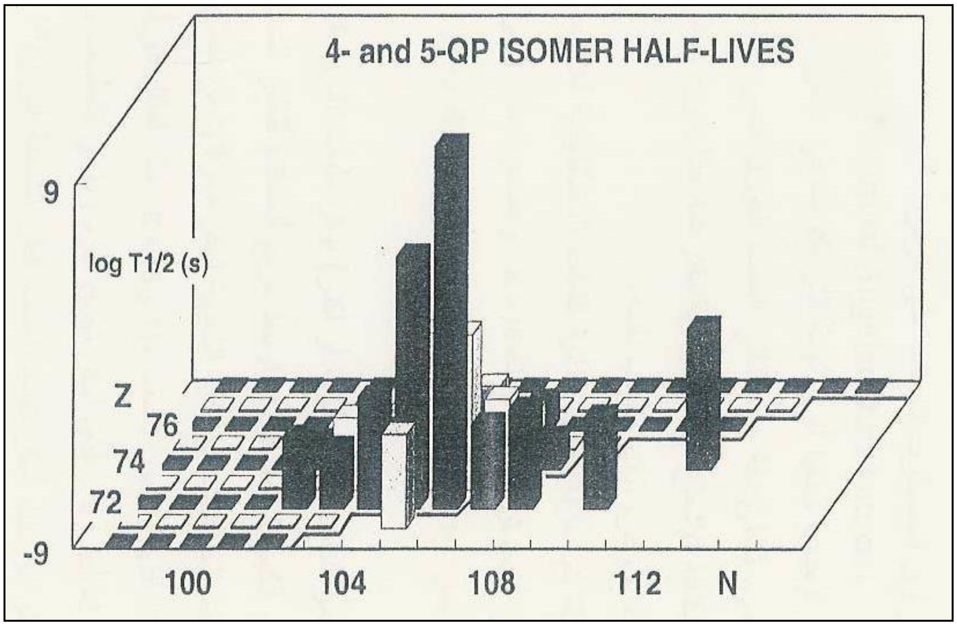

Figure (7): Isomers detected through incomplete fusion reactions

9- Theory (BCS):

The BCS (Bardeen-Cooper-Schrieffer) method, developed to explain the superconductivity of metals as a result of electron pairing in solid state studies, is the simplest possible method successfully used to understand nucleon-dice energies in nuclei.

Applications of(BCS) to highly conductive(highly fluid or diffusive) arose because the Fermion - Fermion (a Fermion with a self spin 1/2 like an electron) generates effective bosons have a rotational moment (L= 0 or L= 2) and apply Bose-Einstein distribution.

We use in nuclear physics (quasi-particle) to denote a nucleon or nucleon hole can be expressed by energy of a single particle (nucleon) (Ei):

$$E_i = \sqrt{\left[\left(\mathrm{E}_i - \lambda_f\right)^2 + \Delta^2\right]} \qquad (3)$$

Where: λ_f Fermi Energy, Δ Pair Gap Energy In The Case Of nucleons $\Delta \approx 12/A^{1/2}\ MeV$

Which corresponds to the difference in mass between the even nucleus and the odd nucleus [5].

9-1 Use of Quasi -Particles:

Pairs occur when there is an even number of identical nucleons and this occurs between the same type of nucleons (proton-proton or neutron-neutron).

Thus, there is a binding energy (Δ) in excess of the binding energy of the nucleon, and that part of the energy gained by the single particle is lost in breaking the bond of the couple when a nucleon is excited and energy is gained, it moves to higher orbits, and thus rotational states can be formed depending on the number of nucleons available and these groups of energy levels we say are the result of a combination of quasi - particles (particles or holes) and these groups vary if they depend on the number of quasi- particles and the spin of each. The number of quasi- particles is (nucleons or holes).

10- Accounts Program (B - BCS):

The program consists of three separate programs (written in FORTRAN).

1 – Pre blocking: This part calculates energy levels, calculates Nelson's numbers for each level, as well as treating both neutrons and protons

separately and calculating the energy of Nelson's levels for a group of deformation factors $\varepsilon_4 , \varepsilon_2$.

2- Blocking: This part excludes the levels that have a block as a result of the presence of a single nucleon in the levels.

3 – Formation (combination): This part reads the previous spin files and then applies the selection rules for angular momentum quantities to obtain levels formed from a number of quasi- particles (1,2,3,4,5,6,7,8,9) for nuclei. From this part of the program we get the final file (Final.dat) containing all the required information about the levels of quasi- particles (energy, spin and asymptotic quantum numbers). Where we draw the relationship between the energy of the planes and the twist I(I+1)) and this shows us the levels that are candidates to be long-lived isomers. In addition to the density of energy levels, on which it depends to obtain isomers.

10-1 Calculations of known isomers:

In atomization (atomic number change) β all (MQP) particles are expected to dissolve to their equivalents in the new nucleus, and this does not lead to a significant change in geometry. For example, a $2qp$ state in will move to a state ^{188}Hf in $2qp$ which a neutrons change into a proton. ^{188}Ta

10.1.1 Calculations for the isomer of Latium (^{177}Lu):

We take the example of a known isomer with a high spin state as in Figure 8, which shows the decomposition β of an isotope ^{177}Lu to ^{177}Hf .

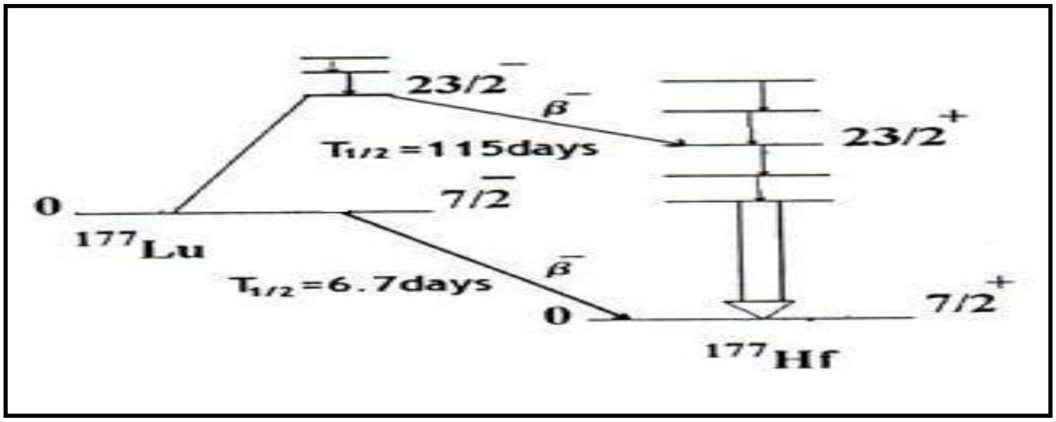

Figure 8: Decay ^{177}Lu to ^{177}Hf by two different ways

The high isomeric state occurs at ^{177}Lu the spin $(23/2)^{-}$, and we note that from this level there are two types of transitions:

1 –Transition to the $(7/2)^{-}$ (lower level) occurs in ^{177}Lu and then to the ground level $(7/2)^{+}$ in ^{177}Hf .

2 – Occurs β decay directly from $(23/2)^{-}$ in ^{177}Lu to $(23/2)^{+}$ in ^{177}Hf .

We note through the initial spin and final spin that the decay (β) is forbidden from the first degree due to the change of symmetry (Parity) and is $\Delta K = 0$ in both cases.

When taking longer-lived isomers $(23/2)^{-}$, the asymptomatic quantum numbers of the parent nucleus ^{177}Lu are:

$\nu\ (7/2)^{+}[514], (9/2)^{+}[624], (7/2)^{+}[633]$
$\pi\ (7/2)^{+}[404], (9/2)^{-}[514]$

The newborn nucleus (Daughter) $(23/2)^{+}$ in (^{177Hf}):

$\nu\ (7/2)^{+}[514], (9/2)^{+}[624]$
$\pi\ (7/2)^{+}[404], (7/2)^{-}[523], (9/2)^{-}[514]$

Thus, the change in the asymptomatic quantum numbers is:

$\Delta\Lambda = 0\ , \Delta n_z = 1, \Delta N = 1, \Delta K = 0$

From Table (1), it is clear that these transitions are prohibited from the first special order (due to the change in symmetry) and are not hindered by the selection rules for asymptomatic numbers $\Delta\pi = -1$.In table (2) It is a value $Log\ (ft) \approx 6$ for both cases.

Estimation of half-life time for two cases of β decay.

1. From ($(7/2)^{-} \rightarrow (7/2)^{+}$) from the lowest level to the lower level $Q_{\beta} = \left[M_{Lu} - M_{Hf} \right] \times 931.5 = \left[176.943233 - 176.942694 \right] \times 931.5$

$Q_{\beta} = 0.5 MeV = E_{e}$. From relation between $Log\left(f\right)$ and E_{e} figure (4) we get:

$Log\left(f\right) \approx 0.7$

$Log\left(ft\right) = 6 = Log\left(f\right) + Log\left(t\right)$

Whereas $Log\left(t\right) = 5.3$, this van gives:

$t = T_{1/2} \cong 2.3\, days$ While the actual value is (6.7days).

The previous example gives clear indications of the half-life of the decay of high spin isomers, and the same calculations can be made for elements expected to have high spin levels and occur β decay.

11- Theoretical calculations of the possibility of obtaining isomers in the mass range (190-200):

11-1 A look at the mass range (190- 200):

This range is characterized by the nucleus being well deformed allowing the formation of compounds of quasi- particles away from the stability zone of nucleons.

This facilitates the experimental measurement process, because these isotopes do not exist in nature and have a very short life span that is not measurable unless they exist in an isomeric state.

In this part, we're going to make extensive calculations of isotopes in the mass range (190-200) and try to find cases that are candidates for the formation of an isomer with a relatively long lifespan.

In these accounts, we will follow the following steps:

1- Calculation of the masses of elements far from the line of stability: Table (3) contains the calculated masses of these isotopes.

Table (3): shows the masses of elements far from the line of stability in the mass range (190-200).

Z	N	A	Mass(a.m.u)	Z	N	A	Mass(a.m.u)
76	114	190	189.8693101	77	118	195	194.875729
77	113	190	189.8707886	76	120	196	195.885507
76	115	191	190.8695541	77	119	196	195.8761568
77	114	191	190.871994	76	121	197	196.8788733
76	116	192	191.8724991	77	120	197	196.8798323
77	115	192	191.8719578	76	122	198	197.9297616
76	117	193	192.8754742	77	121	198	197.9238901
77	116	193	194.875729	76	123	199	198.89660258
76	118	194	193.9186885	77	122	199	189.9271633
77	117	194	193.9145463	76	124	200	199.8864035
76	119	195	194.8751031	77	123	200	199.8834884

2 – Finding the energies and asymptomatic quantum numbers and figures for the levels of rotational groups resulting from many quasi-particles (1,2,3,4,5,6,7,8,9):(MQP) for each peer and choose the lowest level in each band.

Table (4) shows a list of isotopes (even - even) and (even - odd) with an indication of information at the lower level as well as shows the levels that can be transferred to the nuclei (odd - odd) and (odd - even).

3. The energy levels and twists of the elements can be drawn as shown in figures (1.8 and 2.8)

4- Making calculations for the nuclei (odd - odd) as well as for the nuclei (odd - even)

5 – Tables (5) contains the final calculations of the expected isomers.

some expected isomers in the mass range shows the minimum (190-200)
Table (4) : levels of

A	Z	QP	K^{π}	E (Mev)	$K^{\pi}\left[N\ n_z\ \ \Lambda\right]$
194	76	$2qp$	5^{-}	1.3939	$\nu\ \ 9/2\left[505\right],11/2\left[615\right]$
		$4qp$	13^{+}	3.2429	$\nu\, 9/2\left[505\right],1/2\left[651\right],\nu\, 5/2\left[402\right],11/2\left[505\right]$
		$6qp$	25^{+}	5.06901	$\nu\ \ 9/2\left[505\right],11/2\left[615\right],1/2\left[651\right]$ $\pi\, 5/2\left[402\right],11/2\left[505\right]$
		$8qp$	31^{-}	7.8305	$\nu\ \ 9/2\left[505\right],11/2\left[615\right],1/2\left[651\right],13/2\left[606\right]$ $\pi\, 5/2\left[402\right],9/2\left[514\right],11/2\left[505\right],\ 3/2\left[402\right]$
	77	$2qp$	10^{+}	0.000	$\nu\ \ 9/2\left[505\right],\pi\, 11/2\left[505\right]$
		$4qp$	14^{+}	1.8849	$\nu\ \ 9/2\left[505\right]$ $,\pi\, 11/2\left[505\right],3/2\left[402\right],5/2\left[402\right]$
		$6qp$	22^{-}	4.1262	$\nu\ \ 9/2\left[505\right],11/2\left[615\right],1/2\left[651\right]$ $\pi\, 11/2\left[505\right],3/2\left[402\right],9/2\left[514\right]$
		$8qp$	31^{+}	6.9411	$\nu\ \ 9/2\left[505\right],11/2\left[615\right],13/2\left[606\right]$ $\pi\, 11/2\left[505\right],3/2\left[402\right],5/2\left[402\right]$ $9/2\left[514\right],1/2\left[541\right]$
198	76	$\boxed{2qp}$	2^{+}	1.3836	$\nu\ \ 3/2\left[642\right],1/2\left[651\right]$
		$4qp$	10^{-}	2.14704	$\nu\ \ 3/2\left[642\right],1/2\left[651\right],3/2\left[501\right],13/2\left[606\right]$
		$6qp$	18^{+}	3.9632	$\nu\ \ 3/2\left[642\right],1/2\left[651\right],\ 3/2\left[501\right],13/2\left[606\right]$ $\pi\, 5/2\left[402\right],11/2\left[505\right]$
		$\boxed{8qp}$	24^{-}	6.0573	$\nu\ \ 3/2\left[642\right],1/2\left[651\right],\ 3/2\left[501\right],13/2\left[606\right]$ $\pi\, 5/2\left[402\right],9/2\left[514\right],11/2\left[505\right],3/2\left[402\right]$
	77	$2qp$	2^{+}	0.0820	$\nu\ \ 1/2\left[651\right],\ \pi\, 3/2\left[402\right]$
		$4qp$	14^{-}	1.0531	$\nu\ \ 1/2\left[651\right],3/2\left[642\right],13/2\left[606\right]$ $\pi,11/2\left[505\right]$

A	Z	QP	K^{π}	E (Mev)	$K^{\pi}[N\ n_z\ \Lambda]$
		$6qp$	20^{+}	3.1400	$\nu\ 1/2[651],3/2[642],13/2[606]$ $\pi,11/2[505],3/2[402],9/2[514]$
		$8qp$	18^{+}	5.1220	$\nu\ 3/2[501],3/2[642],13/2[606]$ $\pi 11/2[505],3/2[402],1/2[400],9/2[514]$ $,3/2[532]$

11-2 Examples for method of calculations some isomers:

1 - ${}^{194}_{76}Os_{118}$

This isomer could exist in a state ($2qp,4qp,6qp,8qp$) with different half-life.

Through the energy available to decay β to ${}^{194}_{77}Ir_{117}$ and the maximum energy available to the electron and B-BCS calculations:

(a) In the state of level 5^{-} ($2qp$)

$$Q_{\beta}=\left(M\left({}^{194}_{76}Os_{118}\right)-M\left({}^{194}_{77}Ir_{117}\right)\right)\times 931.503$$

$$=(193.9186885-193.9145463)\times 931.5=3.8585\,MeV$$

From Table (4) we get the asymptomatic quantum numbers figures (4) (AQN) for the initial and final states. Level 5^{-} ($2qp$) has energy E=1.3939MeV and state forms are two neutrons $\nu\ 9/2[505]\ ,\ 11/2[615]$. Decomposition occurs β by a single transformation of neutrons into protons, the similar level in ${}^{194}_{77}Ir_{117}$ at energy E=0.00MeV with spin 10^{+} and Nelson's numbers (AQN): $\nu\ 9/2[505]\ ,\ \pi\ 11/2[505]$

Thus, the change in Nelson's numbers (AQN):
$\Delta\Lambda=0\ ,\Delta n_z=1,\Delta N=1,\Delta K=0$

Applying the selection rules Table (1) the transition is constrained by quantum numbers
$\Delta\Lambda=0\ ,\Delta n_z=1,\Delta N=1,\Delta K=0$

If we expect $Log\ (ft) \approx 5.5$

From the graphical relationship between E_e , $Log\ (f)$ shown in Figure (4) we get

$Log\ (f) \approx 4.3$

And the half-life of this case $Log\ (t) = 5.5 - 4.3 = 1.2$, $t = T_{1/2} = 15.85\,\text{sec}$

Table 5 shows half-life calculations for all expected isomer states.

Table (5): Calculation of half-lives of expected isomers in the mass range (190-200)

Element	A	Z	$T_{1/2}$								
			1qp	2qp	3qp	4qp	5qp	6qp	7qp	8qp	9qp
(Os) Osmium	190	76	-	3s	-	360d	-	110d	-	-	-
	191	76	$2x10^3$y	-	-	2.2h	255y	-	6y	-	-
	192	76	-	10.5m	-	3.2h	-	145.7d	-	8.35m	-
	193	76	$1.2x10^6$y	-	$2x10^9$y	-	2y	-	$1x10^9$y	-	12s
	194	76	-	15.85s	-	19.95 s	-	-	-	73d	-
	195	76	50d	-	-	3y	210d	-	10. 5s	-	-
	196	76	-	$1.2x10^5$y	-	23d	-	$1.3x10^4$y	-	-	-
	197	76	124d	-	254d	-	-	-	2.4s	-	2.1y
	198	76	-	3.98s	-	$2x10^9$y	-	183d	-	-	-
	199	76	$2.1x10^4$y	-	8.11s	-	-	-	33d	-	-
(Ir)	190	77	-	-	-	-	-	-	-	-	-
	191	77	-	-	-	-	5.23s	-	2.22h	-	-

Iridium	192	77	-	2.3y	-	10.3s		1.5y	-	11.2s	-
	193	77	-	-	$3.1x10^3$y	-	2.3s	3.6h	-	-	-
	194	77	-	-	-	3.64m	-	-	-	-	-
	195	77	-	-	2.3s	-	55.21m	-	3.4y	-	-
	196	77	-	$1.1x10^2$y	-	5.54m	-	-	-	-	-
	197	77	-	-	-	-	44.2m	-	5.2s	-	-
	198	77	-	10.32s	-	-	-	2.3d	-	-	-
	199	77	-	-	2.33s	-	2.34m	-	2.3d	-	-

The following symbols denote :(S = second, m = minute, h = hour, d = day , y = year)

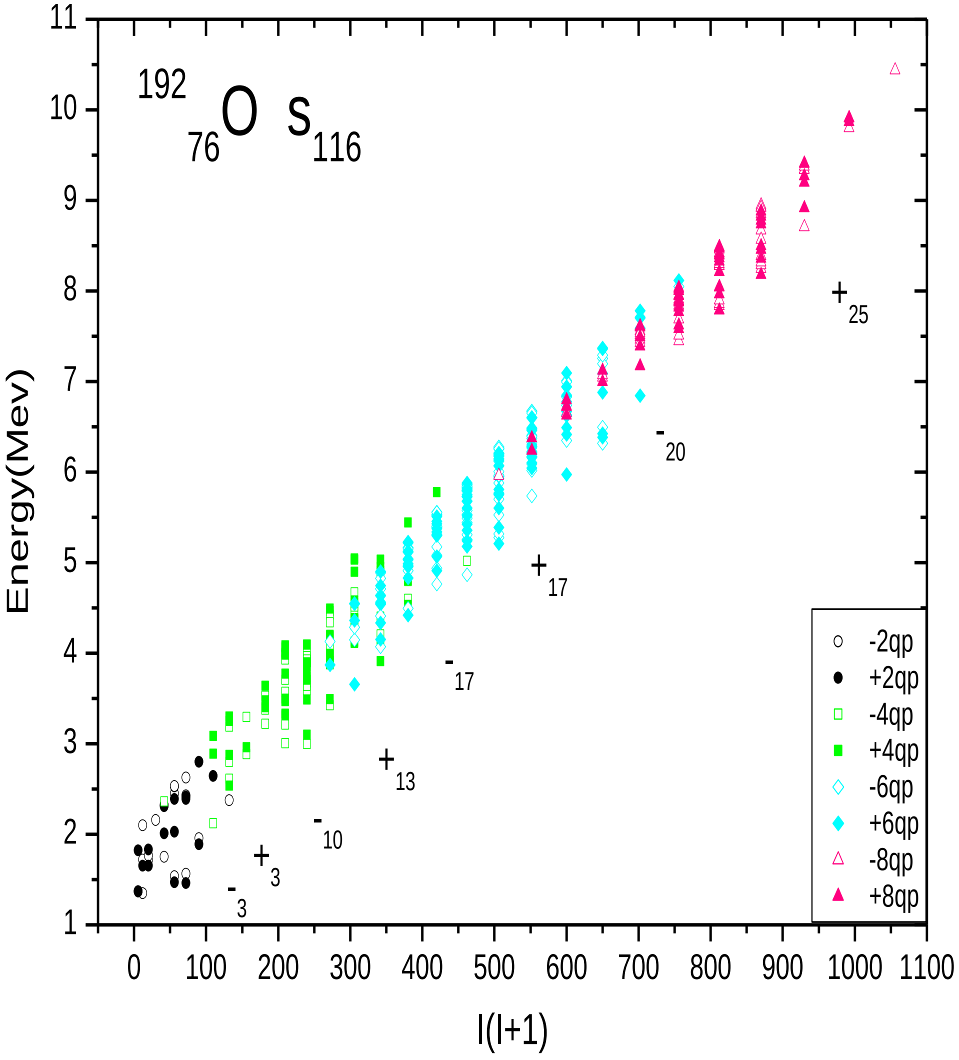

Figure (1.8): Cases state of quasi- particles as a function of the I(I+1) for the isotope of the Osmium ${}^{192}_{76}Os_{116}$

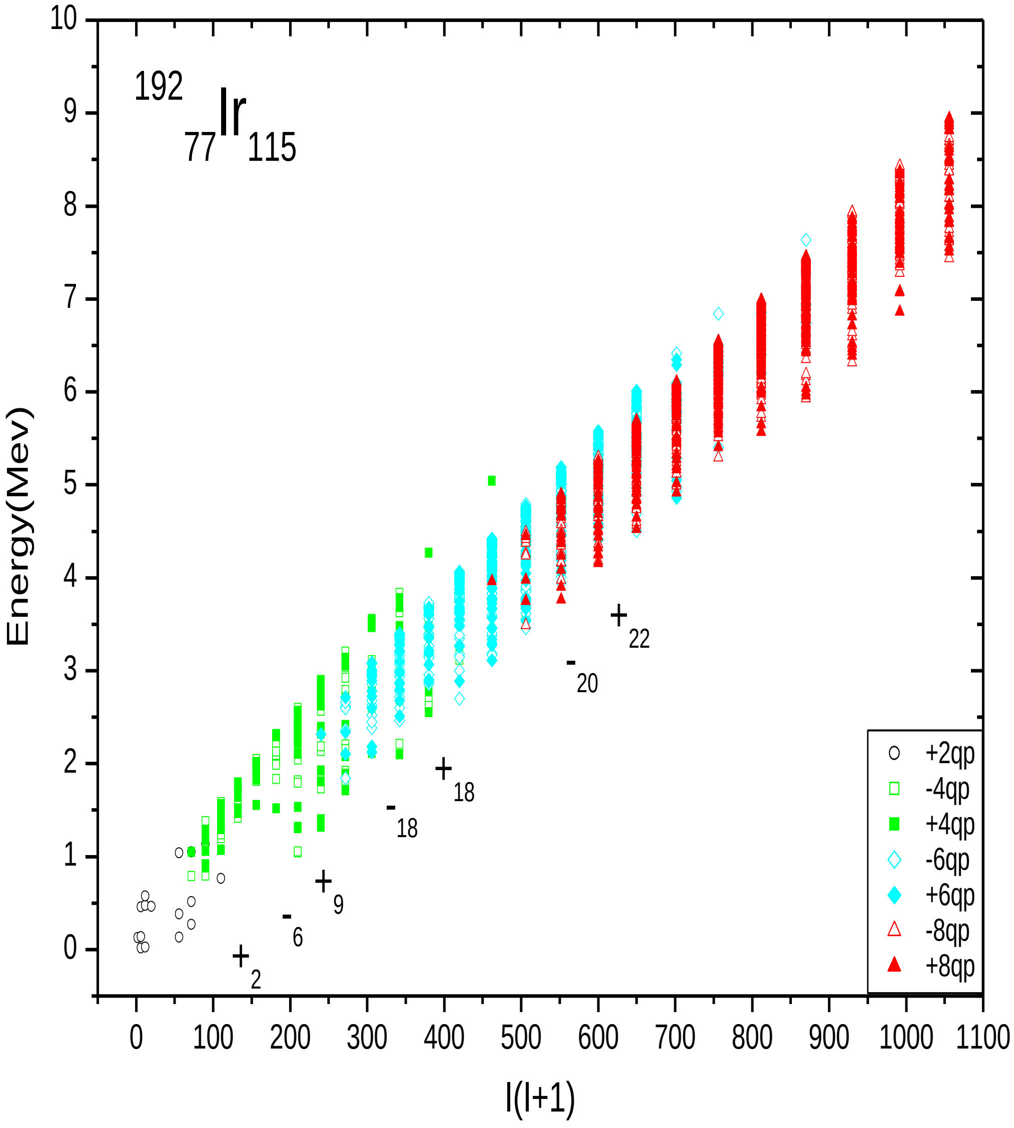

Figure (2.8) :Cases state of quasi- particles as a function of the I(I+1) for the isotope of the Iridium $^{12}_{77}Ir_{115}$

Conclusion

Theoretical calculations and their comparison with practical results are essential in trying to understand natural phenomena as well as paving the way for the possibility of conducting practical experiments. Energy has been the center of human attention since ancient times, as has the need for a way to store this energy, especially now with the development of technology, and the increasing demand for energy is more urgent than ever.

From the calculations that worked on the isotopes of Osmium and iridium shown in Table (5), there are chances of isomers with ages ranging from seconds to thousands of years, and thus we have paved the way for practical experiments of these isotopes, and the possibility of manufacturing them, as they are a large source of energy, and do not need a large storage space, and do not contain radioactive materials such as fission and nuclear fusion, and thus these isotopes can be used peacefully and militarily.

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