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Upper Limit in Mendeleev's Periodic Table

Uhq (Unhexquadium)

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Abstract: *Respecting the double-surface geometry the 164thelement Unhexquadium as the upper limit in Mendeleev's periodic table is predicted. Besides, using the same geometry Bismuth as the first on the 1s electron orbital less stable element in the mentioned periodic table is recognized.*

Keywords: *effective nuclear charge, double-surface geometry, 1s electron orbital, Uhq or element No.164*

1. PREFACE

The subject of interest of this paper is with the help of the double-surface geometry [1] to relate the effective nuclear charge [2],[3] to the electron orbit length [1], [4]. And further, find the last element in Mendeleev's periodic table possessing the highest effective nuclear charge seen by the electron on to the nucleus closest, i.e. 1s orbital.

2. THE ORBIT DOUBLE-SURFACE

Due to the double-surface geometry [1] the length of any orbit–and the electron one is not an exception-is the average elliptic-hyperbolic length s expressed by the elliptic length n of that orbit as [5]:

$$s(n) = n\left(2 - \frac{1}{\sqrt{1+\frac{\pi^2}{n^2}}}\right). \quad (1)$$

For the elliptic length n given in the units of Compton wave lengths of the orbiting body holds [5]:

$$1 \leq n \in \mathbb{N}. \quad (2)$$

The elliptic length n being the natural number is at the same time the orbit name [4]. The number of possible orbits n is in principle infinite but their lengths s expressed in Compton wave lengths of the orbiting body are of irrational discrete values [5].The shortest length having elliptic value $n = 1$ is the 1^{st} one which satisfying the physical body's wave nature makes the motion stable [5]. Other lengths surpass this value [5]:

$$s(1) = 1{,}6966855\ldots \leq \mathrm{s(n)}, \qquad n \in \mathbb{N}. \quad (3)$$

3. THE ORIGINAL AND DISTRIBUTED GROUND STATE ELECTRON ORBIT

In the ground state the electron possesses due to equality of Coulomb and centripetal force the lowest and therefore most favourable total energy W_t consisting of kinetic energy W_k and potential energy W_p expressed as [6]:

$$W_t = W_k + W_p = Z_{effective}\,\frac{m_e c^2}{2\alpha^{-2}} - Z_{effective}\,\frac{m_e c^2}{\alpha^{-2}} = -Z_{effective}\,\frac{m_e c^2}{2\alpha^{-2}}. \quad (4)$$

Where:

$$W_t = -Z_{effective}\,\frac{m_e c^2}{2\alpha^{-2}},$$

$$W_k = Z_{effective}\ \frac{m_e c^2}{2\alpha^{-2}},$$

$$W_p = -Z_{effective}\ \frac{m_e c^2}{\alpha^{-2}},$$

$$Z_{effective}\ = effective\ nuclear\ charge,$$

$$m_e = ground\ mass\ of\ electron,$$

$$\alpha^{-1} = inverse\ fine\ structure\ constant,$$

$$c = speed\ of\ light. \tag{5}$$

Keeping the ratio of given kinetic and potential energy $\frac{W_k}{W_p}$ (5) untouched (4) the length of corresponding, let us say, electron original orbit $s_{original}$ can be expressed as [5]:

$$s_{original}\ = \frac{\alpha^{-1}}{Z_{effective}}. \tag{6}$$

On the other hand the changed electron kinetic energy/potential energy ratio $\frac{W_k}{W_p}$ (5)enabled by the uniform motion on non-Euclidean double surface justifies the electron path distribution on the surrounding orbits [4]. Briefly, the electron orbital consisted of discrete number of distributed orbits can be formed. If so done then the length of distributed electron orbits$s_{distributed}$ is related to the amount of possessed changed kinetic energy $W_k(s_{distributed}\ )$ of the orbiting electron as [4]:

$$s_{distributed}\ = \frac{2}{1+\frac{W_k(s_{distributed}\ )}{W_k}}\ x\ s_{original}\ . \tag{7}$$

Keeping the total energy untouched the electron can in principal possesses any amount of kinetic energy $W_k(s_{dist\,ribuded}\ )$ on the finite interval of orbit lengths $s_{distributed}$ as follows:

$$0 < s_{distributed}\ < 2\ x\ s_{original}\ . \tag{8}$$

Since(7):

$$W_k(s_{distributed}\ ) = W_k\left(2\ x\ \frac{s_{original}}{s_{distributed}} - 1\right). \tag{9}$$

And for instance:

$$W_k(s_{distributed}\ = 0) = \infty, \tag{10a}$$

$$W_k\left(s_{distributed}\ = s_{original}\ \right) = W_k, \tag{10b}$$

$$W_k\left(s_{distributed}\ = 2\ x\ s_{original}\ \right) = 0. \tag{10c}$$

4. THE KINETIC ENERGY OF INTEREST

The kinetic energy of interest is only that one enabling the electron orbiting on the elliptic orbit of integer length n measured in Compton wave lengths of the electron [4]. Thus combining (1) and (7) we have:

$$s(n) = n\left(2 - \frac{1}{\sqrt{1+\frac{\pi^2}{n^2}}}\right) = s_{distributed}\ = \frac{2}{1+\frac{W_k(s_{distributed}\ )}{W_k}}\ x\ s_{original}\ . \tag{11}$$

We can see (11) that the original elliptic orbit $n_{original}$ (manifesting to the observer through $s_{original}$) does not necessarily need to be of integer value (as proposed previously [5]) as long as the electron can adopting its kinetic energy $W_k(s_{distributed}\ )$ chooses some other elliptic orbit n measuring integer value of Compton wave lengths of the electron.

5. THE EFFECTIVE NUCLEAR CHARGE AND ITS MAXIMAL VALUE IN THE ATOM

The electron original orbit length $s_{original}$ and effective nuclear charge $Z_{effective}$ are in inverse proportion (6):

$$Z_{effective} = \frac{\alpha^{-1}}{s_{original}}. \quad (12)$$

Respecting the classical non-distributive electron orbits as well as fixed electron kinetic energy/ potential energy ratio $\frac{W_k}{W_p}$ the maximal effective nuclear charge in any atom should not exceed the next value [5]:

$$Z^{max}_{effective}\ (classical) = \frac{\alpha^{-1}}{s(1)} = \frac{\alpha^{-1}}{1.6966855\ldots} = 80.7669. \quad (13)$$

Respecting the non-classical distributive electron orbits as well as variable kinetic energy/ potential energy ratio $\frac{W_k}{W_p}$ the maximal effective nuclear charge in any atom could be twice as high $(10c)$:

$$Z^{max}_{effective}\ (non-classical) = 2\,x\,\frac{\alpha^{-1}}{s(1)} = 161.5338. \quad (14)$$

6. THE EFFECTIVE NUCLEAR CHARGES OF THE IS ELECTRONS THROUGH THE EXTENDED MENDELEEV'S PERIODIC TABLE

The concerned values are presented in Table 1.

Table1. *The calculated (No.1 to No.86) and estimated (No.87 to No.164)1s effective nuclear charges through the extended Mendeleev's periodic table*

	No.	$Z_{effective}$	ΔZ_{eff}											
H	1	1,0000	0,6875	Mo	42	41,1256	0,9834	**Bi**	**83**	**81,3982**	**0,9786**	124	121,5209	0,9787
He	2	1,6875	1,0031	Tc	43	42,1090	0,9833	Po	84	82,3768	0,9786	125	122,4995	0,9787
Li	3	2,6906	0,9942	Ru	44	43,0923	0,9833	At	85	83,3554	0,9787	126	123,4781	0,9787
Be	4	3,6848	0,9947	Rh	45	44,0756	0,9833	Rn	86	84,3341	0,9787	127	124,4567	0,9787
B	5	4,6795	0,9932	Pd	46	45,0589	0,9834		87	85,3127	0,9787	128	125,4353	0,9787
C	6	5,6727	0,9924	Ag	47	46,0423	0,9833		88	86,2913	0,9787	129	126,4139	0,9787
N	7	6,6651	0,9928	Cd	48	47,0256	0,9841		89	87,2699	0,9787	130	127,3925	0,9787
O	8	7,6579	0,9922	In	49	48,0097	0,9823		90	88,2485	0,9787	131	128,3711	0,9787
F	9	8,6501	0,9920	Sn	50	48,9920	0,9824		91	89,2271	0,9787	132	129,3497	0,9787
Ne	10	9,6421	0,9838	Sb	51	49,9744	0,9824		92	90,2057	0,9787	133	130,3283	0,9787
Na	11	10,6259	0,9830	Te	52	50,9568	0,9823		93	91,1843	0,9787	134	131,3069	0,9787
Mg	12	11,6089	0,9821	I	53	51,9391	0,9824		94	92,1629	0,9787	135	132,2855	0,9787
Al	13	12,5910	0,9835	Xe	54	52,9215	0,9828		95	93,1415	0,9787	136	133,2641	0,9787
Si	14	13,5745	0,9833	Cs	55	53,9043	0,9818		96	94,1201	0,9787	137	134,2427	0,9787
P	15	14,5578	0,9831	Ba	56	54,8861	0,9822		97	95,0987	0,9787	138	135,2213	0,9787
S	16	15,5409	0,9830	La	57	55,8683	0,9798		98	96,0773	0,9787	139	136,1999	0,9787
Cl	17	16,5239	0,9836	Ce	58	56,8481	0,9825		99	97,0559	0,9787	140	137,1785	0,9787
Ar	18	17,5075	0,9820	Pr	59	57,8306	0,9826		100	98,0345	0,9787	141	138,1571	0,9787
K	19	18,4895	0,9835	Nd	60	58,8132	0,9826		101	99,0131	0,9787	142	139,1357	0,9787
Ca	20	19,4730	0,9836	Pm	61	59,7958	0,9825		102	99,9917	0,9787	143	140,1143	0,9787
Sc	21	20,4566	0,9843	Sm	62	60,7783	0,9826		103	100,9703	0,9787	144	141,0929	0,9787
Ti	22	21,4409	0,9847	Eu	63	61,7609	0,9826		104	101,9489	0,9787	145	142,0715	0,9787
V	23	22,4256	0,9882	Gd	64	62,7435	0,9826		105	102,9275	0,9787	146	143,0501	0,9787
Cr	24	23,4138	0,9819	Tb	65	63,7261	0,9825		106	103,9061	0,9787	147	144,0287	0,9787
Mn	25	24,3957	0,9853	Dy	66	64,7086	0,9826		107	104,8847	0,9787	148	145,0073	0,9787
Fe	26	25,3810	0,9858	Ho	67	65,6912	0,9825		108	105,8633	0,9787	149	145,9859	0,9787
Co	27	26,3668	0,9858	Er	68	66,6737	0,9826		109	106,8419	0,9787	150	146,9645	0,9787
Ni	28	27,3526	0,9860	Tm	69	67,6563	0,9826		110	107,8205	0,9787	151	147,9431	0,9787
Cu	29	28,3386	0,9859	Yb	70	68,6389	0,9806		111	108,7991	0,9787	152	148,9217	0,9787
Zn	30	29,3245	0,9849	Lu	71	69,6195	0,9821		112	109,7777	0,9787	153	149,9003	0,9787
Ga	31	30,3094	0,9843	Hf	72	70,6016	0,9821		113	110,7563	0,9787	154	150,8789	0,9787
Ge	32	31,2937	0,9846	Ta	73	71,5837	0,9820		114	111,7349	0,9787	155	151,8575	0,9787
As	33	32,2783	0,9839	W	74	72,5657	0,9821		115	112,7135	0,9787	156	152,8361	0,9787
Se	34	33,2622	0,9849	Re	75	73,5478	0,9821		116	113,6921	0,9787	157	153,8147	0,9787
Br	35	34,2471	0,9845	Os	76	74,5299	0,9820		117	114,6707	0,9787	158	154,7933	0,9787
Kr	36	35,2316	0,9762	Ir	77	75,5119	0,9821		118	115,6493	0,9787	159	155,7719	0,9787
Rb	37	36,2078	0,9833	Pt	78	76,4940	0,9821		119	116,6279	0,9787	160	156,7505	0,9787
Sr	38	37,1911	0,9845	Au	79	77,4761	0,9820		120	117,6065	0,9787	161	157,7291	0,9787
Y	39	38,1756	0,9834	Hg	80	78,4581	0,9828		121	118,5851	0,9787	162	158,7077	0,9787
Zr	40	39,1590	0,9833	Tl	81	79,4409	0,9786		122	119,5637	0,9787	163	159,6863	0,9787
Nb	41	40,1423	0,9833	**Pb**	**82**	**80,4195**	**0,9787**		123	120,5423	0,9787	**164**	**160,6649**	**0,9787**

The 86 known effective nuclear charges seen by the electron on the 1s orbital from Hydrogen to Radon are collected from Chemical Physics literature [2], [3]. The other 78 are estimated applying the effective nuclear charge difference between Astatine (At) and Radon (Rn) [3] so that the upper estimation of the maximal effective nuclear charge is achieved.

The 165th element is not included in the above periodic table of elements since the estimated 1s effective nuclear charge 161.6435of this hypothetical element surpass the allowed maximal nuclear charge 161.5338(14).

7. RESULTS

We can see from Table 1 that the maximal effective nuclear charge based on the classical non-distributive electron orbits (13) lies between the effective nuclear charge of Lead as the 82th element and Bismuth as the 83th element in Mendeleev's periodic table:

$$Z_{effective}^{Pb} = 80.4195 < Z_{effective}^{max}\ (classical) = 80{,}7669 < Z_{effective}^{Bi} = 81.3982. \quad (15)$$

With the help of equation (6) we can state that Bismuth is the first atom whose original position of 1s electrons falls below the average elliptic-hyperbolic length of the 1st orbit:

$$s_{Bi} = \frac{\alpha^{-1}}{Z_{effective}^{Bi}} = 1.6835 < s(1) = 1.6967. \quad (16)$$

This means that classical non-distributive electron orbits do not support the existence of Bismuth and heavier elements. For instance, only the distributed 1s electrons of Bismuth circulating above and on the 1st orbit can survive and enable the orbital stability of Bi atom. But a threat that those electrons may slip below the 1st orbit and fall into the Bi nucleus – no matter how big or small the threat is – always exists. The same danger holds true for all elements possessing higher atomic number than 82.

We can also see from the same table that the maximal effective nuclear charge based on the non-classical distributive electron orbits (14) lies between the nuclear charge of Unhexquadium (Uhq) as the 164th element in the extended Mendeleev's periodic table and the nuclear charge of hypothetical 165th element being located outside it:

$$Z_{effective}^{Uhq} = 160.6649 < Z_{effective}^{max}\ (non-classical) \approx 161.5388 < Z_{effective}^{165} = 161.6435. \quad (17)$$

With the help of equation (14) we can conclude that the 165th or higher elements cannot exist since their 1s electrons possess too little kinetic energy W_k to be distributed on the safe 1st or higher electron orbits:

$$s_{165} = \frac{2\alpha^{-1}}{Z_{effective}^{165}} = 1.6955 < s(1) = 1.6967. \quad (18)$$

The 1s electrons of Uhq are distributed solely on the 1st orbit.

8. CONCLUSIONS

Respecting the limitations of the double-surface geometry the 83th element Bismuth (Bi) should be regarded as the first orbital less stable element and 164thelement Unhexquadium (Uhq) as the last orbital enough stable one to be included in Mendeleev's periodic table.

DEDICATION AND ACKNOWLEDGEMENT

This fragment is dedicated to my dear family: wife Ivka (61) and daughters Natalija (40), Manica (35) and Alenka (28). For every moment of their patience and love.

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