The New Periodic Table of Chemical Elements According to the Deterministic Quantum Model

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Abstract

The current periodic table of chemical elements presents numerous problems because of the presence of many elements that are in actuality out of the periodic classification of groups, like transition elements that are about the half of chemical elements. Here we propose a new table that searches for solving many problems, even if not all. It is supposable hence that in future also this table can undergo changes and improvements because of a greater theoretical understanding and of a further experimental examination of chemical elements. The most important aspects of the new table consist in the 10+1 new groups in place of the present 7+1 and in the 15 periods in place of the present 7 periods. It allows to include inside the new table the numerous elements of transition that at present are out of a coherent classification.

1. Introduction

Every chemical element has a different electronic configuration and consequently it has different physical and chemical characteristic. Anyway similary properties can be identified for different elements as per a few criteria. The most representative criteria are:

a. the same number of electrons into the external level or sub-level
b. noble (or inert) elements are characterized by particular properties of the most external sub-levels
c. configurations of the external level or sub-level with 2 electrons, or with 8 electrons, or with combinations (6+2) and (2+6) electrons have particular properties of chemical inertia.

The relation that gives values of energy of electrons inside atoms with any atomic number Z is given by the Deterministic Quantum Model[1]:

$$E_{nkjs} = -\frac{2Z^2Rhc}{n^2}\left(1 - \frac{k^2}{2n^2}\right)\left(1 - \frac{1}{2}\,\frac{\alpha^2 Z^2 (j-s)}{n^4}\right) \qquad (1)$$

in which R is Rydberg's constant , α is Lamb's constant of fine structure and

$n = 1, 2, ...$ is the quantum number of level
$k = 1, 2, ... n$ quantum number of sub-level
$j = \pm 1, \pm 2, ... \pm k$ quantum number of orbital momentum
$s = \frac{|j|}{2}$ quantum number of spin

An important concept for defining physico-chemical characteristics of elements is the valency.
The **valency** of a chemical element is the number of electrons of the external sub-levels of energy that an atom is able to put at disposal in order to generate chemical bonds.
Because a chemical element generally has more available external electrons, it follows that the **maximum valency** is the maximum number of available electrons and the **effective valency** is the effective number of electrons that atom puts at disposal for every single chemical bond and hence the effective valency can be smaller that the maximum valency.
Another important concept is the **ionization potential**.
It represents energy that is necessary for extracting an electron from atom and it regards largely the external sub-level. Experimental methods that are used for measuring ionization potentials seem nevertheless inappropriate.
In current periodic tables about the half of chemical elements are effectively regrouped while remaining elements constitute so-called transition elements and they are in actuality out of the periodic table.
It represents an evident anomaly and it is due to the fact that in those tables it is assumed wrongly that energy levels of electrons that are effectively present in atoms undergo the same reversals like some potential sub-levels of energy that are available for the only electron of hydrogen atom when it jumps from the fundamental state to more external states: like this for instance, it is assumed that for any element electrons 4s are more internal than electrons 3d and sub-levels 5s, 5p, 5d are more internal than the sub-level 4f.
These assumptions derive from a wrong interpretation of potential levels of energy of hydrogen atom and calculations prove for instance for all atoms electrons 4s are more external than electrons 3d.

2. The current Periodic Table of chemical elements

Before presenting the new periodic table we think it is useful to show the current periodic table so that it is possible also to perform an useful comparison between the two tables.
The current periodic table of chemical elements, due mainly to the Russian chemist Dmitrij I. Mendeleev, is represented in table 1 and it has been derived from the reference [4].

Table 1. Present Periodic Table of Chemical Elements[4]

Period	Group																	
	1	2											3	4	5	6	7	0
1	H 1																	He 2
2	Li 3	Be 4											B 5	C 6	N 7	O 8	F 9	Ne 10
3	Na 11	Mg 12	Transition Elements										Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
4	K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
5	Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
6	Cs 55	Ba 56	* 57-71	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
7	Fr 87	Ra 88	** 89-103	*** 104-118														

*	La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71
**	Ac 89	Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103
***	Rf 104	Db 105	Sg 106	Bh 107	Hs 108	Mt 109	Ds 110	Rg 111	Cn 112	Nh 113	Fl 114	Mc 115	Lv 116	Ts 117	Og 118

How it is possible to observe, the greater part of chemical elements in the present periodic table is in actuality out of a periodic classification.

3. Electronic Configurations of atoms of chemical elements

As per calculations performed in articles[2][3] we are able to define electronic configurations of single atoms of chemical elements and to specify the distribution of electrons into single sub-levels.
These configurations are represented in table 2.

Table 2. Electronic Configurations in the Deterministic Quantum Model

		n	1	2		3			4				5				
Z	Name	k	s	s	p	s	p	d	s	p	d	f	s	p	d	f	q
1	H		1														
2	He		2														
3	Li		2	1													
4	Be		2	2													
5	B		2	3													
6	C		2	4													
7	N		2	4	1												
8	O		2	4	2												
9	F		2	4	3												
10	Ne		2	4	4												
11	Na		2	4	4	1											
12	Mg		2	4	4	2											
13	Al		2	4	4	3											
14	Si		2	4	4	4											
15	P		2	4	4	5											
16	S		2	4	4	6											
17	Cl		2	4	4	6	1										
18	Ar		2	4	4	6	2										
19	K		2	4	4	6	2, 1										
20	Ca		2	4	4	6	2, 2										
21	Sc		2	4	4	6	2, 3										
22	Ti		2	4	4	6	2, 4										
23	V		2	4	4	6	2, 4	1									
24	Cr		2	4	4	6	2, 4	2									
25	Mn		2	4	4	6	2, 4	3									
26	Fe		2	4	4	6	2, 4	4									
27	Co		2	4	4	6	2, 4	5									
28	Ni		2	4	4	6	2, 4	6									
29	Cu		2	4	4	6	6	6	1								
30	Zn		2	4	4	6	6	6	2								
31	Ga		2	4	4	6	6	6	3								
32	Ge		2	4	4	6	6	6	4								
33	As		2	4	4	6	6	6	5								
34	Se		2	4	4	6	6	6	6								

Z	Name	n	1	2		3			4				5				
		k	s	s	p	s	p	d	s	p	d	f	s	p	d	f	q
35	Br		2	4	4	6	6	6	7								
36	Kr		2	4	4	6	6	6	8								
37	Rb		2	4	4	6	6	6	8	1							
38	Sr		2	4	4	6	6	6	8	2							
39	Y		2	4	4	6	6	6	8	3							
40	Zr		2	4	4	6	6	6	8	4							
41	Nb		2	4	4	6	6	6	8	5							
42	Mo		2	4	4	6	6	6	8	6							
43	Tc		2	4	4	6	6	6	8	7							
44	Ru		2	4	4	6	6	6	8	8							
45	Rh		2	4	4	6	6	6	8	8	1						
46	Pd		2	4	4	6	6	6	8	8	2						
47	Ag		2	4	4	6	6	6	8	8	2, 1						
48	Cd		2	4	4	6	6	6	8	8	2, 2						
49	In		2	4	4	6	6	6	8	8	2, 3						
50	Sn		2	4	4	6	6	6	8	8	2, 4						
51	Sb		2	4	4	6	6	6	8	8	2, 5						
52	Te		2	4	4	6	6	6	8	8	2, 6						
53	I		2	4	4	6	6	6	8	8	2, 6	1					
54	Xe		2	4	4	6	6	6	8	8	2, 6	2					
55	Cs		2	4	4	6	6	6	8	8	8	2,1					
56	Ba		2	4	4	6	6	6	8	8	8	2,2					
57	La		2	4	4	6	6	6	8	8	8	2,3					
58	Ce		2	4	4	6	6	6	8	8	8	2,4					
59	Pr		2	4	4	6	6	6	8	8	8	2,5					
60	Nd		2	4	4	6	6	6	8	8	8	2,6					
61	Pm		2	4	4	6	6	6	8	8	8	8	1				
62	Sm		2	4	4	6	6	6	8	8	8	8	2				
63	Eu		2	4	4	6	6	6	8	8	8	8	3				
64	Gd		2	4	4	6	6	6	8	8	8	8	4				
65	Tb		2	4	4	6	6	6	8	8	8	8	5				
66	Dy		2	4	4	6	6	6	8	8	8	8	6				
67	Ho		2	4	4	6	6	6	8	8	8	8	7				
68	Er		2	4	4	6	6	6	8	8	8	8	8				
69	Tm		2	4	4	6	6	6	8	8	8	8	8,1				
70	Yb		2	4	4	6	6	6	8	8	8	8	8,2				
71	Lu		2	4	4	6	6	6	8	8	8	8	8,2	1			

Z	Name	n	1	2		3			4				5				
		k	s	s	p	s	p	d	s	p	d	f	s	p	d	f	q
72	Hf		2	4	4	6	6	6	8	8	8	8	8,2	2			
73	Ta		2	4	4	6	6	6	8	8	8	8	8,2	3			
74	W		2	4	4	6	6	6	8	8	8	8	8,2	4			
75	Re		2	4	4	6	6	6	8	8	8	8	8,2	5			
76	Os		2	4	4	6	6	6	8	8	8	8	8,2	6			
77	Ir		2	4	4	6	6	6	8	8	8	8	8,2	7			
78	Pt		2	4	4	6	6	6	8	8	8	8	8,2	8			
79	Au		2	4	4	6	6	6	8	8	8	8	10	8,1			
80	Hg		2	4	4	6	6	6	8	8	8	8	10	8,2			
81	Tl		2	4	4	6	6	6	8	8	8	8	10	8,2	1		
82	Pb		2	4	4	6	6	6	8	8	8	8	10	8,2	2		
83	Bi		2	4	4	6	6	6	8	8	8	8	10	8,2	3		
84	Po		2	4	4	6	6	6	8	8	8	8	10	8.2	4		
85	At		2	4	4	6	6	6	8	8	8	8	10	8,2	5		
86	Rn		2	4	4	6	6	6	8	8	8	8	10	8,2	6		
87	Fr		2	4	4	6	6	6	8	8	8	8	10	10	6,1		
88	Ra		2	4	4	6	6	6	8	8	8	8	10	10	6,2		
89	Ac		2	4	4	6	6	6	8	8	8	8	10	10	6,3		
90	Th		2	4	4	6	6	6	8	8	8	8	10	10	6,4		
91	Pa		2	4	4	6	6	6	8	8	8	8	10	10	10	1	
92	U		2	4	4	6	6	6	8	8	8	8	10	10	10	2	
93	Np		2	4	4	6	6	6	8	8	8	8	10	10	10	3	
94	Pu		2	4	4	6	6	6	8	8	8	8	10	10	10	4	
95	Am		2	4	4	6	6	6	8	8	8	8	10	10	10	5	
96	Cm		2	4	4	6	6	6	8	8	8	8	10	10	10	6	
97	Bk		2	4	4	6	6	6	8	8	8	8	10	10	10	7	
98	Cf		2	4	4	6	6	6	8	8	8	8	10	10	10	8	
99	Es		2	4	4	6	6	6	8	8	8	8	10	10	10	9	
100	Fm		2	4	4	6	6	6	8	8	8	8	10	10	10	10	
101	Md		2	4	4	6	6	6	8	8	8	8	10	10	10	10	1
102	No		2	4	4	6	6	6	8	8	8	8	10	10	10	10	2
103	Lw		2	4	4	6	6	6	8	8	8	8	10	10	10	10	3
104	Rf		2	4	4	6	6	6	8	8	8	8	10	10	10	10	4
105	Db		2	4	4	6	6	6	8	8	8	8	10	10	10	10	5
106	Sg		2	4	4	6	6	6	8	8	8	8	10	10	10	10	6
107	Bh		2	4	4	6	6	6	8	8	8	8	10	10	10	10	7

Z	Name	n	1	2		3			4				5					6
		k	s	s	p	s	p	d	s	p	d	f	s	p	d	f	q	s
108	Hs		2	4	4	6	6	6	8	8	8	8	10	10	10	10	8	
109	Mt		2	4	4	6	6	6	8	8	8	8	10	10	10	10	9	
110	Ds		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	
111	Rg		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	1
112	Cn		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	2
113	Nh		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	3
114	Fl		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	4
115	Mc		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	5
116	Lv		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	6
117	Ts		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	7
118	Og		2	4	4	6	6	6	8	8	8	8	10	10	10	10	10	8

4. The new Periodic Table of chemical elements

The definition of electronic configurations of chemical elements allows to represent all atoms into a coherent periodic table in which there aren’t transition elements that are effectively out of the table. This table has been deduced from the Deterministic Quantum Model of atom that is the model of the Contemporary Physics in the order of the Manifesto Project and it is presented in table 3.

From the analysis of electronic configurations in table 2 and from calculations performed for energies of single electrons of atoms[2][3] we deduce the rule that situations into external sub-levels represented by electronic configurations 2 ; 4+4; 6+2 ; 8 ; 2+6 ; generate particular inert properties of chemical elements that have those configurations in external sub-levels. We observe also there are a few situations that seem to represent exceptions with respect to this rule and hence it involves a further analysis of the question.

For the representation of the last elements with atomic number that is greater than 111, including a few elements recently recognized by scientific institutions, it needs to consider they make use of the energy level n=6 that has 6 sub-levels, everybody with 12 electrons for a total of 72 potential electrons in the level 6.

We mark besides every period finishes with an inert element, or with an element that has a similar configuration even if it doesn’t show inert properties or with an element that presents anyway a full external sublevel.

Table 3. Periodic Table of Chemical Elements

Period	Group									
	1	2	3	4	5	6	7	8	9	10	0
1	1 H										2 He
2	3 Li	4 Be	5 B	6 C	7 N	8 O	9 F				10 Ne
3	11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl				18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	
5	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br				36 Kr
6	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	
7	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I				54 Xe
8	55 Cs	56 Ba	57 La	58 Ce	59 Pr	60 Nd					
9	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er			
10	69Tm	70 Yb	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	
11	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At				86 Rn
12	87 Fr	88 Ra	89 Ac	90 Th							
13	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	
14	101 Md	102 No	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	
15	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og			

The table has been obtained in the order of the Deterministic Quantum Model of atom that is valid in Contemporary Physics.

5. Properties of chemical bonds

It needs firstly to mark that the existence of very numerous chemical bonds in nature shows every atom has different modalities for producing chemical bonds with similar atoms or with atoms of different elements. This aptitude is defined by the concept of valency, that is the number of electrons that an atom can put at disposal for chemical bonds. It is easy to verify that the maximum valency coincides with the number of group to which the chemical element belongs and this number changes from 0 to 10.
Other important properties of atoms in relation to chemical bonds are:

Electronegativity denotes the tendency of an atom to attract electrons.

The **ionic bond** is a chemical bond in which there is a transfer of electrons from an atom to another with the formation of two ions with opposite charge.

The **covalent bond** is a bond in which a pair of electrons is pooled by atoms with the same or different chemical nature.

The **polar bond** is a covalent bond in which the pair of electrons that are pooled remains more long near one of atoms. The **non-polar bond** instead is characterized by the fact that the pair of electrons is distributed equally between the two atoms.

The **oxidation number** is the apparent electric charge that an atom seems to have in the order of a molecule as a consequence of the nature of chemical bond. An atom has generally numerous numbers of oxidation and the maximum number of oxidation represents the number of electrons that an atom has in the external sub-level of energy. The oxidation number is connected with the concept of valency.

These properties together with the concept of valency and the ionization potential decide the formation of chemical bonds.

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