The correlation of Abiyev's balanced squares with periodic law

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***Abstract*—**For the first time, a perfect algorithm for writing the magic squares has been found by Abiyev. With the help of this algorithm we can write not only magic squares, but also magic cubes from any numbers of any orders. These squares have been called the balanced squares. In such squares of odd order, the numbers have been replaced by electric charges and the moment of electric charges have been calculated in each frame of such a system. In the table drawn, it has been defined sequences of 2, 6, 14, 26, 44, 68, 100, 140, 190 and 2, 12, 38, 88, 170 and also arithmetic progressions, constants of which are 2, 8, 18, 32, 50 and 2, 6, 10 ,14, 18, 22. It has been found out that the observed here regularities have some correlation with the periodic law. This correlation shows that the periodic law ends with the 218th element. So, 2 more repeated periods, which include previous regularities, may have been added to the periodic law. This, could have served a flare for physicists in finding super-heavy elements.

***Keywords*—**algorithm, correlation, magic square, periodic law, sequence, super-heavy

I. INTRODUCTION

The definition of "magic square" has been introduced by a Chinese emperor nearly 3000 years ago as a game of intellect and has been staying as an up today problem for mathematics [1], [2]. The magic squares problem has been becoming one of the critical mathematical problems due to scientific exploring of mathematics for the last 250 years. Here, the problem is to make up an any order magic square consisted of natural numbers. This problem has not still been solved, though it has been tried besides B. Pascal, P. Fermat, L. Euler, A. Calley et. al. by many specialists in different scientific branches.

Typically, a magic square consists of a set of integers arranged in the form of a square so that the sum of the numbers in each row, each column, and each diagonal add up to the same total. If the integers are consecutive numbers from 1 to n^2, the square is said to be of n^{th} order. Today, the main problem of magic square is to find out a general method, which provides required order to form a magic square.

In 03.03.1996, for the first time, I have introduced an algorithm by the help of which any kind of natural magic squares could be constituted of different numbers (rational, irrational, transcendental, complex etc.) [3]. The interesting properties of natural magic squares may open some research directions for several operational research, intelligent computation, physics scientific disciplines like genetic engineering, etc. [4], [5].

II. THE GENERAL ALGORITHM OF BALANCED SQUARES

Let a square is divided into n^2 parts of equal small squares by the help of vertical and horizontal lines of n-1. This square is called a square of n^{th} order.

Let the elements of integer set $\{1, 2,\ldots,n^2\}$ are written in the n x n square so that the sums of integers either on the rows or on the columns and diagonals, as well, are the same and equal to

$$S = n/2(n^2+1)$$

This number is called a magic number or magic constant. If the number in their respective locations in the magic square is considered as a point-mass, then the mass center and geometric center of the system will be coincided. This is one of the most important properties of the magic squares. Therefore, it is advisable to call it "balanced square" rather than "magic square".

The squares, according to their orders, are called either even or odd squares. Even ordered squares, also, are divided into two subgroups: the squares, if order numbers of which being divided by 2, give even numbers, are called double-even squares, but those with the division give odd numbers - single-even squares. The following number groups (4,8,12,16,…,), (2,6,10,14,…,), and (3,5,7,9,…,) are examples for double-even, single-even, and odd square orders, respectively.

In order to understand this algorithm, we begin to:

1- take 4 arithmetic progressions, consisted of any numbers; 2- divide the n^{th} order square into concentric frames; 3- get closed symmetric graphs, or Abiyev's cycle. These 4 arithmetic sequences will be marked α, β, γ, δ with the constants b, c, $-b$ and $-c$, respectively. Let the initial number of the first arithmetic progression is a_0, where a_0, b, c are any number(s) (rational, irrational, transcendental, complex, even symbols). Four arithmetic progressions, which are equal to number of terms, form one group. All sequences of n^{th} order balanced square consist of n/2 groups for even order or (n+1)/2 groups for odd order. Let's see an example; let's get 4 sequences of n^{th} group and n^{th} order square; they are

α_n-$[a_0],[a_0+b],[a_0+2b],\ldots,[a_0+(n-2)b],[a_0+(n-1)b]$;

β_n-$[a_0+(n-1)b][a_0+(n-1)b+c],\ldots,[a_0+(n-1)b+(n-2)c]$, $[a_0+(n-1)b+(n-1)c]$;

γ_n-$[a_0+(n-1)b+(n-1)c]$,$[a_0+(n-2)b+(n-1)c]$,..., $[a_0+b+(n-1)c]$,$[a_0+(n-1)c]$;

δ_n-$[a_0+(n-1)c][a_0+(n-2)c]$,..., $[a_0+2c]$,$[a_0+c]$; a_0

In this case, magic number is $S=n/2[2a_0+(n-1)(b+c)]$.

If $a_0=1$, $b=1$, $c=n$, we obtain magic number for balanced square, consisted of integers $\{1, 2,\dots,n^2\}$, $S = n/2(n^2+1)$.

a+2b+c	a	a+b+2c
a+2c	a+b+c	a+2b
a+b	a+2b+2c	a+c

Fig.1.

Fig. 2.

	a+4b+c	a	a+b+4c	
a+4b+3c	a+2c		a+2b	a+3b+4c
a+4c				a+4b
a+b	a+2b+4c		a+4b+2c	a+c
	a+3b	a+4b+4c	a+3c	

1. General balanced square of 3rd order. 2. Inner (grey) and outer (dark) frames of 5th order of general balanced square of 5th order.

a+3b+2c				a+2b+3c
		a+b+c		
	a+b+3c		a+3b+c	
		a+3b+3c		
a+2b+c				a+b+2c

Fig. 3.

a+3b+2c	a+4b+c	a	a+b+4c	a+2b+3c
a+4b+3c	a+2c	a+b+c	a+2b	a+3b+4c
a+4c	a+b+3c	a+2b+2c	a+3b+c	a+4b
a+b	a+2b+4c	a+3b+3c	a+4b+2c	a+3b+4c
a+2b+c	a+3b	a+4b+4c	a+3c	a+b+2c

Fig. 4.

Fig.3. Inner (grey) and outer (dark) frames of 3rd order of general balanced square of 5th order

Fig.4. General balanced square of 5th order

In figures 1 and 4 it is respectively shown general balanced squares of 3rd and 5th orders. In order to form balanced squares of odd order, 4 arithmetic progressions must be written in step frames with the help of Abiyev's cycle (the closed graph). In figures 2 and 3 it is respectively shown 5th and 3rd frames of balanced square of 5th order. These frames consist of the inner (grey) and outer (dark) frames.

Let's suppose that, point electrical charges have been placed in square's center according to numbers. Electric moment of vector $\vec{A}=\sum_{j=1}^{n^2} q_j \vec{r}_j$ for each inner and outer frames of such a system has been calculated; x and y components of $\vec{A}$ have been marked as A^n_{kx} and A^n_{ky}.

The origin has been placed in the center of square's central cell. x and y axes are parallel to squares' sides and form right coordinate system.

In the table I, $f_1(k)$, $f_2(k,n)$, $f_3(k,n)$ for general balanced squares of 3, 5, 7,…, 21 orders have been calculated.

If we calculate magnitude of $\vec{A}$ vector, that is $\left|\vec{A}_k^n\right|$ from A^n_{kx} and A^n_{ky} for inner, outer and the sum, we will get the following formulas:

$$\left|\vec{A}_k^n(i)\right| = \sqrt{\left(A^n_{k;x}\right)^2+\left(A^n_{k;y}\right)^2} = -\frac{k-1}{2}\left[\frac{k(k-2)}{3}+1\right]\sqrt{c^2+b^2};$$

$$\left|\vec{A}_k^n(o)\right| = \frac{k-1}{4}\left[\frac{k(k+1)}{3}+(k-1)(n-k)\right]\sqrt{c^2+b^2};$$

$$\left|\vec{A}_k^n(s)\right| = \frac{k-1}{4}\left[-\frac{(k-2)(k-3)}{3}+(k-1)(n-k)\right]\sqrt{c^2+b^2}.$$

The direction of vector $\vec{A}$ is calculated by the help of $tg\alpha=(c+b)/(c-b)$ expression.

Where: n- the order of squares; k the order of frames; c and b-constants of arithmetic progressions.

III. $\left|\vec{A}_k^n\right|$ DISTRIBUTION ON FRAMES

$A^n_k(i)$, $A^n_k(o)$, and $A^n_k(s)$, expressions, as it is seen, are in proportion to $f_1(k)$, $f_2(k,n)$, $f_3(k,n)$ functions, which depend on k,n arguments. According to the values of these functions, Table I has been formed. $f_1(k)$ function doesn't depend on n, and these values form decreasing sequence: -2, -12, -38, -88, -170, -292,... ; while $f_2(k,n)$ forms an increasing sequence.

Sum the numbers of the inner and outer frames is denoted by the mark of sum (s). Having maximum value, $f_3(k,n) = f_1(k)+ f_2(k,n)$ function forms a sequence. These maximum values and the proper frame are calculated by following formula: if $(n+1)/2$ is double-even, max $f_3(k,n)=(n-3)(n+1)(n+2)/48$, and $k=(n+3)/2$; if $(n+1)/2$ is single-even, max $f_3(k,n)=(n-2)(n-1)(n+3)/48$ and $k=(n+1)/2$.

It is very interesting that, $A_{\max}$ of balanced squares corresponds to the same frames. For example, maximal values of squares of 7th and 9th orders correspond in the frame of $k = 5$ order, and these values are respectively 6 and 14.

In Table I, the numbers of outer frames 3,5,7,9,11,13,... and these numbers' differences form arithmetic progressions with constants of 2,8,18,32,50,... and 2,6,10,14,18,..., respectively.

So, using general balanced squares of odd orders, we have achieved 4 special sequences:
1) 2, 12, 38, 88,170,…; 2) 0, 2, 6, 14, 26, 44, 68,100, 140,190,…; 3) 2,8,18,32,50,...; 4) 2,6,10,14,18,...;

Here, it is seen that, $\vec{A}=\sum_{j=1}^{n^2} q_j \vec{r_j}=0$ or $\sum_{k=1}^{\frac{n-1}{2}} f_3\left(k,n\right)=0.$ It means that, the center of electric charges coincides with the square's geometric center. From this point of view, these magic squares have been called as balanced squares.

TABLE I. Values $f_1(k)$, $f_2(k,n)$, $f_3(k,n)$ functions for general balanced squares of (3,5,…, 21)th orders. Where: **T**-period; **n**-the order of square; **k**- the order of frames; *i*- inner; *o*- outer; *s*-sum *i*+*o*.

T	n		k 3	5	7	9	11	13	15	17	19	21
	3	i	-2									
		o	2									
		s	0									
1	5	i	-2	-12								
		o	4	10								
		s	2	-2								
2	7	i	-2	-12	-38							
		o	6	18	28							
		s	4	6	-10							
3	9	i	-2	-12	-38	-88						
		o	8	26	46	60						
		s	6	14	8	-28						
4	11	i	-2	-12	-38	-88	-170					
		o	10	34	64	92	110					
		s	8	22	26	4	-60					
5	13	i	-2	-12	-38	-88	-170	-292				
		o	12	42	82	124	160	182				
		s	10	30	44	36	-10	-110				
6	15	i	-2	-12	-38	-88	-170	-292	-462			
		o	14	50	100	156	210	254	280			
		s	12	38	62	68	40	-38	-182			
7	17	i	-2	-12	-38	-88	-170	-292	-462	-688		
		o	16	58	118	188	260	326	378	408		
		s	14	46	80	100	90	34	-84	-280		
8	19	i	-2	-12	-38	-88	-170	-292	-462	-688	-978	
		o	18	66	136	220	310	398	476	536	570	
		s	16	54	98	132	140	106	14	-152	-408	
9	21	i	-2	-12	-38	-88	-170	-292	-462	-688	-978	-1340
		o	20	74	154	252	360	470	574	664	732	770
		s	18	62	116	164	190	178	112	-24	-246	-570

IV. PERIODIC LAW

By applying 4 sequences to periodic table II, which is explained according to the quantum theory, we can enlarge this table. The sequence 2, 8, 18, 32, 50,...,is expressed by $2n^2$ formula in the theory. Periods' repetition can be explained by corresponding of max $f_3(k,n)$ values to the same frame for the squares of sequential order. Number of cells between the pairs (6, 14), (26, 44), (68, 100), (140, 190) in the table II, depending on the repeated period, form geometric progression 1,2 ,4. The number of electrons in *s, p, d, f, g* levels is the same in respect to 2, 6, 10, 14, 18 sequence. Ending of the pair (140, 190) with (5*g*, 6*g*) shows that the elements in the periodic law are limited with 218 elements. The terms 2, 12, 38, 88, 170 of the sequence correspond to the 2nd element of repeated period's *s* level.

TABLE II. Enlarged Periodic Law

1	1s							H 1	He 2							**2**
2	2s							Li 3	Be 4							
	2p					B 5	C 6	N 7	O 8	F 9	Ne 10					**8**
3	3s							Na 11	Mg 12							
	3p					Al 13	Si 14	P 15	S 16	Cl 17	Ar 18					**8**
4	4s							K 19	Ca 20							
	3d			Sc 21	TI 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30			
	4p					Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36					**18**
5	5s							Rb 37	Sr 38							
	4d			Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 37	Cd 48			
	5p					In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54					**18**
6	6s							Cs 55	Ba 56							
	5d			La 57												
	4f	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tu 69	Yb 70	Lu 71	
	5d				Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80			
	6p					Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86					**32**

	7s									**Fr** 87	**Ra** 88									
	6d					**Ac** 89														
7	5f			**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	**Lw** 103			
	6d						**Ku** 104	**Bo** 105	106	107	108	109	110	111	112					
	7p							113	114	115	116	117	118							**32**
	8s									119	120									
	7d					La1 121														
	6f			Ab 122																
	5g	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	
8	6f				141	142	143	144	145	146	147	148	149	150	151	152	153			
	7d						154	155	156	157	158	159	160	161	162					
	8p							163	164	165	166	167	168							**50**
	9s									169	170									
	8d					Ac1 171														
	7f			As 172																
9	6g	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	**190**	
	7f				191	192	193	194	195	196	197	198	199	200	201	202	203			
	8d						204	205	206	207	208	209	210	211	212					
	9p							213	214	215	216	217	218							**50**

There is an interesting point that cells, of which (0, 2), (6, 14), (26, 44), (68, 100), (140, 190) pairs are located, are accordingly the same with 1s, (2*p*, 3*p*), (3*d*, 4*d*), (4*f*, 5*f*), (5*g*, 6*g*) levels.

Correspondence of super-heavy elements theoretically suggested with the elements of enlarged table II, can be accepted as a proof of a new table.

V. CONCLUSION

It should be mentioned that correlation between general balanced squares and periodic law is not a coincidence. This correlation belongs only to Abiyev's balanced squares. Paul Carus' words can be an example to it. "There is no science that teaches the harmonies of nature more clearly than mathematics, and the magic squares are like a mirror which reflects the symmetry of the divine norm immanent in all things, in the immeasurable immensity of the cosmos and in the construction of the atom not less than in the mysterious depth of the human mind"[1].

In addition to these words, I would like to note that, balanced squares can be considered one of major keys of nature laws.

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