Main Structural Armor Component - Metal - from the Point of View of Latest Scientific Concepts

B. M. Makhov, A. A. Artsruni, S. A. Gladyshev, L. A. Tsurgozen, V. P. Yankov

> rmor is one of the oldest inventions of mankind which appeared and has been improving together with weapons (stones, arrows, darts, spears, swords, sabers, bullets and shells). Quite different materials were used as armor – wood, woven rods, clay, leather, sand and even moistened and solidified salt, and of course metals. Metals may and must be named as the dominating material for armor and armored structures. First of all, we should note a wide range of metals used in armor, and a great variety of their structural application - from single structural elements (cover plates and badges) through whole products (helmets, cuirasses, hauberks) to large-sized structural armor (ships, tanks, trains, cars etc.).

> "Metal" is the name of a dominating group consisting of at least 80 chemical elements which corresponds to almost 80% of all presently known chemical elements. Traditionally metals are characterized by a particular solid-state crystal structure and by a number of specific features such as thermal conduction, electric conduction, strength, hardness, glitter, permanent melting temperature. Metals with density up to 5 g/cm^3 are called "light metals", the rest are called "heavy metals". Also such metal categories are known as "noble metals" (gold, silver, platinum etc.), "rare (rare earth) metals", "alkali metals", "transition metals" etc. The number of alloys of metals with other metals or with other chemical elements and compounds is past one thousand and is constantly increasing. The role of metals in the history of mankind does not need any special discussion; it's enough to remember the names of subsequent historical epochs such as "Stone age", "Copper age", "Bronze age", "Iron age".

> It is interesting to note the placement of metals in the modern periodical system of elements. As we know, the Periodical Law and periodical system of elements were invented by the Russian scientist

Dmitry Mendeleev in 1869. The invention brought Russian science to the front line of international science and still constitutes the pride of our country. However, Dmitry Mendeleev could not explain the underlying cause of periodicity and said frankly: "We don't know the cause of periodicity". Mendeleev's periodic system of elements in its today's form features a whole system of evident faults: insufficiently clear distinction between metals and nonmetals; the place of hydrogen, the problem of Group 8 (when well-known iron found itself in the same group as noble gases); lack of the place for lantanoids and actinoids etc.

Our paper focuses on new suggestions aimed at improvement, or rather, at creation of a new Periodic system which is caused by the necessity to eliminate the faults of the existing system. The new suggestions are based on the use of all four quantum numbers. The place of each element is clearly and definitely determined by its own combination of four quantum numbers (a kind of personal passport) which is responsible for the quantum equilibrium of the atom as a whole. The system is based on the results of investigation of linear optical spectrums and related to them Pauli exclusion principle, V.M.Klechkovsky and D.N.Trifonov rules and on radical reconsideration of the customary model of atom. The system is called "Symmetric quantum periodic system of neutral atoms", or "Makhov's Tree" by the name of its inventor Boris F. Makhov (Fig.1). The essence of the system is as follows:

The sequence of elements (Mendeleev's row) is maintained, but a new division for periods is introduced on the basis of distinct and clear parameters (quantum numbers).

All periods presented by horizontal rows form dyads with successively increasing number of superstructing horizontal rows (successive one-row, tworow, three-row and four-row pairs of periods, i.e. all in all eight periods). Length and composition of the periods increase along with increase of the dyad number, forming a kind of "tree".

The new system retains all vertical groups.

In the new system metals and nonmetals are distinctly separated.

In the new system there's a proper place for lantanoids and actinoids.

The problem of Group 8 of Mendeleev's system has been solved.

The new system is a continuous sequence of elements (each element which finishes the previous row, starts the next row, which means that the system can be presented in the form of a 3D model) (Fig.2-7).

Development of the new system required consideration of the neutral atom model and has led to development of a radically new model of atom structure which has been called "Oscillatory resonance model of neutral atom" (Fig.8). In contrast to the existing model of atom, the new model treats the nucleus as pulsing and generating around itself an alternating electromagnetic field which spreads in the surrounding medium to a depth, strictly typical for each atom, and in this way generating a standing (elastic, coherent) electromagnetic wave. The new model does not imply the notion of a negatively charged particle (electron). At interaction of neutral atoms (chemical interaction) their electromagnetic fields overlap and they transfer to some degree of excitation. In this process selection of partners and particular physical conditions of interaction are very important.

According to the new Periodic system and the new atom model each element is characterized by the radius of propagation of the alternating electromagnetic field, generated by the nucleus, or of the standing electromagnetic wave (atom radius).

The characteristics of atom radius values of the elements in the new Periodic system are presented in Fig. 9, from which we can see that the metal atom radiuses are significantly larger than the radiuses of non-metal atoms. It also explains the nature of high-strength of metal bonds.

Another fact is as interesting: in the new System the main alloying components of steel – carbon and nitrogen – are situated next to each other, at the top and in the centre of the new Table. They are p-elements which feature high bond energy (especially nitrogen; that's why it is present also in all such vital organic matters as proteins, and in all explosives.

As applied to one of the main "title" metals – iron – it can be seen that iron itself as well as the main alloying elements are d-elements (Cr, Ni, Mo, V etc.) which belong to the 7-th horizontal row of the new System.

Going back to the problems of armor materials science, and comparing the properties of most accepted "title" metals of alloying systems – iron (steel), titanium and aluminium – we must specially emphasize the efficiency of using aluminium as the armored hull material (Fig.10) and also note the higher efficiency of composing new aluminium-based alloys as compared to composing iron-, copper- and titaniumbased alloys. For example, strength improvement ratio in the comparison "pure aluminium – aluminium alloys" can be in the range of 15-20 whereas it is only 10 in the pair "iron-steel", and only 8 in the pairs "pure copper-copper alloys" and "pure titanium-titanium alloys". Thus, aluminium alloys are worth being considered as very efficient and promising armor materials.

Presently good results has been achieved in both two-component and more complex alloys of aluminium with Mg Si Cu Zn (recently attention has been attracted also to Li Ag) which can be explained by better and varying solubility of these metals in aluminium. Maximum solubility of the element in the solid solution is 17.4 1.65 5.7 82% accordingly. It is known that variable solubility provides thermal hardening (tempering) effect. It can be explained by the metallophysical similarity of the above alloying materials with aluminium which expresses itself in closeness of their atom radiuses to the atom radius of aluminium. In Fig.11 the authors present the forecast of development of aluminium-based high-strength armor materials.

The authors are absolutely sure that the new system of periodization of elements and the new atom structure model offer great potentialities and can serve as the basis for further development of fundamental research in natural sciences and in particular in armor material science.

it.	a 1			First sub	-shell	<i>m</i> _* =-	+1/2			Second :	sub-shell	$m_{i}=-1/2$	2 1	5.		P
0		00	Reputeronalit more 2	Maccusor varias A				Alexand a			1	0		-	-	
0		0	5D.	Fe				" I Babiyan				901		-	- 0	1
1	10	1	[Ca]3d' Жел	m - 1 neao	-		n bai	¹ ¹ S ₁₂ H b0r set	is, He			ĒL		2	1	
2	20	2	Namepagan Rospitypagan attain	Marsarmer Recentation restation Pa			is, He	i i is ₁₁ Li mdu' -	is, Be		RA	F		2	2	
	21	3			is, Be	s II ² P ₁₀ B (le))/ serie	in i	1 H 4S _{AB} N (Bellp' and	1 II 37. 0 Belly'	Pan Fise N	Profe	essor Bor	is.	6	1	
3	30	4			-		ia m la _s Ne pape ~	¹¹ ²³ S ₁ ²¹ Na piepe' art	in 14		M	AKHÖV		2	3	
	31	5			is, Mg	17 H ³ P ₁₀ Al (MgBe/	ia ia 1-p. Si 1Me34/ art	10 21 45 ₂₁ P (Me30'	18 28 3p S	17 III III 19 ₃₅ Cl 15, A Meter ~ Meter ~			5	6	2	ţ.
4	40	6			Marten	Allentes	is at	18 39 ¹ S _{1,5} K (Ar)62	18 48 ISa Ca				1	2	4	
	32	7		is Ca to _{3/1} S	c 'r, Ti	n n tr _{k/2} V jospir are	IN IL IS, Cr Kapfwi	San Mn	s s ⁵ D _i Fe	P H H V _{K/2} Co V, N Kobr e-1 Kobr -		Zn	1	10	1	
5	41	8		Constant Constant	is, Zn	n n ³ P ₁₂ Ga	n h hpg Ge philip' and	11 11 45.15 As 121/49*	an an ap ₂ Se page an	10 10 10 14737 Br 155 K (2490' ~ 2090' ~			į	6	3	
10000	50	9			2000	Calmet	is an is in its in the internet is an internet is an internet in the internet is an internet is an internet in the internet is an internet is an internet in the internet is an inter	ar es 28 ₁₅ Rb	in in 18. Sr pullet and	Byon Figures				2	5	
	42	10		is is in the second sec	i i i ii i ir Zr	et an *D _{V2} Nb print's.*	41 M ² S ₃ Mo	ta pen ta To	er in Sy Ru peperse	to too at to ty _{k/2} Rh to ₅ P proteine proteine	os er an er d ¹ S _{1/2} Ag ¹ S ₈ (septro-	Cd	1	10	2	8
6	51	11			an in as, Cd	** 110 ² P _{1/2} In	Pa In Pa Sn	11 121 45 ₂₇ Sb 1009/	10 171 Te 1009/ ++1	10 107 H 1 10 107 H 1 10 107 X 1009/	in			6	4	
	60	12			Facent	Read	64 100 18. Xe Doin'	25 130 2845 CS	Interpret and a second	But Bono				2	6	
	43	13	n in n in in 's, Ba to, La part - mars.	10 10 10 10 1	r 1, Nd	et (14) en Pm Dollf ant	To internet in the second seco	** 100 *S _{3.2} Eu (86)**	PD, Gd	"HILLET TO TO D	194 67 105 80 Py 91,112 Ho 216, 194 (20,007	Er 2732 Tm	s, Yb	14	1	
	52	14	Rost James	is por port	Incare in it in in 27, Hf	Thomas III	Dancest	*S52 Re	The set	Toplat Rampin	t is Au is	Hg	itroplat	10	3	
7	61	15		Bregfet Animat	In and a set of the se	n an P ₁₂ TI P ₁₂ ti	Participant	es an tes Bi	the company of the co	Harris H com			3	6	5	
	70	16			Paris	Tatanti	is, Rn	tt (110) 2S12 Fr	15 Internet	Arter Pupe			5	2	7	
-	53	17	¹⁶ ¹⁰⁶ ¹⁰⁷ ¹⁰⁷ ¹⁰⁷ ¹⁰⁷ ¹⁰⁷	tr, Th th, P	a na un a na U	st III st, NJ paperar	Pass No class Pra Pu pape and	M DAD	Puest PD, Cm (Matrice	in man in or filling Bk ft, C	11) # (015 1# 1 *1:15 Es *R	(2019) 101 (200) 1 Fm ギディン Md	s, No	14	3	2
	62	18	Puzel Arread	Topol Протостой 148 (234) 140 (24) ¹⁵ S ₉ NO ² D ₃ /2 L [Buffelf were [Buffelf were [Buffelf were [Buffelf were	10 7pm 10 104 201 τ ³ Ψ ₃ Rf 1 (20)30f m ⁻¹	Harryant 101 202 473,12 Db	Ingread IM 365 Sg Diobit acti	Assegnment 187 Int Bh	Hepel 100 100 Hs	Termini Burnippe 100 110 Mit E Dishif was Dishif w	111 171 118 111 171 118 Dis Rg public west Disk	pant Hepperant	Balanat 1	10	4	
8	71	19		Educat Segreca	111 III	Agricuati 113	1345-335	legest 2:1	Xavat 138	Multrapalt dispersion 117 118	Pervet		3	6	6	
	80	20					-	1.00	13		-		3	2	8	
	1 0 1 2 3 4 4 6 6 7 7	$\begin{array}{c} & & & & & & \\ & & & & & \\ 0 & & & $	$\begin{array}{c} & & & & & & & & & & & & & & & & & & &$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Image:	Image:	Image:	Image:	Image: Instant Sub-State H Image: Instant Sub-State H <th< td=""><td>No. No. No.</td></th<>	No. No.

Fig. 1 Symmetrical quantum version of Mendeleev's periodic system of elements ("Makhov's Tree")

	net Ge		- 行語		1	First	sub-s	shell	$m_i =$	+1/2		1	Seco	nd si	ıb-sh	ell m	,=-1/	2	55	in the last	54
-	0		0	A sector	ŝ	/	dan teritori Martina di Langa				n Retter								1	-	1
	1	10	1	114	13 2p	27 A1				n n here w	1 18,19 H	s, He							2	1	
1	2	20	2		1/2 [Mg]3 Amo	p' eq=-1				So He	Sto La	i Bi							2	2	2
	<u> </u>	21	3	E	etere persone	Hardwood Barton B		s, Be	ite market	re C	1 48 ₂₀ N (9-39/	v ₁ O	an a	S. Ne					6	1	
2	9	30	4							is, Ne	R.o Na	× Mp							2	3	
		31	5					is, Mg	Pro Al	n n 2p _k Si (h(t)	H P	Ta S	n, C	is Ar					6	2	0
	4	40	6							18, Ar	is K	A. Ca							2	4	
the		32	7			in Ca	25 44 ¹⁰ D _{3/2} Sc 25400 x=1 Constant	zi e Pre Ti Poder and Tatas	ir _{s,0} V	St. St. St. Cr Haberber Store	st s	to, Fe	Total	in in Ni solor en	an Cu	is is Zn			10	1	
	5	41	8					in in in in its second	ν ¹ τ ¹ τ ¹ σ ₁ τ ¹ Ψ ₁ Ga μαθη στο Γραφορ	II IN Ge	10 70 15 ₁₀ As (2-34	a Se andy -	en He	S. Kr					6	3	
		50	9							III III IN KI IN KI IN III	Ste Rb	× Si							2	5	
.0	1000	42	10			is, Sr	²⁰ ²⁰ ² D ₁ Y ² ² D ₁ × 1	r Zi	ⁱⁿ D _{UJ} Nb	in in in in in its Mo	S. Te	W. Ru	Tank	s. Pd	s Ag	40 100 18, Cd			10	2	18
	6	51	11					a n Se Ce Kalar	ap _{1,1} In	$\frac{10}{2} \frac{10}{F_h} \frac{10}{Sn}$	ti in ts _{et} Sb	ha te		× Xe					6	4	
		60	12							14 16 US ₀ Xe (Solar ar	45 in 45 CS Note	a Ba				- <u>f-9.0</u>	менты (Г	- 31	2	6	
		43	13	u in 9, Ba narr	Poly La	a de la ce	10 101 40,11 Pr (m)# 4-1	n in Nd injet at	1 (14) 1 (14) 1 (14) 1 (14) 1 (14)	41 150 77.5 Sm (81.81	te ist tega Eu	D, Gd	n in U ₍₁₎ Th not in Total	te Dy	se in A _{TEX} Ho more set	H. Er	r_{1}^{10} (10) $r_{10}Tm$ (50) (7) (10) (10) (7) (10) (10) (7) (10)	in in S. Yb Ball series	14	1	
	16	52	14			the T	²¹ III ³ D _{1/3} Lu (m.tof uma horsesue	ni ili Ng Hi Major	trant To	¹⁴ (18 ¹⁰ D ₀ W (1000	te int	n oo bu Os mor	rr ini rr _{s.1} Ir mod s-r	n in Pt	in in Au National Au Instance	is, Hg	$\frac{d}{ l =2}$	Meterna D	10	3	
		61	15					in i	Para Ti	in in ¹ P ₂ Pb (Rays' are Content	ti sii ts _{ii} Bi thate	Po Po	en. At	is, Ri	← p-	otemento	(l = 1)		6	5	
		70	16							is, Rn	er cant bega Fr	2 84	~~ +	NUMBER	(l = 0)			, I.	2	7	
3		53	17	n in Se Ra Peler-i-	n n D., Ac	w in W, Th Introj	n Pa m Pa ndrie		³ 1, N Detroy	0. (iii) 19. Pu (b.)7 === thermal	in inter-	Dy Cm	u sala u se Bk	Ta Cr	ni Hill N ₂₁₁₁ Es puist in Numerical	in orth	111 1111 17 _{2/2} Md (34/87	100 (004) ¹ S ₀ NO (haff ² area thereast	14	2	34
		62	18			is and is No population	¹⁰ D _{k/2} Lr	an an Briter Ri	W OR	Int class Sg (No.844	Bh	HS	Mt	Da	Rg	(1) (5-84°			10	4	
	8	71	19					141	141	114	445	110		110					6	6	
		80	20							110	119	90 T			2	e (8		0	2	8	





(group s¹) (group s²) (group p⁵) (group p⁵)

Fig. 2 Distribution of groups of elements in "Symmetric quantum periodic system of neutral atoms"

	010		金属		1	First	sub-	shel	$m_i =$	+1/2		3	Seco	nd si	ıb-sh	ell m	a,=−1∕	2	ġc,	1000	*
1	0	H	0	<u>transmine</u>	2	P	tanona a				R								1	1	1
	1	10	1	Call Call	13 2p	27 A1				a Bild' - se Bilder - se	No H	is He							2	1	-
1	2	20	2		1/2 [Mg]3] A.mos	() BHHHH				is, He population	Sa Li	S. Be							2	12	2
2 -		21	3	E		14		us Be	1.8	т. С 1- С	1.1	0 10	and P	S. No					6	1	
	2	30	4							is, Ne	Sia Na	is, Mg							2	3	
		31	5					n S S, Mg Mily-	10 2 10 10 10 10 10 10 10 10 10 10 10 10 10	t s	S. B		1, 0	A					6	2	8
	4	40	6							A	10 30 15 15 K 14 16 1	is Ca							2	4	2
	1000	32	7			is, Ca	n a Po _{kit} Sc	u e Tr ₂ Th	W N	and a failed	si Mn	D ₄ Fe	r _{an} Co	²¹ II II ² F ₄ NI (odd) odd	25 Cu	se Zn se Zn	1		10	1	
	5	41	8			Kinart	Crimer	si si is, Zn	a a a a a a a a a a a a a a a a a a a	Try Ge	1	5, 30	r _e Br	in Re	- the				6	3	
25		50	9						Turre	Acres in	A Ro	s Sr							2	5	
3	6	42	10			"" " "8, Sr	10 10 10 10 10 10 10 10 10 10 10 10 10 1	ar ar Tre Zr	n n n Nb	s s S, Mo		44 int iF, Ru	er in FragRh	is, Pd	e ie Sill Ag	in in In Cd			10	2	18
		51	11			Commit	Umpan	is Cd	Print In	tr, Sp	100000 - 10000000 - 100000000	r Te	10 1	i si	- Dearlos	Cagend .			6	4	ă
		60	12		-			Tabot	Hoat	in an	Si in Si Si Si Ca Sini co	A Ba				- f-ais	монты ()	= 3)	2	6	2
		43	13	is in is, Ba	to La	n in 'n, Ce iste's	** 10 *1, Pr 18:07 ***	** 10 '1, Nd (8-37 ***	11. Pm	Trease Tr. Sm Judit' was	Sin Eu	n in m in m Gd	a in Sint Th	it, Dy	er in 4 ₁₃₇₁ Ho 18-82 oct	n V sa 'il, Er Jage and	v., Tm	n in Is, Yb	14	1	
	line co	52	14	Reptil	Jana	is, Yb	u m u Lu u Lu	theam 15 14 17 Hi (Value are	The second secon	Compit No. 20 No. W	San Re	in of	Topinii ¹⁷¹ 191 ¹ F _{2/2} Ir ¹⁹⁶ /2 corr	D. D. Pt.	S. Au	n an N, Hg	$\frac{d}{d} = 2$	mesticka S	10	3	
	7	61	15			December	Januar .	Talanai 16 (8) 15, Hg 15, Hg	Tarras Tarras Trans	nondepart Ny Plo Data ao	Firmi Sign Bi	timet M DR Po Thaty -	A. A.	ii, Bi	ann ← p-	Pages Schelster BCT's	(1 - 1)		6	5	8
	10.00	70	16					Fern	Tated	n oraș Reference	Santo Fr	in the	4.	acte Meterra	$a \in l = 0$				2	7	8
4		53	17	** 25 16, Ra 2027	Des Ac	The Th	in Pa	ti in L _{ei} U	L N	False N Table Pr Pu False	*noniti ** inter **_Arm	Pulat n ort 10, Cm	In B	S. Cf	a interest	111 - 220 74, Fm	in ≉,₁ Md	us no	14	2	32
		62	18	Pubel	Arrante	Tuest 90 (2016) 195 No	Participation of the second se	Post Pr det	Herries 18 (DD WARDD	in on Sg	ur un Bh	in Hs	fepepen min (par Mt	Ds	Rg	Antonia 112	Hoperant	Educat	10	4	2
	8	71	19			list-net	Arresta	Po+a-p-san 112	100 101	Con-post 114	Riper Lin	Accest 10	Naturial	1	Pater				6	6	2
	0.000	80	20				<u>.</u>			11.8	114	ы		1	-			-	2	8	3

Fig.3 Distribution of metals and nonmetals in "Symmetric quantum periodic system of neutral atoms"

	1911.6		小出		First	sub-	shell	<i>m</i> ₂ =	+1/2		1	Seco	nd su	ıb-sh	ell n	n,=−1/	2	36	1441	-
	0	-	0	tary and	Ż	talisan Nita A				n								1	1	1
	1	10	1	13 2p	27 . Al				4 H	1 1810 H 1911	is, He							2	1	
1	2	20	2	1/3 [Mg]3 Amo	p' ++1				is, He	istoria	s Be							2	2	2
2 -		21	3	E .	Maria State	È	s, Be	10-12 B	4 0 4p ₅ C 0600	uniter and the second s	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 141 F	S. Ne					6	1	
	3	30	4						is, Ne	in market in the second	in si Se Mg							2	3	
		31	5				n n İs, Mg	${}^{ii}_{P_{13}} \stackrel{ii}{\underline{Al}}$	н и ² ть Si (п(т)	ri n 45 ₅₀ P	ri in Pra S	$\left(\begin{array}{c} \psi_{\chi\chi} & \psi_{\chi\chi} \\ \psi_{\chi\chi} & \mathbf{C} \\ \mu_{\mu}\rho_{\mu'} & \cdots \end{array} \right)$	in in Sp Ar					6	2	8
	4	40	6				No. more		18, Ar	in star	in el Sa Ca Salar en	114						2	4	
~~		32	7		is s S Ca For c	n 40 PD ₄₁₁ Sc. Staffer con	o in Martin	Tran V	S Cr	at in the second	to Fe	ar co ar _{all} Co man ar	a in Ar, Ni Paper en	S. Cu	a a 18, Zn 19, cor			10	1	
	5	41	8		- Louise	Constant	in in in in its	ni in P ₁₂ Ga (nda -	Pr Ge	10 % 45 ₆₂ As (20.44/ ~~~)	u m P, Se	n v V _{SS} Br	S. Kr		1000			6	3	
2015		50	9				Dee	Deset	S, Kr	Real Property and	in in is, Sp Grife	Apra	- Aparton					2	5	
3	F	42	10		in in No St post -	${\stackrel{\scriptscriptstyle{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\scriptscriptstyle{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}}{\stackrel{\mathrm{in}}}{\stackrel{\mathrm{in}}}}}$ {}}	e e 91 Zr	⁴¹ ¹⁰ ¹⁰ Nb	S Mo	Te See Te	H MI W, Ru	at an	s, Pd	a in Sin Ag	18. Cd		6 C	10	2	18
	6	51	11		(farmer	thrpail	a in is, Cd	an so ap ₁₀ In 1000 years	9	to contract to the second seco	reason Tra Te	Public Providence Prov	is, Xe	Gadyr	- bijmet			6	4	
		60	12			1	haven	These .	11000 14 100 18 Xe	Green N Lin N _{LO} Cs Darfor and	Se in is, Ba	Re.	Trong		- /->	awama (= 31	2	6	
	T	43	13	ing . Die State La	1.00		1	Bu	3. 485		10. CA	10	1	10		1	1. W. 1	14	1	
		52	14	Second Control	n n B, Yb	the man	a in a Hi	10 10 14 Ant The	¹⁴ In ² D ₀ W	n ni 's _{te} Re	to, Os	a a Watter In	D. Pt	s. Au	is is is, Hg	$\leq \frac{d}{d} = 3$	смоятые	10	3	
	7	61	15		Division	2010.0	Topost In Int IS, Hg	Tartes At in Prat T1	Frankrak	Press 14 (19) 15 ₉₇₂ Bi (19)96	Parate	Honari Pogg At	Saran Sa Re	- p-	Same erre	(l=1)		6	5	6
		70	16				- Prove	Tankt	Al Obs	si una isi nga	in in in Ra	4.000	Date of the other	(l = 0)				2	7	5
4		5.3	17	n an ta st	n.p	1.74	1. 10 1. 10	1	The Party		The second	n., 388	(D)	5. Å	St. Tex	288	11 111 12, 351	14	2	32
		62	18		the sense 15 No	un un Tu _{lun} Lr	Ma Re	™ ost V _{A12} Db	Sg	III CINI Bh	tie Hs	Mt	Data Data	Rg	20	States - Loose		10	4	2
	8	71	19		Fricer	(Creekin)	ist.	2004 10	- Catogona 111	Rept #	North	Marriad	tin.	Person				6	6	
		80	20						W (7	410.	10							2	8	â

Instanoids and actinoids (f-elements, l=3)

Fig.4 Distribution of lantanoids and actinoids in "Symmetric quantum periodic system of neutral atoms"



Fig. 5 Distribution of dyads in "Symmetric quantum periodic system of neutral atoms"

	010	1	1		F	irst	sub-s	shell	<i>m_</i> =	+1/2		5	Seco	nd su	b-sh	ell m	n=-1/	2	àc.	1248	N.
	0	F	0	2177	2		terr_				R								1	1	1
	1	10	1	111	13 2p	27 A1]			1 11 11 11 11	No.	- B.							2	1	
1	2	20	2		1/3 [Mg]3 Amo	г р' ма=-1 миний				× 11.	San Li San Li Palai an	e Be						1	2	2	2
		21	3			100		1. Pe	in i	Pally'	National Science	1 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/	a b ap _{pi} E isiya wa	5. N.					6	1	
	2	30	4							. N.	¹¹ 11 ¹ B ₁₂ Na ^[1] B ₁₂ Aa ^[1] B ₁₂ Aa	Mg							2	3	
2		31	5					Ma	and A	in i Tri S milly -	Ball P		or e or _{en} Cl						6	2	8
	1	40	6							5. A	and K	- Ca							2	4	
225	Γ	32	7			с. С.	n in Day St	ii de Pr ₂ Th Malef ion	11 1 17 _{1/1} V (0.10 1	S. C.	San Ma	^{br} ^b D ₄ Fe rater and	n n Hr _{Al} Co Popel and	²⁰ T ₄ Ni ² T ₄ Ni ¹ Oddif and	²⁸ Cu	1. Zr.			10	1	
	5	41	8					1. Z.	a da a la da	т. G.	Sa a	bi Al	10 10 ¹ P ₃₅ Br 16(8) 10 1000	. Ki					6	3	
		50	9							<u>к</u>	San Rh	5. 51							2	5	
3		42	10			s. S1	in i	ar o Tr, Zr	n Solet NR	S. Me	5. Te	r, Ru	er in Pro Rh	s, Pd	e ie Siga Ag	- C4			10	22	18
	6	51	11					e. Cd	ar ir ar _{ki} Ir	Pr. St	1 10 10 1 14 ₃₅ Sb	10 10 271 Te	10 10 17 00 1 10104						6	4	
		60	12		2 2		8			. x.	and Ca	s, Bu				- <u>f-iam</u>	монты ()	= 2)	2	б	
	T	43	13	e. Ba	in La	n in ng Ce marie	n in N ₁ , Pr	41 (4) 4, Nd (8-97	ч. Ро	Fr. Str.	Si Eu	th Gd	an an Thing The Index or a	L Dy	Hard Ho	in V in in, Er	v _{st} Tin		14	1	
		52	14			. 15	D Lu	n un Fra Hit Population	W A	in a b, W	Sal Re	in in Dia Os	n in P _{RE} Ir Table	a Pt	Au Au	. Ц.	$\leftarrow \frac{d}{d} = 2$	owesettaa O	10	3	
	1	61	15					s. 154	r ₁₀ T	v, Pk	Sa Bi	ni om Pa Po Papy e-	n in P ₁₂ At (8)99 -	8.	с р	star serier s	(i = 1)		6	5	2
		70	16							• n	s _{in} Fr	s. Ba	<i>←</i> ,	alter Mederta	$\alpha (l = 0)$				2	7	
4	F	53	17	s. 80	n in D _{US} Ac	s in s, Th more	n in n Pa ndru	ni in N _{ali} U	t, N	in market	**************************************	w. Cm	n inn Mari Bk	a ci a Ci	en and Unite	na one na Fra	™ == ¥ _{x1} Md	a, No	14	2	32
		62	18			A. 80	no mo Dan Lr	TH data	100 (100 97,11 Db	Sg max	Bh	Hs	na con Mt	100 cm Ds (1000 ~~	nt dra Rg				10	4	Ì
8	8	71	19						112	118	43.6	20	ett .						6	6	
		80	20								114	34					· · · ·	-	2	8	

Fig.6 Diagram of relation and continuity of the successive row of elements (each horizontal row starts and finishes with spectral term 1S0)



Fig.7 Specific weights of elementary substances formed by particular elements



Fig.8 Makhov's oscillatory resonance model of neutral atom



Fig.9 Dependence of the atom orbital radius on the element serial number. The upper line is the interface between metals (above) and non-metals (below).



Fig.10 Comparative evaluation of the efficiency of "title metals" application (Fe, Ti, Al) for hull armoring





Fig. 11 Development of aluminium alloy-based light armor materials