Semiotic nature of Genetic code: Further elaboration. Part 1
(Materials for upcoming paper, in preparation)

Miloje M. Rakočević
University of Niš, Faculty of Sciences and Mathematics
Department of Chemistry,
Višegradska 33, 18000 Niš, Serbia
(http://www.rakocevcode.rs)
(mirkovmiloje@gmail.com)

Verzija 1, od 27.03.2025.

Abstract. This is a continuation of my main paper (MP) (10.26434/chemrxiv-2024-1b9h7) on the semiotic nature of the genetic code, published a year ago in pre-print form. Here now I give the first set of additional facts proving the semiotic nature of the genetic code. [Version 2, updated 03/30/2025, in relation to Version 1, dated 03/27/2025]

Keywords: Genetic code, Chemical code, Periodic system of chemical elements, Periodic system of numbers, Chemism, Semiosis, Protein amino acids, Mirror symmetry.

The hidden harmony is stronger than the visible one.
Heraclitus (Fragment 54)

In the main paper (MP) (Rakočević, 2024).[1] of which this is a continuation, we presented several chemical system-arrangements that in themselves testify to the semiotic nature of the genetic code. In this paper, we provide new evidence about that semiotic nature, through additional elaboration. And as examples of said system-arrangements, we list four fundamental ones: (1) Perfect Protein Amino Acid Similarity System [PPAASS in MP, Tabs 1 and 2], (2) Harmonic system of Genetic Code (HrS, Tabs 1 and 2 in this paper), (3) Four types of diversity of protein amino acids (Four DvT: Table 3), (4) Four stereochemical types of amino acids (Four StT: Table A1).

Even with the first look at Table 1 (and most of the illustrations in this paper) it is obvious that the key determinant of the order of the number of nucleons[2] in the set of 20 protein amino acids (AAs), in their side chains, is actually the *Unit change law*[3].

[1] In the following text, instead of "Rakočević", only MMR.

[2] When it comes to the arrangement of the amino acid system-arrangement from the aspect of the number of nucleons (or any other particles), then two things are on the scene: we are talking about the number of particles in the "body" (side chain) or the number of particles in the whole molecule – in the "head" and "body" of the molecule (in the amino acid functional group and in side chain).

----

[3] "Such strict regularity [within Boolean spaces] in a change (move) exactly for a unit shall be specified and definite as the unit change law" (MMR, 1994Logic, p. 36). Note in 2025: Tada je bilo samo u Bulovim. Od 1993 Shcherbaka sam našao … Prvo Njregoš u CG 1993. … Tada (1988) nisam smeo direktno pominjati sdmiotiku već onoliko koliko sam predočio in Box 1 of Main Paper (MP) of which this is a continuation

T A B L E S

Table 1. The harmonic structure of Genetic code

Atom number					a	b	c	d	M
D_{07}	N_{08}	A_{04}	L_{13}	$\rightarrow$	**189**	**189**	**221**	**221+3**	485.49 ≈ **485**
R_{17}	F_{14}	P_{08}	I_{13}	$\rightarrow$	*289*	*289*	*341*	*341+0*	*585.70 ≈ 586*
K_{15}	Y_{15}	T_{08}	M_{11}	$\rightarrow$	299	299	351	351+2	595.71 ≈ 596
H_{11}	W_{18}	S_{05}	C_{05}	$\rightarrow$	*289*	*289*	*331*	*331+1*	*585.64 ≈ 586*
E_{10}	Q_{11}	G_{01}	V_{10}	$\rightarrow$	**189**	**189**	**221**	**221+3**	485.50 ≈ **485**
60	66	78			1255	1255	1465	1465+9	2738.04
									2 (37 x 37)

Nucleon number

D_{59}, N_{58}, A_{15}, L_{57} / R_{100}, F_{91}, P_{41}, I_{57} / K_{72}, Y_{107}, T_{45}, M_{75},
H_{81}, W_{130}, S_{31}, C_{47} / E_{73}, Q_{72}, G_{01}, V_{43}

"Four choices after four types of isotopes: (a) The number of nucleons within 20 AAs side chains, calculated from the first, the lightest nuclide (H-1, C-12, N-14, O-16, S-32). (b) The number of nucleons within 20 AAs side chains, calculated from the nuclide with the most abundance in the nature [the same patterns as in (a): H-1, C-12, N-14, O-16, S-32; at heavier nuclides of other bioelements the data by (a) and (b) are not the same]. (c) The number of nucleons within 20 AAs side chains, calculated from the nuclide with the less abundance in the nature (H-2, C-13, N-15, O-17, S-36); (d) The number of nucleons within 20 AAs side chains, calculated from the last, the heaviest nuclide (H-2, C-13, N-15, O-18, S-36). (M) The AAs molecule mass. Notice that (d) is greater from (c) for exactly one modular cycle (in module 9) and that total molecules mass is equal to 2 372. Notice also that molecule mass within five rows is realized through the same logic-patterns of notations as the first nuclide, i.e. isotope." (MMR, 2004, Tab. 1, p. 223.)

Table 2. Number of nucleotides and codons

					n	c	
K	Y	T	M	→	27	9	
							2
H	W	S	C	→	33	11	
							1
E	Q	G	V	→	36	12	
							2
D	N	A	L	→	42	14	
							1
R	F	P	I	→	45	15	

The distribution of codon number (n = nucleon number; c = codon number). Relation with path of greatest change on four-bit binary tree [Cf. MMR in: Journal of Theoretical Biology 229 (2004) 221–234, Tab. 6, p. 225 with MMR, BioSystems 46 (1998) 283–291, Fig. 1]. Relation through the influence of the law of unit change (1010 + 1111 = 2121).

Table 2.1. Number of stable isotopes in 20 AAs, within their side chains (I)

<table>
<tr><td>K 30</td><td>Y 31</td><td>T 17</td><td>M 24</td><td>→</td><td>102</td><td rowspan="3">250</td></tr>
<tr><td>H 22</td><td>W 36</td><td>S 11</td><td>C 12</td><td>→</td><td>81</td></tr>
<tr><td>E 22</td><td>Q 23</td><td>G 02</td><td>V 20</td><td>→</td><td>67</td></tr>
<tr><td>D 16</td><td>N 17</td><td>A 08</td><td>L 26</td><td>→</td><td>67</td><td rowspan="2">250 – 79</td></tr>
<tr><td>R 34</td><td>F 28</td><td>P 16</td><td>I 26</td><td>→</td><td>104</td></tr>
<tr><td>↓</td><td>↓</td><td>↓</td><td>↓</td><td></td><td rowspan="2">421</td><td rowspan="2"></td></tr>
<tr><td>124</td><td>135</td><td>54</td><td>108</td><td></td></tr>
<tr><td colspan="2">259</td><td colspan="2">259 – 97</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">(25)9</td><td colspan="5">[259 = 258 + 1] [258 = 2 x 129]
[129 + 168 = ½ 594] (594 | 495) (495 = 496-1)</td></tr>
</table>

Table 2.2. Number of stable isotopes in 20 AAs, within their side chains (II)

K 30	Y 31	T 17	**M 24**	→	102	*174*
						↓
H 22	W 36	S 11	**C 12**	→	**81**	
						(99
E 22	Q 23	G 02	**V 20**	→	67	↑
						273
D 16	N 17	**A 08**	**L 26**	→	**67**	**148**
						↓
R 34	P 16	**F 28**	**I 26**	→	104	(99)
↓	↓	↓	↓			↑
124	123	66	108		421	**247**
247		*174*		**2121** – 1111 = 1010		
073				174 – 073 = 0101		

[a-polar 277 (semi 76 + p-polar 201]

nonpolar 144 + semi-p 76 = 220

semi-polar GPWH 76

220 + polar 201 = 421

992 – 772 = 220

Table 2.3. Number of stable isotopes in 20 AAs, within their side chains (III)

K 30	Y 31	T 17	**M 24**	→	102	*174*
						↓
H 22	**W 36**	S 11	**C 12**	→	**81**	
						(99
E 22	Q 23	**G 02**	**V 20**	→	67	↑
						273
D 16	N 17	**A 08**	**L 26**	→	**67**	**148**
						↓
R 34	**P 16**	**F 28**	**I 26**	→	104	
						(99)
↓	↓	↓	↓			↑
124	123	66	108		421	**247**
247		*174*		**2121** – 1111 = 1010		
	073	(174 -073 = 101)		174 – 073 = 0101		

yellow 194 – orange 083 = 111 yellow 194 – red 60 = 67 x 2 orange 083 – red 16 = 67 x 1 red: 76 194 + 083 = **277**	**277**–76 = 201 gray up 67 – 11 (56) gray down 67 + 21 (88) 56 + 88 = 144 [144 + 277 = 421 421+76 = 496+1

Table 3. Four diversity of 20 amino acids

<table>
<tr><td>G 01</td><td>S 05</td><td>Y 15</td><td>W 18</td><td>39</td><td rowspan="2">78</td><td rowspan="3">102</td></tr>
<tr><td>A 04</td><td>D 07</td><td>M 11</td><td>R 17</td><td>39</td></tr>
<tr><td rowspan="2">C 05</td><td rowspan="2">T 08</td><td rowspan="2">E 10</td><td rowspan="2">F 14</td><td rowspan="2">37</td><td>24</td></tr>
<tr><td>13</td><td rowspan="2">102</td></tr>
<tr><td>N 08</td><td>Q 11</td><td>V 10</td><td>I 13</td><td>42</td><td>89</td></tr>
<tr><td>P 08</td><td>H 11</td><td>L 13</td><td>K 15</td><td>47</td><td colspan="2"></td></tr>
<tr><td>26</td><td>42</td><td>59</td><td>77</td><td colspan="3"></td></tr>
<tr><td></td><td>16</td><td>17</td><td>18</td><td colspan="3"></td></tr>
<tr><td></td><td>(1 x 68)</td><td colspan="2">(2 x 68)</td><td colspan="3"></td></tr>
</table>

Table 4. xx

1st	2nd letter								3rd
	U		C		A		G		
U	UUU UUC UUA UUG	F14 L13	UCU UCC UCA UCG	S05	UAU UAC UAA UAG	Y15 CT	UGU UGC UGA UGG	C05 CT W18	*U* *C* *A* *G*
C	CUU CUC CUA CUG	L13	CCU CCC CCA CCG	P08	CAU CAC CAA CAG	H11 Q11	CGU CGC CGA CGG	R17	*U* *C* *A* *G*
A	AUU AUC AUA AUG	I13 M11	ACU ACC ACA ACG	T08	AAU AAC AAA AAG	N08 K15	AGU AGC AGA AGG	S05 R17	*U* *C* *A* *G*
G	GUU GUC GUA GUG	V10	GCU GCC GCA GCG	A04	GAU GAC GAA GAG	D07 E10	GGU GGC GGA GGG	G01	*U* *C* *A* *G*

10 AAs	13 AAs
$(F_{14} L_{13} L_{13})$ 40 $(C_{05} W_{18} R_{17})$ 40 $(N_{08} K_{15}\ D_{07} E_{10})$ 40	$(I_{13} M_{11} V_{10} S_{05} P_{08} T_{08} A_{04})$ 60-1 $(Y_{15} H_{11} Q_{11}\ S_{05} R_{17} G_{01})$ 60

adekvatan kompliment sa uvažavanjem Rumera, to jest aranžmana vodoničnih veza (4-5-5-6), tada mora biti: okso – amino. a to znači: prva kolona sa četvrtom, gornji deo GCT sa gornjim delom; tek potom donji deo. ako je utrošeno UG, posle toga ne može više biti G nego mora biti središnje A, kao sredisnji nukleotid u kdonu.

Table 4.1. xxx

(**90** x 2 = 180) (**10** x 18 = 180)	91 + 11 = 102
(**80** x 2 = 160) (**20** x 8 = 160)	81 + 21 = 102
(**70** x 2 = 140) (**30** x 4.67 ≈ 140)	71 + 31 = 102
(**60** x **2** = 120) (**40** x **3** = **120**)	**61 + 41 = 102**
(50 x 2 = 100) (50 x 2 = 100)	51 + 51 = 102

Odnosi na dijagonali 0-ended. Unikatnost pretposlednjeg reda je u blskom susedstvu sa središnjom tačkom (sa brojem 50). S druge strane, unikatnost brojeva 5 i 6 je u tome što njihovom susedstvu korespondira i susedstvo njihovim kvadrata. T je jedan jedini takav slučaj. Korespondencija sa Table 5.

AAs kodirane preostalim Py kodonima 60-1, a 60 je kad je kodiranje preostalim Pu kodonima. …

Table 5. xx

1st	2nd letter								3rd
	U		C		A		G		
U	UUU UUC UUA UUG	**F14** **L13**	UCU UCC UCA UCG	**S05**	UAU UAC UAA UAG	**Y15** CT	UGU UGC UGA UGG	**C05** CT **W18**	*U* *C* *A* *G*
C	CUU CUC CUA CUG	**L13**	CCU CCC CCA CCG	**P08**	CAU CAC CAA CAG	**H11** **Q11**	CGU CGC CGA CGG	**R17**	*U* *C* *A* *G*
A	AUU AUC AUA AUG	**I13** **M11**	ACU ACC ACA ACG	**T08**	AAU AAC AAA AAG	**N08** **K15**	AGU AGC AGA AGG	**S05** **R17**	*U* *C* *A* *G*
G	GUU GUC GUA GUG	**V10**	GCU GCC GCA GCG	**A04**	GAU GAC GAA GAG	**D07** **E10**	GGU GGC GGA GGG	**G01**	*U* *C* *A* *G*

8 AAs $(I_{13}\ M_{11}\ V_{10})$ 34 11 $(S_{05}\ R_{17}\ G_{01})$ 23 10 $(S_{05}\ P_{08})$ 13 (60+10)	10 AAs $(C_{05}W_{18}R_{17})$ 40 $(F_{14}\ L_{13}\ L_{13})$ 40 $(N_{08}K_{15}D_{07}E_{10})$ 40 5 AAs $(Y_{15}H_{11}Q_{11}\ T_{08}\ A_{04})$ 50-01

F I G U R E S

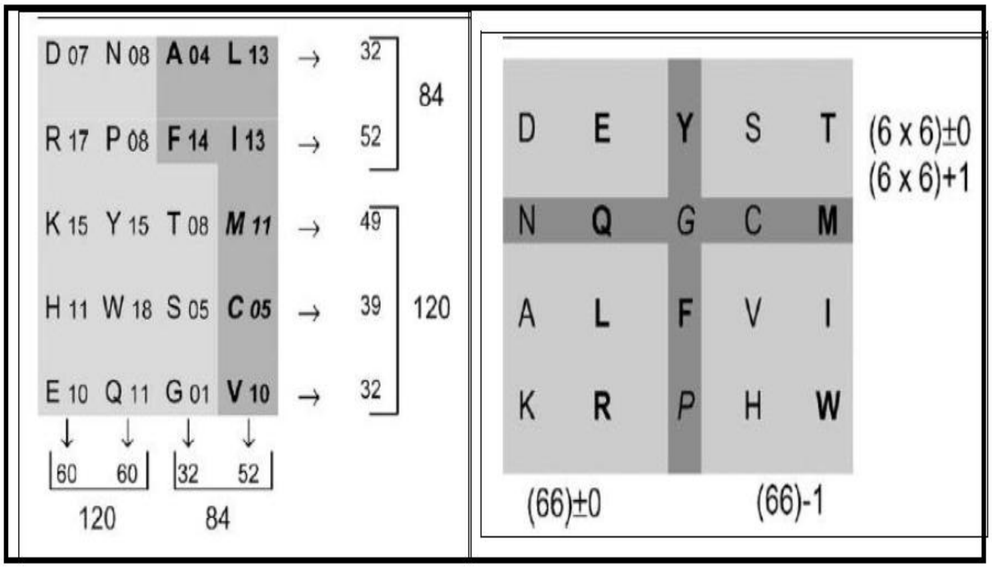


Figure 1. xxx figura 5.1 ponovo; bile su 2.6 i 3.2 da bi se pokazalo …

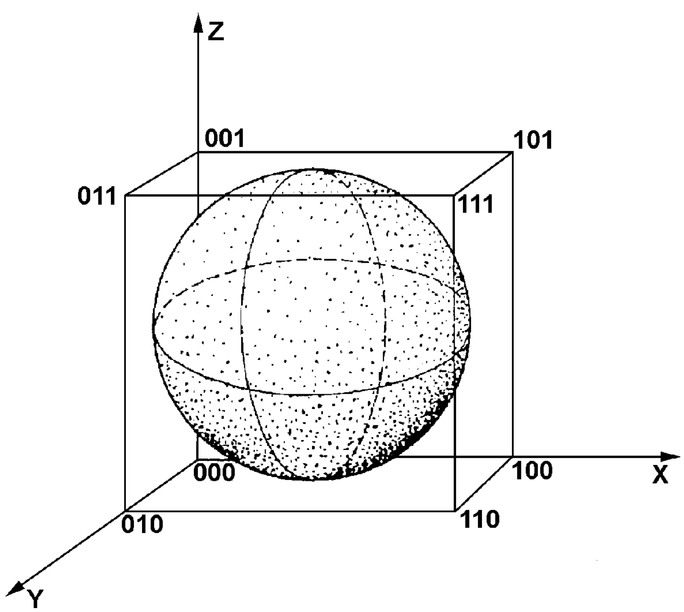


Figure 1.1. xxx

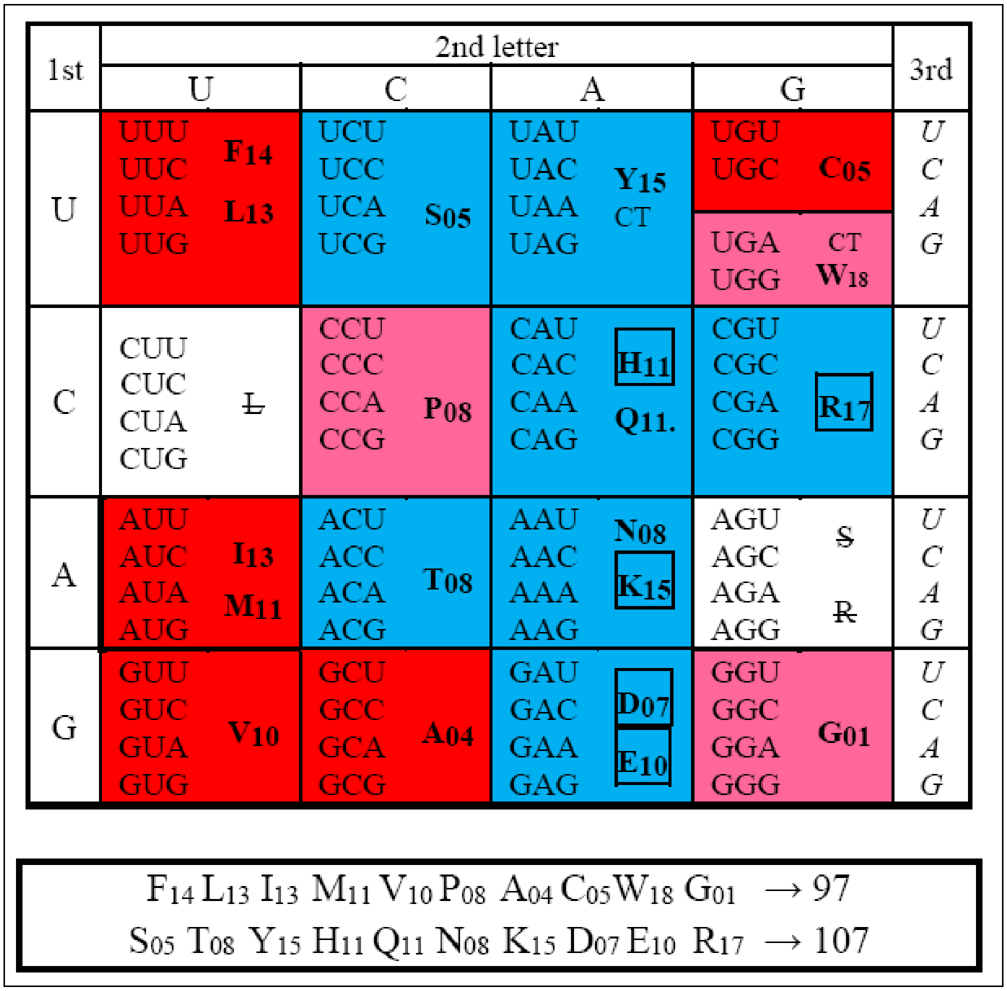
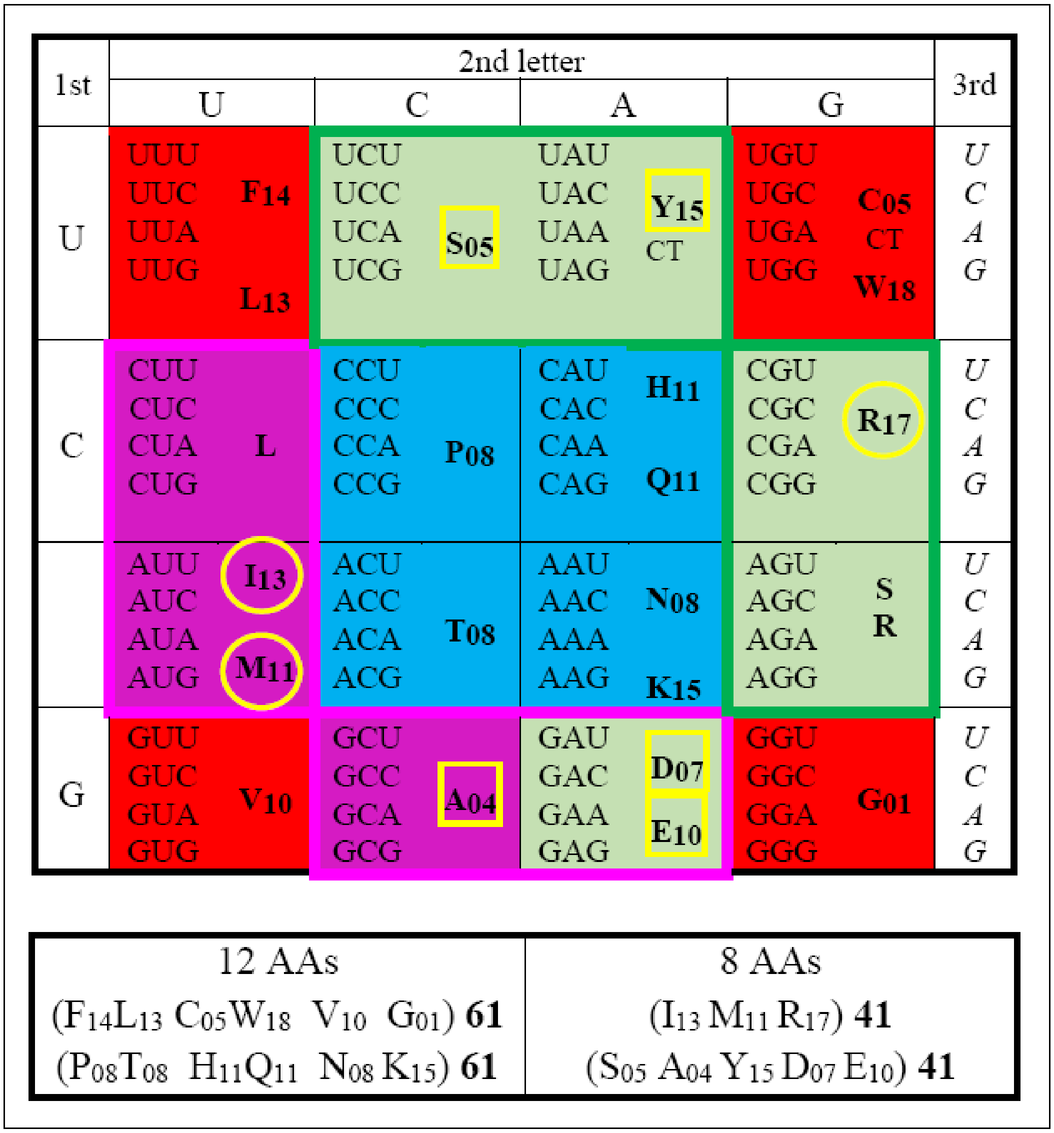


Figure 2. Kvantiteti su (117 – 10 i 87 + 10) [(107 + 17 = 124) (97 + 18 = 115)] [(107 + 18 = 125) (97 + 17 = 114)].

Distribucija of AAs na 10 polarnih i 10 koje nisu polarne (7 nonpolar and 3 semipolar). Od 61 u nepolarnim, povecano je za (IMAP) 36 → 36 + 61 = 97. A kod polarnih smanjenoje za 8 i povećano za (SYR DE) 54 → 54 + 61 = 115; minus 8 jednako je 107. … Ako H pređe u nepolarne, njih je onda 107+1, a olarnih 97 – 1. .. Naelektrisane imaju 60 atoma, te 107 – 60 = 47 polarnih nenaelektrisanih. S druge strane, semipolarne imaju 27. … Možemo reći da polarnih nenaelektrisanih ima 37 + 10, a semipolarnih 37 – 10. Bez semipolarnih čisto nepolarnih ima 97 – 27 = 70. Znači, nepolarnih nenaelektrisanih ima 50 + 10, a nepolarnih



1st	2nd letter: U	C	A	G	3rd
U	UUU UUC UUA UUG **F14** **L13**	UCU UCC UCA UCG **S05**	UAU UAC UAA UAG **Y15** CT	UGU UGC UGA UGG **C05** CT **W18**	U C A G
C	CUU CUC CUA CUG **L**	CCU CCC CCA CCG **P08**	CAU CAC CAA CAG **H11** **Q11**	CGU CGC CGA CGG **R17**	U C A G
	AUU AUC AUA AUG **I13** **M11**	ACU ACC ACA ACG **T08**	AAU AAC AAA AAG **N08** **K15**	AGU AGC AGA AGG **S** **R**	U C A G
G	GUU GUC GUA GUG **V10**	GCU GCC GCA GCG **A04**	GAU GAC GAA GAG **D07** **E10**	GGU GGC GGA GGG **G01**	U C A G

12 AAs	8 AAs
($F_{14}L_{13}$ $C_{05}W_{18}$ V_{10} G_{01}) **61**	(I_{13} M_{11} R_{17}) **41**
($P_{08}T_{08}$ $H_{11}Q_{11}$ N_{08} K_{15}) **61**	(S_{05} A_{04} Y_{15} D_{07} E_{10}) **41**

Figure 3. Kvalitativno-kvantittini odnosi u skupu 20 AAs. CITIRATI: Tabis, ali iz OSF. Cloister by Swanson. A harmonic: redosled 20 AAs. Rumera iz moje Cipher. Pišem i sve ovo: (SYRSR) 59 and (LIMADE) 58. Zatim, 2 reda i 2 kolone po 41; to su SA i YDE. Crvena i plava polja isto tako: zauzimaju po 2 r3da i po dve kolone. ... Dole, u Description su dva reda: gornji sa 8 nepolarnih i 1 polarna (R); i donji sa 10 polarnih i 1 nepolarna (A) ... Dalje: 41 + 41 = 82; zatim, 82 – (17 + 4 = 21) = 61. ... Polarnih ima 61 + (41 – 4) + 17 = 54.

		119			
G 01	**N 08**	**L 13**	**M 11**	**(33)**	120
A 04	D 07	K 15	F 14	(40)	
V 10	**S 05**	**R 17**	**Y 15**	**(47)**	
P 08	T 08	Q 11	W 18	(45)	117
I 13	**C 05**	**E 10**	**H 11**	**(39)**	
G 01	N 08	L 13	M 11	(33)	
24/13	**18**/23	**40/39**	**37**/43	118/**119**	
(37)	**(41)**	**(79)**	(80)	117/**120**	
		118			

Figure 4. xxx 33, 40, 47, 45, 39, 33

Ovde njih 10 daju 120-1, a na Fig 2.1 njih 14 daju 120+1.

Quintets of AAs in PPAASS (Table 1 in MP) with the first repeated at the end. [See in: Seminar and Round Table: *Science – Religion – Society*, Serbian Academy of Sciences and Arts (SANU), Belgrade, April 12, 2002; https://www.dejanrakovicfund.org/knjige/2002-nauka-religija-drustvo.pdf); also in OSF Preprints: https://doi.org/10.31227/osf.io/qb2p5 and in my site: http://www.rakocevcode.rs . From OSF Preprints, p. 12: “The first row is repeated at the bottom, and thus one cyclic system is obtained. There are 117 atoms in two outer columns; at even positions 118, at odd 119; in two inner columns 120 atoms. On the other hand, in the lower half of the Table there are 117 atoms ones more; in the lower diagonally "wrapped" area 118, and in the upper 119; in the upper half of Table 120 atoms. The repeated four AAs at the bottom of the Table make to achieve a diagonal balance with a difference of only one atom; moreover, to establish a sequence from the series of natural numbers: 117, 118, 119, 120.” [Cf. Table 4.2 in Main Paper (MP).]

<table>
<tr><td>G 01</td><td>N 08</td><td>L 13</td><td>M 11</td><td>33</td><td rowspan="3">120</td><td rowspan="9">08 / 17 (09 / 18)
18 / 27 (19 / 28)
28 / 37 (29 / 38)
38 / 47 (39 / 48)
48/ 57 (49 / 58)
58 / 67 (59 / 68)
68 / 77 (69 / 78)
78 / 87 (79 / 88)
88 / 97 (89 / 98
98 / 107 (99 / 108
108 / 117 (109 / 118
. . .</td></tr>
<tr><td>A 04</td><td>D 07</td><td>K 15</td><td>F 14</td><td>40</td></tr>
<tr><td>V 10</td><td>S 05</td><td>R 17</td><td>Y 15</td><td>47</td></tr>
<tr><td>P 08</td><td>T 08</td><td>Q 11</td><td>W 18</td><td>45</td><td rowspan="2">84</td></tr>
<tr><td>I 13</td><td>C 05</td><td>E 10</td><td>H 11</td><td>39</td></tr>
<tr><td>36</td><td>33</td><td>66</td><td>69</td><td rowspan="2">40
47
↓
87</td><td rowspan="2">33
↓
117</td></tr>
<tr><td colspan="4">102 / 102
(36 +33 = 69)</td></tr>
<tr><td colspan="7">Red: 36; green: 35 (as 36–1); blue: 35 x 2 = 70 (as 60+10);
white / gray 31 / 32, in total 63 | 36; (Column difference ± 3);
(69 + 9 = 78) (78 + 9 = 87)
(81 – 84 – 87 – 90) / (123 – 120 – 117 – 114)</td></tr>
</table>

Description of Figure 4: Prvi i treći kvintet prvim dvema kolonama; deugi i četvrti kvintet u drugim dvema kolonama. … Ovde je poenta u prisabiranju broja 9 → 78 + 9 = 87, dok je 68 + 9 = 77.

S U R V E Y S

Suvey 1. xxx

CE	HP								HP	CE
-0.16	-0.4	G	01				01	G	-0.4	-0.16
-0.09	+1.8	A	04	15	(12)	27	13	L	+3.8	-0.54
-0.52	+4.2	V	10				13	I	+4.5	-0.56
+0.24	-0.8	S	05				08	T	-0.7	+0.27
-0.73	+2.5	C	05	20	(12)	32	11	M	+1.9	-0.57
-0.52	+4.2	V	10				13	I	+4.5	-0.56
+0.69	-3.5	D	07				10	E	-3.5	+0.71
+0.52	-3.5	N	08	30	(08)	38	11	Q	-3.5	+0.91
+1.46	-3.9	K	15				17	R	-4.5	+0.87
+0.46	-1.6	P	08				08	P	-1.6	+0.46
±0.00	-3.2	H	11	33	(08)	41	18	W	-0.9	-0.25
-0.56	+2.8	F	14				15	Y	-1.3	+0.42

Suvey 1.1. xxx

TABLE 1

The order of involvement of amino acid precursors in biosynthesis paths

1. 3-Phosphoglycerate	G	•	•	•	•	•
2. Pyruvate	A	L	V	•	•	•
3. Oxaloacetate	•	•	I	•	•	•
1. 3-Phosphoglycerate	S	*C*	•	•	•	•
2. Pyruvate	•	•	V	•	•	•
3. Oxaloacetate	T	M	I	D	N	K
4. 2-Oxoglutarate	•	•	P	E	Q	*R*
5. Ribose-5-phosphate	•	•	*H*	•	•	•
6. Phosphoenolpyruvate plus eritrose-4-phosphate	•	•	W	F	Y	•

Survey 2. xxx

(84) (14. x 6)					**72** (12 x 6)			
G 01	A 04	N 08	D 07	(**20**)	G 01	A 04	N 08	D 07
V 10	P 08	S 05	T 08	(31)	V 10	P 08	S 05	T 08
I 13	L 13	C 05	M 11	(**42**)	I 13	L 13	C 05	M 11
K 15	R 17	F 14	Y 15	(61)	K 15	R 17	F 14	Y 15
Q 11	E 10	W 18	H 11	(**50**)	Q 11	E 10	W 18	H 11
(**120**) (60 x 2) [60 = **10** x 6]					**132** (66 x 2) [66 = 11 x 6]			

[**20** + 42 + **50** = 102 + 10] [31 + 61 = 102 – 10]

(68 x 2) – 11 [68 = **78** – 10]					**(120)**			
G 01	A 04	N 08	D 07	(**20**)	G 01	A 04	N 08	D 07
V 10	P 08	S 05	T 08	(31)	V 10	P 08	S 05	T 08
I 13	L 13	C 05	M 11	(**42**)	I 13	L 13	C 05	M 11
K 15	R 17	F 14	Y 15	(61)	K 15	R 17	F 14	Y 15
Q 11	E 10	W 18	H 11	(**50**)	Q 11	E 10	W 18	H 11
(68 x 1) + 11 [**78** = 13. x 6]					**(84)**			

Description of Figure 1 (I): Mirroring relations in the set of five quartets taken from PPAASS (Tables 1 and 2 in MP). Five quartets: the first four AAs in PPAASS form the first quartet, etc.

Survey 3. xxx

G 01	A 04	N 08	D 07	(**20**)	G 01	A 04	N 08	D 07
V 10	P 08	S 05	T 08	(31)	V 10	P 08	S 05	T 08
I 13	L 13	C 05	M 11	(**42**)	I 13	L 13	C 05	M 11
K 15	R 17	F 14	Y 15	(61)	K 15	R 17	F 14	Y 15
Q 11	E 10	W 18	H 11	(**50**)	Q 11	E 10	W 18	H 11
(**62** / 142) (62 x 1) / (71 x 2) 31 + 61 = 102 – 11					↓ 51-1	↓ 51+1	↓ 51-1	↓ 51+1
					(102)		(102)	
					20 + **42** + **50** = **102 + 11**			

Balancing and nuancing in terms of positions of AAs in both even and odd rows, as well as in even and odd columns. Apart from that, distinctions are manifested as outer and inner space (illustration on the left). The quantity 62 corresponds to the golden section, and 142 to friendly numbers.

Survey 3.1. xxx

PCR 30 SLF 31+1	KY 30 VITM 41+1	GDQH 30 ANEW 40	90 114 [204]
61+1	71+1	70	62 + 72 = 134
[70 – 80 – 90] [114 – 124 – 134]			

0-ebded diagonal …

Survey 4. xxx

G 01	S 05	Y 15	W 18	**(39)**	G 01	S 05	Y 15	W 18
A 04	D 07	M 11	R 17	(39)	A 04	D 07	M 11	R 17
C 05	T 08	E 10	F 14	**(37)**	C 05	T 08	E 10	F 14
N 08	Q 11	V 10	I 13	(42)	N 08	Q 11	V 10	I 13
P 08	H 11	L 13	K 15	**(47)**	P 08	H 11	L 13	K 15

[(**68 x 1) – 11**] [(68 x 2) + 11] 39 ρ 39 → 00 (78) 47 ρ 37 → 10 (84) 78 = 68 + 10	↓ 26 ↓ 42 ↓ 59 ↓ 77 (68 x 1) (68 x 2) **39** + **37** + **47** = **123** 39 + 42 = 81 42 + **47** = 78 + 11

Survey 4.1. xxx

(DEQ 28 + MTV 29 = 57), (NI 21 + ACRF 40 = 61) → 117 + 1

GWPK 42 + SYHL 44 → 87 – 1

(57 + 44 = 102 – 1) (61 + 42 = 102 + 1)

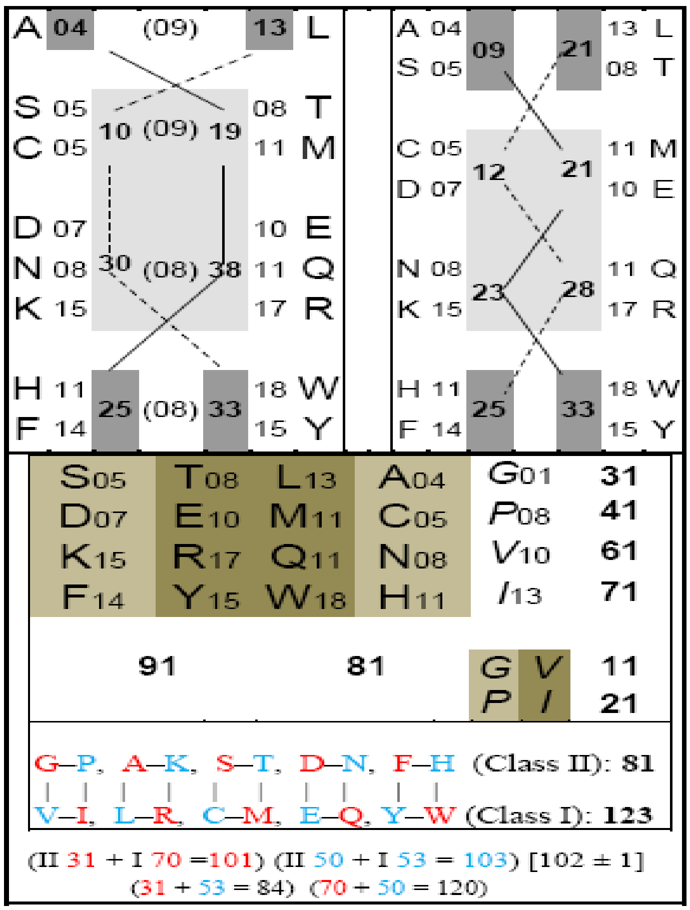
Survey 5. xxx

81 + 1					111 (37 x 3)			
G 01	S 05	Y 15	W 18	(**39**)	G 01	S 05	Y 15	W 18
A 04	D 07	M 11	R 17	(39)	A 04	D 07	M 11	R 17
C 05	T 08	E 10	F 14	(**37**)	C 05	T 08	E 10	F 14
N 08	Q 11	V 10	I 13	(42)	N 08	Q 11	V 10	I 13
P 08	H 11	L 13	K 15	(**47**)	P 08	H 11	L 13	K 15
123 – 1)					93 (31 x 3)			
[123 = **39** + **37** + **47**] [122 + 123 = (**117** x 2) + 11]					[81 = 39 + 42] [81 + 93 = (**87** x 2) + 00]			
117 + 11 (128 x 1)					148 (37 x 4)			
G 01	S 05	Y 15	W 18		G 01	S 05	Y 15	W 18
A 04	D 07	M 11	R 17		A 04	D 07	M 11	R 17
C 05	T 08	E 10	F 14		C 05	T 08	E 10	F 14
N 08	Q 11	V 10	I 13		N 08	Q 11	V 10	I 13
P 08	H 11	L 13	K 15		P 08	H 11	L 13	K 15
87 – 11					56 (028 x 2)			

Appendix A

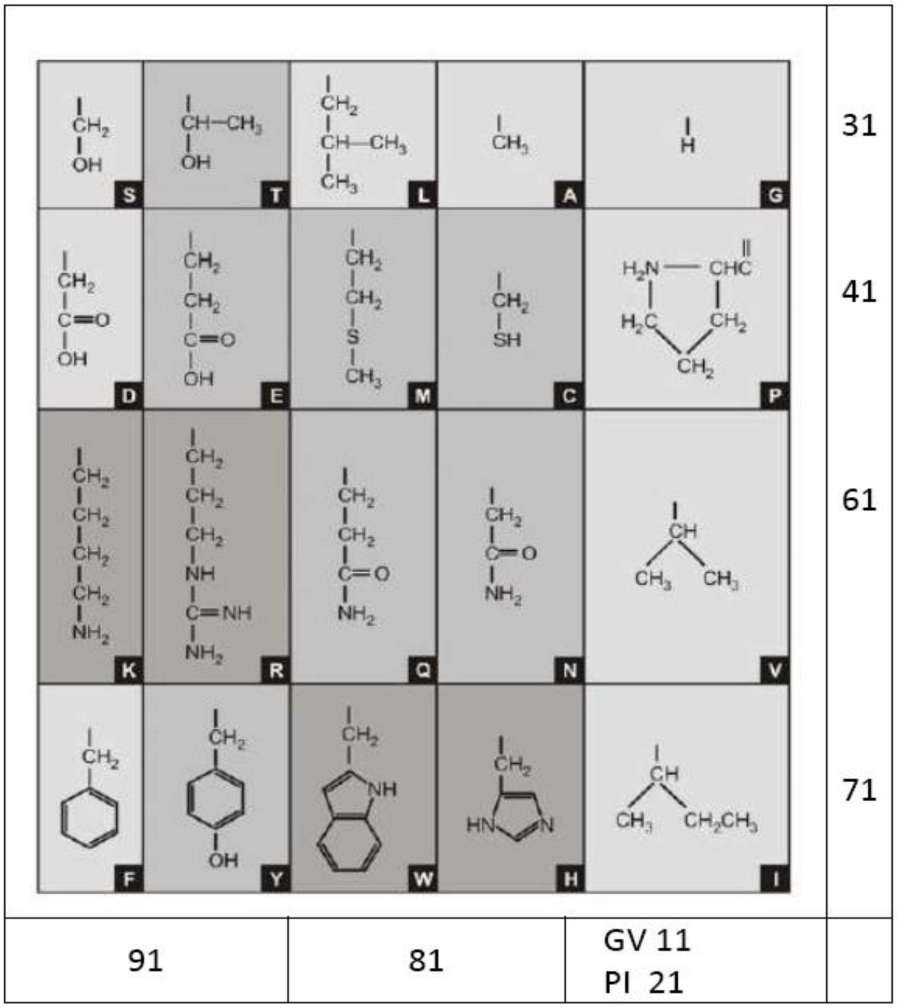
QUALITATIVE AND QUANTITATIVE CHEMICAL UNIQUENESS

Table A1. xxxx



Top left are 16 AAs of the alanine stereochemical type (MMR & AJ, J. Theor. Biol. (1996) 183, 345–349). On the right are the same AAs, but arranged by pair neighborhood (MMR, 2011, Neuroquantology, 2011, 9 (4), 821–841, Table 2.1, p. 823: "The atom number within 8 pairs of alanine stereochemical type of AAs: on the full line, as well as on the dotted one, there are 86 atoms; the differences 8 and 9 (9 - 8 = 1) express ‘the minimum change relation among the amino acids’ (Swanson, 1984, p 191). The order follows from the atom number hierarchy. ... By that notice that within outer class of AAs (AL + FY + HW) there are [(4 + 33 = 37) + (13 + 25 = 38) = 75] of atoms; and within inner class (SC + EQR & TM + DNK) there are [(10 + 38 = 37 + 11) + (19 + 30 = 38 + 11) = 75 + 22 = 97] atoms, respectively. In the middle area: as in Main Paper., Table 6. Dark tones: Class I of amino acids handled by class I of enzymes aminoacyl-tRNA synthetases, except T; light tones: Class II, except C. Quantities of the number of atoms, by rows and columns (11, 21, 31, ..., 81, 91) are "taken off" from 1-ended diagonal in the Periodic System of Numbers (PSN, Tab. 1 in this paper). Bottom: the best possible chemical pairing of AAs, taken from the middle arrangement, within two classes of amino acids, handled by two classes of aminoacyl-tRNA synthetases.

Table A2. xxxx



The structure of amino acid molecules. From MMR, 2011, Neuroquantology, 2011, 9 (4), 821–841, Figure 10, p. 835: "The simplest amino acid is glycine (G) whose side chain is only one atom of hydrogen. It is followed by alanine (A) whose side chain is only one CH_3 group, which is the smallest hydrocarbon group. There are total of 16 amino acids of alanine stereochemical type with one CH_2 group, each between the 'body' and the 'head'. The glycine type contains glycine (G) only; valine type contains valine and isoleucine (V, I). The last stereochemical type is proline type with proline (P) which represents the inversion of valine in the sense that the 'triangle' of three CH_2 groups for the 'head' is not bound by the basis, therefore not only with one but with two CH_2 groups (Popov, 1989; Rakočević & Jokić, 1996). Light tones [(G, P, V, I) (32 atoms)] & [(A, L, S, D, F) (43 atoms)]: invariant AAs; most dark tones [(K, R, W, H) (61 atoms]: most variant AAs; less dark tones [(T, E, M, C, Q, N, Y) (68 atoms)]: less variant AAs. Notice a further possibility for splitting: 1. two aliphatic AAs [(K, R) (32 atoms)], 2. two aromatic AAs [(W, H) (29 atoms)], 3. chalcogen AAs plus aromatic hydroxide derivative [(MC, TY) (39 atoms), and 4. one dicarboxylic amino acid [only E but D is invariant] plus two amides [(E, QN) (29 atoms). A specific calculation: less variant AAs, all aliphatic but one (Y), plus two more variant (aromatic: W, H), equals 68 + 29 = 97 atoms; invariant AAs, all aliphatic but one (F) plus two more variant (aliphatic: K, R), equals 75 + 32 = 107 atoms; if so, then: 107 – 97 = 10; 107 + 97 = 204. [Additional calculations: 32 + 43 = 75; 61+68 = 129.]" [Note, 2025: The sum of 1**0**7 + **9**7 is in relation to the number of hydrogen and non-hydrogen atoms in the set of 20 AAs, in their side chains: 1**1**7 + **8**7 = 204.]

Table A3. xxxx

I	II	III	IV	V		VI
10		20	10 + B9 = 129	160		06 + 123 = **129**
21	(31)	31	21 + A8 = 129			17 + 112 = **129**
	44			*44*		
32		42	32 + 97 = 129	204		28 + 101 = **129**
43	(75)	53	43 + 86 = 129			39 + 90 = **129**
	44			*44*		
54		64	54 + 75 = 129	**248**		50 + 79 = **129**
65	(**119**)	75	65 + 64 = 129			61 + 68 = **129**
	44			*44*		
76		86	76 + 53 = 129	292		72 + 57 = **129**
87	(163)	97	87 + 42 = 129			83 + 46 = **129**
	44			*44*		
98		A8	98 + 31 = 129	336		94 + 35 = **129**
A9	(207)	B9	A9 + 20 = 129			A5 + 24 = **129**

Minimally modified Table A 4.1 in Neuroquantology, 2011, 9 (4), p. 840.

160 + 336 = 496 204 + 292 = 496 248 + 248 = 496	31+ 207 = 248 – 10 75+ 163 = 248 – 10 119 + 119 = 248 - 10	31 – 31 = 00; 31 – 20 = 11 75 – 53 = 22; 75 – 42 = 33 119 – 75 = 44; 119 – 64 = 55 163 – 97 = 66; 163 – 86 = 77 207 – 119 = 88; 207 – 108 = 99
496 – 238 = 2 x 129		

Description of Table A3:

Table A4. xx

	...										
(-2)	...									...	-22
(-1)	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11
(0)	-10	-09	-08	-07	-06	-05	-04	-03	-02	-01	00
(1)	01	02	03	04	05	06	07	08	09	10	11
(2)	12	**13**	14	15	**16**	**17**	**18**	19	20	21	22
(3)	**23**	24	25	**26**	27	28	29	30	31	32	33
(4)	**34**	35	36	37	38	39	40	41	42	43	44
(5)	45	46	47	48	49	50	**51**	52	53	54	55
(6)	56	57	58	59	60	61	62	63	64	65	66
(7)	67	68	69	70	71	72	73	74	75	76	77
(8)	78	79	80	81	82	83	84	85	86	87	88
(9)	89	90	91	92	93	94	95	96	97	98	99
(A)	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	AA
(B)	B1	B2	B3	B4	B5	B6	B7	B8	B9	BA	BB

. 0-1, 01-2, 012-3, 0123-4, …

prva dijagonalnost jeste 01, sledeća je 1 2, i tu je prvi par 13, 23; zbir daje kvadrat broja 6; u susedstvu je 26; 26 - 23 = 03, i tu je ta savršena unikatnost.

niska (lanac) kvaniteta koji determinisu početak i kraj dijagonale: 02-12, 03-13-23, 04-14-24, 34; prva premalo, tre’a, i sve sledece premnogo. druga je taman. Bez nulte drug ii tre’i ;lan daju 36, kako u Polihedronu, Survey 3b.

03-13-23 (03) 26; (26+16 = 42) (42+17 = 59) (59+18 = 77)

Table 1. The Table of minimal adding in decimal numbering system. A specific arrangement of natural numbers in decimal numbering system, going from 01 to 11 and so on, with Shcherbak’s "simulation" analogs (13, 25, 37, 49 ...) within the first diagonal. For details see the text.   13 + 23 = 36

Table A5. xxxx

more	less		
G P	V I A L F S D	invariant	66
H W K R	T E Y N Q C M	variant	68
60 + 10	68 = 78 - 10		

[GHK 27 vs PWR 43 (43 = 27 + 16)] (27-16 = **11**) 27 + 43 = 70 (**99** – **29**) [VASTNC 40 (40 = 70 – 30)] [(70 + 40 = 110) (110 = **55** x 2) [ILDEQM **65** (65 = 55 + **10**)] (FY **29**) (110 – 29 = (**9** x **9**)	97 – 01 107 + 01 (87 / 117) 96 + (**9 x 9**) [187 – 10] 108 + **99** [197 + 10]

Nepolarne takođe 70. [(VI 23 + AL 17 = 40)] + [(CM 16 + F 14 = 30)] = 70

VIALF 54 – CM 16 = 38 (GPHW 38) [38 – GHK 27 = 11]
(GHK 27 + PWR 43 = 70) = (VI 23 + ALF 31 + CM 16 =70);
(SD 12 + TEY33 + NQ 19 = 64)

(VI 23 + CM 16 =39) + (SD 12 + NQ 19 = 31) = 70
Semi imaju 38 atoma, to jd pola od broja izotopa (Tab 2.2).

The logic of positioning. Expression of AAs in Figure 4 from the aspect of polarity and variability (variant vs invariant AAs). Atom number as indicated, plus distinction: shaded AAs, strictly polar, with (97–1) and unshaded (GP & HW as semi-polar and other as nonpolar) with (107+1) atoms within amino acid side chains. Relations with quantities 60, 66, 78 on the 6-bit binary tree of GC [MMR, BioSystems 46 (1998) 283–291].

Survey A1. xxx

Bulletin of Mathematical Biology, Vol. 59, No. 4, pp. 645–648 1997
Elsevier Science Inc.

0092-8240/97 $17.00 + 0.00

S0092-8240(97)00026-8

TWO CLASSES OF THE AMINOACYL-tRNA SYNTHETASES IN CORRESPONDENCE WITH THE CODON PATH CUBE

■ MILOJE M. RAKOČEVIĆ*
Department of Chemistry,
Faculty of Science,
University of Niš,
Ćirila i Metodija 2 18000 Niš, Yugoslavia

Codon corresponding amino acids within the Codon path cube exist in a strict relation to two classes of enzymes aminoacyl-tRNA synthetases. © 1997 Society for Mathematical Biology

Codons									
2nd letter	1st letter								3 rd letter
	A		*G*		*C*		*U*		
A	N	II	D	II	H	II	Y	I	*C*
	N		D		H		Y		*U*
	K	II	E	I	Q	I	□		*A*
	K		E		Q		□		*G*
G	S	II	G	II	R	I	C	I	*C*
	S		G		R		C		*U*
	R	I	G	II	R	I	□		*A*
	R		G		R		W	I	*G*
C	T	II	A	II	P	II	S	II	*C*
	T		A		P		S		*U*
	T	II	A	II	P	II	S	II	*A*
	T		A		P		S		*G*
U	I	I	V	I	L	I	F	II	*C*
	I		V		L		F		*U*
	I	I	V	I	L	I	L	I	*A*
	M	I	V		L		L		*G*
	Amino acids								

Figure 1. The distribution of amino acids within the "Codon path cube" (Swanson, 1984) is followed with a strict distinctiion into the two and two spaces for two classes (I and II) of the enzymes amino-acyl-tRNA synthetases; a strict distinction, with only one exception, valid for arginine (R) in positions: A–G–A and A–G–G. Bearing this in mind, by the calculation of atom number, the amino acid R must be included: four times in space I ($4 \times 17 = 68$; row 1′ in Table 1) and two times ($2 \times 17 = 34$; row 2′ in Table 1) in space II.

Fgure A1. xxxx

Table A5.1. xxxx

Table 1. Atom number balance within "Codon path cube"

1	$11 + 39 + 40 + 78 = 168 - 0$ $M + I + V + L = (\mathbf{4})$
2	$32 + 16 + 32 + 20 + 28 = 129 - 1$ $T + A + P + S + F = (\mathbf{5})$
1′	$30 + 22 + 20 + 68 + 10 + 18 = 168 + 0$ $Y + Q + E + R + C + W = (\mathbf{6})$
2′	$16 + 14 + 22 + 30 + 10 + 04 + 34 = 129 + 1$ $N + D + H + K + S + G + R = (\mathbf{7})$

The two (1 and 1′) and two (2 and 2′) rows correspond to two and two sub-blocks within Fig. 1. By calculation of total atom number within side chains of amino acid molecules, each molecule must be included so much times how much condons code it.

Table A5.2. xxxx

Table 2. The pu-pyr bases arrangement (ordering according to Watson–Crick's table)

	U	C	A	G	In/out pair's sum
BV	0	1	2	3	3 ± 0
AN(I)	12	13	15	16	28 ± 0
AN(II)	34	35	37	38	72 ± 0

BV: Binary values 00, 01, 10, 11, i.e., binary numbers expressed in decimal numbering system [cf. the same numbers in Fig. 1 in Swanson (1984, p. 188) and in Shcherbak (1994, p. 476: "The four numbers 0, 1, 2, 3 are used instead of the base symbols T, C, A, G")]. AN(I): the total atom number within pu-pyr bases U, C, A, G respectively; AN(II): the total atom number within pu-pyr nucleotides, UMP, CMP, AMP, GMP, respectively; In/Out pair's sum: the sum within the inner pair C–A and outer pair U–G. [Notice that the nucleon (barionic) number is also pair's depending; so, for the ione form the "barionic numbers are: A + T = 259 and G + C = 259 + 1"; and, on the same page: "The product of both prime quantums, i.e., 037×07, is equal to 259" (Shcherbak, 1994, p. 476)]. The zero minimum changes, ± 0, correspond to the same such changes in amino acid AN valid for the rows 1 and 1′ in Table 1.

Table A5.3. xxxx

Table 3. The pu-pyr bases arrangement (ordering according to "Codon path cube")

	U	C	G	A	In/out pair's sum
BV	0	1	3	2	3 ± 1
AN(I)	12	13	16	15	28 ± 1
AN(II)	34	35	38	37	72 ± 1

The designations as in Table 2. The inner pair is C−G and outer pair U−A. The unit minimum changes, ± 1, correspond to the same such changes in AN valid for the rows 2 and 2′ in Table 1.

Table A5.4. xxxx

0	09	18	27	…	90	99	99 + 1 = 100	100 + 100 = 200
1	10	19	28	…	91	100	100 + 1 = 101	101 + 101 = 202
2	**11**	**20**	29	…	**92**	101	101 + 1 = **102**	102 + 102 = **204**
3	12	21	30	…	93	102	102 + 1 = 103	103 + 103 = 206
…								

(101+1 = 102), (100+2 = 102), (99+3 = 102), (98+4 = 102) … (52+50 = 102), [**51**], (52+50) = 102)

(91+11 = 102), (81+21 = 102), (71+31 = 102), (61+41 = 102), (51+51 = 102)

[(09 / 90), (19 / 91), (29 / 92)], (39 / 93), (49 / 94), (59 / 95), (69 / 96), (79 / 97), (89 / 98), (99 / 99)

Description of Tables A5 and A5.1: Ovde je glavno – zašto 29 (FY) u Tab A5. Gaus je kod jedinice

Table A5.5. xxxx

109	119	129	139		118	128	138	148
119	129	139	149		128	138	148	158
129	139	**149**	159		138	**148**	158	168
1–4–9 → (1^2)– (2^2)–(3^2).					**148 → 248 (248 x 2 = 496)**			
139	149	159	169		148	158	168	178
. . .	129 →120 ["0" in modulo 9]				[**1–4–8** → (1^2)– (2^2)–(2^3)]			

(168 = 2 x 84) (168 → 068) (068 x 3 = 204)

Table A6. Atom number in the set of 61 amino acid molekules, withn their side chains (I)

1st lett.	2nd letter U		C		A		G		3rd lett.
U	UUU UUC UUA UUG	F II L I	UCU UCC UCA UCG	S II	UAU UAC UAA UAG	Y I CT	UGU UGC UGA UGG	C I CT W I	U C A G
C	CUU CUC CUA CUG	L I	CCU CCC CCA CCG	P II	CAU CAC CAA CAG	H II Q I	CGU CGC CGA CGG	R I	U C A G
A	AUU AUC AUA AUG	Ile I M I	ACU ACC ACA ACG	T II	AAU AAC AAA AAG	N II K II	AGU AGC AGA AGG	S II R I	U C A G
G	GUU GUC GUA GUG	V I	GCU GCC GCA GCG	A II	GAU GAC GAA GAG	D II E I	GGU GGC GGA GGG	G II	U C A G

Table 6.1. Atom number in the set of 61 amino acid molekules, withn their side chains (II)

/

Table A7. xxxx

1st	2nd letter								3rd
	U		C		A		G		
U	**UUU**	**F**	UCU	S	UAU	Y	UGU	C I	*U*
	UUC		UCC		UAC		UGC		*C*
	UUA	**L**	UCA		UAA	CT	UGA	CT	*A*
	UUG		UCG		UAG		UGG	W I	*G*
C	CUU	L	**CCU**	**P**	CAU	H	CGU	R	*U*
	CUC		**CCC**		CAC		CGC		*C*
	CUA		**CCA**		CAA	Q	CGA		*A*
	CUG		**CCG**		CAG		CGG		*G*
A	AUU	Ile	ACU	T	**AAU**	**N**	AGU	S	*U*
	AUC		ACC		**AAC**		AGC		*C*
	AUA		ACA		**AAA**	**K**	AGA	R	*A*
	AUG	M	ACG		**AAG**		AGG		*G*
G	GUU	V	GCU	A	GAU	D	**GGU**	**G**	*U*
	GUC		GCC		GAC		**GGC**		*C*
	GUA		GCA		GAA	E	**GGA**		*A*
	GUG		GCG		GAG		**GGG**		*G*

Table A8. xxxx

1st	2nd letter								3rd
	U		C		A		G		
U	UUU	F	UCU	S	UAU	**Y**	UGU	C I	*U*
	UUC		UCC		UAC		UGC		*C*
	UUA	L	UCA		UAA	**CT**	UGA	**CT**	*A*
	UUG		UCG		UAG		UGG	**W I**	*G*
C	CUU	L	CCU	**P**	CAU	**H**	CGU	**R**	*U*
	CUC		CCC		CAC		CGC		*C*
	CUA		CCA		CAA	**Q**	CGA		*A*
	CUG		CCG		CAG		CGG		*G*
A	AUU	Ile	ACU	**T**	AAU	**N**	AGU	**S**	*U*
	AUC		ACC		AAC		AGC		*C*
	AUA		ACA		AAA	**K**	AGA	**R**	*A*
	AUG	M	ACG		AAG		AGG		*G*
G	GUU	V	GCU	A	GAU	**D**	GGU	**G**	*U*
	GUC		GCC		GAC		GGC		*C*
	GUA		GCA		GAA	**E**	GGA		*A*
	GUG		GCG		GAG		GGG		*G*

(n) 4V+1M+3I+4A+**2L**+**4L**+**2F**+2C = 22 molecules
40+ 11+39+16+26 + 52 +28+10 = 2**2**2 atoms (42**0**)
(o) 4V+1M+3I+4A+**2Y**+**4R**+**1W**+2C = 21 molecules
40+ 11+39+16+ 30 + 68 +18+ 10 = 2**3**2 atoms (42**1**)

(p) 4G+2K+2N+4P+**2Y**+**4R**+**1W**+2E+2D+4T+2R+2S+2Q+2H+4S = 39
04+30+16+32+30 + 68+ 18+ 20 +14+ 32+ 34+10+22+22 + 20 = 3**7**2 (72**3**)

(i) 4G+2K+2N+4P+**2L**+**4L**+**2F**+2E+2D+4T+2R+2S+2Q+2H+4S = 40
04+30+16+32+26+52 + 28+20+ 14+32+ 34 +10+22+ 22+ 20 = 3**6**2 (72**2**)

Description of Table A7 and A8: xxx

(129, 139, 149, 159) (138, 148, 158, 168)

(1, 2, 3, 4) (10, 11, 12, 13) (11, 12, 13, 14) (15, 16, 17, 18)	(20, 30, 40, 50) (60, 70, 80, 90)

Appendix B

BALANCING AND NUANCING WITHIN PPAASS

Table B1. xxxx

<table>
<tr><td colspan="6">123 + 11 [11 + 22 = 33]</td></tr>
<tr><td>G 01</td><td>N 08</td><td>L 13</td><td>M 11</td><td>33</td><td rowspan="3">120</td></tr>
<tr><td>A 04</td><td>D 07</td><td>K 15</td><td>F 14</td><td>40</td></tr>
<tr><td>V 10</td><td>S 05</td><td>R 17</td><td>Y 15</td><td>47</td></tr>
<tr><td>P 08</td><td>T 08</td><td>Q 11</td><td>W 18</td><td>45</td><td rowspan="3">117</td></tr>
<tr><td>I 13</td><td>C 05</td><td>E 10</td><td>H 11</td><td>39</td></tr>
<tr><td>G 01</td><td>N 08</td><td>L 13</td><td>M 11</td><td>33</td></tr>
<tr><td colspan="4">81 + 22 [22 – 11 = 11]</td><td colspan="2">(119 / 118)</td></tr>
</table>

Amino acid F sa benzenom koji je savršeni reprezrnt aromčnosti, G je savršeni reprezent alifatčnosti, ali je u i savršeno reprezetstvo aminokiselsti (struktura metana – 2H, amino grupa i karboksilna). … Odigran log kvadrat sa PSN: 00, 11, 22, 33. Veza sa 4 tipa diverziteta. Tamo je distinkcija 24 – 11 = 13, a ovde 14 – 01 = 13. To je broj 6 + 7 (6+7 = 13), (66+77 = 143)) (Imat na umu: 5 + 6 = 11, a ne može 4 + 5 = 9 kao jednocifrei).

Table B2. xxxx

<table>
<tr><td colspan="5">(120 + 1)</td><td></td></tr>
<tr><td>G 01</td><td>N 08</td><td>L 13</td><td>M 11</td><td>33</td><td rowspan="3">120</td></tr>
<tr><td>A 04</td><td>D 07</td><td>K 15</td><td>F 14</td><td>40</td></tr>
<tr><td>V 10</td><td>S 05</td><td>R 17</td><td>Y 15</td><td>47</td></tr>
<tr><td>P 08</td><td>T 08</td><td>Q 11</td><td>W 18</td><td>45</td><td rowspan="3">117</td></tr>
<tr><td>I 13</td><td>C 05</td><td>E 10</td><td>H 11</td><td>39</td></tr>
<tr><td>G 01</td><td>N 08</td><td>L 13</td><td>M 11</td><td>33</td></tr>
<tr><td colspan="4">(117–1)</td><td colspan="2" rowspan="2">119 / 118
116 / 121</td></tr>
<tr><td>[37</td><td>(41</td><td>79)</td><td>80]</td></tr>
<tr><td colspan="6">[37 + 79 = 116] [41 + 80] = 121</td></tr>
</table>

…	
9 x 9 = 81	81+ 80 + 79 + 78 + 77 + 76 = 471 (157 x 3)
10 x 10 = 100	100 + 99 + 98 + 97 + 96 + 95 = 595 (195 x 3)
11 x 11 = **0121**	121 + 120 + 119 + 118 + **117** + 116 = **711** (237 x 3)
	711 | 117
12 x 12 = 144	144 + 143 + 142 + 141 + 140 + 139 = 849 (283 x 3)
…	

(**1210** & **11**84), (**2**84 & 220) [½ 1184 → **592** → GC

[592 – 333 = **259**] [592 + 333 = **925**]

1184 → 1, 2, 4, 8, 16, 32 / **037**, 074, 148, 296, 592, 1184

496 → 1, 2, 4, 8, 16 / (32-**1**), (64-**2**), (128-**4**), (256-**8**), (512-**16**)

28 → 1, 2, 4 /(8-**1**), (16-**2**) (32-**4**)

06 → 1, 2 /(4-**1**), (8-**2**)

8128 → 1, 2, 4, 8, 16, 32, 64 / (128-**1**), (256-**2**), (512-**4**), (1024-**8**), (2048-**16**), (4096-**32**),(8192-**64**)

Description of Table B2 (I): xxx

	(x 3)	
037	**111**	21 + 20 + 19 + 18 +17 + 16 = 111 [111 + **22** + **15** = 2 x 74]
	600	[037 x 3 = 111] 600
237	**711**	121+120 +119 +118+117+116 = 711
	600	[237 x 3 = 711] 6000
437	(13)11	1121+1120 +1119 +1118+1117+1116 = (67)11
	600	[2237 x 3 = 6711] 60000
637	(19)11	11121+11120 +11119 +11118+11117+11116 = (667)11
	600	[22237 x 3 = 66711] 600000
837	(25)11	111121+111120 +111119 +111118+111117+111116 = (6667)11
		[222237 x 3 = 666711]

Description of Table B2 (II): xxx

121 = **1**21
121 + 120 = **2**41
121 + 120 + 119 = **3**60
121 + 120 + 119 + 118 = 478
121 + 120 + 119 + 118 + 117 = **5**95
121 + 120 + 119 + 118 + **117** + 116 = **711**
121 + 120 + 119 + 118 + 117 + 116 + 115 = **8**26
121 + 120 + 119 + 118 + 117 + 116 + 115 + 114 = **9**40
121 + 120 + 119 + 118 + 117 + 116 + 115 + 114 + 113 = **A**53
121 + 120 + 119 + 118 + 117 + 116 + 115 + 114 + 113 + 112 = **B**65
121 + 120 + 119 + 118 + 117 + 116 + 115 + 114 + 113 + 112 + 111 = **C**76
121 + 120 + 119 + 118 + 117 + 116 + 115 + 114 + 113 + 112 + 111 + 110 = **D**86
…
122 + 121 + 120 + 119 + 118 + 117 + 116 + 115 = 948 [711 + 237]
(122 = 121 + 01) (122 = 112 + 10) [0112 as Fibonacci start sequence]

Description of Survey B2 (III): xxx

Table B3. xxxx

117 - 2					
G 01	N 08	L 13	M 11	**33**	120
A 04	D 07	K 15	F 14	40	
V 10	S 05	R 17	Y 15	**47**	
P 08	T 08	Q 11	W 18	45	117
I 13	C 05	E 10	H 11	**39**	
G 01	N 08	L 13	M 11	33	
120 + 2				**119** / 118	

Appendix C

THE UNITY OF GENETIC AND CHEMICAL CODE

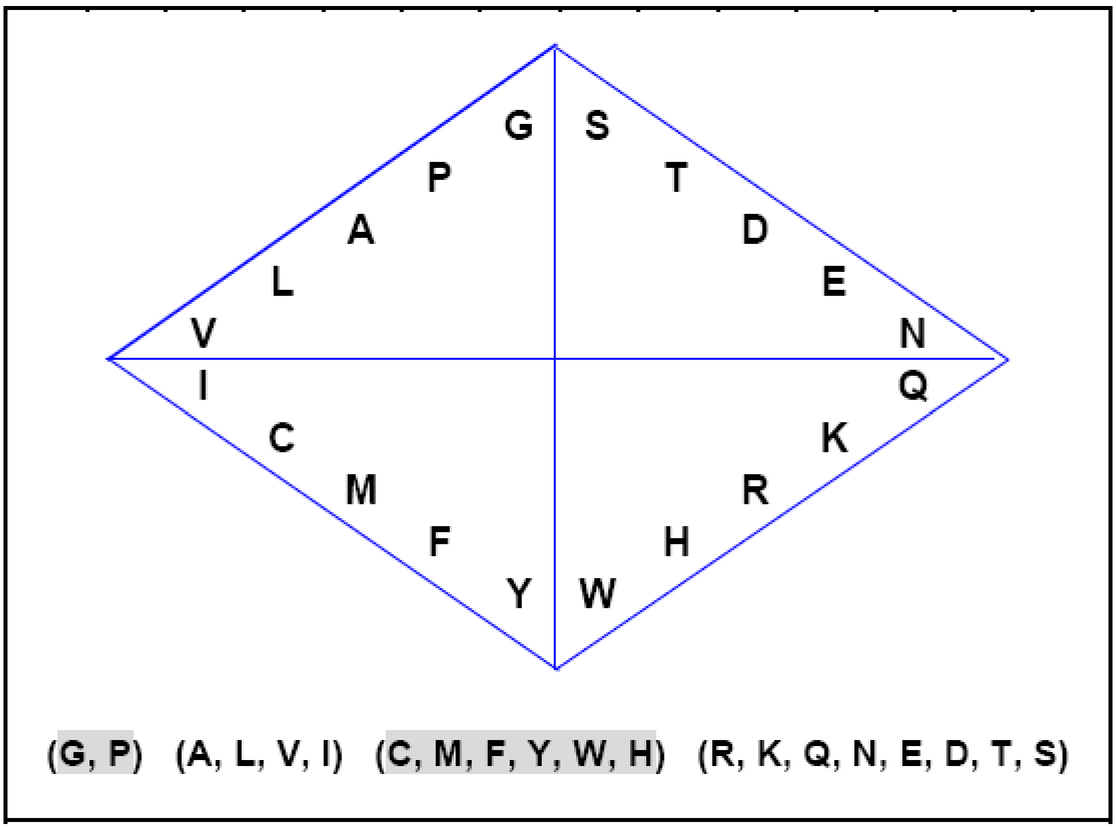


Figure C1. xxx

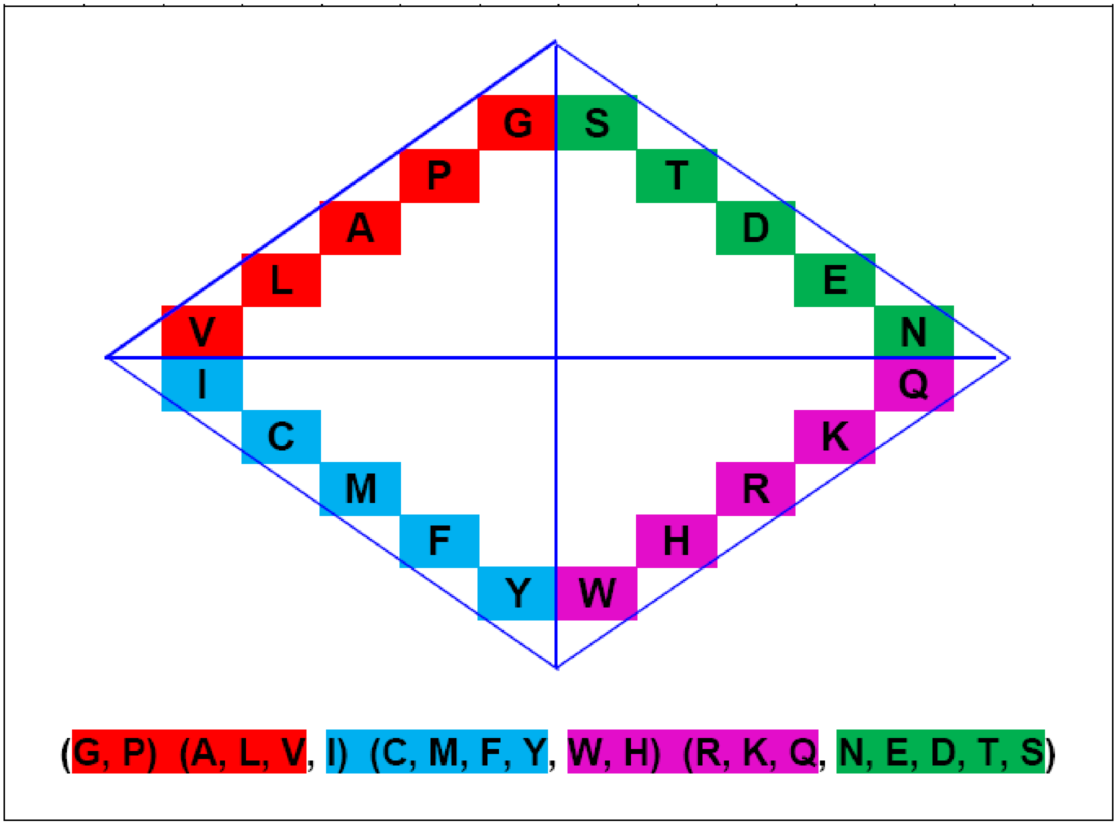
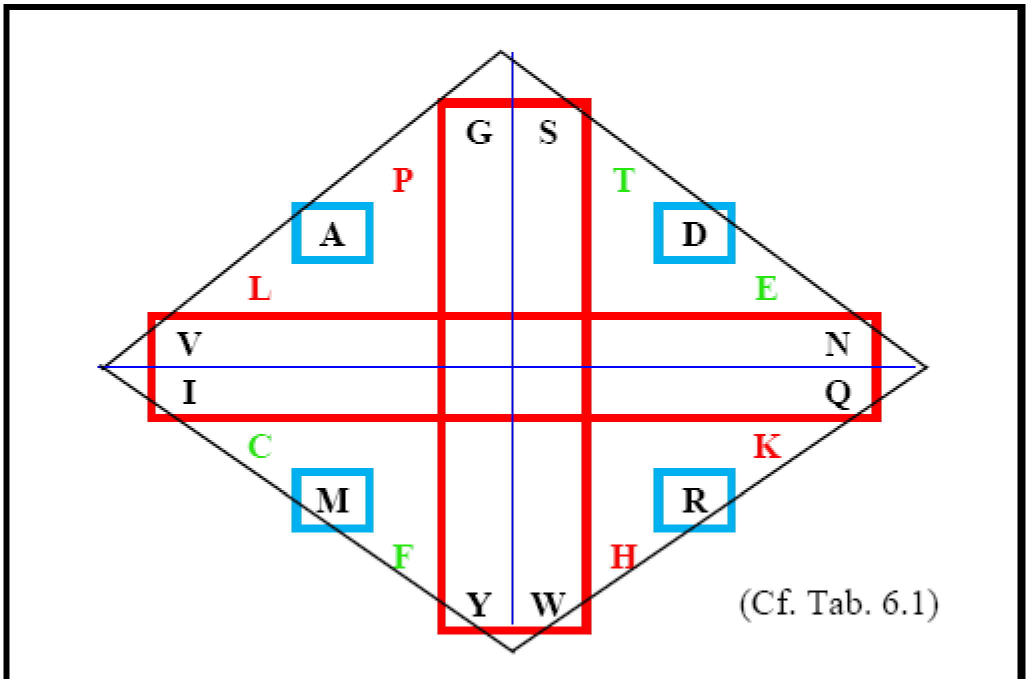


Figure C2. xxx



I (G, P); II (A, L, V, I); III (C, M, F, Y, W, H);

IV (R, K, Q, N, E, D, T, S)

Codon number for (III + IV): [**23**] + [(CM & TS) **13**] = 36

Figure C3. xxx

XX

Survey 2a	
$y_1 - x_1 = 3^2$ $y_1 + x_1 = 5^2$	$y_2 - x_2 = 4^2$ $y_2 + x_2 = 6^2$
$x_1 = 8$ $y_1 = 17$	$x_2 = \underline{\mathbf{10}}$ $y_2 = 26$

Survey 2b	
26 = x = **26** 26 + 16 = **42** 42 + 17 = **59** 59 + 18 = **77**	16+17+18=z z = 51 z = y/4
26 + 42 + 59 + 77 = y y = 204; y/4 = 51	
In any other case, y/4≠z	

Survey 3a	
$y_1 - x_1 = \mathbf{9}^1$ $y_1 + x_1 = 25^1$	$y_2 - x_2 = \underline{\mathbf{10}}^1$ $y_2 + x_2 = 36^1$
$x_1 = 8$ $y_1 = 17$	$x_2 = 13$ $y_2 = 23$

Survey 3b

a	b	c	d
00	**<u>10</u>**	26	(16)
01	11	25	(14)
02	12	24	(12)
03	13	23	(**<u>10</u>**)
04	14	22	(08)
05	15	21	(06)
06	16	20	(04)

Figure C4. xxx

Table C1. Таблица Периодног система хемијсих елемената са шест колона: позиције вишеизотопних елемената који поседују стабилне изотопе

	DIADS																				MONADS			
					TRIADS																			
	D1				T1				**T2**				T3				**D2**							
1	1	H	(2+0)	VII	2	He	(2+0)	VIII	3	Li	(2+0)	I	4	**Be**	(1)	II	5	B	(2+0)	III	6	C	(2+0)	IV
2	7	N	(2+0)	V	8	O	(3+0)	VI	9	F	(1)	VII	10	Ne	(3+0)	VIII	11	Na	(1)	I	12	Mg	(3+0)	II
3	13	Al	(1)	III	14	Si	(3+0)	IV	15	P	(1)	V	16	S	(4+0)	VI	17	Cl	(2+0)	VII	18	Ar	(3+0)	VIII
4	19	K	(2+1)	I	20	Ca	(5+1)	II	21	Sc	(1)	III	22	Ti	(5+0)	IV	23	V	(1+1)	V	24	Cr	(4+0)	VI
5	25	Mn	(1)	VII	26	Fe	(4+0)	VIII	27	Co	(1)	IX	28	Ni	(5+0)	X	29	Cu	(2+0)	I	30	Zn	(5+0)	II
6	31	Ga	(2+0)	III	32	Ge	(4+1)	IV	33	As	(1)	V	34	Se	(5+1)	VI	35	Br	(2+0)	VII	36	Kr	(6+0)	VIII
7	37	Rb	(1+1)	I	38	Sr	(4+0)	II	39	Y	(1)	III	40	Zr	(4+1)	IV	41	Nb	(1)	V	42	Mo	(6+1)	VI
8	43	Te	(0)	VII	44	Ru	(7+0)	VIII	45	Rh	(1)	IX	46	Pd	(6+0)	X	47	Ag	(2+0)	I	48	Cd	(6+2)	II
9	49	In	(1+1)	III	50	Sn	(9+1)	IV	51	Sb	(2+0)	V	52	Te	(6+2)	VI	53	I	(1)	VII	54	Xe	(8+1)	VIII
10	55	Cs	(1)	I	56	Ba	(6+1)	II	57	La	(1+1)	III	58	Ce	(4+0)	IV	59	Pr	(1)	V	60	Nd	(5+2)	VI
11	61	Pm	(0)	VII	62	Sm	(5+2)	VIII	63	Eu	(1+1)	IX	64	Gd	(6+1)	X	65	Tb	(1)	XI	66	Dy	(7+0)	XII
12	67	Ho	(1)	XIII	68	Er	(6+0)	XIV	69	Tm	(1)	I	70	Yb	(7+0)	II	71	Lu	(1+1)	III	72	Hf	(5+1)	IV
13	73	Ta	(2+0)	V	74	W	(4+1)	VI	75	Re	(1+1)	VII	76	Os	(6+1)	VIII	77	Ir	(2+0)	IX	78	Pt	(5+1)	X
14	79	Au	(1)	I	80	Hg	(7+0)	II	81	Tl	(2+0)	III	82	Pb	(4+0)	IV	83	Bi	(1)	V	84	Po	(0)	VI
			08				36				06				38				12				30	

(D 20 + M 30 = DM 50) (DM 50 + T 80 = DMT 130)

Према: MMR in: DOI https://doi.org/10.31219/osf.io/34c8n. (Table 1, p. 17.) Ознаке: шеста колона је колона-монада; прву и пету колону чине две колоне дијада (D1 и D2); другу, трећу и четврту колону чине три колоне тријада (T1, T2, T3). Приказан је број стабилних изотопа хемијских елемената. Како се види тај број, по колонама класификованим у једну колону-монаду, две колоне као дијаде и три колоне као тријаде, детермнисан је Фибоначијевим низом: секвенцом 2, 3, 5, 8 и 13, истом оном коју налазимо код Његоша у детерминацији односа броја стихова у шест певања *Луче микрокозма*. (ЊИЛ 1, Слика 3.4, стр. 71; ЊЕП, Слика 3, стр. 110.) [*Напомена*: Таблица је у свему иста као у оригиналу, с тим што се тамо не помиње Његош.]

Table C2. Таблица Периодног система хемијсих елемената са шест колона: позиције моноизотопних елемената

	DIADS																				MONAD			
					TRIADS																			
	D1				T1				**T2**				T3				**D2**							
1	1	H	(2)	VII	2	He	(2)	VIII	3	Li	(2)	I	4	**Be**	**(1)**	II	5	B	(2)	III	6	C	(2)	IV
2	7	N	(2)	V	8	O	(3)	VI	9	F	**(1)**	VII	10	Ne	(3)	VIII	11	Na	**(1)**	I	12	Mg	(3)	II
3	13	Al	**(1)**	III	14	Si	(3)	IV	15	P	**(1)**	V	16	S	(4)	VI	17	Cl	(2)	VII	18	Ar	(3)	VIII
4	19	K	(3)	I	20	Ca	(6)	II	21	Sc	**(1)**	III	22	Ti	(5)	IV	23	V	(2)	V	24	Cr	(4)	VI
5	25	Mn	**(1)**	VII	26	Fe	(4)	VIII	27	Co	**(1)**	IX	28	Ni	(5)	X	29	Cu	(2)	I	30	Zn	(5)	II
6	31	Ga	(2)	III	32	Ge	(5)	IV	33	As	**(1)**	V	34	Se	(6)	VI	35	Br	(2)	VII	36	Kr	(6)	VIII
7	37	Rb	(2)	I	38	Sr	(4)	II	39	Y	**(1)**	III	40	Zr	(5)	IV	41	Nb	**(1)**	V	42	Mo	(7)	VI
8	43	Te	(0)	VII	44	Ru	(7)	VIII	45	Rh	**(1)**	IX	46	Pd	(6)	X	47	Ag	(2)	I	48	Cd	(8)	II
9	49	In	(2)	III	50	Sn	(10)	IV	51	Sb	(2)	V	52	Te	(8)	VI	53	I	**(1)**	VII	54	Xe	(9)	VIII
10	55	Cs	**(1)**	I	56	Ba	(7)	II	57	La	(2)	III	58	Ce	(4)	IV	59	Pr	**(1)**	V	60	Nd	(7)	VI
11	61	Pm	(0)	VII	62	Sm	(7)	VIII	63	Eu	(2)	IX	64	Gd	(7)	X	65	Tb	**(1)**	XI	66	Dy	(7)	XII
12	67	Ho	**(1)**	XIII	68	Er	(6)	XIV	69	Tm	**(1)**	I	70	Yd	(7)	II	71	Lu	(2)	III	72	Hf	(6)	IV
13	73	Ta	(2)	V	74	W	(5)	VI	75	Re	(2)	VII	76	Os	(7)	VIII	77	Ir	(2)	IX	78	Pt	(6)	X
14	79	Au	**(1)**	I	80	Hg	(7)	II	81	Tl	(2)	III	82	Pb	(4)	IV	83	Bi	**(1)**	V	84	Po	(5)	VI
15	85	At		VII	86	Rn		VIII	87	Fr		I	88	Ra		II	89	Ac		III	90	Th		IV
16	91	Pa		V	92	U		VI	93	Np		VII	94	Pu		VIII	95	Am		IX	96	Cm		X
17	97	Bk		XI	98	Cf		XII	99	Es		XIII	100	Fm		XIV	101	Md		I	102	No		II
18	103	Lr		III	104	Ku		IV	105	Ns		V	106			VI	107			VII	108			VIII
19	109			IX	110			X	111			I	112			II	113			III	114			IV

D1 [13(**4**), 25(**7**), 55(**10**), 67(**13**), 79(16)], **T2** [9(**10-1**), 15(**7-1**), 21(**4-1**), 27(**10-1**), 33(**7-1**), 39(**4-1**), 45(**10-1**), 69(**7-1**)]

D2 [11(**1+1**), 41(**4+1**), 53(**7+1**), 59(**4+1**), 65(**1+1**), 83(**1+1**)]

Према: MMR in: https://doi.org/10.1016/j.poly.2018.07.004 [Polyhedron 153 (2018) 292-298.] Сенчењем и болдирањем назначени су моноизотопни елементи (њих 20). У оригиналној Таблици нема сенчења, нити придодатог доњег дела где је показана строга кореспонденција са Дантеовим и Шчербаковим низом, укључујући (у *закон очувања три цифре* неуклапајући) и почетни број 1.

Appendix D

ARITHMETICAL BACKGROUND

Table D1. xxx

q	A	B	C	D_q	q	S_q	S_{10}
4	03	13	23	10	(4)	102	(18)
6	03	13	23	10	(6)	40	(24)
8	03	13	23	10	(8)	36	(30)
10	0**3**	1**3**	2**3**	10	(10)	**36**	(**36**)
12	03	13	23	10	(12)	36	(42)
14	03	13	23	10	(14)	36	(48)
16	03	13	23	10	(16)	36	(54)
18	03	13	23	10	(18)	36	(60)
20	03	13	23	10	(20)	36	(66)
22	03	13	23	10	(22)	36	(72)
…							
98	03	13	23	10	(98)	36	(300)

Opis Tabele je

Table D2. xxxx

q	A	B_q	C	D_{10}	E
4	02	12	22	(2 x 2) + **6**	6
					0
6	03	13	23	(3 x 3) + **6**	6
					2
8	04	14	24	(4 x 4) + **4**	4
					4
10	**05**	**15**	**25**	**(5 x 5) ± 0**	**0**
					6
12	06	16	26	(6 x 6) **- 6**	6
					8
14	07	17	27	(7 x 7) **- 14**	14
					10
16	08	18	28	(8 x 8) **- 24**	24
					12
18	09	19	29	(9 x 9) **- 36**	36
					14
20	0A	1A	2A	(10 x 10) **- 50**	50
					16
22	0B	1B	2B	(11 x 11) **- 66**	66
…					

Opis Tabele je

Table D3. xxxx

11 + 11 → 022	1 to 6 → 021	1 to 7 → 028	028 – 022 = 6
11	7	8	$\boxed{3}$
12 + 21 → 033	1 to 7 → 028	1 to 8 → 036	036 – 033 = 3
11	8	9	$\boxed{2}$
13 + 31 → 044	1 to 8 → 036	1 to 9 → 045	045 – 044 = 1
11	9	10	$\boxed{1}$
14 + 41 → 055	1 to 9 → 045	1 to 10 → 055	055 – 055 = 0
11	10	11	$\boxed{0}$
15 + 51 → 066	1 to 10 → 055	1 to 11 → 066	066 – 066 = 0
11	11	12	$\boxed{1}$
16 + 61 → 077	1 to 11 → 066	1 to 12 → 078	078 – 077 = 1
11	12	13	$\boxed{2}$
17 + 71 → 088	1 to 12 → 078	1 to 13 → 091	091 – 088 = 3
11	13	14	|**3**|
18 + 81 → 099	1 to 13 → 091	1 to 14 → **0A5**	|**0A5**| – 099 = 6
11	14	15	4
19 + 91 → 0AA	1 to 14 → 0A5	1 to 15 → 0C0	0C0 – 0AA = 10
11	15	16	5
1A + A1 → 0BB	1 to 15 → 0C0	1 to 16 → 0D6	0D6 – 0BB = 15
11	16	17	6
1B + B1 → 0CC	1 to 16 → 0D6	1 to 17 → 0F3	0F3 – 0CC = 21
. . .			

Table D4. xxxx

<table>
<tr><td></td><td></td><td>…</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>9</td><td>10</td><td>11</td><td>4 |8 | 16 → 496 (496 x 1)</td></tr>
<tr><td></td><td></td><td>…</td><td></td><td></td><td></td></tr>
<tr><td>$\boxed{2}$</td><td>←</td><td>6</td><td>$\boxed{7}$</td><td>8</td><td>8 |16 |32 → 992 (496 x 2)</td></tr>
<tr><td></td><td></td><td>5</td><td>6</td><td>7</td><td></td></tr>
<tr><td></td><td></td><td>4</td><td>5</td><td>6</td><td>16 |32 |64 → 1984 (496 x 4)</td></tr>
<tr><td>$\boxed{1}$</td><td>←</td><td>3</td><td>$\boxed{4}$</td><td>5</td><td></td></tr>
<tr><td></td><td></td><td>2</td><td>3</td><td>4</td><td>32 |64 |128 → 3968 (496 x 8)</td></tr>
<tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td></td></tr>
<tr><td>$\boxed{0}$</td><td>←</td><td>0</td><td>$\boxed{1}$</td><td>2</td><td>64 |128 |256 → 7936 (496 x 16)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>…</td></tr>
<tr><td></td><td></td><td>0</td><td>1</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>1</td><td>2</td><td>4</td><td></td></tr>
<tr><td></td><td></td><td>2</td><td>4</td><td>8</td><td></td></tr>
<tr><td></td><td></td><td>4</td><td>8</td><td>16</td><td></td></tr>
</table>

Table D5. xxx

q	p-qu	end	q = 10	q	q = 10
4	013	2 + 3	2+ 3	12 + 13 = 31	7 + 6
					(6 x 2)
7	025	5 + 6	5+ 6	15 + 16 = 34	19 + 6
					(6 x 2)
10	037	8 + 9	8+ 9	18 + 19 = 37	37 ± 0
			(17)		(6 x 2)
13	049	B + C	11+ 12	1B + 1C = 3A	61-12
					(6 x 2)
16	05B	E + F	14 + 15	1E + 1F = 3D	91-30
					(6 x 2)
19	06D	H + I	17 + 18	1H + 1I = 3G	127 - 54
…					
[…117 (118 + 119 = 237) 120 …]					

Table D6. xxxx

2 ^ 2 = 4	2 ^ 4 = (4 x 4)	0 - 15	0 (1-2) 3	00 | 11
			2	
2 ^ 3 = 8	2 ^ 6 = (8 x 8)	0 - 63	2 (3-4) 5	0<u>1</u>0 | 1<u>0</u>1
			4	
2 ^ 4 = 16	2 ^ 8 = (16 x 16)	0 - 255	6 (7-8) 9	0110 | 1001
			8	
2 ^ 5 = 32	2 ^ 10 = (32 x 32)	0 - 1023	14 (15-16) 17	01110 | 10001
…				

Position of three-dimensional space on the 6-bit binary tree

Real world

00 (01 / 10) 11
0 1 2 3

010 (011 / 100) 101
2 3 4 5

0110 (0111 / 1000) 1001
6 7 8 9

01110 (01111 / 10000) 10001
14 15 16 17

011110 (011111 / 100000) 100001
30 31 32 33

...

A possible intelligent choice

00100 / 11011
11011 | 00100

1 1 0 1 1 | 0 0 1 0 0 | 1 1 0 1 1

$(110110010011011)_2 = (27803)_{10}$

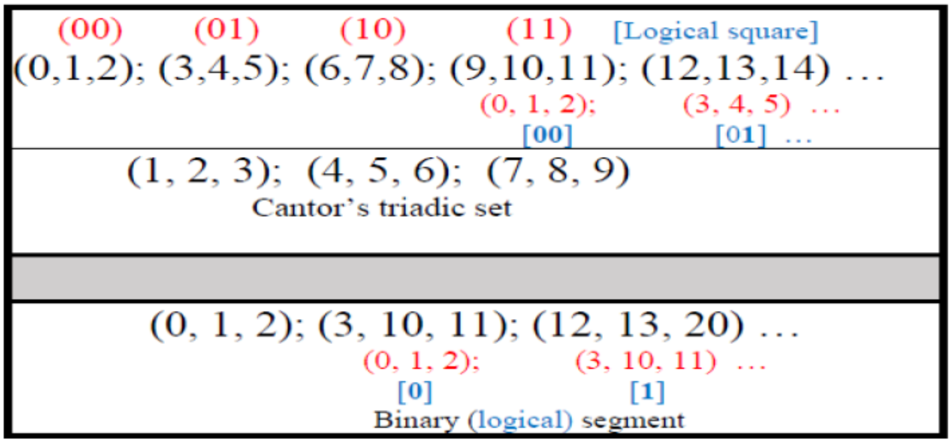
1,2,4,8,16,32,64,128,256,512,1024,2048,4096,8192,16384

Description of Table D6): xxx (6 x 9 = 54) (5 x 9 = 45) … Ovo je 3 x 5 = 15, uvek taj moj san.

Survey D1. xxx

q	
4	(**1**) (**2**) (**3**)
6	(1, 2) (3, 4) (5)
8	(1, 2, 3) (4, 5, 6) (7, □ □)
10	(1, 2, 3) [**(4, 5, 6)**] (7, 8, 9)
12	(1, 2, 3, 4) (5, 6, 7, 8) (9, A, B)
14	(1, 2, 3, 4, 5) (6, 7, 8, 9, A) (B, C, D □ □)
16 …	(1, 2, 3, 4, 5) (6, 7, 8, 9, A) (B, C, D, E, F)

Survey D2. xxx



Pairing I, p. 162

Decimal and quaternary number systems in correspondence with the logical square and the logical segment, respectively

References

Alvager, T., et al., 1989. On the information content of the genetic code. Bio Syst. 22, 189–196.

Attardi, G., 1985. Animal mitochondrial DNA: an extreme example of genetic economy. Int. Rev. Cytol. 93, 93–145.

Barbieri, M., 2018. What is code biology? BioSystems 164, 1–10.

Barbieri, M., Edit, 2008. The Codes of Life, Biosemiotics, vol. 1. Springer, pp. 1–437.

Barbieri, M., Hofmeyr, J.-H.S., Edits, 2018. In: In: Barbieri, Marcello, Hofmeyr, Jan Hendrik S. (Eds.), Code Biology, BioSystems, vol. 164. pp. 1–226.

Castro-Chavez, F., 2010. The rules of variation: amino acid exchange according to the rotating circular genetic code. J. Theor. Biol. 264, 711–721.

Collins, F.S., 2006. The Language of God. Free Press, Bethesda, Maryland, USA.

Crick, C.H.F., 1966. The genetic code yesterday, today and tomorrow, cold Spring Harbor symposia on quantitative biology, 31, 3-9; Published also in: "The chemical basis of life– an introduction to molecular and cell biology". Sci. Am. 1973, 192–198.

Crick, C.H.F., 1968. The origin of the genetic code. J. Mol. Biol. 38, 367–379.

Damjanović, Z., 1998. Logic core of genetic code. Proceedings (Glasnik) of the Section of Natural Sciences of Montenegrin Academy of Sciences and Art (CANU) 12, 5–8.

Damjanović, Z.M., Rakočević, M.M., 2005. Genetic code: an alternative model of trans lation. Ann. N.Y. Acad. Sci. 1048, 517–523.

Damjanović, Z.M., Rakočević, M.M., 2006. Genetic Code: A New Understanding of Codon-Amino Acid Assignment. arXiv:q-bio/0611033 [q-bio.OT].

Damjanović, Z.M., Rakočević, M.M., 2007. Genetic code: a New understanding of Codon amino acid assignment. Proceedings (Glasnik) of the Section of Natural Sciences of Montenegrin Academy of Sciences and Art (CANU) 17, 121–153.

Darwin, Ch, 1859. On the Origin of Species. John Murray, London.

Doolittle, R.F., 1985. Proteins. Sci. Am. 253, 74–85.

Dragovich, B., Dragovich, A., 2006. P-Adic Model of DNA Sequence and Genetic Code. arXiv:q-bio/0607018v1 [q-bio.GN].

Dragovich, B., Khrennikov, A.Yu., Mišić, N.Ž., 2017. Ultrametrics in the genetic code and Dragovich, B., Dragovich, A., 2010. P-adic modeling of the genome and the genetic code. Comput. J. 53 (4), 432–441 arXiv:0707.3043 [q-bio.OT]. Appl. Math. Comput. 309, 350–358 arXiv:1704.04194 [q-bio.OT].

Jukes, T.H., 1973. Possibilities for the evolution of the genetic code from a preceding form. Nature 246, 22–27.

Kedrov, B.M., 1977. Predictions of Mendeleev in Atomism– Unknown Elements. Atomizdat, Moscow [in Russian].

Knight, R.D., Freeland, S.J., Landweber, L.F., 2001. Rewiring the keyboard: evolvability of the genetic code. Nat. Rev. Genet. 2 (January (1)), 49–58.

Koruga, D.L., 1992. Neuromolecular computing. Nanobiology 1, 5–24.

Kyte, J., Doolittle, R.F., 1982. A simple method for displaying the hydropathic character of a protein. J. Mol. Biol. 157, 105–132.

Leunissen, J.A., De Jong, W.W., 1986. Phylogenetic trees constructed from hydro phobicity values of protein sequences. J. Theor. Biol. 119, 187–196.

Mišić,N.Ž., 2011. Nested numeric/geometric/arithmetic properties of shCherbak's prime quantum 037 as a base of (biological) coding/computing. Neuroquantology 9 (4), 702–715.

Négadi, T., 2009. The genetic code degeneracy and the amino acids chemical composition are connected. Neuroquantology 7 (1), 181–187 arXiv:0903.4131v1 [q-bio.OT].

Negadi, T., 2011a. The Multiplet Structure of the Genetic Code, in One and Small Number. arXiv:1101.2983v2 [q-bio.OT] (Submited to Neuroquantology Journal).

Négadi, T., 2011b. On rakočević's amino acid biosynthetic precursors relations. Neuroquantology 9 (4), 772–798.

Negadi, T., 2014. The genetic code invariance: when euler and fibonacci meet. Symmetry Cult. Sci. 25 (3), 145–288 arXiv:1406.6092 [q-bio.OT].

Nirenberg, M., Caskey, T., Marshall, R., Brimacombe, R., Kellogg, D., Doctor, B., Hatfield, D., Levin, J., Rottman, F., Pestka, S., Wilcox, M., Anderson, F., 1966. The RNA code and protein synthesis. Cold Spring Harb. Symp. Quant. Biol. 31, 11–24.

Petoukhov, S., 2016. The system-resonance approach in modeling genetic structures. BioSystems 139, 1–11.

Popov, E.M., 1989. Strukturnaya Organizaciya Belkov. Nauka, Moscow (in Russian).
Pullen, S., 2005. Intelligent Design or Evolution? Free Press, Raleigh, N. Carolina, USA.

Rakočević, M.M., 1998a. The genetic code as a Golden mean determined system. Biosystems 46, 283–291.

Rakočević, M.M., 1988b. Three-dimensional model of the genetic code. Acta Biologiae Et Medicinae Experimentalis (Prishtina) 13, 109–116. An excerpt in: http://www. rakocevcode.rs.

Rakočević, M.M., 1988c. Genes, Molecules, Language (in Serbian With an English Language Supplement) Naučna Knjiga. Belgrade. http://www.rakocevcode.rs.

Rakočević, M.M., 1990. Information-topological concept of the amino acid code, Compendium (Zbornik radova, Sekcija Hemja) of the Faculty of Science – The Faculty of mathematics and natural sciences (former Faculty of philosophy), Niš, Serbia, Section 1, 3-23.

Rakočević, M.M., 1991. The coherence of the chemical and genetic code, in: Proceedings of Faculty of Science (former: Faculty of Philosophy), Chemistry, Niš, Serbia, Section, 2, 1–29.

Rakočević, M.M., 1994. Logic of the Genetic Code, Naučna knjiga, Belgrade (Beograd). (http://www.rakocevcode.rs)

Rakočević, M.M., Jokić, A., 1996. Four stereochemical types of protein amino acids: synchronic determination with chemical characteristics, atom and nucleon number, J. Theoretical Biology, 183, 345–349.

Rakočević, M.M., 1997a. Two classes of the amino acyl-tRNA synthetases in correspon dence with the Codon path cube. Bull. Math. Biol. 59, 645–648.

Rakočević, M.M., 1997b. The Genetic Code as a Unique System, Studentski Kulturni Centar. Niš. www.rakocevcode.rs.

Rakočević, M. M., 1997c. The universal consciousness as a universal comprehension of the universal code, in: Brain and Consciousness, ECPD, Belgrade.

Rakočević, M.M., 1998a. The genetic code as a Golden mean determined system. Biosystems 46, 283–291. Also in: (http://www.rakocevcode.rs): January 18, 2014.

Rakočević, M.M., 1998b. Whole-number relations between protein amino acids and their biosynthetic precursors. J. Theor. Biol. 191, 463–465.

Rakočević, M.M., 2000. The factors of the classification of protein amino acids. Proceedings, (Glasnik) of the Section of Natural Sciences of Montenegrin Academy of Sciences and Art (CANU) 13, 273–294 (arXiv:q-bio/0611004 [q-bio.BM])arXiv:q bio/0703011v2 [q-bio.OT].

Rakočević, M.M., 2004. A harmonic structure of the genetic code. J. Theor. Biol. 229, 221–234.

Rakočević, M.M., 2007. Determining the genetic code with perfect and friendly numbers. In: Tesla - visions, work, life. Faculty of Mechanical Engineering, Belgrade, p. 95 (in Serbian). Also in: http://www.rakocevcode.rs

Rakočević, M.M., 2006. Genetic Code as a Harmonic System. arXiv:q-bio/0610044 [q bio.OT] [Also in MMR, 2017b, Chapter 1, pp. (1–26) (4–29)].

Rakočević, M.M., 2007. A New Genetic Code Table. arXiv:q-bio/0703012 [q-bio.GN].

Rakočević, M.M., 2009. Genetic Code: The Unity of the Stereochemical Determinism and Pure Chance. arXiv:0904.1161 [q-bio.BM].

Rakočević, M.M., 2011a. Genetic Code: Four Diversity Types of Protein Amino Acids. arXiv:1107.1998v2 [q-bio.OT].

Rakočević, M.M., 2011b. Genetic code as a coherent system, NeuroQuantology, 9 (4), 821–841. http://www.rakocevcode.rs

Rakočević, M.M., 2013a. Harmonic Mean as a Determinant of the Genetic Code. arXiv:1305.5103v4 [q-bio.OT].

Rakočević, M.M., 2013b. Golden and harmonic mean in the genetic code. In: Proceedings of the 2nd International Conference "Theoretical Approaches to BioInformation Systems" (TABIS.2013). September 17–22, 2013, Belgrade, Serbia. http://dx.doi.org/ 10.17605/OSF.IO/2PFE7. Also in: OSF Preprints.

Rakočević, M.M., 2015. Enigma of Darwin Diagram. http://dx.doi.org/10.17605/OSF. IO/QZG69. stored on 2015-01-06. Also stored in: OSF Preprints, 2017-11-29 (UTC). www.rakocevcode.rs.

Rakočević, M.M., 2017a. Analogies of Genetic and Chemical Code. http://dx.doi.org/10. 17605/OSF.IO/MXECJ. (stored also in: OSF Preprints 2017-08-09; and a new, minimally modified version 2017-10-02. www.rakocevcode.rs.

Rakočević, M.M., 2017b. Harmony of Genetic Code Vol. 1 OSF Preprintshttp://dx.doi. org/10.17605/OSF.IO/C38RG. 2017-12-9.

Rakočević, M.M., 2017c. Harmony of Genetic Code Vol. 2 OSF Preprintshttp://dx.doi. org/10.17605/OSF.IO/89UAH. 2017-12-13.

Rakočević, M. M., 2017d. Golden and Harmonic Mean in the Genetic Code, OSF Preprints, DOI 10.31219/osf.io/2pfe7. [Previously published in Proceedings of the 2nd International Conference "Theoretical Approaches to BioInformation Systems" (TABIS.2013), September 17–22, 2013, Belgrade, Serbia.] Extended version: [DOI 10.31219/osf.io/fzgjp]

Rakočević, M.M., 2018a. The Cipher of the Genetic Code, BioSystems 171 (2018) 31–47.

Rakočević, M. M., 2018b. Analogies of Genetic and Chemical Code, Polyhedron, 153, 292–298.

Rakočević, M.M., 2019. Protein amino acids as a complete (periodic) system, Chemia Naissensis, Vol 2, Issue 1, pp. 1-43. hhttps://www.pmf.ni.ac.rs/chemianaissensis/archives/volume-2-number 1-2019/. (Also in: www.rakocevcode.rs)

Rakočević, M.M., 2021a. A new type of mirror symmetry in the set of protein amino acids. arXiv:2108.01563v4 [q-bio.BM]

Rakočević, M.M., 2021b. Genetic code: the unity of chemism and semiosis, A hypothesis (Synopsis). DOI 10.31219/osf.io/me8sj

Rakočević, M.M., 2022. Genetic code as the unity of chemism and semiosis. DOI 10.31219/osf.io/3ubzr

Rakočević, M.M., 2024. Semitic nature of Genetic code. ChemRxiv, Camridge: Open arhive server of three chemical socities. (10.26434/chemrxiv-2024-1b9h7)

Rumer, Yu.B., 1966. O sistematizacii kodonov v geneticheskom kode, doklady. Akad. Nauk. SSSR 167, 1393–1394.

Shcherbak, V.I., 1994. Sixty-four triplets and 20 canonical amino acids of the genetic code: the arithmetical regularities. Part II. J. Theor. Biol. 166, 475–477.

Shcherbak, V.I., 2008. The arithmetical origin of the genetic code. In: Barbieri, M. (Ed.), The Codes of Life: the Rules of Macroevolution. Springer, Berlin, pp. 153–181.

Sukhodolec, V.V., 1985. The meaning of the genetic code: the reconstruction of the stages of prebiological evolution (in Russian). Генетика XXI (10), 1589–1599.

Swanson, R., 1984. A unifying concept for the amino acid code. Bull. Math. Biol. 46, 187–207.

Taylor, R.J.F., Coates, D., 1989. The code within codons. Biosystems 22, 177–187.

Verkhovod, A.B., 1994. Alphanumerical divisions of the universal genetic code: new di visions reveal new balances. J. Theor. Biol. 170, 327–330.

Voet, Donald, Voet Judith (2004) Biochemstry, 3rd edition, John Wiley & Sons, INC. p. 66-67: Table 4-1.

Wade Jr., L.G., 2013. Organic Chemistry, 8th international edition. New York.

Weaver, R.F., 2012. Molecular Biology, fifth international edition. McGraw-Hill, New York.