

GEOMETRICAL PHENOMENA IN THE PHYSICS OF SUBATOMIC PARTICLES

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The article considers phenomenal geometry figures being the carriers of value spectra for the pairs of the remaining additive quantum numbers occurred in the nature of strongly and weakly interacting particles. The unusual feature of such figures is that during their building no data about particles are used at all but the data about the mentioned spectra though can be found in these figures and this can be discovered with the help of special coordinate systems.

At present we know more than two hundred strongly interacting particles and about twenty weakly interacting particles. Some important features of these particles' spectra help to reveal geometrical phenomena in the physics of subatomic particles. Let us give this name to the geometrical figures being the carriers of some important characteristics of strongly and weakly interacting particles that are observed in nature. The paradox is that while building these geometrical figures we don't use any data about particles at all.

Let us call a flat geometrical figure composed of 13 identical rectilinear hexagons as phenomenon 1 (fig. 1, a). The centers of the hexagons we will call as magic points and designate them as C_k where k is a reference number of the magic point. The positions of these points in the figure are marked with yellow circles.

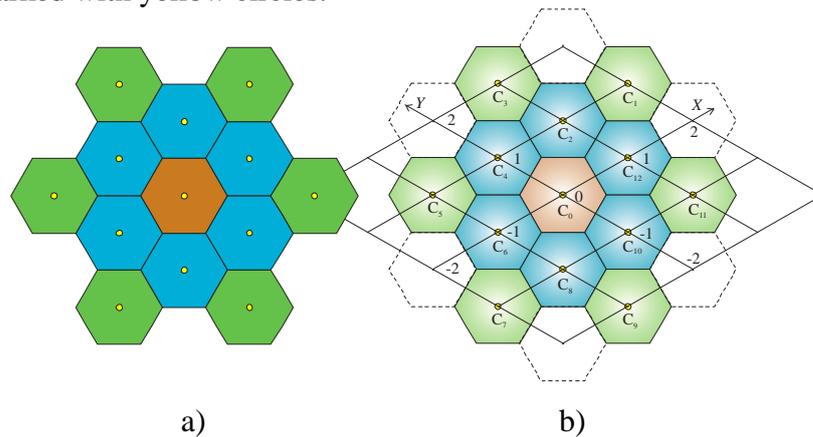


Figure 1: a) Phenomenon 1; b) Phenomenon 1 with its own coordinate system 1.

In the figure under consideration several groups of magic points can be singled out and in each of them these points are located equidistantly along the straight line, and some of these lines appear to be parallel to each other and also located equidistantly from each other. This allows us to use the magic points as reference points for building different oblique-angled coordinate systems with uniform scales along the coordinate axes. In such coordinate systems all the magic points coincide with the nodes of the coordinate grids and the values of these points' coordinates are equal to integer numbers. These coordinates can be called as the proper coordinates of phenomenon 1. They don't change at different linear transformations of this figure.

One of the proper coordinate systems (system 1) is shown in Fig. 1, b. The origin of the coordinates in this system is decided to be at the point C_0 . The coordinates Y and X of the magic points of phenomenon 1 in this system are integer numbers (Tab. 1) as it should be.

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Table 1

Values for the coordinates of the magic points in system 1 and quantum numbers B and Q for the quark structures

Magic points	Values for the coordinates		Values of the numbers B and Q for the structures when $Y = B$, $X = Q$			Values of the numbers Q and B for the structures when $Y = Q$, $X = B$		
	Y	X	B	Q	Structure	Q	B	Structure
C_1	1	2	1	2	uuu	1	2	$uuuddd$
C_2	1	1	1	1	uud	1	1	uud
C_3	2	1	2	1	$uuuddd$	2	1	uuu
C_4	1	0	1	0	udd	1	0	$u\bar{d}$
C_5	1	-1	1	-1	ddd	1	-1	$\bar{d}\bar{d}\bar{d}$
C_6	0	-1	0	-1	$\bar{u}d$	0	-1	$\bar{u}\bar{d}\bar{d}$
C_7	-1	-2	-1	-2	$\bar{u}\bar{u}\bar{u}$	-1	-2	$\bar{u}\bar{u}\bar{d}\bar{d}\bar{d}$
C_8	-1	-1	-1	-1	$\bar{u}\bar{u}\bar{d}$	-1	-1	$u\bar{d}$
C_9	-2	-1	-2	-1	$\bar{u}\bar{u}\bar{d}\bar{d}\bar{d}$	-2	-1	$\bar{u}\bar{u}\bar{u}$
C_{10}	-1	0	-1	0	$\bar{u}\bar{d}\bar{d}$	-1	0	$\bar{u}d$
C_{11}	-1	1	-1	1	$\bar{d}\bar{d}\bar{d}$	-1	1	ddd
C_{12}	0	1	0	1	$u\bar{d}$	0	1	udd
C_0	0	0	0	0	$u\bar{u}\bar{d}\bar{d}$	0	0	$u\bar{u}\bar{d}\bar{d}$

It is paradoxical however that the values of these coordinate pairs coincide with the values of the pairs of the remaining additive quantum numbers B and Q , where B is a baryon number and Q is an electric charge in the system of units where the modulus of an electron charge is assumed to be equal to one. Indeed, the following accurate equalities $Y = B$ and $X = Q$ for the quark structures designated in column 6 of table 1 and also equalities $Y = Q$ and $X = B$ for the quark structures designated in the last column of the table take place. However, the group of structures in the last column differs from the group of structures in the sixth column in only rearrangements of the structures in lines.

At first sight it may seem that all the mentioned above are the result of a good choice of the coordinate system 1 or a random coincidence. But it is not true. Really, let us apply another proper coordinate system with number 2 to phenomenon 1 (Fig.2).

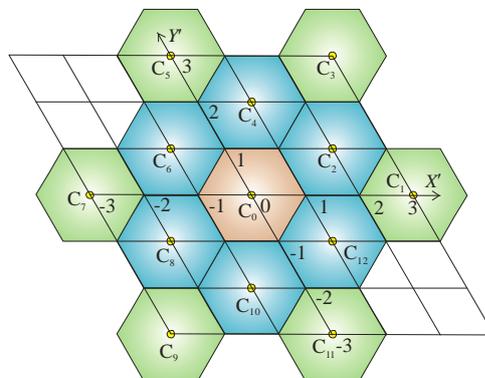


Figure 2: Phenomenon 1 with its own coordinate system 2.

Table 2

Values for the coordinates of the magic points in system 2 and quantum numbers B and Q for the quark structures

Magic points	Coordinates		Numbers B and Q as functions of the coordinates Y' and X'		Structures
	Y'	X'	$(Y'+X')/3=B$	$(2X'-Y')/3=Q$	
C_1	0	3	1	2	uuu
C_2	1	2	1	1	uud
C_3	3	3	2	1	$uuuddd$
C_4	2	1	1	0	udd
C_5	3	0	1	-1	ddd
C_6	1	-1	0	-1	$\bar{u}d$
C_7	0	-3	-1	-2	$\bar{u}\bar{u}\bar{u}$
C_8	-1	-2	-1	-1	$\bar{u}\bar{u}\bar{d}$
C_9	-3	-3	-2	-1	$\bar{u}\bar{u}\bar{d}\bar{d}\bar{d}$
C_{10}	-2	-1	-1	0	$\bar{u}\bar{d}\bar{d}$
C_{11}	-3	0	-1	1	$\bar{d}\bar{d}\bar{d}$
C_{12}	-1	1	0	1	$u\bar{d}$
C	0	0	0	0	$u\bar{u}\bar{d}\bar{d}$

In this system, as it follows from Tab. 2, the total values for the coordinates Y' and X' of the magic points differ from the total values for the quantum numbers B and Q . But the definite linear combinations of the coordinates Y' and X' of the magic points coincide with the quantum numbers B and Q , namely $(Y' + X')/3 = B$ and $(2X' - Y')/3 = Q$. This example shows that despite the choice of the proper coordinate system, phenomenon 1 is indeed the carrier of the value pairs for the numbers B and Q for the observable strongly interacting particles, and the coordinate system 1 allows us to be obviously convinced in it.

These facts, though, don't exhaust mysterious features of phenomenon 1. Let's consider the middle part of phenomenon 1 that remains after removing external hexagons of green colour (Fig. 3). This part of phenomenon 1 contains magic points with only even numbers.

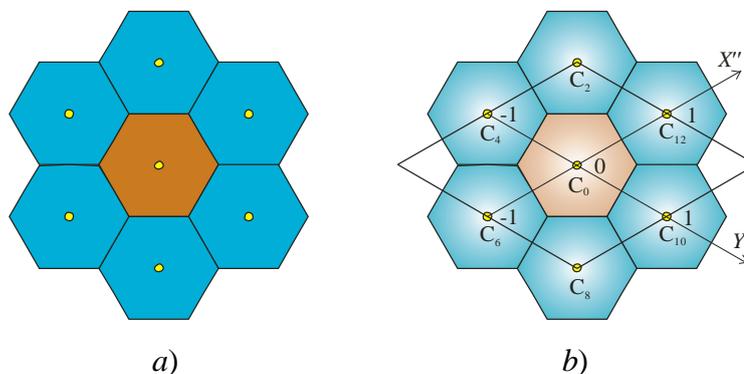


Figure 3: a) The middle part of phenomenon 1; b) The middle part of phenomenon 1 with its own coordinate system 3.

On the basis of the magic points of this part of phenomenon 1 we build the proper coordinate system 3 (Fig. 3, *b*). The coordinates X'' и Y'' of the magic points in this system are integer numbers (Tab. 3). The paradox is that the values of these pairs of coordinates coincide with the values of the pairs of the remaining additive quantum numbers L_l and Q of weakly interacting particles, where L_l is a lepton additive quantum number ($l = e, \mu, \tau$), and Q is an electric charge in the system of units where the modulus of an electron charge is taken equal to one.

Table 3

Values for the coordinates of magic points with even numbers in coordinate system 3 and the pairs of additive quantum numbers L_l and Q of weakly interacting particles

Magic points	Values for the coordinates		Particles, for which $Y'' = L_l, X'' = Q$	Particles, for which $Y'' = Q, X'' = L_l$
	Y''	X''		
C_2	-1	1	e^+, μ^+, τ^+	e^-, μ^-, τ^-
C_4	-1	0	$\bar{\nu}_e, \bar{\nu}_\mu, \bar{\nu}_\tau$	W^-
C_6	0	-1	W^-	$\bar{\nu}_e, \bar{\nu}_\mu, \bar{\nu}_\tau$
C_8	1	-1	e^-, μ^-, τ^-	e^+, μ^+, τ^+
C_{10}	1	0	ν_e, ν_μ, ν_τ	W^+
C_{12}	0	1	W^+	ν_e, ν_μ, ν_τ
C_0	0	0	Z^0	Z^0

Indeed, the following exact equalities $X'' = Q$ and $Y'' = L_l$ for the particles designated in column 4 of Tab. 3 and also equalities $X' = L_l$ и $Y' = Q$ for the particles designated in the last column of the table take place. However, the group of particles in the last column differs from the group of particles in the 5th column in only rearrangements of the structures in the lines. Therefore the constituent part of phenomenon 1 shown in Fig. 3, *a* is indeed the carrier of the values of the remaining additive quantum numbers L_l and Q of the weakly interacting particles under consideration and the coordinate system 3 makes it possible to be directly convinced in it. There remains one thing to note that Tab. 3 has all the known weakly interacting particles and doesn't have any hypothetical particles. Therefore phenomenon 1 in whole is the carrier of value pairs for the numbers B and Q and also L_l and Q of the known strongly and weakly interacting particles accordingly.

The centers of the regular hexagons become magic points of phenomenon 1 only when these hexagons are connected into the figure shown in Fig. 1, *a*. This figure doesn't have any geometrical restrictions on adding new hexagons to it. For example, this figure can be added several more hexagons as is shown in dotted lines in Fig.1, *b*. If the coordinates of the centers of the added polygons in the coordinate system 1 are taken equal to $Y = B$ and $X = Q$, then the coordinates of these centers are equal to the pairs of the quantum numbers $B = \pm 2, Q = 0, \pm 2$ and $B = 0, Q = \pm 2$ of six exotic hadrons with explicit exoticism that haven't been discovered during the experiment.

So there is a limitation on the magnitude of the modulus of the radius-vector drawn from the point C_0 to other magic points of phenomenon 1. These vectors will be designated with the same

letters as magic points but only in bold type. Let us note the following important features of these vectors.

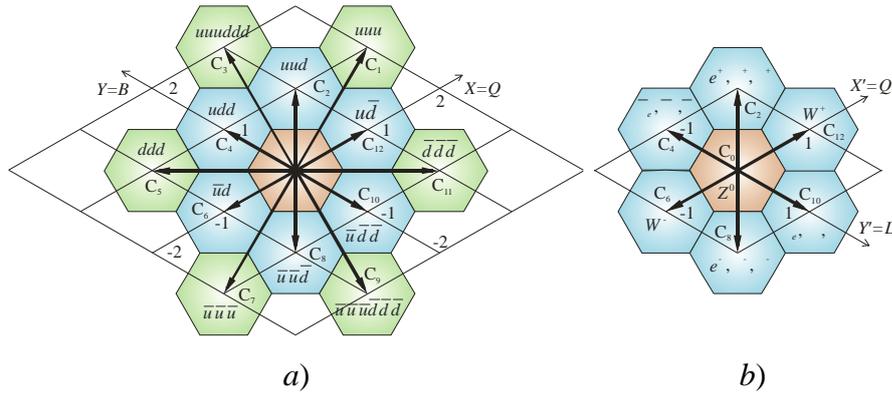


Figure 4: Distribution of radius-vectors drawn from the figure center to the magic points.

The angles between random radius-vectors in Fig.4, a are multiple to $\pi/6$. Any radius-vector C_k can be represented as a sum of two other radius-vectors. For an odd number k the equalities $C_k = C_{k+1} + C_{k-1}$ и $C_k = C_{k+2} + C_{k-2}$ occur. For even numbers k the equalities $C_k = C_{k+2} + C_{k-2}$ occur. When choosing the specific proper coordinate system, for example system 1 (Fig.4, a), each magic point of the phenomenon 1 according to the values of quantum numbers $B = Y$ and $Q=X$ can be compared to a hadron. Then the above written equalities describe possible transmutations of hadrons in which the numbers B and Q are retained separately. For example vector equality $C_3 = C_4 + C_2$ represents the transmutation $uuuddd \rightarrow uud + udd$ and the equality $C_4 = C_6 + C_2$ represents the transmutation $udd \rightarrow uud + \bar{u}d$.

Similarly when choosing the proper coordinate system 3 for the middle part of phenomenon 1 (Fig. 4, b) each magic point in accordance with the values of quantum numbers $L_1 = Y$ и $Q = X$ can be compared to a weakly interacting particle. Then the vector equalities $C_k = C_{k+2} + C_{k-2}$ describe possible transmutations of the given particles in which the numbers L_1 и Q are retained separately. For example the vector equality $C_6 = C_8 + C_4$ describes the transmutation $W^- \rightarrow e^- + \bar{\nu}_e$. Therefore phenomenon 1 represents in a graphic form potentially possible transmutations of subatomic particles at which the quantum numbers B and Q or L_1 and Q remain.

One more flat geometrical figure is of interest, it can be regarded as phenomenon 2 (Fig. 5).

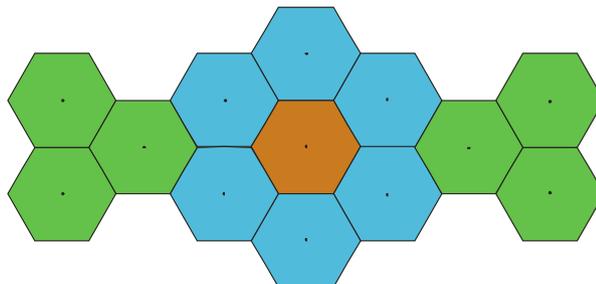


Figure 5: Phenomenon 2 is a carrier of value pairs for the retained additive quantum numbers of strongly and weakly interacting particles.

In fact, having applied coordinate system 4 (Fig. 5) to phenomenon 2 and having determined the values for the coordinates Y''' и X''' of the magic points of this figure we discover that $Y''' = B$, and $X''' = Q$ for the quark structures designated in the 6th column of Tab. 1.

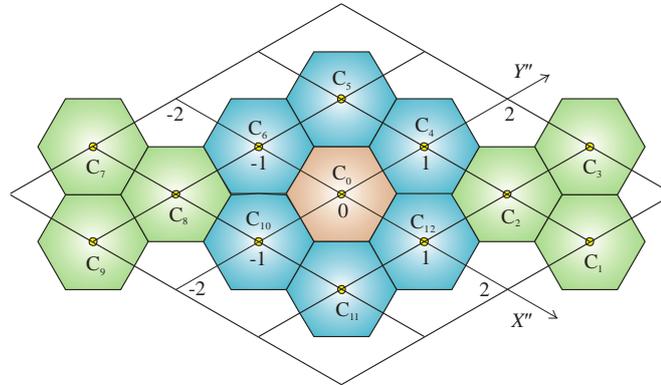


Figure 6: *Phenomenon 2 with its own coordinate system 4.*

One more phenomenon 3 can be built using six identical rhombuses, the acute angle of which equals $\pi/3$ (Fig. 7). The vertices of the rhombuses occur to be the magic points here.

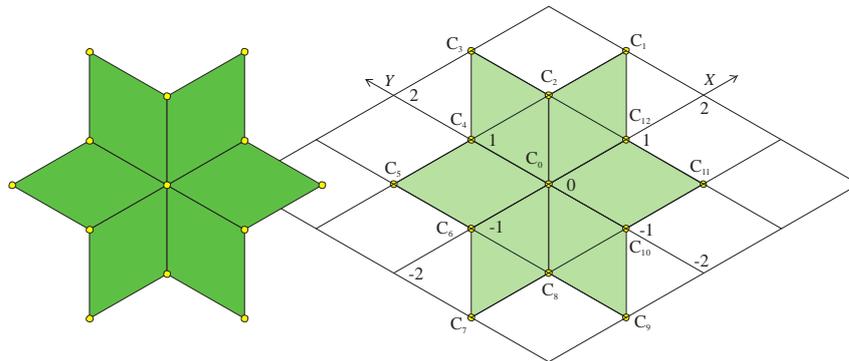


Figure 7: *a) Phenomenon 3; (b) Phenomenon 3 with its own coordinate system 5.*

The coordinate values for the magic points of phenomenon 3 in the coordinate system 5 (Fig. 7) fully coincide with the coordinate values for the magic points of phenomenon 1 in the coordinate system 1 (Fig. 1, b) represented in Tab. 1. So phenomenon 3 is fully identical to phenomenon 1.

Conclusion

It was assumed in [1] that the distribution of the pairs of the remaining additive quantum numbers of subatomic particles is subject to the definite regularity that doesn't obviously follow from the modern theory of particles. This assumption, in our opinion, is confirmed by phenomenal geometrical figures, while building them we don't use any data of the particles. However they appear to be the carriers of the pairs of values for the remaining additive quantum numbers of the real strongly and weakly interacting particles.

The following regularities result from distribution of the magic points on any of the phenomena: if a hadron with the values of quantum numbers B_1 and Q_1 is real, then there also exists a hadron with the number values $B_2 = Q_1$ and $Q_2 = B_1$; if a weakly interacting particle with the values of quantum numbers L_{11} and Q_1 is real, then there also exists a particle with the values of the numbers $L_{12} = Q_1$ and $Q_2 = L_{11}$. These particles can be regarded as BQ - or LQ -symmetrical partners.

Finally we note that the striking features of the presented above geometrical figures indicate that there is a common law that determines the values of the retained additive quantum numbers of the real quark structures and weakly interacting particles that is represented in geometrical form in the produced phenomena.

Reference

1. E.N. Klenov. Structural unit of the matter and its state, RGASHM GOU, Rostov-on-Don, 86 (2006)