

Models for Quarks and Elementary Particles — Part I: What is a Quark?

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A quark is not a tiny sphere. The formal model idea is based on a vector group which is constructed like an outer vector product. The vectors perform dynamic movements. Two vectors (vector pair) which rotate in opposite directions in a plane have an increasing and diminishing result vector as consequence. At the same time the vector group rotates about the bisectrix of the vector pair. The two movements matched to each other result in that the tip of the resultant vector draws so-called geometrical locus loops in a plane. The u- and the d-quarks have characteristic loops. Each vector group has its own orthogonal, hyperbolic space. By joining three such spaces each, two groups of spaces, one group with a quasi-Euclidian and one group with a complex space are obtained. Based on the u- and d-quarks characterized with their movements and spaces a first elementary particle order is compiled.

1 Introduction

The models are presented in a comprehensive work* and comprise a large number of aspects. Not all of these can be reflected in the present publication. For this reason, only the prominent aspects are presented in four short Parts I to IV.

It is clear that the answer to the question of the heading cannot originate from experiments. A quark is a part of the confinements, of the interior of the elementary particles, which are not accessible for experiments. For this reason the answer in the present case is based on a model, (*lexically = draft, hypothetical presentation to illustrate certain statements; hypothesis = initially unconfirmed assumption of legitimacy with the objective of making them a guaranteed part of our knowledge through confirmation later on*) which on the one hand is based on secured, e.g. QED, physical theories (*lexically = scientific presentation, system of scientific principles*). The answer is not based on one or several axioms (*lexically = immediately obvious tenet which in itself cannot be justified*).

The model or the models were developed during a journey of thinking taking decades from the galaxies to the quarks, to the elementary particles, back to the stars and again to the confinement, the universe as a puzzle.

2 The vector principle

The photon contains electric and magnetic fields and is described with appropriate vectors. This formal description possibility is utilised. Why does the photon have the electric and magnetic vectors positioned vertically to the direction of flight and vertically with regard to each other, the understanding of this will be developed during the course of the model

*There is a homepage under the Internet address www.universum-un.de where a book with the title "Models for Quarks and Elementary Particles" will be displayed, having a volume of approximately 250 DIN A4 pages.

development. For this reason it is obvious that a long distance over highly formal stretches was covered which is not re-enacted here in detail.

It is highly productive to start from the idea of the outer vector product known from mathematics: two vectors of identical size start in a coordinate origin and open up a plane. The resultant vector (EV) stands vertically on this plane and likewise starts in the coordinate origin. In the next step the three vectors of the outer vector product are given a dynamic characteristic. Two movements are introduced:

Firstly, the two identically sized vectors perform a movement in opposite directions. Since the angle between the two vectors $\mathbf{V1}$ and $\mathbf{V2}$ is called 2φ , this is described as φ -rotation or φ -swivelling; see Fig. 1.

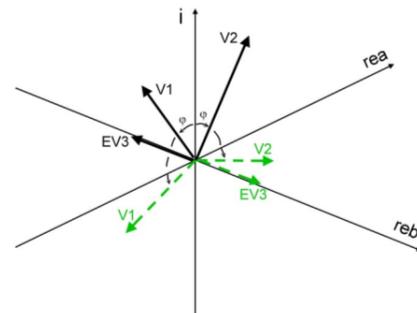


Fig. 1

If the two vectors according to Fig. 1 perform smaller and opposing φ -swivel movements, the resultant vector $\mathbf{EV3}$ becomes greater and smaller in its orientation.

Secondly, the entire vector arrangement measured by Fig. 1 performs a rotation about the bisectrix between the vectors $\mathbf{V1}$ and $\mathbf{V2}$. Since this angle of rotation is referred to as ρ , this rotation is a ρ -rotation or a ρ -swivelling. If the vectors $\mathbf{V1}$ and $\mathbf{V2}$ during the ρ -rotation enclose a fixed angle, the vector tip of the \mathbf{EV} draws an arc of a circle. However,

should the angle 2φ between $\mathbf{V1}$ and $\mathbf{V2}$ change during the ρ -rotation, the tip of the \mathbf{EV} deviates from the arc of the circle; see Fig. 2.

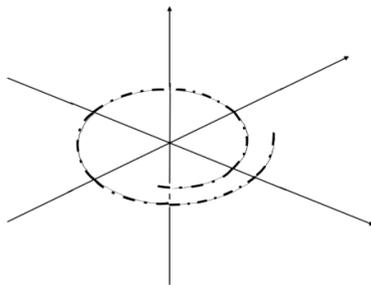


Fig. 2

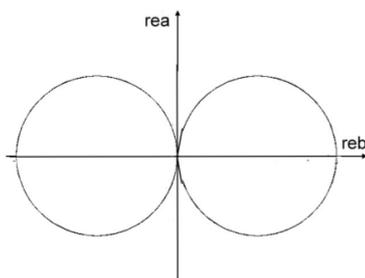


Fig. 3

It is immediately obvious that there are a huge number of possible combinations of the two φ - and ρ -movements in a coordinate system. In developing the models attention was paid to ensure that only φ - and ρ -movements that were matched to one another were considered. If for example each vector $\mathbf{V1}$ and $\mathbf{V2}$ starting from the vertical axis covers an angle $\varphi = 90^\circ$ and the \mathbf{EV} at the same time covers an angle of $\rho = 180^\circ$ in the horizontal plane, the tip of the \mathbf{EV} draws a loop in a plane. Assuming two vector pairs (one drawn black and one green) with the arrangement as in Fig. 1, two loops, see for instance Fig. 3 are obtained. Loops of this type are called geometric loci or geometric locus loops.

3 The three types of space

The limitation to a defined few coordinated φ - and ρ -movements is not yet sufficient to understand quarks. It is necessary to go beyond the Euclidian space with three orthogonal axes. At the same time, the principle of the vectors, especially that of the outer vector product should be maintained. The transition is made from the Euclidian space to the hyperbolic space with right angles between the axes. Here, it must be decided if the hyperbolic space should have one or two imaginary axes. Just as in the case of the vectors only very few models with matched φ - and ρ -movements were found to be carrying further, only few variants carry further with the space as well. (It has not been possible to find a similarly selective way from the amount of the approximately 10^{500} string theories and, in my opinion, will never be found either.)

Just as an outer vector product is productive as idea, it is also productive for the outer vector product, (for the first quark generation) to assume an orthogonal, hyperbolic space with two real axes and one imaginary axis; Fig. 4.

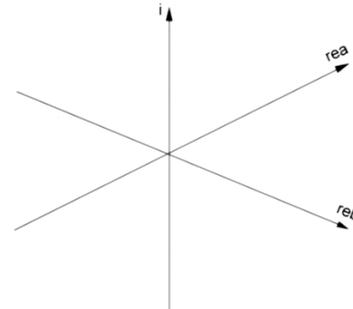


Fig. 4

So as not to create any misunderstanding at this point: it is not that several vector groups (one vector pair, \mathbf{VP} , and one \mathbf{EV} each) are placed in a hyperbolic orthogonal space with two real axes and one imaginary axis but each vector group has its own hyperbolic space. Here, the \mathbf{VP} can be positioned in the real plane or in a Gaussian plane.

Various combinations of the vector groups are possible, as a result of which individual spaces can also be combined differently. As with the φ - and ρ -movements and as with the hyperbolic space, a selection has to be performed also with the combination of individual spaces. Fig. 5 to Fig. 9 show such a selection. The choice of words of the captions to the Figures becomes clear only as this text progresses.

Taking into account quantum chromodynamics, which prescribes three-quark particles, the result of the selected combinations of such individual spaces is the following: only two groups of combined spaces of three vector groups each are obtained: either spaces which in each of the three orientations have at least one real axis (if applicable, superimposed by an imaginary axis) and are therefore called “quasi-Euclidian” (see Fig. 7 and Fig. 8), or spaces which only have imaginary axes in one of the three orientations and are therefore called “complex” (see Fig. 6).

Particles of three quarks have either a quasi-Euclidian or a complex overall space. The Euclidian space from the view of this model is fiction.

Note for Fig. 6 to Fig. 9: Variants of three hyperbolic spaces linked in the coordinate origin consisting of the hyperbolic spaces of a dual-coordination and the hyperbolic space of a singular quark in various arrangements.

4 The four quarks (of the first generation)

Taking into account the construction of a vector group, the matched φ - and ρ -movements, the orientation of \mathbf{VP} and \mathbf{EV} in the hyperbolic space and the electric charge a geometrical locus loop according to Fig. 10 is obtained for the d -quark

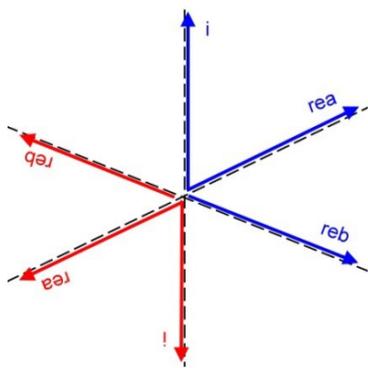


Fig. 5: The two ideal-typically arranged hyperbolic spaces of a dual-coordination as $\underline{dd}, \underline{uu}, \underline{dd}, \underline{uu}$, linked in the coordinate origin.

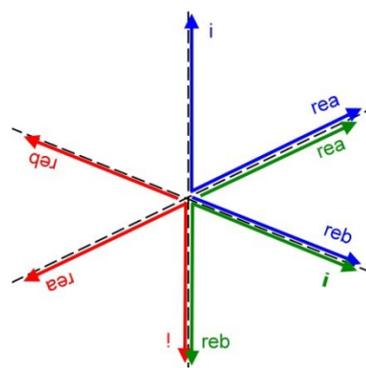


Fig. 9

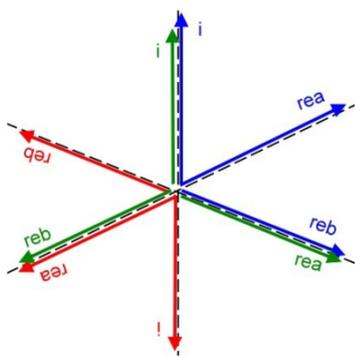


Fig. 6

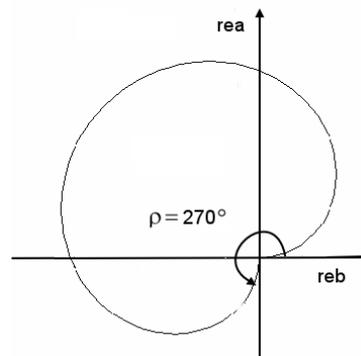


Fig. 10

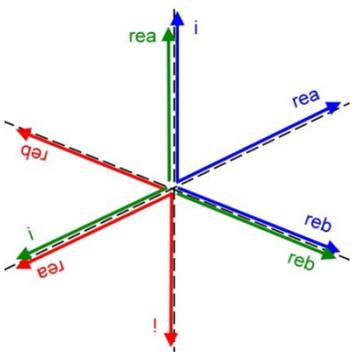


Fig. 7

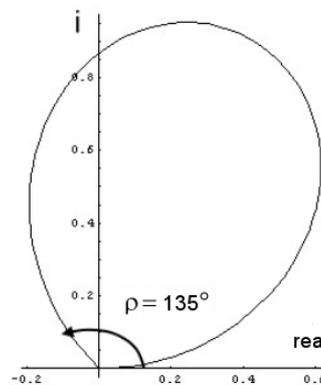


Fig. 11

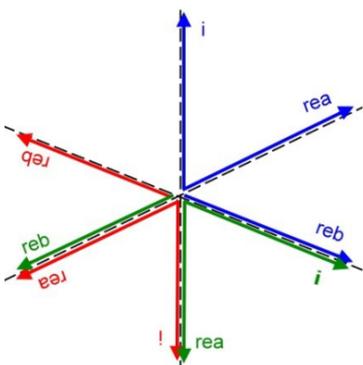


Fig. 8

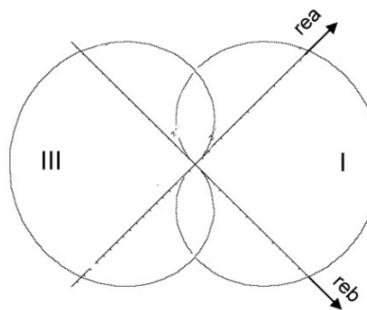


Fig. 12

with negative electric charge and a loop according to Fig. 11 is obtained for the u-quark with positive electric charge.

Antiquarks are characterized by an opposite electric charge so that the geometrical locus loop of the \bar{d} -quarks with positive electric charge is situated in a Gaussian plane and the geometrical locus loop of the \bar{u} -quark with negative electric charge is situated in the real plane.

5 Experiment of an order of elementary particles

Fig. 1 shows two vector groups (black and green) and Fig. 5 shows two hyperbolic spaces (blue and red); the vector groups and the hyperbolic spaces are each inter-linked in the coordinate origin. These presentations stem from the realisation that two quarks of the same type of each three-quark particle assume a particularly close bond. In the text this is called “dual-coordination”, or briefly, “Zk”. The third remaining quark of a three-quark particle is then called a “singular” quark. The different orientations of the quarks (**VP** and **EV**) with their spaces result in that the geometrical locus loops can stand at different angles relative to one another. A $\bar{d}\bar{d}$ -Zk for example has an angle zero between both ρ -rotation planes, see Fig. 12. The same applies to a uu -Zk with angle zero between both ρ -rotation planes. Since the planes are positioned in parallel, the symbol \parallel is used. If the rotation planes of two geometrical loci stand vertically on top of each other, the symbol \perp is used. Table 1 is produced with this system.

Line	ddd	ddu	duu	uuu
A	$\underline{d}\underline{d}\parallel d \equiv e_e$	$\underline{d}\underline{d}\parallel u \equiv n^0$	$d\parallel uu \equiv p^+$	$uu\parallel u \equiv \Delta_\Delta$
B	$\underline{d}\underline{d}\perp d \equiv e^-$	$\underline{d}\underline{d}\perp u \equiv \nu_e$	$d\perp uu \equiv ?^+$	$uu\perp u \equiv (\Delta^{++})$
C	$\underline{d}\underline{d}\underline{d} \equiv \Delta^-$	$\underline{d}\underline{d}u \equiv \Delta^0$	$duu \equiv \Delta^+$	$uuu \equiv \Delta^{++}$

Table 1: The order of particles, sorted by quark flavours and the parallel \parallel and vertical \perp orientation of the geometrical loci.

The esteemed reader will be familiar with four of the spin $\frac{1}{2}\hbar$ -particles (neutron n^0 , proton p^+ , electron e^- and neutrino ν_e) and, if applicable, the Δ -particles with spin $\frac{3}{2}\hbar$ from line C from high-energy physics. Because of the brevity of the present note the individual quark compositions will not be discussed. However, it is immediately evident that highly interesting consequences for the standard model of physics are obtained from the methodology of Table 1. This is evident on the examples of the electron and the neutrino, which, in the standard model, are considered as uniform particles, but here appear to be composed of quarks. In Parts II and IV of the publication the aspect of the electron composed of quarks is deepened. The structural nature of the quarks in the nucleons is another example for statements of these models that clearly go beyond the standard model.

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