

Number Archetypes and “Background” Control Theory Concerning the Fine Structure Constant¹

Péter Várlaki

Budapest University of Technology and Economics
Széchenyi István University
Bertalan Lajos utca 2, H-1111 Budapest, Hungary
varlaki@kme.bme.hu

László Náldai, József Bokor

Computer and Automation Research Institute of Hungarian Academy of Sciences
Kende utca 13-17, H-1111 Budapest, Hungary
(naldai)|(bokor)|@sztaki.hu

Abstract: In this paper we analyze in detail the central role of number ‘137’, the so-called Fine Structure Constant in the collaboration of Pauli and Jung. First, we present the fascination or the obsession of Pauli for the interpretation of number ‘137’. Second, we treat the spontaneous messages originating from unconscious concerning number ‘137’ in the well-known dreams of Pauli. We restrict our investigations to the dreams containing the especially important formulae of Fine Structure Constant ($4\pi^3 + \pi^2 + \pi$), and also that containing the so-called background models of mathematical control systems. Third, we shortly mention four of the numerous synchronicities arising during the Pauli–Jung collaboration.

1 Introduction

The co-operation and correspondence of Wolfgang PAULI and Carl Gustav JUNG in physical, philosophical and psychological topics have led many authors from the 60ties onwards to discuss and analyze these issues. A special feature of these discussions is that they are directed, apart from philosophical and physical aspects, to the interpretation of the dreams of Pauli by Jung. This statement of ours is

¹ Extended version of a lecture given at 12th International Conference on Intelligent Engineering Systems, February 25-29, 2008, Miami, Florida.

based on Jung’s book *Psychology and Alchemy* [14] where he analyzes, apart from 4 explicitly religious dreams, 72 other dreams that all share a pattern presumably from alchemy and Cabbala.² (He analyzes three out of the four religious dreams in the *Terry Lectures* at Yale in 1937 [13].)

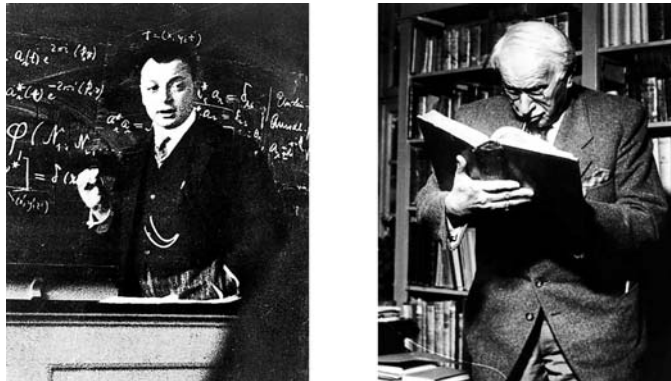


Figure 1
Wolfgang Pauli and Carl Gustav Jung

The *World Clock* vision is of special importance here because of its complex dynamical symmetry structure which gives an appropriate basis both to physical and psychological interpretations as well as to hermeneutics. We mention just three names of those authors who yielded analysis of this vision: W. Byers-Brown, D. F. Peat [36], van Erkelens [41].

We can associate to these dreams the other series of dreams uncovered and published in the Pauli–Jung correspondence (see [27], in German 1992, in English 2002), whose patterns, language, and dynamic shows a close tie to those analyzed in the publication mentioned above. The date of the last dream mentioned in the correspondence is August, 1957. The *World Clock* vision (1932) plays a central role in the correspondence; one of its paraphrases is communicated to Jung by Pauli in 1955. The quarter-of-a-century correspondence of the two thinkers puts emphasis on this dream.

Another significant aspect of the analysis of dreams and visions is the concept of background processes introduced by Pauli. According to Pauli, these background processes have an impact not only on the development of scientific concepts and ideas, but also on the so-called *Weltanschauung* approaches.

² There is the well known medieval mystical pattern $(4 + 72)$ – the name of God with 4 or 72 letters – which is echoed in Jung’s writing, probably quite unintentionally. It functions like pure synchronicity.

In this paper we analyze in detail the hidden governing role of number ‘137’, the so-called *Fine Structure Constant*³ in the collaboration of Pauli and Jung. The analysis covers four different areas.

- 1 First, we present the fascination or the obsession of Pauli for the *interpretation of number ‘137’*. Here we consider primarily his theoretical or philosophical writings instead of his professional papers; and we quote five especially important extracts word for word.
- 2 Second, we treat the spontaneous messages originating from unconscious concerning number ‘137’ in the well-known dreams of Pauli [14], [27]. They are so numerous that even to comment them would require a whole supplementary book. So we restrict our investigations to the dreams containing the especially important *formulae* of Fine Structure Constant ($4\pi^3 + \pi^2 + \pi$) [42], and also containing the so-called *background models* of mathematical control systems.
Remark. It is astonishing that neither Pauli, nor Jung have ever thought of interpreting number ‘137’ in the dreams of Pauli, however, from their correspondence [27] it can be proved without any doubt that Jung had read at least four of the five cited studies.
- 3 Third, we deal with the comparison of the two kinds of “observations” (external and internal) concerning the computation and interpretation of the fine structure constant. The epistemological aspect of the *two observations problem* will also be briefly touched upon.
- 4 Fourth, we shortly mention some of the numerous interesting and significant *synchronicities* arising during the Pauli–Jung collaboration.

To anticipate, we shall stress that our approach is basically *empirical* and *heuristic* and it concerns the questions of discovery rather than that of philosophical legitimating.

2 The Fine Structure Constant and Pauli

2.1 Number ‘137’ – the Fine Structure Constant

The concept of fine structure constant (*Feinbaukonstante*) was introduced in the early 1910s by A. SOMMERFELD explaining the spectral lines of hydrogen atom radiation, i.e. the fine structure of hydrogen spectrum. Indirectly this “innovation” played an important role in the development of the Bohr–Sommerfeld atom modeling framework [40].

³ In fact $1/\alpha = 137.035\,999$ is the *inverse* Fine Structure Constant [38].

Definition 1. Fine structure constant is a ratio which characterizes the “amount” of the electromagnetic (mutual) effect (independent of the selection of the dimension) and can be found in the description of the fine structure of the hydrogen spectrum:

$$\alpha = \frac{e^2}{4\pi\epsilon_0\hbar c}$$

where e is the elementary charge of electron, c is the speed of light, $\hbar$ is the Planck-constant and ϵ_0 is the vacuum permittivity.

On the other hand, the value of fine structure constant can be calculated from the direct spectroscopic measurement of hydrogen spectrum too, without knowing the concrete values of the above non-dimensionless fundamental constants. However, the specific “value of the concept” obtained from the spectroscopic measurements depends upon the type (and accuracy) of the concrete quantum-electrodynamic model, which can describe the fine and hyperfine structure of hydrogen spectrum very naturally.

Consequently, despite the fact that it cannot be directly determined from measurement, it can be considered from a “hermeneutic point of view” as an empirical concept “interpreted minimally”, i.e. on the basis of the three most important constants of physics, and (at the same time) defines the fine (and hyperfine) structure of hydrogen spectrum.

Properly, in the center of the arising question we can find basically the “true” or “best” value of the fine structure constant [38], because the values “obtained” from the above two possible numerical determinations are not equal to each other. It is natural because we can measure “precisely” neither the speed of light, nor the Planck constant and the elementary charge of electron, furthermore, the accuracy of spectroscopic measurements of hydrogen-spectrum are also very limited not to mention the “higher members” of the intermediate calculations. Therefore, after 1910 the demand has arisen, beside the definitive calculations and spectroscopic measurements, to determine the “true value” of the fine structure constant on a geometric basis, first of all using the value of π .

The intellectual and spiritual challenge of fine structure constant for Pauli can be characterized by the following “emotional impression” of Richard FEYMAN:

“There is a most profound and beautiful question associated with the observed coupling constant, e , the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to -0.08542455 . (My physicist friends won't recognize this number, because they like to remember it as the inverse of its square: about 137.03597 with about an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.) Immediately you would like to

know where this number for a coupling comes from: is it related to π or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the »hand of God« wrote that number, and »we don't know how He pushed his pencil.« We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of dance to do on the computer to make this number come out, without putting it in secretly!”

2.2 Pauli on the Fine Structure Constant

As mentioned above the concept of fine structure constant (*Feinbaukonstante*) was introduced in the early 1910s by A. SOMMERFELD explaining the spectral lines of hydrogen atom radiation. In an essay⁴ Pauli wrote appreciation of Sommerfeld as follows:

“It must however not be forgotten that here, on account of the well-known divergences in the results following that here, on account of the well-known divergences in the results following from the quantum theory of wave fields, we already find ourselves outside the range of a logically closed theory, and are once more reduced to guessing the correct final formulae. The smallness of these new effects is a consequence of the smallness of the so-called fine structure constant, which is often linked with Sommerfeld’s name, since its fundamental significance first came clearly to light through his theory of 1916 of the fine structure of hydrogen spectra. The theoretical interpretation of its numerical value is one of the most important unsolved problems of atomic physics.” [31]

While the other fundamental physical constants of Nature are all immensely small or enormously large, this fine structure constant ≈ 137 (precisely unknown value) turns out to be a human sized number. The number ‘137’ and its (possible) place in the scale of the universe particularly fascinated and at the same time puzzled Pauli and continues to challenge the physicists today as well [36].

“On the other hand the law of conservation of electric charge occupies a fundamental and equally important place side by side with the laws of conservation of energy and momentum. There are some interesting attempts at classical field theories which, by using a formally more unified representation of the connection of electromagnetic and gravitational fields, unite the law of conservation of electric charge with the laws of conservation of energy and momentum into a single structure, consisting of five equations. But so far these theories have no natural connection with quantum theory, and are unable to interpret the additional fundamental property of charge, namely that it is atomic. By this latter property we mean

⁴ “Sommerfeld’s Contributions to Quantum Theory.” Dedicated to A. Sommerfeld on his 80th birthday on 5th December, 1948. – First published in *Die Naturwissenschaften*, 35, 129 (1948).

the fact that every electric charge occurring in nature is always a (positive or negative) integral multiple of the elementary electric charge

$$e = 4.8 \times 10^{-10} \text{ e.s.u.}$$

This constant of nature has not yet found its appropriate place beside the constants c , h and κ . A new formulation of quantum theory would be satisfactory only if by an interpretation of the numerical value of the dimensionless number

$$\frac{hc}{2\pi e^2} = 136.8 \pm 0.2 .$$

In one of his most interesting, philosophical writings⁵ dated from 1936 Pauli wrote as follows:

It were to oppose the atomic nature of charge to the classical law of its conservation as its quantum-theoretical correlate in the same way as it opposes as complementary the laws of conservation of momentum and energy to the description in space-time. Nor do we yet know if such a future theory will or will not modify the connection between the notion of charge and that of space-time, which is so characteristic of theories available at present.” [29]

In one of his last essays⁶ Pauli set a high importance on fine structure constant:

“One of the most assured empirical results of physics is the atomistic structure of electric charge. Charge values are integral multiples of a fundamental unit, the electric elementary quantum, from which, along with the quantum of action and velocity of light, one can form a dimensionless number, 137.04. To reach this result one requires a considerable part of the classical theory of electricity. In the 17th century, for instance, when it was not known how to measure electric charges and how they are defined quantitatively, this empirical result could never have been obtained and formulated. But we are unable to understand or explain the above number.” [34]

As mentioned, in the centre of the arising question we can find basically the “true” or “best” value of the fine structure constant because the values “obtained” from the above two possible numerical determinations are not equal to each other. It is natural because we can measure “precisely” neither the speed of light, nor the Planck constant and the elementary charge of electron, furthermore, the accuracy of spectroscopic measurements of hydrogen spectrum are also very limited not to mention the “higher members” of the intermediate calculations.

⁵ “Space, Time and Causality in Modern Physics.” Expanded version of a lecture to the Philosophical Society in Zurich in November 1934. From *Scientia*, 59, 65-76 (1936).

⁶ “Phenomenon and Physical Reality.” *Dialectica*, 11 (March 15, 1957), pp. 35-48. Introduction to a Symposium on the occasion of the International Congress of Philosophers in Zürich, 1954.

In his *Nobel Lecture*⁷ Pauli summarizes the epistemological conclusion:

“From the point of view of logic, my report on ‘Exclusion principle and quantum mechanics’ has no conclusion. I believe that it will only be possible to write the conclusion if a theory will be established which will determine the value of the fine structure constant and will thus explain the atomistic structure of electricity, which is such an essential quality of all atomic sources of electric fields actually occurring in nature.” [30]

As also mentioned above, after 1910 the demand has arisen, beside the definitive calculations and spectroscopic measurements, to determine the “true value” of the fine structure constant on a geometric basis, first of all using the value of π . This concept in a certain measure was intuitively advanced by EINSTEIN.⁸

“Inside physics in the proper sense we are well aware that the present edifice of quantum mechanics is still far from its final form, but, on the contrary, leaves problems open which Einstein considered already long ago. In his previously cited paper of 1909 [4b], he tresses the importance of Jeans’ remark that the elementary electric charge e , with the help of the velocity of light c , determines the constant e^2/c which is of the same dimension as the quantum of action h (thus aiming at the now well known fine structure constant $2\pi e^2/hc$). He emphasized (l.c., p. 192) “that the elementary quantum of electricity e is a stranger in Maxwell-Lorentz’ electrodynamics” and expressed the hope that “the same modification of the theory which contains the elementary quantum e as a consequence, will also have as a consequence the quantum structure of radiation.” The reverse of this statement certainly turned out to be not true, since the new quantum theory of radiation and matter does not have the value of the elementary electric charge as a consequence, so that the latter is still a stranger in quantum mechanics too.

The theoretical determination of the fine structure constant is certainly the most important of the unsolved problems of modern physics. We believe that any regression to the ideas of classical physics (as, for instance, to this goal. To reach it, we shall, presumably, have to pay with further revolutionary changes of the fundamental concepts of physics with a still farther digression from the concepts of the classical theories.” [32]

⁷ “Exclusion Principle and Quantum Mechanics.” *Nobel Lecture* in English, delivered at Stockholm on December 13, 1946 (Stockholm 1948).

⁸ “Einstein’s Contribution to Quantum Theory.” First published in P. A. Schilpp: *Albert Einstein: Philosopher Scientist*. The Library of Living Philosophers, Vol. 7, Evanston, Ill. 1949, pp. 149-160. The present version is translated from the German edition, *Albert Einstein als Philosoph und Naturforscher*, ed. P. A. Schilpp, Stuttgart (1955), pp. 74-84, which is believed to be Pauli’s original wording.

2.3 Our Formula and Interpretation for the Fine Structure Constant

Without knowing the “accepted”, probably, most accurate two values (considering just the 137.03... value of FSC), the following formula for the general (synchronistic) definition of the fine structure constant was proposed [12]:

$$\alpha^{-1} = 4\pi^3 + \pi^2 + \pi^1 = \pi(4\pi^2 + \pi + 1) = 137.036\,303\,7\dots = \alpha^{-1}(\pi) \quad (1)$$

It can be seen that this formula is simple, general, self-expressive and aesthetically also neat. Furthermore, besides π , sufficiently (according to certain alchemical and traditionally hermeneutical rules) it consists only of the first four integer numbers. The first three numbers (as powers) have some “generative characteristics” but the fourth one (4) with certain topological characteristics (as a multiple) also meets the usual “symbolic demands”.

Therefore it is able to symbolize the completeness or perfectness according to the mentioned Caballo-Alchemistic and hermeneutical principles. On the other hand, the first three integer numbers appear in generative way as powers of π , while the fourth one, the ‘4’ hints at a topological structure (as a multiple) satisfying the usual Jungian interpretations as well [14].

The generative geometric structure number version of the fine structure constant can ensure a rather *unique* possibility of hermeneutical interpretation through the tetragonal substitution (interpretation) of π , a slightly similar to the classical alchemical problem of “quadratura circuli”. The quaternary substitutive interpretation of $\pi \sim 4$ or $\pi \sim 2$ numbers rewriting into the expression of $\alpha^{-1}(\pi)$ the following natural (integer) structure numbers can be obtained.

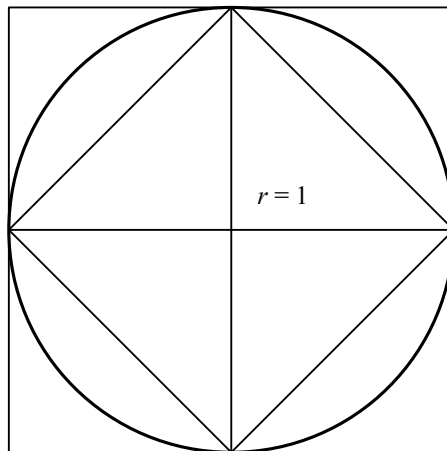


Figure 2

A geometric illustration for problem of “quadratura circuli”



Figure 3

Squaring the circle: two makes the two sexes one whole. (Maier, *Scrutinium chymicum*, 1687)

$$\alpha^{-1}(4) = 4 \cdot 4^3 + 4^2 + 4^1 = 4 \cdot 64 + 16 + 4 = 256 + 16 + 4$$

$$\alpha^{-1}(2) = 4 \cdot 2^3 + 2^2 + 2^1 = 4 \cdot 8 + 4 + 2 = 32 + 4 + 2$$

$$\frac{\alpha^{-1}(4)}{2} - 1 = 137 < \alpha^{-1}(\pi) < 138 = \frac{\alpha^{-1}(4)}{2}$$

The essence of the interpretations is that the tetragonal substitution of π – according to the schema shown in Fig. 2 – can be only the $\pi \sim 4$ as outside the square-measure and $\pi \sim 2$ as the inside square-measure of the “generative circle” with unit radius [44, 46].

3 Background Control Theory

The *Kalmanian* view of systems and their models [20], [9], besides the usual dichotomic reality and description/model “attitude” use trichomic paradigm. It means that besides the (in itself unknowable) “reality” – which is characterized by a certain kind of measurement data – the theory postulates hypostatized *system classes* (using a neutral language of conception), furthermore, constitutes, as a third entity, the model classes related to the former classes of systems.

Our intention is to demonstrate the “background” forms of mathematical system theory both in Pauli’s dreams and in the writings of Pauli and Jung, with a special emphasis on the controlling/regulating principle. While Jung intuitively hypostatize the self-regulating psyche, and stress on the regulating principles, therefore one can perceive a kind of *geometric system theory* with the adoption of the significant concept of ‘projection’. Pauli instead emphasizes the role of iso- and homomorphic relations, algebraic groups and automorphisms that is he intuitively formulates the cognitive basis of background *algebraic system theory*.

“As a consequence of the rationalistic attitude of scientists since the eighteenth century, the background processes that accompany the development of the natural sciences, although present as always and of decisive effect, remained to a large extent unheeded, that is to say, confined to the unconscious. On the other hand, in the Middle Ages down to the beginning of modern times, we have no natural science in the present-day sense but merely the pre-scientific stage, just mentioned, of a magical-symbolical description of nature. This, of course, is also to be found in alchemy, the psychological significance of which has been the subject of intensive investigation by C. G. Jung. My attention was therefore directed especially to the seventeenth century, when, as the fruit of a great intellectual effort, a truly scientific way of thinking, quite new at the time, grew out of the nourishing soil of a magical-animistic conception of nature.

I was well aware, as a pupil of Sommerfeld’s, how these Pythagorean elements appearing in Kepler retrain their vitality even today. That ancient spiritual ‘dynamics’ of number is still active, which was formerly expressed in the ancient doctrine of the Pythagoreans that number are the origin of all things and as harmonies represent unity in multiplicity.” [35]

Pauli postulates a transcendental background, an “informational cosmos” (symbolically returning to the “concept” of *Anima Mundi* – see e.g. [48]) which is the (probabilistic) basis of both physics and psychology, or the subject of both theological and mythological ways of cognition; in which the physical, mental, and spiritual layers create a unity on the basis of a transcendental informational and control language, cf. [37]. This “background” (from which the white noise “steps out”) is called by the authors *Pleromatics* (after the Greek word *πλήρωμα*), and “contains” only symmetry structures and related abstract fields of random variables or fields of contingency without any direct information about the space-time continuum.

Pauli’s theory on background cognitive processes is clearly introduced in his famous study on archetypal influences in Kepler’s scientific discoveries:

“Their agreement with the »primordial images« or archetypes introduced into modern psychology by C. G. Jung and functioning as »instincts of imagination« is very extensive. When modern psychology brings proof to show that all understanding is a long-drawn-out process initiated by processes in the unconscious long before the content of consciousness can be rationally formulated, it has di-

rected attention again to the preconscious, archaic level of cognition. On this level the place of clear concepts is taken by images with strong emotional content, not thought out but beheld, as it were, while being painted.” [19, 35]

So, the human recognition concerning the above processes – according to Pauli – formulates dynamical control systems of informational type, where one can not preclude the possibility of personal connections of dynamical systems.

“Furthermore, although I have no objection the existence of relatively constant psychic contents that survive the personal ego, it must always be borne in mind that we have no way of knowing what these contents are actually like ‘as such’. All we can observe is their effect on other living people, whose spiritual level and whose personal unconscious crucially influence the way these contents actually manifest themselves.” [27]

These can be discussed as a relatively natural and artificial competence in the form of mythological, theological, psychological and biological recognition. The presence of regulating (control) systems can be shown in all of them on the level of both natural and artificial competence. This can be traced in on the level of natural competence in mythology and theosophy as the directing dynamics of the pleromatic world, e.g. in the sephirotic system of the Cabbala. A good example of artificial competence regarding this is Paul RICOEUR’s “control-theoretical” hypothesis regarding the magical–mythological ideas, the hermeneutics of meaning, and the Jewish–Catholic religion [39].

Natural competence in psychology, just like artificial competence, appears in less reflected experiments too. The concept of the archetype considered as regulator can be seen in Jung’s hermeneutics, tightly connected with the concept of the self-regulating psyche. Quoting Pauli:

“The concept ‘archetype’ in Jung’s psychology, and of its transformation from the original meaning of ‘primordial image’ to that of an irrepresentable (unanschauliches) structural element of the unconscious, a regulator, which organizes representations (Vorstellungen). Personally I see in this the first indications of the recognition of ordering principles, which are neutral in respect of the distinction psychical-physical, but which, in contrast with the concretistic psycho-physical unified language of ancient alchemy are ideal and abstract, that is, of their very nature irrepresentable (unanschaulich). Thus the great difficulties and paradoxes in the problem of observation appear clearly. These changes in the ideas of the unconscious show that while still far from having been definitively worked out from the logical side, they are the expression of a line of research in course of development.” [35]

In physics artificial competence appears in the control-theoretical and informatical interpretation of Schrödinger’s equation, at the same time, it can be discovered in Pauli’s dreams, reflections and conscious works corresponding to background control.

Pauli's aim was to establish connection with those cognitive and emotional unconscious processes bearing a transcendental-type and maybe personality which are in tight connection with the evolution of natural and artificial competence of mankind in these fields in a constant interaction. In this aim, new in its own reflection, an idea of central importance which can really be observed in the modern scientific concept in the Jung–Pauli relation.

According to both Jung and Pauli the number archetype is '137' above all, and in tight connection with it the *interpretation* of the number '137'; and in connection with this the mathematical system theory, as well as the use of the control-theoretical paradigm.

In Pauli's view it is the number '137', the value of fine structure constant which surpasses the present quantum theory. As Pauli's former assistant Professor Charles P. ENZ formulated, it takes us beyond physics, and, leaving the separate observers behind, transforms the thinking and feeling scientist confronting with former unconscious processes into the active role of the partaking observer.

"My feeling is that the common ground shared by physics and psychology does not lie in the parallelism of the formation of concepts but rather in »that ancient spiritual 'dynamics'« of numbers that you point out on p. 295. The archetypal numinosity of number expresses itself on the one hand in Pythagorean, Gnostic, and Cabbalistic (Gematria!) speculation, and on the other hand in the arithmetical method of the mantic procedures..."

"Even mathematicians cannot agree among themselves as to whether numbers have been discovered or invented, a fact that finds its counterpart in the modern dilemma of whether the archetype is acquired or is innate. (In my view, both are true.) »In the Olympian host, Number eternally reigns« is a valuable acknowledgment from mathematicians as to the numinosity of number." [27]

Pauli explains several times in his letters and essays that there are at least three different type of mediator "languages" of cognition corresponding to usual (e.g. scientific discovery) and unusual (e.g. active imagination, dreams) ways of knowledge transition:

- theological/metaphysical language;
- physical/symbolic language; and
- language of the psyche or analytical psychology.

Besides the above he postulates a fourth symbolic mediator language that is based on *number archetypes*, but he considers this language "unknown" so far. These four languages can be related to the four ontical layers of Jung–Pauli: spiritual, psychical, material, and transcendent.

In addition to the competence and language of the three fields mentioned (mythological, theological, and physical background theory) the fourth is in our opinion not a future "neutral" new language connected to the number archetype, but an ar-

tistic competence (and language) in the widest sense: the *aesthetical category*. The mentioned fourth neutral language appears in the focus as a fifth one, with the number archetype, with the number '137', and maybe with the paradigm of the background system and control theory. This scheme corresponds to the four functions of the conscious, where the central, not as a fifth, but as the entity unifying the other four there is the *transcendent function* according to Jung. In his answering letter Jung wrote that:

"Your explanation of the consciousness quaternio is interesting and, I would say correct. This is also where the 'origin' and primordial home of the number is probably to be found. At any rate where it begins to make its presence felt." [27]

Pauli intuitively grasped the significance of perspective mathematical system and control theory. In one of his important letters to M. FIERZ (Jan. 1948) he wrote:

"The ordering and regulating (controlling) must be placed beyond the difference between psychical and physical as known as Plato ideas are something of the concepts and also something of the natural forces." [48]

K. V. LAURIKAINEN summarized Pauli's ordering and regulating concepts in the following way:

"Pauli understood this ordering and regulating as the common source for science and religion. With the aid of intuition we can come in contact with it in the depths in the psyche, but we can come to studying the logical orders and changes in the nature."

In another place Laurikainen discussed the Pauli approach to the concept of the synchronicity:

"Idea of synchronicity [...] is idea that noncausal (acausal) events would be controlled by some kind of regular correspondence." [48]

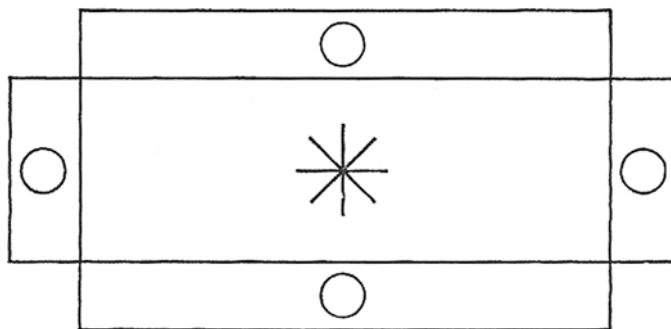


Figure 4

Dream of the four rectangles forming a geometric quaternio [17]

4 The Dream of World Clock as an “Algebraic” Archetype of Control Systems

The *Dream of World Clock* essentially contracts the dream of the four-eyed bear (dream No. 39) with the dream of the four rectangles forming a geometric quaternion (dream No. 51, see Fig. 4).

The dream of two rectangles which we may derive the $32 + 4 + 2$ structure from, has a further interesting dynamic feature. Namely, people move clockwise around the four colored waters in the middle of the four derived rectangles. In the centre, however, people move anti-clockwise around the asterisk. This *contrary motion* of the centre already refers to the connection between the energy and the controlling systems. The etymology of the English word ‘control’ is in complete consonance with the background control image of Pauli’s dream. The word ‘control’ originates from the medieval let in expression ‘contra rotulare’ being the linguistic mapping of the dream image mentioned above. This feature synchronistically connects the four colors with the World Clock dream, the number ‘137’ and the concept of control together with its dynamic system. The delineation reaches the English world control through the English-French ‘contreroller’ and the French ‘contrôle’.

Jung rather frequently speaks about his patient’s dreams containing symmetry structures which are very similar to the “Ezekiel pattern” without any knowledge of the vision of Ezekiel. He remarks that despite its significance in the spiritual history of the Christian-Jewish world, even among the highly educated people there is an almost complete ignorance “in this field”. Jung classified this kind of dreams as Mandala ones, which can be experienced as certain psychic synthesis of a psychoid transcendental background and real psychic “foreground”. Furthermore, the appearance of the possible synchronistic phenomena was interpreted by him as the parapsychological equivalent of this transgressive totality (completeness) experience [46].

“I have always been particularly interested to see how people, if left to their own devices and not informed about the history of the symbol, would interpret it to themselves. I was careful, therefore not to disturb them with my own opinions and as a rule I discovered that people took it to symbolize themselves or rather something in themselves. They left it as belonging intimately to themselves as a sort of Creative background, a life-producing sun in the depths of the unconscious mind. Though it was easy to see that it was often almost a replica of Ezekiel’s vision, it was very rare that people recognized the analogy, even when they knew the vision –which knowledge, by the way, is pretty rare nowadays.”

Pauli probably was influenced by the concept of “creative background” from Jung’s *Terry Lectures* (1937).

Unfortunately, we have no possibility here to give even a short survey about the known analysis and interpretations for the symmetry structures of the vision of

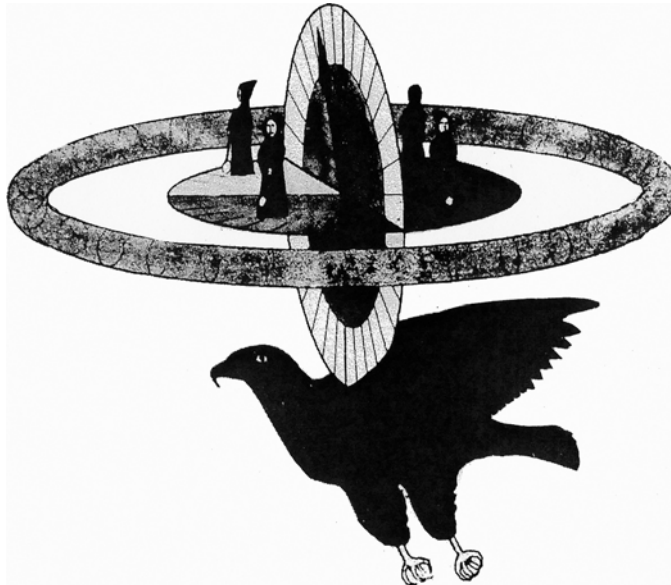


Figure 5
The World Clock.

An impression generated by W. Byers-Brown based on accounts of Pauli's dream [17].

Ezekiel. It would demand a separate book... However, in the following we shortly outline the background control system "interpretation" of the vision, and the $4 + 16 + 256$ system representations. In this rare interpretation one counts the four Cherubims standing at the four corners of the Chariot of God. All the Cherubims have 4×4 body-parts (4 faces, 4 wings, 4 hands, and 4 legs) according to the four natures (man, lion, bull, and eagle). This system of $4 + 16 + 256$ can be related to the 39th dream of Pauli [46]:

"Dreamer is falling into the abyss. At the bottom there is a bear whose eyes gleam alternately in four colours: red yellow green and blue. Actually it has four eyes that change into four lights."

Inasmuch the bear symbolizes north in mythology, as well as in astronomy and the Chariot of God arrives from north on the sky in the vision. The algebraic variation system of the four lights of the four eyes can be related in a natural way to the $4 + 16 + 256$ system interpreted in the previous paragraphs. According to the parity conception of Pauli (right-left sides of space), the above structure can be simplified into $128 + 8 + 1$. That is, the dream of Pauli connects the Merkabah vision with the fine structure constant – without any knowledge of mythology [46].

In the dream of four rectangles (dream No. 51, see Fig. 4) beside the four colors we can identify 32 geometric elements (12 corners, 16 lines and 4 rectangles). It is originally formed from two basic rectangles, so the structure $32 + 4 + 2$ is valid.

The exact text of the dream of World Clock is the following:

"There is a vertical and a horizontal circle, having a common centre. This is the world clock. It is supported by the black bird.

The vertical circle is a blue disc with a white border divided into $4 \times 8 = 32$ partitions. A pointer rotates upon it.

The horizontal circle consists of four colours. On it stand four little men with pendulums, and round about it is laid the ring that was once dark and is now golden (formerly carried by the children).

The »clock« has three rhythms or pulses:

- 1) The small pulse: the pointer on the blue vertical disc advances by $1/32$.*
- 2) The middle pulse: one complete revolution of the pointer. At the same time the horizontal circle advances by $1/32$.*
- 3) The great pulse: 32 middle pulses are equal to one revolution of the golden ring."*

The rotations define three rhythms that are in an order of powers: $1/32, 1, 32, 32^2$. The archetype number of rotation (or the circle) is naturally the π . In the spatial structure – as Jung analyzes the dream – number 4 dominates over number 3 of temporality. The rotation itself symbolizes Time, in this manner the spatial and temporal structure of the Dream of World Clock is symbolically isomorphic with the formula of the fine structure constant $\alpha^{-1} = 4\pi^3 + \pi^2 + \pi$.

Namely, the dream can be considered as a central algebraic (system) archetype, and at the same time, as an automorphic mapping of the cardinal number archetype in the symbolic system of the dream.

From the Pauli–Jung letters [27] it is clear that the black bird is supported by the female symbolic figure of *anima*, where anima is suited with number '7'. In this way the black bird (1), the rotating discs and ring (3), and the figure of anima (7) altogether associates to number '137'.

Furthermore, the temporal structure (rotation scale) itself is double 32, and the spatial structure is also evidently $2 \times (32 + 4)$ (the four little men with pendulums – horizontal disc, and four cardinal positions of pointers – vertical disc), that altogether results in $1 + 2 \times 32 + 2 \times 36 = 137$.

The dreams No. 39 and 51 naturally and evidently contained in the structure of World Clock vision (four little men, four colors create an isomorphic map with the four eyes and four colors of the bear). Therefore, the three power-like rhythms with the four space-like quaternion (like a multiplicator) is a natural and evident isomorphic map of the $4\pi^3 + \pi^2 + \pi = 137,036\dots$ Consequently, the structure of the World Clock vision (together with the dreams No. 39 and 51) is a perfect isomorphic structure of the above formula of fine structure constant and its discussed

isomorphic interpretations (if $\pi \sim 4$ or $\pi \sim 2$). Jung often refers to the old familiar saying: *on the Olympus numbers reign*. Following this pattern, we regard the supreme ruler (“controller”) of number archetypes the specific formula introduced for fine-structure constant.

Remark. The interpretation of the four wheels in the Ezekiel vision with the (then usual) 8 spokes can ensure a structure number of ‘32 + 4 + 2’ beside the above ‘256 + 16 + 4’ one. Since the number of the Hebrew word for wheel (which is a fundamental concept in the tradition of Ezekiel vision) 137 (אופן = 137), so the isomorphy with the structure of World Clock vision and the formula $4\pi^3 + \pi^2 + \pi$ can be considered as a complete one. The interpretation of three rhythms and space quaternion also can be easily detected from the structure of the Ezekiel vision. (Other similar historical examples were mentioned in our earlier works [44, 45, 46]). From the point of view of the depth psychology the “numbers” 137 and $4\pi^3 + \pi^2 + \pi$ are the twin number archetypes of the Self (Selbst).

Table 1

The role of fine structure constant in topological and dynamical structure of the hydrogen atom

Combination	Atomic property	Characteristic length (m)
$\alpha^3/4\pi R_\infty$	The classical electron radius, r_e	$2.8179380(70) \times 10^{-15}$
$\alpha^2/2R_\infty$	The Compton wavelength of the electron, λ_e	$2.4263089(40) \times 10^{-12}$
$\alpha/4\pi R_\infty$	The Bohr radius of the hydrogen atom, a_0	$5.2917706(44) \times 10^{-11}$
$1/R_\infty$	The reduced wavelength of hydrogen radiation	$9.11267034(83) \times 10^{-8}$

5 Two Kinds of ‘Observations’

5.1 The Interpretation of the Five Concepts of FSC in Physics

On the vertical axes of the Pauli–Jung quaternion we can see the concept of spatial-temporal continuum and the indestructible energy. The fine structure constant (FSC) appears as a connecting constant, just like in connection with electro photon. Its value can be taken as a wavelength. It plays a vital role in the spatial-temporal structure of the hydrogen atom since it matches to the ratio of the reduced radiation and the *Compton wavelength*. The same ratio is determined between the *Bohr radius* and the elementary radius of the electron. The hydrogen atom gives the measure of the component of the relativistic energy during the energy emission and can easily be measured from the spectrum of the hydrogen atom by well-known spectroscopic measurements. These two determination conceptions stand in a complementary relation to each other. The horizontal axes illustrate the contingent (synchronistic) and causal concept of FSC.

EDDINGTON's model already mentioned matches the causal descriptive mode in which the four variables of the spatial temporal continuum gives 16 equations where the number of the independent variables arranged in a matrix is $137 = (16^2 - 16)/2 + 16 + 1$. This approach seems to be synchronistic from the perspective of classical physics while it seems causal in character from the perspective of modern quantum physics. As appose to the real physical phenomena of the previous axis it is obvious that we do not have concepts emerging from immediate experience but an intuitively appealing mathematical (or meta-mathematical) interpretation leading out from physics. Although it starts out from physical thought, the result – properly speaking – is not physical, but it is the concept of a background language. This solution is near to Pauli's mental world since he often makes references to the problem of FSC and his explanation lies outside quantum physics. Pauli applies the same line of thought to the Einsteinien criticism against the quantum theory. According to him these lifelike questions are outside physics (*In Sinne des Lebens betrachtet*), or, in other words, these questions can be interpreted and approached in a wider framework.

We have suggested the $4\pi^3 + \pi^2 + \pi$ formula to the concept of FSC. This fulfills the claim of maximal simplicity, and also it ensures the value exactly matching the measurements. Simplicity is fulfilled by the four integer and the π appearing in the equation in the simplest way. The connection opens the possibility of interpretations on the basis of approaching the circle by quadrates and so it gives the expressions $256 + 16 + 4$, and $32 + 4 + 2$. The former also reflects the Eddington approach.

This way the determination of FSC of the horizontal axis is complementary too, but also mutually containing. In a similar way the contingency approach and the causal approach are complementary. Obviously this connection also leads out from physics although the measured values within the error limit and is derived from the π and it can be interpreted only in the wider conceptual framework called life realization by Pauli. We put into the centre unifying concept in contrast to the Pauli–Jung idea. Jung did the same in the case of the four orientation function, where the unifying transcendent function is in the centre. In our case the central concept is the controlling of the world and the concept unifies the information cosmos and the controlling world. With regard to FSC the central concept is intimately connected to '137' as it appears in the Dirac hypothesis and his calculation according to which the electron trajectories are stable up to the nucleus containing maximum 137 protons. (As we could see '137' is seen as the structure number of mathematical controlling systems.) Thus we could get to the unique number '137' in five different ways.

Remark: From the point of view of the depth psychology the number '137' is the number archetype of Self (Selbst).

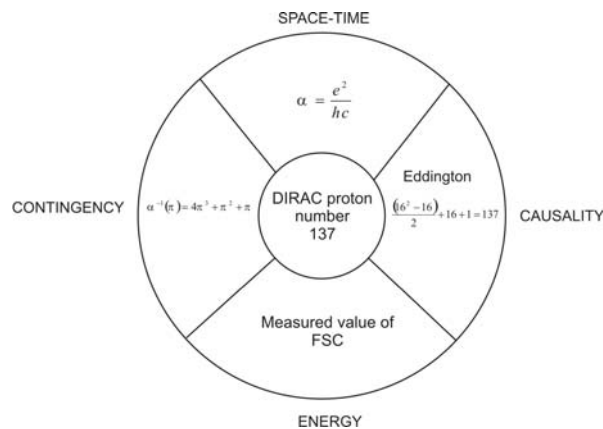


Figure 7

“Optical versions” of the interpretation of the fine structure constant

5.2 The Interpretation of the Five Concepts of FSC in the World Clock Dream

The contingency interpretation of FSC appears with the three temporal rhythms and the spatial quaternion in the dream. This interpretation is not ad hoc, since Jung gave the same summary about the dream. The rotation consisting in a power-like 32 rhythm metric corresponds to the triple: π , π quadrature, π cube. The rotation whose basic rhythm has length π and whose shape is a *sin* or *cos* time function matches well to the elements of formula (1). The semi-wave with length π is information without redundancy.

That is the rhythm of rotation is isomorphic with π , and the operation of rising to power is isomorphic with the mutual embedding of the three rhythms. The spatial quaternion is connected to the three rhythms of time. Thus this connection is isomorphic with the multiplication of four and the π . These considerations are supported by Pauli’s later dreams showing oscillation (vibration) curves [27]. The dream interpretation of causal FSC can be arrived at by taking the four small men with pendulum and the four spatial directions changing permanently with temporal rotation. In this case we get a 16 by 16 system on the basis of the symbolic interpretation of the spatial temporal quaternion, which is isomorphic with the Eddington model concerning the identification of the number of independent variables.

We can derive the permanent symbolic equivalent of the FSC determined by spectroscopic measurements from the dream of bears having four eyes in four colors. In this description the four (basic) colors randomly alternate with the four eyes making a “stochastic process”, whose (virtual) spectrum is the symbolic equivalent of the color spectrum. As we have seen, the order with a $256 + 16 + 4$ struc-

ture also leads to the number '137', as to the number of its independent variables. The dynamic picture of the colored bear with four eyes is isomorphic with the four different little men and the four colors. Since Pauli's dream succeeds Eddington's model with two years it can, at best be called cryptomnesic symbolization.

The spatial-temporal symbolic interpretation of FSC can be understood with quadrate of '32'. Namely, '32' in the contingency formula of FSC symbolize '137'. Thus it matches to the ratio of the Compton wavelength and the reduced radiation wavelength of the hydrogen atom. In the spatial interpretation the same applies to the ratio of the elementary radius of the electron and the Bohr radius. Thus the World Clock dream can be considered as a symbolic isomorphic representation of the spatial temporal structure of the hydrogen atom. Here again we have '137' in the centre whose spatial structure 2×36 and temporal structure 2×32 plus the unique entity (the black bird), altogether give 137.

According to Jung's concise interpretation of World Clock dream:

"Thus circle and quaternity on the one side and the threefold rhythm on the other side interpenetrate each other so that the one is also contained in the other." [13, p. 88]

Remark: The relationship between the two observations can be explained with the help of the $4\pi^3 + \pi^2 + \pi$ formula. Number '137' is not entirely sufficient in itself, since it does not directly explain the value of the physical measurements. The $4\pi^3 + \pi^2 + \pi$ formula is a productive concept, being reliable guide to leading out the interpreter from physics and directing him to the hermeneutics of Pauli's life "realization". Meanwhile it gives an obvious explanation of the three physical interpretations. It also reflects the Eddington model and shows its legitimacy. Similarly, it leads to the control theoretical interpretation which is central importance. The discovery, rather than the construction of the system and control theoretic approach is the discovery in a Popperian sense of the laws of nature just like the laws of physics are discovered by the physicists. As the quotations demonstrated Pauli has come very near to recognizing the significance of the information ordering principals. He was explicit about it, but there were not available modern mathematical and control theoretic "operators" to support his point. As we have mentioned Jung talks about self-regulating psyche from the 10s, and conceives the archetypes, together with Pauli, as an ordering and regulating system (entities).

There arises the question whether we are entitled to establish a connection between these two different observations. The epistemology of our enterprise cannot be easily settled. Either we can appeal to analogies and afford analogical explanation; the retort could be that it is a mere contingency that we have the associations which are not upheld by the objective underlying phenomena. In this case we can defend our approach by its satisfying the minimum constraint of coherency, albeit we are fully conscious of the possibility of alternative coherent explanations. Or, the unification has an objective character; in this case we can appeal to the so-called inference to the best explanation (IBE) which justifies us to accept a theory

provided it yields the best possible explanation of the phenomena (Harman, *The Thought*, 1960). Thus, our formula and interpretation satisfies either the less ambitious criterion of coherency, or, the more ambitious one of inference to the best Explanation.

Remark. The relevance of the two observations is this: In the first case we are related to the detached observer, in the sense of Pauli, in the second case we are related to the undetached observer and his experiences concerning the synchronicities. In the latter the “validity condition” depends upon the density and quality of the appropriate synchronistic events.

Remark. The synchronistic feature of the dream and the four plus one scheme interpretation is unambiguously shown by the fact that in the *Collected Works* of Jung (Psychology and Alchemy) the number of the footnote referring to the dream is astonishingly ‘137’.

The spontaneous feeling of Pauli about of supreme harmony after the dream and Jung’s reflections to it together with the number ‘137’ of the footnote constitute reliable basis to the serious consideration of our analysis. Not to speak of the frivolous fact that Pauli died, as it is familiar in the room ‘137’ of the Red Cross Hospital of Zurich.

Here we can assume also a unifying fifth meta-language based on number archetype, and geometric and algebraic system theories. Jung often refers to the old familiar saying: “*in the Olympus numbers reign*”. Following this pattern, we regard the supreme ruler of number archetypes the specific formula introduced for fine-structure constant.

6 First Manifestations of Pauli’s Preoccupation

Coming back to the original thought, already in his school years, Pauli was fascinated by RYDBERG’s famous Formulae about the length of the periods in the periodical system of elements. In his famous book *Atombau und Spektrallinien* [40], Sommerfeld called this ‘two-p-square’ equation a Cabbalistic formula. This is exactly the book which has the atomic model structure identifiable from the measured spectral lines in its focus. Further the introduction of the fine structure constant and the emphasizing of its central importance in the construction of the atomic structure. This means that the purely synchronistic coherence of the word Cabbala⁹, cabbalistic sequence of numbers, and the number ‘137’ appear in the book at simultaneously. All these fascinated Pauli reading and listening to Sommerfeld. As Pauli said in a lecture appreciating Rydberg [33]:

⁹ The Hebrew letters of ‘Kabbalah’ sums up to 137.

"After the lecture of Professor Bohr I only briefly mention Rydberg's idea of a relation between the parity of multiplicity of spectral lines and the parity of the chemical valence. If the one is even the other is odd and vice versa. However, Rydberg was not sure of this idea being unable to give a general proof of it. The reason for it was first that the order and the resolution of more complicated spectra (as for instance copper) was not sufficiently advanced at that time to determine correctly this multiplicity. Secondly the difference between spark spectra and arc spectra made complications, as it was not known at that time that the first are emitted by ions. Only much later it became clear that the rule holds without exception if the chemical valence is replaced by the number of electrons in the emitting atom. This exact rule of alternation (»Wechselsatz«) was called after Rydberg by Sommerfeld."

The Rydberg formula is explained in detail later in the same text [33]:

"A further progress in the order of the periodic system was made by Rydberg in his paper »Elektron, der erste Grundstoff« of 1906. Here (p. 11) he said for the first time that the 3 numbers 2, 8, 18 for the periods in the system of the elements are represented by $2 \cdot 1^2$, $2 \cdot 2^2$, $2 \cdot 3^2$. There was still some uncertainty about the number of the rare earths, which Rydberg assumed to be 36 instead of 32. His atomic numbers were still too high but not as high as in his earlier papers.

In a big paper »Untersuchungen über das System der Grundstoffe« of 1913 he goes one step further. After the quotation of the earlier formulas $2 = 2 \cdot 1^2$, $8 = 2 \cdot 2^2$ and $18 = 2 \cdot 3^2$ he goes on (§3): »the continuation would be $2 \cdot 4^2 = 32$, $2 \cdot 5^2 = 50$ etc.« This is the famous formula $2 \cdot p^2$ (p integer) which Sommerfeld called »cabbalistic« in his book »Atombau und Spectrallinien« and which impressed me very much as student. Definitely he says now about »the group G4« ($p = 4$, rare earths) that it consists of 32, not of 36 elements."

The formula yields to numbers 2, 8, 18, 32, 50, 72, 98, 128, ..., and Rydberg dealt especially with 32 of them. The even numbers 8, 32, 72, and 128 have a particular connection, and indeed, play a central role in the number system of Cabbala. We remark that 8, 128 and the unity sums up to 137, moreover, 32 and 72 sums up to 104, and these two numbers play important role in *Bahir* ("Book of the Brightness"). Here 72 is the number of *Tamar* (cf. Exodus 15:27) who bore the Messiah twins *Zarah* and *Pharez* (Genesis 38:29–30) – they can be suited to paired spectral lines, the so-called *doublets* which appeared frequently in Pauli's dreams.

It is also interesting to mention in connection with Rydberg that he expected the period-length to be 36 instead of 32. Therefore, the curious young Pauli became very early acquainted with the ambivalence, and at the same time with the identity of 32 and 36 (this is perceptible e.g. in the dream of World Clock).

The ambivalence of pair 32–36 together with unity is always a reference to '137', forasmuch, according to Pauli: *"The initial stage is a dyadic archetype whose proton corresponds to the same one and whose electron correspond to the other one. Through reflection of the unconscious a quaternity is produced."* [27]

Numbers 36 and 32 play decisive role in Bahir, namely, the 36 *Dekan* (the 36 hidden men) walk on the 32 ways of Wisdom. This is in Hebrew written as 'LVLB' and pronounced as 'Lulav' (לולב = $36 - 32$) that is the shoot on the Date Palm 'Tamar'. Therefore we get again a reference to Tamar, to the twins, or to the doublets that were primordial – as Pauli himself stated in his Nobel Lecture [30] – in the formulation of the *Exclusion Principle*.

At the same time, in the introductory part of the Lecture he reported that the first impulse for his research work was given by Sommerfeld, who explained the structure of atoms using Rydberg's Formula and the numbers 2, 8, 18, and 32 (the natural period lengths of chemical elements). However, Sommerfeld emphasized number 8 among the former, and used the geometry of the *cube* to demonstrate it. With Pauli's own words:

"Sommerfeld to the structure of the atom – somewhat strange from the point of view of classical physics. I was not shared the shock which every physicist, accustomed to the classical way of thinking, experienced when he came to know of Bohr's 'Basic postulate of quantum theory' for the first time. At that time there were two approaches to the difficult problems connected with the quantum of action. One was an effort to bring abstract order to the new ideas by looking for a key to translate classical mechanics and electrodynamics into quantum language which would form a logical generalization of these. This was the direction which was taken by Bohr's Correspondence Principle. Sommerfeld, however, preferred, in view of the difficulties which blocked the use of the concepts of kinematical models, a direct interpretation as independent of models as possible, of the laws of spectra in terms of integral system, an inner feeling for harmony. Both methods, which did not appear to me irreconcilable, influenced me. The series of whole numbers 2, 8, 18, 32... giving the lengths of the periods in the natural system of chemical elements, was zealously discussed in Munich, including the remark of the if 'n' takes on all integer values. Sommerfeld tried especially to connect the number 8 and the number corners of a cube."

It is interesting, that the other inspiring lecture that led Pauli to the Exclusion Principle was given by Niels BOHR, and also was connected with the period-length of the periodic system. However, Bohr emphasized number 2 instead of number 8.

"A new phase of my scientific life began when I met Niels Bohr personally for the first time. This was in 1922, when he gave a series of guest lectures at Göttingen, in which reported on his theoretical investigations on the periodic system of elements. I shall recall only briefly that the essential progress spherical symmetric atomic model. [...]"

It made a strong impression on me that Bohr at that time and in later discussions was looking for a general explanation which should hold for the closing of every electron shell and in which, the number 2 was considered to be as essential as 8 in contrast to Sommerfeld's approach." [30]

Thus, the starting points of the Nobel Lecture were the interpretation of Sommerfeld and the cabbalistic numbers of Rydberg, and logically, the closing statements were emphasizing the significance of fine structure constant itself.

“From the view of logic my report on ‘Exclusion principle and quantum mechanics’ has no conclusion. I believe that it will only be possible to write the conclusion if a theory will be established which will determine the value of the fine structure constant and will thus explain the atomistic of electric fields actually occurring in nature.” [30]

In the preceding paragraphs we have shown that the properly given and explained formulae of fine structure constant ‘137’ (see Eq. 1) can lead far beyond physics in the narrow sense. Therefore the young (19–20 years old) Pauli – without any previous knowledge (!) – was enormously effected by Cabbala, especially by the *number archetypes* of the proto-cabbalistic Bahir. These synchronicities concerning number ‘137’ were in close correlation with his conscious physical aims. (This is certified also by his dreams relating to Sommerfeld.)

These associations does not decrease the spontaneous character of Pauli’s dreams that are analyzed by Jung in *Psychologie und Alchemy* [14], moreover, they emphasize the presence of a strong synchronistic influence –a prematurely constellated archetype using the common term of Pauli and Jung.

Therefore, both at the beginning and at the termination¹⁰ of Pauli’s career there emerging the Cabbala, the Jewish traditions, and the number ‘137’. *“According Quispel, Pauli, searching for a meaning to his life while confronting his death, came to reassert his Jewish tradition.” [27]*

7 Understanding Synchronicity

(1) The Dream of World Clock in the final (both English and German) version of Jung’s *Collected Works* [15] is associated with a footnote numbered by ‘137’. This is a replacement of *asterisk* (character ‘*’, in Latin ‘asteriscus’), which – beyond emphasizing some meaning – symbolically denotes the crown. (Both the celestial star as a physical body, the linguistic symbol, the liturgical object of Eucharist, and the Holy Crown of Hungary are equally corresponding to the asterisk.)

¹⁰ The “final meeting” of Pauli with the number ‘137’ can be considered as an astonishing “subjective case” and example of synchronicity. “It was a mystery how Pauli was taken to his death, for on being carried into hospital, the physicist was told that he would be put into room 137. According to one version of story, learning his room number, Pauli said: ‘I will never get out of here’, and it happened so really (he died shortly after)” [36].

The content of footnote No. 137 is about augmentation, and the expanded version can be found in Jung's book *Psychology and Religion* [13]. Therefore the opus of *alchemy* expands, and – through religion – is connected naturally to the meaning of *redemption* and *eternal life*.

(2) The death of Pauli in the room No. 137 of Red Cross's Hospital in Zurich represents the same idea: number '137' mediates between physical existence, the psychic experience of death and resurrection, and spiritual eternity.

(3) Jung commenting the Dream of World Clock two times mentions that the dream has a possibly *cabbalist* character, besides its obvious connections with alchemy. Then in *Psychology and Alchemy* [14] there are numerous examples from (mostly Christian) cabbalist writings.

On the other hand, Jung emphasizes that the dreamer (Pauli) has a highly biased intellectual modality, and does not possess any (deeper) knowledge of mythology, mystics, or religions. It is important for Jung to emphasize the spontaneous formation of those dreams that are connected to alchemic and cabbalist motifs.

However, as it was demonstrated earlier in this paper, the *number archetype* had a decisive effect on Pauli in his student years, and exactly, in connection with the co-occurrence of word 'Cabbala' and number '137'.

Moreover, the well-known conversation¹¹ between Victor WEISSKOPF, a leading physicist and a former assistant of Pauli and Gershom SCHOLEM, one of the most eminent scholars of Jewish mysticism is also clearly imply the direct connection between number '137' and Cabbala. It is also an interesting synchronicity that after World War II Jung was the one who invited Scholem from his Palestinian isolation to the *Eranos Lectures*, and therefore introduced him into the European scientific community. Pauli wrote in a letter to Scholem the following:

"I read your book »Major Trends in Jewish Mysticism« already several years ago, and since then I have taken the opportunity to cite it, especially concerning the ideas of Isaac Luria, in my paper on Kepler (see »Naturerklärungen in Psyche« especially p. 149 – Rascher Verlag, Zurich 1952).

As you can see from this work, among others, I sit on the ground between the two stools of Orthodoxy and rationalism, but stronger still, I consider this to be the only fair and rational position. I find that the Rationalist authors, (and should not be surprised if I was attacked by this group because of my Kepler paper), also misunderstand the mental processes totally, because, in part they judge everything from the point of view of pure psychology consciousness and partly they hold on to

¹¹ When Scholem met Weisskopf, he asked about the prominent unsolved problems in physics. Weisskopf said, "Well, there's this number, 137..." And Scholem's eyes lit up! He said, "Did you know that one hundred thirty-seven is the number associated with the Cabala?" [21] (We want to clarify that this means that the *Hebrew letters of 'Kabbalah' sums up to 137.*)

a world view which has been superseded by modern physics long ago – on the other hand, I think that I am sensitive to where a psychological mental phenomenon begins for the Orthodox, which I would call »waverings«. (It seems that in Jewish and Christian orthodoxy, this is not essentially different.) I think I also detect this wavering in Luria quite clearly (see the cited passage in my article). Also, I have some doubts whether Jewish mysticism is really fundamentally different from the non-Jewish, – I am interested in mysticism in general."

Semantic quaternio is determined by the connection of the four persons Jung, Scholem, Pauli and Weisskopf who know well each other. One can often meet such semantic quaternion with the dream interpretation of Pauli and Jung (for example Pauli, Bohr, Einstein and Jung).

(4) An interesting synchronistic phenomenon (properly a precognition) happened in October 1949. In his important dream we can read: *"I am with colleagues on one of the upper floors of a house where a local conference on mathematics and physics is being held. I see that under my name a course of cookery is announced: 'Start: December 15.' Surprised, I ask a young man near me why the course begins so late in the year. He answers: 'Because the Nobel prize will be granted.' Now I notice that a fire has started in the adjacent room."* Without any detailed interpretation of the dream we all can feel the deep dark atmosphere of the precognition for the death of dreamer on 15th December, cf. [41]. (The Nobel Lecture in English was delivered at Stockholm, on December 13, 1946.)

It is part of the synchronicity of the dream from 1949 that the sum of the preindicated date in dream (15/12/1949) is '32', just like the sum of the numbers in the date of Pauli's death (15/12/1958). It is interesting that the opposition day of 15th of December is 16th of June to a large extent (according to $182 + 5/8$ calculation). These two days make a contrary just like the twins *Castor* and *Pollux*, or the day and the night, or *Olympus* and *Hades*, the past and the future etc. These two twin points of time referred to '32' and '36' in the years of 1949 and 1958, respectively. Taking twice 32 and 36 extending with the unique entity we obtain 137. The background physical conception of *Castor* and *Pollux*¹² explained by Pauli is revealed to his letter to Jung dated 23/10/1956. Bear in mind that 16/06/1958 is the day of the execution of the Hungarian Prime Minister Imre NAGY, while the former date is the date of the outburst of the Hungarian revolution. Synchronicity is supported further by Pauli's letter to Jung dated 16/06/1936 where the sum of

¹² It is almost certain that Pauli did not know the next original version (or its translation) from *Nostradamus* concerning the "fate of Hungary". It seems to be an astonishing example for the conjunction (the most important purpose of Pauli's intellectual and spiritual endeavour) of the precognition and retrocognition in the synchronistical phenomena.

"Par vie et mort changé regne d'Ongrie La loy fera plus aspre que feruice En grand cité urlemens plains et crys Castor et Polux ennemis dans la lyce." (Nostradamus, Centuries, II. 90.)

the numbers in the date gives 32. In this letter he deals with the very important dream on 'Ace Club' and the card '7' (it is the 16th initial dream in Jung's *Psychology and Alchemy*).

Pauli's letter to Jung dated 16/06/1948 is also worth mentioning because a so called "Pauli effect" took place during the foundation ceremony of the Jung Institute. Synchronicity and Hungarian references are demonstrated in the last (13th) dream written to Jung in 23/10/1956. Pauli has dreamed that on the day of St. Stephen (26/12/1955) a king visited him, a great authority who praises him for the ability to see the important phenomena of the world in a "twin-like" manner. St. Stephens's day, the king and the mirror symmetry, together with October 23, 1956 make the strong Hungarian reference highly probable. The fundamental Hungarian references of *Bloomsday* (June 16 in the Ulysses of James JOYCE) are familiar just to refer to Bloom's coronation with the crown of St. Stephen of Hungary in the 15th Chapter. The Hungarian references of number '137' has been mentioned in our previous paper [44].

8 New Ways of Cognition

In a late work in 1957 Jung supposed that the era traditional art closed because the modern art completely diverged from the archetypal source of the great art.

"The pleasingness of the artistic product is replaced by chill abstractions of the most subjective nature which brusquely slam the door on the naive and romantic delight in the senses and on the obligatory love for the object. This tells us, in plain and universal language, that the prophetic spirit of art has turned away from the old object-relationship towards the -for the time being -dark chaos of subjectivisms. Certainly art, so far as we can judge of it, has not yet discovered in this darkness what it is that could hold all men together and give expression to their psychic wholeness. Since reflection seems to be needed for this purpose, it may be that such discoveries are reserved for other fields of endeavour.

Great art till now has always derived its fruitfulness from myth, from the unconscious process of symbolization which continues through the ages and, as the primordial manifestation of the human spirit, will continue to be the root of all creation in the future. The development of modern art with its seemingly nihilistic trend towards disintegration must be understood as the symptom and symbol of a mood of universal destruction and renewal that has set its mark on our age." [16].

Similarly, 1956 Pauli had the same impression on the contemporary philosophy:

"For my impression is that the philosophy of the contemporary philosopher specialist is not really produced with and for the intellect but comes across as a complex and involved emotional attitude [...] I regard it is a regression into the undifferentiated." [27]

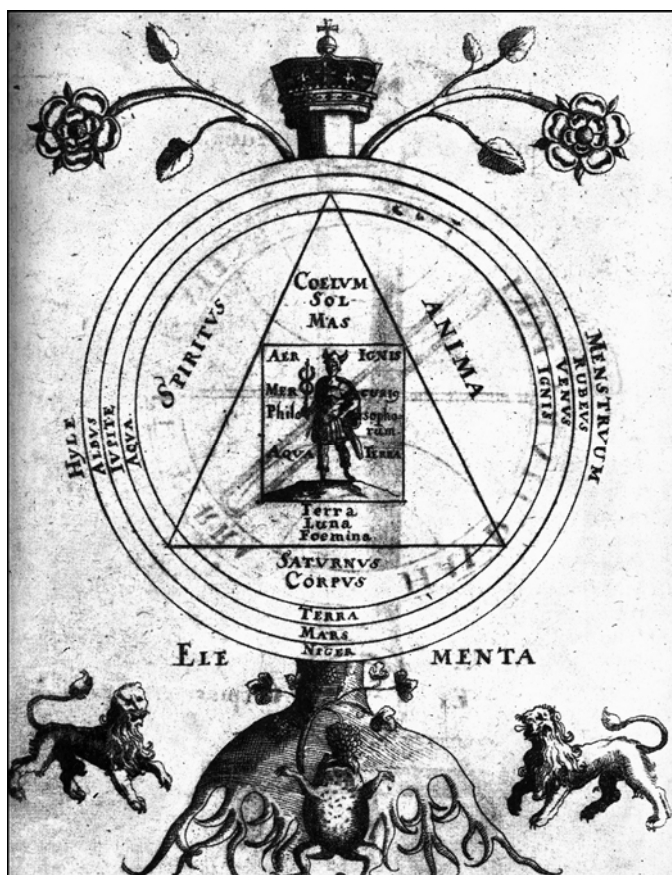


Figure 7

Symbol of Hermetic transformation: the *homo philosophicus* Mercurius (Samuel Norton, *Mercurius redivivus*, 1630)

Without concerning the truth of their judgments the question arises for us what the substitutive and constructive new endeavors are, which have the attribute of reflection. Beside his correspondence with Jung, Fierz and von Franz, Pauli introduces the idea of *background processes* in his famous Kepler studies in a joint book with Jung (*Naturerklärung und Psyche* [19]). The essence of this idea for the alchemists is that the creative (partly cognitive, partly emotional) background processes together with the structure of magico-animistic knowledge form the entirely pattern of the science.

“Furthermore, my feeling is that the purely psychological interpretation only apprehends half of the matter. The other half is the revealing of the archetypal basis of the terms actually applied in modern physics. What the final method of observation must see in the production of ‘background physics’ [Hintergrundphysik]

through the unconscious of modern man is a directing of objective toward a future description of nature that uniformly comprises physics and psyche, a from of description that at the moment we are experiencing only in a pre-scientific phase. To achieve such a uniform description of nature, it appears to be essential to have recourse to the archetypal background of the scientific terms and concepts.” [27]

It was shown by him that this cognitive and emotional character of the background processes was observable in the main work of Kepler creating really new forms of scientific thinking. At the end of his study Pauli emphasizes the significance of this feature of the scientific creation. *“Just because in our times the possibility of such symbolism has become an alien idea, it may be considered especially interesting to examine another age to which the concepts of what is now called classical scientific mechanics were foreign but which permits us to prove the existence of a symbol that had, simultaneously, a religious and a scientific function.” [35]*

In our times the background processes are also associated with the development of scientific knowledge, causing a decisive influence on them. However, from the 18th Century the above background processes cannot be observed directly, i.e. confined to the unconsciousness. In his correspondence Pauli also deals with these problems hoping that in the future a new kind of the cognition will demand both the scientific approaches and symbolic nature of the so called creative background processes. This could be a precognition of a new form of knowledge when the subject of the creative cognition is a scientific mediator and medium at the same time who is confronted with the directions and autonomy of the creative background processes. Furthermore as a scholar applying the prospective productive form and efficient methods of a future artificial intelligence can survey, and then analyze the possible largest fields of the contemporary human knowledge. Supposedly, he will also relate to the above factual knowledge with the symbolic potential of unconsciousness using the direction and dynamics of the creative background processes.

Therefore, in Karl Popper’s so-called *First World* the acting scholar mediator/medium perceives intuitively the actual unconscious patterns of the extended *Second World*; at the same time, applies the methods of the artificial intelligence. Thus, he will be able to achieve the suitable data and appropriate pattern of the knowledge of the *Third World* [37]. The conscious intellect of the new scholar can be obtained help from the future artificial intelligence. Similarly his ‘mediumship’ of the new scholar artist (Cabbalo-Alchemistic artist) can gain a today still unknown support from the unconscious background processes. Naturally, it is true only in case of active cooperation of unconsciousness (‘deo concendente’). In the case of Pauli whom can be considered as a prototype of this new scholar-artist (with his intellect and mediumship) the artificial intelligence was replaced by the extended knowledge of the professors of his ‘loved Polytechnic’ (ETH) together with the professor of University of Zurich.

"What is particularly praiseworthy is the caution with which Pauli applies Jung's 'amplification method'. One cannot help admiring his courage, honesty, and attention to detail. When it came to work of this nature, Pauli was in a very fortunate position in Zurich, for at the university and the ETH he could call on a number of highly qualified advisers from all branches of science. This was a major factor in Pauli feeling so much at home there; he loved 'his Polytechnic' dearly and was happy to return after the war." [27]

The amplifying application of the potential knowledge of the unconsciousness could be realized by the hypothetical principles of spiritualistic communication according to the ideas William JAMES, James HYSLOP and others (see the concept of physical and psychical 'fields' of W. James). The best example/allusion for the possible future development is Pauli himself who could make a strong influence unconsciously under physical measurement equipments. This is so-called *Pauli-effect* that is not a legend, but a pure fact, the relatively frequently occurred events. At the same time this is a good example for wholeness, and for at least a close relationship between the psychical and physical processes. Because even the split of conscious-unconscious psychic state of Pauli which 'destroys synchronistically' the laboratory measurement systems. In the future these phenomena could be an allusion for the artificial amplification of the psychical and physical relationship. Thus, the symmetry structure of the three worlds and their interfaces could be considered as a complete one at least according to our disputable speculations.

Conclusions

Let us finish with the words of Professor Charles Enz [35]:

"An important detail in this thinking about duality is the meaning of the numerical value of the electric charge which in the form of Sommerfeld's fine-structure constant is approximately $1/137$. Pauli repeatedly stressed that progress in quantum field theory was linked to an understanding of this number [...]. But the number 137 also had an irrational, magic meaning for Pauli; it was the room number 137 in the Red Cross Hospital in Zurich where he died on 15 December 1958 [...]"

The enigmatic conjecture »that the observer in present-day physics is still too completely detached« also has a meaning beyond physics. Indeed, in his article for Jung's 80th birthday [...], Pauli compares the observational situation in physics with that in psychology: »Since the unconscious is not quantitatively measurable, and therefore not capable of mathematical description and since every extension of consciousness ('bringing into consciousness') must be reaction alter the unconscious, we may expect a 'problem of observation' in relation to the unconscious, which, while it present analogies with that in atomic physics, nevertheless involves considerably greater difficulties.«

For Pauli this analogy had implications in both directions: On the one hand, in the concluding remarks of the birthday article for Jung [...] he expresses the expectation that in the future the idea of the unconscious should emerge from the

purely therapeutical realm and become more a problem of objective research. On the other hand, he thought that in physics the remedy for the too complete detachment of the observer may lie in the integration of the subjective, psychic. Indeed, in Science and Western Thought [...] Pauli asks the question: »Shall we be able to realize, on a higher plane, alchemy's old dream of psycho-physical unity, by the creation of a unified conceptual foundation for the scientific comprehension of the physical as well as the psychical?«

This quest for a unity of physics and psyche is a recurrent theme in the exchange between Pauli and Jung and is the main concern in Pauli's Background Physics in which he was guided by his dream motives (Hintergrundphysik [...])."

References

- [1] A. Ádám, L. Jánossy, P. Varga, *Acta Phys. Hung.*, Vol. 4, p. 301, 1955
- [2] C. Anderson, "The Positive Electron," *Phys. Rev.*, Vol. 43, p. 491, 1933
- [3] A. Antoulas, Ed., *Influence of R. Kalman et al., Mathematical System Theory*. Springer Verlag, 1991
- [4] A. Aspect, J. Dalibard, G. Roger, "Experimental Test of Bell's Inequalities Using Time-Varying Analyzers," *Phys. Rev. Lett.*, Vol. 49, No. 25, p. 1804, 1982
- [5] W. Barker, F. Glover, "Reduction of Relativistic Two-Particle Wave Equations to Approximate Forms," *Phys. Rev.*, Vol. 99, No. 1, pp. 317-324, 1955
- [6] J. Bokor, L. Keviczky, *Topics in Stochastic Systems: Modelling, Estimation and Adaptive Control*, ser. Lecture Notes in Control and Information Sciences Series 161, Springer Verlag, 1991, ch. Parametrizations of Linear Stochastic Systems, pp. 47-65
- [7] J. Bokor, L. Nádai, "Controllability of Quantum Bits – from the von Neumann Architecture to Quantum Computing," in *3rd Intl. Conference on Computational Intelligence and Intelligent Informatics*, Agadir, Morocco, March 28-30 2007, on CD-ROM
- [8] J. Dan, "Three Types of Ancient Jewish Mysticism," in *7th Rabbi Feinberg Memorial Lec. in Judaic Studies*, University of Cincinnati, 1984
- [9] R. Kalman et al., *Mathematical System Theory*. Springer Verlag, 1971, ch. On Invariants, Canonical Forms, Moduli for Linear Constant Final Dimensional Dynamical Systems
- [10] H. Grotch, D. Yennie, "Effective Potential Model for Calculating Nuclear Corrections to the Energy Levels of Hydrogen," *Rev. Mod. Phys.*, Vol. 41, No. 2, pp. 350-374, 1969
- [11] I. Hargittai, Ed., *International Conferences on Symmetry Research*, Vols. 1-2, SpringerVerlag, 1987-89

- [12] I. Joó, P. Várlaki, "Stabilization of Dirac Expansions by Riesz and Other Means," *Annales Univ. Sci. Budapest*, Vol. 39, pp.113-123, 1996
- [13] C. Jung, *Psychology and Religion*, ser. Terry Lectures. Yale University Press, 1938
- [14] —, *Psychologie und Alchemy*. Olten: Walter Verlag, 1972
- [15] —, *Collected Works*, ser. Bolingen. Princeton University Press, 1973, Vols. 8, 9, 11, 12, 14
- [16] —, *Collected Works*. Princeton University Press, 1973, Vol. 10. Civilization in Transition, ch. The Undiscovered Self (Present and Future)
- [17] —, *Synchronicity*, ser. Bolingen. Princeton University Press, 1973
- [18] —, *Geheimnisvolles am Horizont : von Ufos und Ausserirdischen*. Olten: Walter Verlag, 1992
- [19] C. Jung, W. Pauli, *Natureerklärung und Psyche*. Zürich: Rascher Verlag, 1952, in English *The Interpretation of Nature and the Psyche*, New York, 1955
- [20] R. Kalman, P. Falb, M. Arbib, *Topics in Mathematical System Theory*. McGraw-Hill, 1969
- [21] E. Klopfer, T. Raj, *The Number 137*, Budapest: Makkabi, 2006, in Hungarian
- [22] A. Koestler, *The Roots of Coincidence*. New York: Random House
- [23] D. Lindorff, *Pauli and Jung: The Meeting of Two Great Minds*. Quest Books, 2004
- [24] A. Lindquist, G. Picci, "On the Stochastic Realization Problem," *SIAM J. Control and Optimization*, Vol. 17, pp. 361-389, 1979
- [25] M. Maimonides, *The Guide of the Perplexed*. Chicago and London: The University of Chicago Press, 1963
- [26] G. Marx, *Quantum-Electrodynamics*. Budapest: Tankönyvkiadó, 1972, in Hungarian
- [27] C. Meier, Ed., *Atom and Archetype: The Pauli/Jung Letters, 1932-1958*. London: Routledge, 2002
- [28] G. Michaletzky, J. Bokor, P. Várlaki, *Representability of Stochastic Systems*. Budapest, Hungary: Akadémiai Kiadó, 1998
- [29] W. Pauli, "Space, Time and Causality in Modern Physics," *Scientia*, Vol. 59, pp. 65-76, 1936, expanded version of a lecture to the Philosophical Society in Zurich in November 1934
- [30] —, "Exclusion Principle and Quantum Mechanics," Nobel Lecture in English, delivered at Stockholm, December 13 1946

- [31] —, “Sommerfeld’s Contributions to Quantum Theory,” *Die Naturwissenschaften*, Vol. 35, p. 129, 1948, dedicated to A. Sommerfeld on his 80th birthday on 5th December, 1948
- [32] —, “Einstein’s Contribution to Quantum Theory,” in *Albert Einstein: Philosopher Scientist. The Library of Living Philosophers*, P. Schilpp, Ed. Evanston, 1949, Vol. 7, pp. 149-160
- [33] —, “Rydberg and the Periodic System of Elements,” in *Rydberg Centennial Conference on Atomic Spectroscopy*, Vol. 50, No. 21. Lund, Sweden: Universitetes Årsskrift, 1954
- [34] —, “Phenomenon and Physical Reality,” *Dialectica*, Vol. 11, pp. 35-48, March 15 1957, introduction to a Symposium on the occasion of the International Congress of Philosophers in Zürich, 1954
- [35] W. Pauli, (Eds. C. Enz, K. V. Meyenn), *Writings on Physics and Philosophy*. Springer, 1994
- [36] D. Peat, *Synchronicity: A Bridge Between Matter and Mind*. Toronto, New York: Bantam Books, 1987
- [37] K. Popper, J. Eccles, *The Self and its Brain. An Argument for Interactionism*. London, New York: Routledge and Kegan Paul, 1986
- [38] Committee on Data for Science and Technology, <http://www.codata.org/>
- [39] P. Ricoeur, “Structure et herméneutique,” in *Le Conflit des Interprétations*. Seuil, 1969, pp. 31-63
- [40] A. Sommerfeld, *Atombau und Spektrallinien*. Braunschweig: Friedrich Vieweg und Sohn, 1919, in English see *Atomic Structure and Spectral Lines*, translated from the third German edition by H. L. Brose, Methuen, 1923
- [41] H. van Erkelens, “Wolfgang Pauli’s dialog with the spirit of matter,” *Psychological Perspectives*, Vol. 24, pp. 34-53, 1991
- [42] P. Várlaki, J. Bokor, “Cognitive Symmetry-Structures in Stochastic Control Theory and Early Quantum Physics,” in *MAKOG I. – Cognitive Systems*, Visegrád, Hungary, 1993, in Hungarian
- [43] —, “On Synchronistic Random System’s Theory: Cognitive Symmetry-Structures, Natural and Geometric Structure-Numbers in Stochastic Control and Quantumphysics,” MTA SZTAKI–BME,” *Research Report*, 1993
- [44] P. Várlaki, J. Bokor, L. Náday, “Historical Background and Coincidences of Kalman System Realization Theory,” in *5th IEEE Int. Conference on Computational Cybernetics*, Gammarth, Tunisia, 2007, on CD-ROM
- [45] P. Várlaki, L. Kóczy, “A Comparative Study of Pictures From Pala d’oro in St. Mark Cathedral of Venice and from the Holy Crown of Hungary,” in

Intl. Conference on Genealogy and Heraldry, Nagykanizsa, Hungary, 2006, in Hungarian

- [46] P. Várlaki, L. Náday, J. Bokor, “Numbers and System Representations in Perspective of the Pauli-Jung Correspondence,” in CD-ROM of the 6th *Slovakian-Hungarian Joint Symposium on Applied Machine Intelligence and Informatics (SAMI 2008)*, Herlany, Slovakia, 2008
- [47] P. Várlaki, B. Vasvári, personal consultations, Physical Institute of BUTE, 1989
- [48] Laurikainen, K., *Beyond the Atom: The Philosophical Thought of Wolfgang Pauli*, Springer Verlag, Berlin, 1988
- [49] Keve, T., *TRIAD*, Rosenberger & Krausz, London, 2000 (n. 215)
- [50] A. S. Eddington, *Fundamental Theory*. Cambridge University Press, 1946