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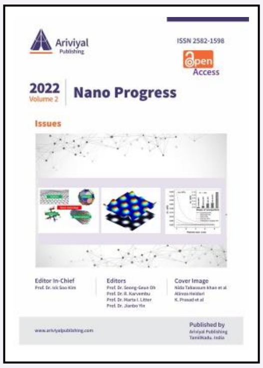

Electron Creation by Photon Annihilation According to Twin Physics

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Abstract: According to twin physics, which is a complementary method to describe phenomena, a photon exists asymmetrically in a spherical magnetic space having a molecular size. The photon itself consists of a four dimensional magnetic vector attached to a point of space. In the center of this surrounding magnetic space a potential electron is described. As soon as a mass carrying particle approaches this system too closely, the photon will be annihilated and the potential electron appears. This means that the absorption of the photon does not speed up an already existing electron, as is supposed in classical physics, but that the photon is replaced by the electron and so charge is generated. Thus, as soon as a photon comes close enough to matter, it is transformed into an elementary solar cell.

Keywords: photon; magnetism; twin physics; quantum mechanics; relativity theory

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1. Introduction

Photonics is a vast region of physics, but the features of the photon are still not yet fully understood. It is a phenomenon which cannot be contemplated without thinking of space and so the concept of space is essential for understanding the photon. A few centuries ago scientists developed mechanics by using Carthesian coordinates and because physics was supposed to be identical to mathematics, it was logical to consider space as being empty and infinite.

When optics was developed, and later, when Maxwell presented his laws describing electromagnetic waves, the question arose how they could exist in an empty space. As many new inventions assured the world of the splendour of science, this question was ignored until 1927, when something remarkable happened in the ***Davisson-Germer experiment***.[7] In this quantum mechanical experiment, electrons were sent on a straight forward trajectory through a vacuum box, all together producing a black dot on the photographic layer at the other side of the box. Next a clear crystal was placed in between to study the track of the few electrons which would hit the lattice. It was supposed that most electrons would go straight ahead through the loopholes in the crystal. A loophole is schematically depicted in Fig. 1, showing the expected emptiness in the crystal and one electron moving through it perpendicular to the paper.

To the experimenters' surprise, they got a different result: almost all electrons ***deviated*** from the straight path and formed a ring-shaped pattern, somewhat similar to that of water waves (see Fig. 2).

This result was a major shock in the entire scientific community, believing as everyone did in a determinate universe which obeyed the laws of Newton. It seemed that electrons had two distinct characteristics, popularly called the 'particle-like' and the 'wave-like' character. The rather chaotic behaviour associated with the wave-like character, by which each electron hit the photographic layer in another place, seemed to be related to uncertainty, but this was not compatible with the laws of Newton. How could an electron have two characters? How could the paths followed by electrons be influenced by relatively far-away particles in the lattice without hitting them?

If we abandon the supposition that space is infinite, there is an explanation. Suppose that the outermost electrons, revolving around the lattice protons, are embedded in ***finite spaces*** of a molecular size, each carrying a ***magnetic field*** as far as this space reaches. This seems to be a reasonable supposition, as previously we described four types of electrons,[6] two of them which are surrounded by a finite magnetic space and one of these occurring in the higher levels of molecules. Then the loopholes in the lattice would be not as empty as it seems in Fig. 1: the magnetic spaces of the outer electrons in the crystal would more or less overlap the magnetic

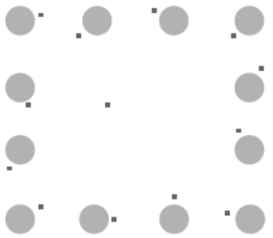

Fig. 1. A single loophole in the crystal, in the view of Davisson and Germer. The larger dots represent protons in the crystal; the small ones represent electrons revolving around them.

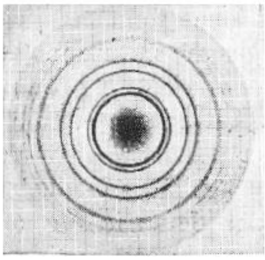

Fig. 2. Wave-like pattern at the photographic layer in the Davisson-Germer experiment.

space of the passing electron, which is indicated in Fig. 3, depending on their accidental positions, and so influence its course. Only electrons traveling through the middle of the loophole would not be affected and still produce the central dot, which is exactly what the experiment shows.

This idea is a starting point of ***twin physics***. In this model, space is a ***finite, energetic object***, as important as mass. Just as many elementary masses may form one large mass, many elementary spaces may form one large space. Heisenberg believed all his life that the enigmatic results of this quantum mechanical experiment were an indication that the universe is constructed in a ***complementary way***.[9,10] The supposition that mass is small and heavy, and space is large and light, is one of the keys to describe this universal complementarity. But this is not enough; we need more adaptations of classical physics, which will shortly be summed up below.

The most remarkable theory in the 20^{th} century was the development of relativity theory by Einstein, expressed in 4-dimensional spacetime. Although nobody could imagine this or relate it to everyday life, it was accepted because it convincingly described experimental results at an ***astronomic scale***. Unfortunately this was not compatible with the quantum mechanical results at an ***atomic scale***. In one of his lectures between 1936 and 1950,[8] Einstein suggested that perhaps the idea of 4-dimensional idea had to be abandoned, to reconcile large and small scale phenomena. He gave some advice on how to construct an entirely new theory, in which 3-dimensional space and 1-dimensional time would be treated alike mathematically. He also suggested returning to ***imaginable*** physics by devising mathematical descriptions in a ***geometric*** way in three-dimensional space, instead of searching for more algebraic details. This is followed up in twin physics.

Physics is based on concepts and theories explaining the behaviour of nature as it appears to us by ***observation***. In twin physics we break with the classical conviction that physics is fully determined by mathematics and suppose that ***mathematics is only a***

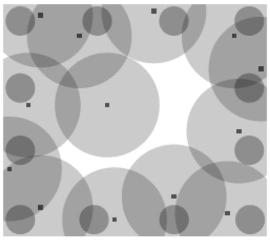

Fig. 3. A single loophole in the crystal, in the view of twin physics. The largest circles indicate finite spherical magnetic spaces around the electrons.

tool, appropriate as long as it reflects the physical reality which not necessarily reaches to infinity. Together with the considerations above, this makes a ***phenomenological*** view on physics possible. Moreover, in combination with spherical coordinates it offers a method to describe particles revolving around a nucleus without needing the concept of a force.

Returning to the principal idea of a universal complementarity, we have found a useful mathematical tool in the ***definition for complementarity***, published by Max Jammer.[11] Based upon this definition, it was possible to create a complementary language,[1] which in Section 2 will be elucidated in a more popular way, suitable to be expressed in geometric items. Combinations of these geometric items can easily be described by using ***set theory***, described by Kahn.[12] With this mathematical method, all kind of items may be combined, even if they have different dimensions. For example, three apples and two pears cannot be added up algebraically, but by calling them 'elements', they may form a 'set of five elements'. By using specific ***operators***, set-elements can be combined.

The obtained mathematical results will be ***transformed*** into physical phenomena by means of some definitions, related to the mass and charge of a ***proton***, chosen to be the link between mathematics and physics in twin physics. To prove the realistic meaning of this link, we deduced the relationship between the speed of light and Planck's constant as $c = 4 \times \hbar/(R \times m)$, in which R and m are the proton radius and proton mass, respectively, and $\hbar = h/2\pi$.[5] This relationship builds a bridge between the proton as a solid particle and the ***photon*** as a massless particle, as the photon moves with the speed of light and its energy is proportional to Planck's constant.

A photon is a rather mysterious entity in physics: it has electromagnetic features but no charge, no mass, and it cannot be slowed down. This is difficult to imagine. To deal with it, we developed a clearer and more accessible explanation of twin physics. Earlier we considered ***electricity and magnetism*** more thoroughly in a previous paper,[6] to find the best comprehensible presentation. In this paper we will present a short overview of it, as well as a new, shorter and more accessible explanation of the basic ***structure*** of twin physics. This required some simplifications of previously used formulas. Based upon this slimmed down representation of twin physics, we will explain how the photon forms a stable system, together with a magnetic space and a potential electron, which can travel unaffected over large distances. On the other hand, this photon-system is very sensitive to specific external influences by which the photon will be annihilated and the potential electron will be converted into an actual electron.

2. Complementary Language

In this section we will explain the structure of twin physics in the most accessible way, as far as it has been developed until now. The central concept is complementarity, which may be recognized in mathematics and physics as well as in everyday life. Next, a few new concepts will be introduced step by step and expressed in mathematics. To adapt these mathematical items to the physical reality, three restrictions will be introduced, deduced from respectively quantum mechanics, daily observations and general coherency in physics. The obtained formalism will be applied to space and time in sections 2.1 and 2.2, respectively and an example will be shown in section 2.3.

The definition of ***complementarity*** was published in 1974 by Max Jammer.[11] It says that, for any complementary interpretation, you need ***two descriptions***, referring to the ***same*** universe of discourse, being ***mutually exclusive***, and none of them may describe ***everything*** in this universe. A simple example is woven textile, constructed from woof and weft, being threads perpendicular to each other; both are a part of textile, they are mutually exclusive, and cloth cannot be made using only one of them.

Another example is given by the colors ***red*** and ***green***, each painted upon two shelves *A* and *B*. They are distinct, refer to colors, exclude each other, and each cannot describe all colors, so the shelves *A* and *B* are complementary colored. If the colors ***pink*** and ***yellow*** are painted upon the shelves *C* and *D*, they are also complementary colored. So a complementary pair of shelves may describe the ***complete*** universe of discourse (like woof and weft in woven textile), but also ***only a part*** of it (like a pair of complementary painted shelves).

To involve the ***Heisenberg principle***, which turned out to be very dependable in physics, we have to express it in a complementary way. This principle says that each observation of ***certainty*** implies a small amount of ***uncertainty***. This may be represented in a visual way by defining the shelf *A* (red) as the 'certain shelf' and shelf *B* (green) as the 'uncertain shelf', and leave a tiny green drop of paint upon the red shelf *A*. If we also leave a tiny red drop of paint on the green shelf *B,* representing that each observation of ***uncertainty*** also implies a small amount of ***certainty***, we have a complementary expression: each observation of ***uncertainty*** implies also a small amount of ***certainty***. Together with the original principle, this is called the ***extended Heisenberg principle***.

To ***create mathematics*** of these two shelves, we shave the two tiny drops from them and collect the four painted wooden objects in a ***set***, containing two slightly damaged painted shelves *A* and *B* and two splinters *a* and *b*. For set theory, see Kahn.[12] This is called the ***set of color attributes***, called AB and written as:

$$AB = \{A, B, a, b\}, \tag{1}$$

We will call A and B *major* elements, and a and b ***minor*** elements. A further explanation of complementarity in colors can be found in [4], also as a YouTube version. Here we will continue to develop this concept in physical terms.

In the past century an abundance of elementary particles was discovered, suggesting that a truly ***elementary physical unit*** does not exist. If the universe is complementarily constructed, indeed an elementary mass does not exist, as it does not contain space in an equivalent way. So, instead of a physical unit, we will create a mathematical one, closely related to physics. This is the ***unit of potential energy***, called the ***Heisenberg unit***, abbreviated to H-unit and indicated by H_i. Potential energy is not a physical reality; it is a mathematical construct which was defined for calculating how an amount of energy can be converted into another type of energy.[13] For instance, we cannot measure how much potential energy a ball resting at a height of 10 meter has; we can only measure its (spent) energy ***after*** it has fallen - but then its potential energy is gone.

To incorporate relativity theory from scratch, by definition an H-unit H_i may convert its potential energy into actual energy only by ***interaction with another H-unit*** H_j. This interaction, written as $H_i * H_j$, may generate one or more physical phenomena, characterized by three ***qualities***: three-dimensional space, one-dimensional time and mark (the mathematical precursor of charge and field). These phenomena may be mass-carrying as well as spatial objects.

To describe interaction $H_i * H_j$, each H-unit will be supplied with three sets: a ***space set***, a ***time set*** and a ***mark set***. Analogous to equation (1), each set contains four elements, called mathematical ***attributes***, and so these sets contain subsequently space, time and mark attributes. ***Interaction of space*** is determined by the relative position of space attributes of H_i and H_j; if at least one of each is partly overlapping, then H_i and H_j have ***space interaction***.

The complete interaction is described by the combination of these three types of interactions.

By installing suitable mathematics, we can deduce $H_i * H_j$ for all three qualities in one and the same formulation, called the ***general zipper***, which will be deduced for each of the qualities separately, obtaining the space zipper, the time zipper and the mark zipper.

For clarity, we will first adapt the color set of equation (1) to a general set of attributes for an H-unit. The red objects (*A* and *a*) are called ***determinate attributes***, written in general as D_i and d_i; the green ones (*B* and *b*) are called ***indeterminate attributes***, written in general as U^i and u^i. Note that a determinate attribute has a lower index and an indeterminate one a higher index. The letter *U* is chosen as a reflection of uncertainty. Inserting this in equation (1), we obtain the ***general set of complementary attributes*** h_i of H-unit as:

$$h_i = \{D_i, U^i, d_i, u^i\}. \tag{2}$$

In the remaining part of this section, we will consider these general attributes to construct the general zipper. In Section 2.1 the general attributes will be replaced by space attributes and in Section 2.2 by time attributes. Mark attributes will be considered in Section 3, as they deviate from the chosen definitions for space and time.

Interaction $H_i * H_j$ will be described by ***chains of linked attributes***, taken from both sets $\{D_i, U^i, d_i, u^i\}$ and $\{D_j, U^j, d_j, u^j\}$. The ***link operator*** between the attributes is written as $\propto$ (this operator will later be defined for each quality separately), connecting attributes in such a way, that both will occur in the resulting phenomenon. If we were to link all 8 attributes in all possible ways, forming chains of arbitrary sequence and length, so containing 2 up to 8 attributes (like for instance $(d_j \propto u^j \propto D_j \propto U^j \propto D_i)$), we would obtain a ***countable infinite amount of chains***. We are only interested in chains reflecting the ***physical reality*** in some way or another and so, to reduce the amount of allowed chains in a relevant way, we will apply restrictions which are characteristic for physics in general.

This is carried out by dividing all chains up into three types: ***major chains*** containing only major attributes, ***minor chains*** containing only minor attributes, and ***mixed chains*** containing at least one major and one minor attribute. We will use only the first two types; they will be elaborated upon below, to find out which combinations may describe the physical reality. Mixed chains turned out to be useless for physical descriptions.

Each major chain C_n will be collected with one minor chain c_n into a ***set of two elements***. Both chains have an arbitrary length and content. This set is called a ***zip***, indicated in general by z_n and written as:

$$z_n = \{C_n, c_n\}, \tag{3}$$

with $n \epsilon \{1, 2, \dots, N-1, N\}$; *N* is a ***countable infinite number*** of combinations of one C_n and one c_n.
An example of a random zip is:

$$z_n = \{D_i \propto U^j, d_j \propto u^i \propto u^j\}. \tag{4}$$

Next we collect ***all possible zips*** in a set of *N* elements, called a ***zipper***, indicated in general by Z_{ij} and written as:

$$Z_{ij} = \{z_1, z_2, \dots, z_{N-1}, z_N\}, \tag{5}$$

in which *i* and *j* indicate the two involved H-units H_i and H_j. We want to reduce the huge amount of *N* elements by applying three general restrictions, related to physics. They are derived subsequently from quantum mechanics, an everyday observation, and physics in general.

The ***first restriction*** is deduced from ***quantum mechanics***, based upon the experimental results concerning the particle-like and the wave-like appearances of electrons, showing that they cannot be observed simultaneously. In terms of twin physics, we may consider the particle-like appearance as a 'certain observation' and the wave-like appearance as an 'uncertain observation'. This can be translated to mathematics as the ***exclusion principle***, saying that complementary attributes belonging to one and the same H_i cannot appear simultaneously in one physical observation. Consequently, in a major chain ***two major attributes of one and the same H-unit*** are forbidden, and similarly, in a minor chain ***two minor attributes*** of one and the same H-unit are forbidden.

For example in a major chain, the links $D_i \propto U^i$ and $D_j \propto U^j$ are forbidden and so the remaining allowed ***major links*** are: $D_i \propto D_j$, $U^i \propto U^j$, $D_i \propto U^j$ and $D_j \propto U^i$. They cannot be linked to each other without violating the exclusion principle. Similarly, in a minor chain the links $d_i \propto u^i$ and $d_j \propto u^j$ are forbidden. The remaining allowed ***minor links*** are: $d_i \propto d_j$, $u^i \propto u^j$, $d_i \propto u^j$ and $d_j \propto u^i$. In this way we obtain 4 allowed major links and 4 allowed minor links. So the first restriction reduces *N* from a countable infinite amount to 4 x 3 x 2 possibilities, so to 24.

For the ***second restriction*** we look again at our painted shelves. A red dot upon a red shelf would add nothing to the color-observation of the shelf. Translating this to interacting H-units: if major determinate attribute D_i occurs in a major chain C_n, then minor determinate attribute d_i ***adds nothing new to the zip*** and so we will drop zips containing both D_i and d_i. Similarly, if major indeterminate attribute U^i occurs in a major chain c_n, then minor indeterminate attribute u^i adds nothing new to the zip and so we will drop zips containing both U^i and u^i. For instance the zip $\{D_i \propto D_j, d_i \propto u^j\}$ will be dropped, as it contains D_i as well as d_i.

This reduces the amount of remaining zips from *N* = 24 further to *N* = 4 and so the general zipper for use in physics, ***under the first and second restrictions***, can be reduced to a set of only 4 elements, being:

$$Z_{ij} = \{z_1, z_2, z_3, z_4\} = \begin{Bmatrix} \{D_i \propto D_j, u^i \propto u^j\} \\ \{U^i \propto U^j, d_i \propto d_j\} \\ \{D_i \propto U^j, u^i \propto d_j\} \\ \{D_j \propto U^i, u^j \propto d_i\} \end{Bmatrix}. \tag{6}$$

Each zip z_n of this zipper Z_{ij} is a set of two mathematical items (C_n and c_n). In the next sections we will explain how they will be transformed into physical items, to obtain the description of an actual phenomenon. The way of transforming will be defined for each quality separately. Once having established these transformations, we need to know under which conditions the two transformed items of one zip may be combined to one physical expression, describing a realistic phenomenon.

To this purpose we define a ***third restriction***, deduced from physical experiments in general. No experiment ever has revealed holes in the surrounding space, through which a moving object could not cross that specific region, nor was a particle ever found having its charge stored somewhere else instead of inside the particle. So we suppose that in general ***phenomena are coherent***. This can be expressed as the ***coherence restriction****:* the two transformed major and minor chains of one zip have to ***form a unity in space*** and ***move uniformly***. 'Forming a unity in space' means that one overlaps the other. 'Moving uniformly' means that they move in the same way, linear or circular, and in the same direction. If one of both conditions is not met, the zip cannot be transformed into a physical space and time. As we will see later, this restriction concerns only space and time; the mark zip is not involved in the coherence principle.

The coherence restriction is translated into mathematics by requiring that ***each minor*** attribute c_n in zip z_n has to be coherent with ***both major*** attributes C_n. For example, in equation (4) this means for z_n that both u^i and u^j have to be coherent with D_i as well as with D_j. This can be written by defining the ***coherence operator*** $\bowtie$ as follows:
The operation $x \bowtie Y$ is called a ***coherence test***, pronounced as "x coherent with Y". If $x \bowtie Y = x$, then x and Y are coherent; if $x \bowtie Y = \emptyset$, then they are not coherent. (7)
Previously we called $\bowtie$ the join operator.

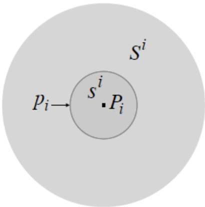

Fig. 4. Schematic representation of the 3-dimensional set of space attributes of an H-unit.

Thus the coherence operator acts as an ***excluding operator***, leaving the minor attributes untouched if ***both*** are coherent, but dropping the complete minor chain if not.

Applying the coherence test to the four minor chains in equation (6), we obtain the ***definitive version of the general zipper*** for interaction $H_i * H_j$ as:

$$Z_{ij} = \{z_1, z_2, z_3, z_4\} = \left\{ \begin{array}{l} \{D_i \propto D_j, (u^i \bowtie D_i) \propto (u^i \bowtie D_j) \propto (u^j \bowtie D_i) \propto (u^j \bowtie D_j)\} \\ \{U^i \propto U^j, (d_i \bowtie U^i) \propto (d_i \bowtie U^j) \propto (d_j \bowtie U^i) \propto (d_j \bowtie U^j)\} \\ \{D_i \propto U^j, (u^i \bowtie D_i) \propto (u^i \bowtie U^j) \propto (d_j \bowtie D_i) \propto (d_j \bowtie U^j)\} \\ \{D_j \propto U^i, (u^j \bowtie D_j) \propto (u^j \bowtie U^i) \propto (d_i \bowtie D_j) \propto (d_i \bowtie U^i)\} \end{array} \right\}. \quad (8)$$

This formula is the heart of twin physics. Each horizontal line in equation (8) is a zip, which is a set of two elements; the element at the left is called a ***major chain*** and the element at the right is called a ***minor chain***. In the next sections this zipper will be deduced for each quality separately, so for the time zipper $Z_{ij}(t)$, the space zipper $Z_{ij}(\mathbf{r})$ and the mark zipper $Z_{ij}(q)$. The variable $\mathbf{r}$ indicates spherical coordinates. Then for each quality the minor chains can be reduced to a chain of only minor attributes.

After having obtained these three zippers for a specific interaction, the mathematical chains will be ***transformed*** from $\{C_n, c_n\}$ into a set of ***two physical elements***. Then, as the last step, we will combine them (if possible) into a single expression for time, space and mark, describing ***one physical phenomenon***. This phenomenon is called a ***Heisenberg-event***, abbreviated to H-event and indicated by $\Omega_n(t, \mathbf{r}, q)$. The reason why t is placed before $\mathbf{r}$ will become clear in Section 2.2.

As the zipper contains four zips, in principle at most four phenomena (including possible empty elements) may be generated by interaction $H_i * H_j$. They will be collected in the ***set of H-events*** $\Omega_{ij}(t, \mathbf{r}, q)$, written as:

$$\Omega_{ij}(t, \mathbf{r}, q) = \{\Omega_1(t, \mathbf{r}, q), \Omega_2(t, \mathbf{r}, q), \Omega_3(t, \mathbf{r}, q), \Omega_4(t, \mathbf{r}, q)\}. \quad (9)$$

For clarity, the four H-events may be written extensively as:

$$\begin{array}{l} \Omega_1(t, \mathbf{r}, q) = \{\Omega_1(t), \Omega_1(\mathbf{r}), \Omega_1(q)\} \\ \Omega_2(t, \mathbf{r}, q) = \{\Omega_2(t), \Omega_2(\mathbf{r}), \Omega_2(q)\} \\ \Omega_3(t, \mathbf{r}, q) = \{\Omega_3(t), \Omega_3(\mathbf{r}), \Omega_3(q)\} \\ \Omega_4(t, \mathbf{r}, q) = \{\Omega_4(t), \Omega_4(\mathbf{r}), \Omega_4(q)\} \end{array} \quad (10)$$

In these expressions the indices i and j of the involved H-units H_i and H_j are not shown, but if specific attributes are inserted, their indices will be indicated and so it is clear which H-units are concerned.

In the next sections we will deduce attributes, zippers and transformations, first for space in Section 2.1, next for time in Section 2.2 after which in Section 2.3 an example is given, and finally for mark in Section 3.

2.1. The Space Zipper

We will start with the quality '***space***' by defining the set of space attributes $h_i(\mathbf{r})$ and deduce the space zipper $Z_{ij}(\mathbf{r})$. For convenience we repeat equation (2):

$$h_i = \{D_i, U^i, d_i, u^i\}. \quad (11)$$

For D_i we take ***point of space*** P_i. For U^i we take a spherical space with P_i in the center, called ***major space*** S^i, the center and the border excluded. Note that S^i is not defined as a collection of points, but as a ***part of space*** and so, it is an ***indeterminate object***, as its location cannot be determined exactly. Its complement, point of space *P*, is a ***determinate object***, as it has an exact location. Together P_i and S^i describe a sphere, they exclude each other, each alone cannot describe a complete sphere and so they are complementary attributes.

For u^i we take a tiny sphere called ***minor space*** s^i, the center P_i included and the border excluded. Similar to S^i, minor space s^i is an ***indeterminate*** object. For minor element d_i we take an infinitesimally thin layer upon the surface of s^i, called ***pellicle*** p_i. It is a ***determinate*** object, as all points have a fixed distance to point of space P_i. Because a pellicle is a mathematical object which cannot be found in nature, it can only be transformed into a real space object by breaking it up in two parts and transforming each part separately. Minor elements s^i and p_i together refer to a sphere including the skin (like an apple, if the stalk and duckweed are neglected), they exclude each other and each alone cannot describe the complete apple, so they are complementary attributes.

Then the ***set of space attributes*** $h_i(\mathbf{r})$ of H-unit H_i can, analogous to equation (11), be written as:

$$h_i(\mathbf{r}) = \{P_i, S^i, p_i, s^i\}. \quad (12)$$

The space set of H-unit h_j is similar, with indices j. The set elements will be called ***space attributes***; if occurring as independent items or combinations of them, we may call them also ***geometric objects***. In Fig. 4 the space attributes of one H-unit are indicated schematically.

The ***link operator*** $\propto$ ***for space*** (see the general zipper (8)) is defined as follows: the link of any two space attributes is their ***intersection***. Thus non-intersecting space attributes cannot be linked. The ***coherence operator*** $\bowtie$ ***for space*** is defined as: minor space attribute x is coherent with major space attribute Y if $x \subset Y$ (x is contained in Y) or $Y \subset x$ (Y is contained in x). This somewhat curious definition creates a tool for ***both major attributes***, catering to the extreme character of the major space attributes. For the space attributes of equation (8) the coherence test says: if $s^i \subset S^j$, then $s^i \bowtie S^j = s^i$ and so they are coherent; if $P_j \subset s^i$, then similarly $s^i \bowtie P_j = s^i$ and so they are coherent.

Inserting the space attributes in equation (8), the zipper contains two coherence tests for two space attributes belonging to ***one and the same H-unit***. In space zip $z_1(\mathbf{r})$ they reduce to $s^i \bowtie P_i = s^i$, $s^j \bowtie P_j = s^j$. Then the zip reduces to:

$$z_1(\mathbf{r}) = \{P_i \propto P_j,\ s^i \propto (s^i \bowtie P_j) \propto (s^j \bowtie P_i) \propto s^j\}, \tag{13}$$

in which the two reduced links s^i and s^j have no influence anymore upon the results of the remaining coherence tests $s^j \bowtie P_i$ and $s^j \bowtie P_j$, so the items for one and the same H-units may be dropped. The same is valid for the links of one and the same H-unit in zips $z_2(\mathbf{r})$, $z_3(\mathbf{r})$ and $z_4(\mathbf{r})$. So the ***space zipper*** in general can be written as:

$$Z_{ij}(\mathbf{r}) = \begin{Bmatrix} \{P_i \cap P_j, (s^j \bowtie P_i) \cap (s^j \bowtie P_j)\} \\ \{S^i \cap S^j, (p_j \bowtie S^i) \cap (p_i \bowtie S^j)\} \\ \{P_i \cap S^j, (p_j \bowtie P_i) \cap (s^i \bowtie S^j)\} \\ P_j \cap S^i, (p_i \bowtie P_j) \cap (s^j \bowtie S^i) \end{Bmatrix}. \tag{14}$$

The space zipper contains ***all mathematical information*** about the ***space interaction*** of $H_i * H_j$. Each horizontal line in equation (14) is a zip, which is a set of two elements (a major chain at the left and a minor chain at the right). They are dependent on the relative position of H_i and H_j, primarily determined by the distance of P_i and P_j.

For space interactions of two H-units of the same size, we use ***7 distinct space cases*** (see [3] or the Appendix of [2]). Here we give only two examples:
Space case 1 is characterized by $P_i \cap P_j = P_i$; then the zipper is:

$$Z_{ij}(\mathbf{r}) = \{\{P_i, s^i\}, \{S^i, p_i\}, \emptyset, \emptyset\}; \tag{15}$$

Space case 7 is characterized by $S^i \cap S^j \neq \emptyset$, $P_i \in S^j$ and so $P_j \in S^i$; then the zipper is:

$$Z_{ij}(\mathbf{r}) = \{\emptyset, \{S^i \cap S^j, \emptyset\}, \emptyset, \emptyset\}. \tag{16}$$

In general the zipper in specific cases is much simpler than the general zipper is.

In Section 3.2 a larger type of H-unit will be introduced, leading to 12 additional distinct space cases.

After having deduced the space zipper in a specific case, we have to transform the obtained major and minor chains of each zip into physical items. The ***transformation operator*** will be indicated by square hooks, so mathematical space item X will be transformed into a physical space item $[X]$. Then major chain $C_n(\mathbf{r})$ will be transformed into $[C_n(\mathbf{r})]$ and minor chain c_n into $[c_n(\mathbf{r})]$.

We need a definition for this transformation operator formulated in such a way that it ***combines*** coherent minor chains with the major chains, and ***removes*** incoherent minor chains. After that, we ascribe ***actual energy*** *to* the appearing object.

To ascribe energy to the appearing object in a complementary way, we distinguish ***two types*** of real space*:* an ***extended space*** having an extremely low energy density, abbreviated to ***space***, and a ***compact space*** having an extremely high energy density, abbreviated to ***mass***. So transformations of major spaces have a low energy density and transformations of minor spaces have a high energy density. The amount of ascribed energy is proportional to the size of the object.

To be able to identify the obtained phenomenon, we have to choose a ***basic connection*** between mathematics and physics. We have chosen the proton by defining the transformation of ***coinciding minor spaces*** as follows:

If $s^i = s^j$, then $[s^i \cap s^j] = [s^i] = \theta_{ij}(s^i)$, being the space occupied by a ***proton***. (17)

More transformations for non-empty intersections of space attributes are:
For $s^i \neq s^j$ is $[s^i \cap s^j] = \theta_{ij}(s^i \cap s^j)$, called a ***femtospace***. (18)

$[S^i \cap S^j] = \Theta_{ij}(S^i \cap S^j)$, called a ***free space***. (19)

If $P_i \cap P_j$ is non-empty, then $[P_i \cap P_j] = \Pi_{ij}(P_{ij})$, called a ***pointspace***. (20)

As a pointspace has no spatial extension, $\Pi_{ij}(P_{ij})$ carries no space energy.

A pellicle p_i seems to have no similar physical realization and so the transformation of a ***pellicle intersection*** is less obvious. We define the transformation of ***two coinciding or intersecting pellicles*** as a tiny spherical particle, existing inside the common region.

If $p_i \cap p_j = p_{ij}$, then $[p_i \cap p_j] = o_{ij}(p_{ij})$, called a ***pelletspace*** at the surface of s^{ij}. (21)

If $p_i \cap p_j \neq p_{ij}$, then $[p_i \cap p_j] = o_{ij}(p_i \cap p_j)$, a ***pelletspace*** inside the ringshaped intersection. (22)

The transformation of the intersection between a minor space s^i and a pellicle p_j is defined as:
$[s^i \cap p_j] = \odot_{ij}(s^i \cap p_j)$, called a ***dotspace***, being a curved, disc-shaped space. (23)

The spatial objects as defined above will be identified with well-known phenomena by comparing their size with the proton, after having also deduced the time and mark zips, and identifying them as known physical objects.

The coherence principle requires that the transformed chains ***form a unity in space***. To this purpose we will define a ***second coherence operator***, being complementary to the one defined for the third restriction. Complementary operators are not new; for instance the operators differentiating and integrating are also complementary. In the previously defined ***coherence test*** (7), indicated by $\bowtie$, we used the coherence operator as an ***excluding tool****:* the minor chain will be excluded if both minor attributes are not coherent with both major attributes. In the complementary case, we will use the coherence operator as an ***including tool***, indicated by $\triangleleft\triangleright$, unifying the transformed major and minor chains of zip z_n unless they are not coherent. The ***union operator*** for the elements of zip z_n is defined as:

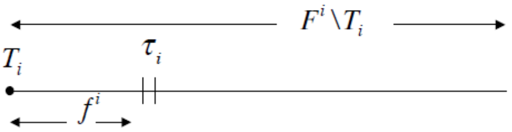

Fig. 5. Schematic representation of the 1-dimensional set of time attributes of an H-unit.

If $[C_n]$ and $[c_n]$ are coherent, then the transformed zip is $[z_n] = \{[C_n] \lhd\rhd [c_n]\}$;
if $[C_n]$ and $[c_n]$ are not coherent, then $[z_n] = \emptyset$. (24)

In this way zip z_n, being a set of ***two mathematical elements***, will be transformed into transformed zip $[z_n]$, being a set of ***one physical item***. In case the chains are not coherent, the zip reduces to an empty set.

After having carried out the operation 'union' for all four zips of equation (8), according to a specific space case, the transformed space zipper can in general be written as:

$$[Z_{ij}(\mathbf{r})] = \{[z_1(\mathbf{r})], [z_2(\mathbf{r})], [z_3(\mathbf{r})], [z_4(\mathbf{r})]\}. \quad (25)$$

By defining $[z_n(\mathbf{r})] = \Omega_n(\mathbf{r})$, we can write equation (25) as:

$$\Omega_{ij}(\mathbf{r}) = [Z_{ij}(\mathbf{r})] = \{\Omega_1(\mathbf{r}), \Omega_2(\mathbf{r}), \Omega_3(\mathbf{r}), \Omega_4(\mathbf{r})\}, \quad (26)$$

This is called the ***set of space aspects*** $\Omega_{ij}(\mathbf{r})$ of interaction $H_i * H_j$, in which $\mathbf{r}$ indicates spherical coordinates (r, ϑ, φ), with r being the radial distance, ϑ (theta) the polar angle and φ (phi) the azimuthal angle. This set contains all physical space information about interaction $H_i * H_j$.

2.2. The Time Zipper

We will continue with the quality '***time***', but first we will explain the historical notion of time. A time axis as used in classical physics exists only mathematically. In the real physical world a continuous time measurement is not possible, because the measuring of time is a ***cyclic process*** in which you compare the change of a phenomenon with the amount of cycles that a ***clock*** completes in the same time and indicating these numbers as points on a straight line. When clocks became more and more refined, these points came closer to each other and finally they were replaced by a solid line. Then people started to believe that a time measurement may be carried out in a continuous way, which is incorrect as there will always be in interval, however small, between two measurements. In twin physics we will step back to the cyclic process of time measurement and use it in a complementary way: the points are considered as determinate items and the intervals in between as indeterminate items. In choosing time attributes, we follow the advice of Einstein,[8] saying that, if the concept of four-dimensional spacetime ever has to be abandoned, space and time should be treated ***mathematically similarly***. So the time attributes are chosen similar to the space set (12), reduced from three dimensions to one dimension. Then the ***set of time attributes*** $h_i(t)$ of H-unit H_i can be defined as:

$$h_i(t) = \{T_i, F^i, \tau_i, f^i\}. \quad (27)$$

Determinate major attribute T_i is called the ***point of time***, which is 'now', just like in classical physics. Indeterminate major attribute F^i is called the ***future***, being finite, just like the major space is, but different from the classical idea of time being infinite. Determinate minor attribute τ_i is called the ***flash***, a tiny interval of time in which a ***change*** can be observed. Indeterminate minor attribute f^i is called the ***flying time***, being an 'extended now', comparable with the time you need to press the stopwatch. The flying time is the time item which in classical physics is hidden by extrapolating the measured points to a continuous time axis. Note that the ***past is not represented*** in the time set, in agreement with the physical reality that no phenomenon can be observed in the past. In Fig. 5 the time attributes of H-unit are indicated schematically.

The ***time zipper*** for $H_i * H_j$ is obtained by interchanging the space attributes in equation (14) by time attributes:

$$Z_{ij}(\mathrm{t}) = \begin{Bmatrix} \{T_i \cap T_j, (f^i \bowtie T_j) \cap (f^j \bowtie T_i)\} \\ \{F^i \cap F^j, (\tau_i \bowtie F^j) \cap (\tau_j \bowtie F^i)\} \\ \{T_i \cap F^j, (f^i \bowtie F^j) \cap (\tau_j \bowtie T_i)\} \\ \{T_j \cap F^i, (f^i \bowtie F^i) \cap (\tau_i \bowtie T_j)\} \end{Bmatrix}. \quad (28)$$

Like in space zipper (14), each horizontal line in equation (28) is a time zip, being a set of two elements (a major chain at the left and a minor chain at the right). The similarity between mathematical space and time disappears when we cross the border between mathematics and physics, because ***time contains no energy***. Thus ***no transformation of time zips*** is necessary. This means that the time zip is the ***connection*** between mathematical and physical descriptions of a phenomenon, guarding the ***relationship between potential and actual energy***.

The time zipper depends on the relative distance between T_i and T_j of the two H-units, expressed in time attributes.

The ***4 distinct time zippers*** for interaction $H_i * H_j$ are given for $T_i > T_j$ (so $T_i \in F^i$) (see [3] or the Appendix of [2]):

time case 1: $Z_{ij}(\mathrm{t}) = \{T_i \cup f^i, \tau_i, \emptyset, \emptyset\}$, characterized by $T_i \cap T_j = T_i$ (so $T_i = T_j$) (29)
time case 2: $Z_{ij}(\mathrm{t}) = \{\emptyset, \tau_i \cap \tau_j, T_i, \emptyset\}$, characterized by $\tau_i \cap \tau_j \neq \emptyset$ (30)
time case 3: $Z_{ij}(\mathrm{t}) = \{\emptyset, F^i \cap F^j, T_i, \emptyset\}$, characterized by $\tau_i \cap \tau_j = \emptyset$ and $T_i \notin \tau_j$ (31)
time case 4: $Z_{ij}(\mathrm{t}) = \{\emptyset, F^i \cap F^j, T_i \cup (f^i \cap \tau_j), \emptyset\}$, characterized by $T_i \in \tau_j$ (32)

If a ***time zip*** is considered in combination with a space zip, we may call it the ***time label*** of the zip. Each time zip contains two non-empty elements; supposing that an H-event cannot exist if it has an empty time label, the set of H-events may contain ***at most two non-empty elements***. If indeed two phenomena are generated, we suppose that they have equal actual energies.

The time cases above are called ***regular time cases*** of $H_i * H_j$; then T_i is located at the right of T_j. In each regular time case is $z_4(t) = \emptyset$ so only the 3d H-event appears. In the ***mirrored time case*** T_i is located at the left of T_j, in each mirrored case is $z_3(\underline{t}) = \emptyset$ so only the 4th H-event appears. This interaction is indicated by a dash underneath the H-units: $\underline{H_i} * \underline{H_j}$ and in that case, time will also be indicated with a dash (like in $z_3(\underline{t})$). For instance, the time zipper of mirrored time case 3 is:

$$Z_{ij}(\underline{t}) = \{\emptyset, F^i \cap F^j, \emptyset, T_j\}. \tag{33}$$

Clearly zips $z_3(t)$ and $z_4(\underline{t})$ cannot occur both as non-zero in a zipper and so H-events $\Omega_3(t, \mathbf{r}, q)$ and $\Omega_4(t, \mathbf{r}, q)$ cannot appear simultaneously.

We will consider what might be the difference between H-events generated by $\underline{H_i} * \underline{H_j}$ or $H_i * H_j$. A time mirrored interaction makes no difference for H-events $\Omega_1(t, \mathbf{r}, q)$ and $\Omega_2(t, \mathbf{r}, q)$, describing a solid particle (proton or neutron) in the first element. Also for interactions of two ***equally marked*** H-units it makes no difference; then H-events $\Omega_3(t, \mathbf{r}, q)$ and $\Omega_4(t, \mathbf{r}, q)$ both describe an electron of the same type and so it doesn't matter if $T_i \in F^j$ or $T_j \in F^i$; thus time zipper (33) gives the same result as time zipper (31). But for ***opposite*** marked H-units, $\Omega_3(t, \mathbf{r}, q)$ is an electron and $\Omega_4(t, \mathbf{r}, q)$ is a positron. Then the interaction may be called ***asymmetrical***.

We have two additional asymmetrical interactions. The first is $H_i^- * H_j$ in time case 4 and space case 8C (see [3] or [6]), in the regular time case generating an electron of type 2 with a spin particle. In the mirrored time case it describes a photon with a spin particle at the distance of the radius of the neutral pellicle, which because of their distance is not a coherent H-event, it does not exist and so $\Omega_4(t, \mathbf{r}, q) = \emptyset$ in the time mirrored case.

The second asymmetrical interaction is the most important one of this paper. This is $H_i * H_{0i}$, an interaction of a marked and a neutral H-unit in time case 3 and space case 7C, generating in the regular time case H-event an ***electron of type 4*** as the 3rd H-event, but in the mirrored time case a ***photon*** as the 4th H-event. In Sections 4 through 6 we will consider this more closely to describe the photon and its decay.

If a time zip occurs combined with a transformed space zip $[z_n(\mathbf{r})]$, it is called the ***time label*** $L_n(t)$ of the space zip. It is just another name to make it easier to remember that it doesn't contain energy, so it doesn't have to be transformed:

$$L_n(t) = z_n(t). \tag{34}$$

A set of time labels is called the ***time aspect*** of the set of H-events, indicated by $\Omega_{ij}(\mathrm{t})$ and in general written as:

$$\Omega_{ij}(\mathrm{t}) = [Z_{ij}(\mathrm{t})] = \{L_1(t), L_2(t), L_3(t), L_4(t)\}. \tag{35}$$

Each time label supplies information about the static or dynamic character of the belonging H-event, based upon a combination of ***immutability*** and ***change***.[3] We listed the possibilities below.

- If the time label contains ***point of time*** T_i, then the speed is ***constant and may be zero***. In spherical coordinates, a constant movement is ***in a straight line*** if ϑ and φ are constant, and ***rotational*** if r and ϑ are constant.
- If the time label contains the ***flying time*** f^i, then the speed is ***constant and nonzero***. Further, the difference with T_i is, that during the flying time a measurement is not possible (as f^i is indeterminate) and so the object may revolve around a point; when returning to the same point, the speed might seem zero, but in reality the object possibly has turned around one or more times.
- If the time label contains the flash τ_i, then the movement is ***changing***, like with accelerating.
- If the time label contains the future F^i, overlapping the flying time as well as the flash, it cannot be ascertained how the belonging H-event will behave, as F^i is indeterminate, and so the H-event may ***adapt*** its movement to that of the other one.

Because in all cases the set of time labels contains two elements, the ***set of H-events in general***, generated by interaction $H_i * H_j$ (see equation (9)), can be reduced from a set of four elements to a set of two elements, written as:

$$\Omega_{ij}(t, \mathbf{r}, q) = \begin{Bmatrix} \Omega_n(t, \mathbf{r}, q) \\ \Omega_m(t, \mathbf{r}, q) \end{Bmatrix} = \begin{Bmatrix} [C_n] \bowtie [c_n] \\ [C_m] \bowtie [c_m] \end{Bmatrix}, \tag{36}$$

with *n* and *m* being two different elements of the set $\{1,2,3,4\}$. A space zipper in general contains 3 non-empty zips, so one of them has an empty time label and does not appear in a real physical space. It depends on the chosen time case which two H-events of the potential three will appear, which is expressed by placing t before $\mathbf{r}$, to prevent the superfluous elaboration of a non-appearing space zip.

2.3. Example: Description of a Free Space

We will consider the interaction of two H-units H_i and H_j in ***space case 7***, having partly overlapping ***major spaces*** without minor attributes being involved. Then $S^i \cap S^j \neq \emptyset$ and all other intersections are empty. This is the simplest interaction; only in this case, space zipper (14) can be reduced to a set with only one non-empty element, containing only a major chain:

$$Z_{ij}(\mathrm{t}) = \{\emptyset, S^i \cap S^j, \emptyset, \emptyset\}. \tag{37}$$

The overlapping region may be smaller or larger, but the zipper stays the same, so we don't need algebraic details about the size. This is characteristic for a phenomenological view of physics, as in many experiments we don't have to know everything, only enough to understand what happens. The ***set of space aspects*** of $H_i * H_j$ (26) has only one element:

$$\Omega_{ij}(\mathbf{r}) = \{\Omega_2(\mathbf{r})\} = \{[S^i \cap S^j]\}. \tag{38}$$

Because this element contains no minor chain, the coherence operator has no effect, so the transformation can be carried out straightforwardly, and the ***set of space aspects*** is:

$$\Omega_{ij}(\mathbf{r}) = \{\Omega_2(\mathbf{r})\} = \{\Theta_{ij}(S^i \cap S^j)\}. \tag{39}$$

We will choose ***time case 3 or 4*** (see equations (31) and (32)), to have a second time label entailing all possibilities of movement. The third time label may be dropped, as the third space zip is empty, so the ***set of time labels*** belonging to the set of space aspects (39) is:

$$\Omega_{ij}(t) = \{\Omega_2(t)\} = \{F^i \cap F^j\}. \tag{40}$$

The ***set of time-space aspects*** of is the combination of (39) and (40). If the quality '***mark***' is not involved, then the complete set of H-events, generated by $H_i * H_j$, can be written as:

$$\Omega_{ij}(t,\mathbf{r}) = \{\Omega_2(t,\mathbf{r})\} = \{\Theta_{ij}(F^i \cap F^j, S^i \cap S^j)\}, \tag{41}$$

in which Θ_{ij} is identified as a ***free space*** (see equation (19)), having the more or less oval shape of two partly overlapping spheres. It may also be written as $\Theta_{ij}(S^i \cap S^j)$. Because time label $F^i \cap F^j$ is indeterminate, $F^i \cap F^j$ can adapt its movement to other interactions in which these H-units might be participating.

H-event $\Omega_2(t,\mathbf{r})$ describes that a part of the potential energy of H_i and H_j is ***converted*** into actual energy of the spatial region $S^i \cap S^j$, having a low energy density. We will return to this example after having defined the mark zipper.

3. The Mark Zipper

The quality '***mark***' will be indicated by q. After having defined a set of space attributes (12) and a set of time attributes (27), we will ***create an identity*** for H-unit H_i by defining a set of four mark attributes $h_i(q)$, one of them being unique for this H-unit. To this purpose, both ***major space attributes*** P_i and S^i will be marked; each in a complementary way and so ***each major element*** of $h_i(q)$ will be a set of ***two elements***.

First we will explain marking of a point of space and next marking of a major space. In Section 3.1 the mark zipper for ***two points of space*** involved in an interaction will be deduced and in Section 3.2 the mark zipper for ***two major spaces***, after which they may be combined into one zipper. In Section 3.3 an example will be given.

Point of space P_i will be marked by two complementary *numbers*: a real number $\tilde{Q}_i$ and an imaginary number $\tilde{Q}_i \times i$. A ***positive*** marked H-unit will be written as H_i^+, having a positive $\tilde{Q}_i$; a ***negative*** marked H-unit will be written as H_i^-, having a negative $\tilde{Q}_i$, and an ***unmarked*** H-unit as H_{0i}. In this way we created three types of H-units: H_i^+, H_i^- and H_{0i}.

Then the ***set of mark attributes for point of space*** P_i of H_i is (see equation (2)):

$$h_i(q_n) = \{\tilde{Q}_i, i \times \tilde{Q}_i, 1, i\}, \tag{42}$$

in which q_n indicates that the set contains only marking ***numbers***. The letter i occurs as an index as well as the imaginary number; later this turns out to be no problem.

Major space S^i will be marked by two complementary ***vectorfields***: electric field $\boldsymbol{E}_i$ and magnetic field $\boldsymbol{B}^i$.

Electric field $\boldsymbol{E}_i$ is defined as an infinite, ***radial*** 3-dimensional vectorfield, having a real source $\tilde{Q}_i$ in P_i, so $\nabla \cdot \boldsymbol{E}_i = \tilde{Q}_i$, and in P_i the field is not defined. It is a ***determinate*** mark, as an arbitrary vector $\boldsymbol{e}_i$ of $\boldsymbol{E}_i$ is determined. Two electric fields $\boldsymbol{E}_i$ and $\boldsymbol{E}_j$, belonging to H-units H_i and H_j, are equal if $P_i = P_j$ and $\tilde{Q}_i = \tilde{Q}_j$.

Magnetic field $\boldsymbol{B}^i$ is defined as an infinite, ***circular*** 3-dimensional vectorfield, having an imaginary source $\tilde{Q}_i \times i$ in point of space P_i, and in P_i the field is not defined. An arbitrary vector $\boldsymbol{b}^i$ of $\boldsymbol{B}^i$ is directed in a plane perpendicular to the radius of $\boldsymbol{E}_i$ and so perpendicular to the electric vector. Thus $\boldsymbol{E}_i \cdot \boldsymbol{B}^i = 0$ and because $\boldsymbol{E}_i$ is radial, is $\nabla \cdot \boldsymbol{B}^i = 0$. To define $\boldsymbol{B}^i$ as an ***indeterminate*** mark, each vector $\boldsymbol{b}^i$ has an ***indefinite*** magnitude and direction, so adjacent vectors may differ in direction as well as in absolute value. This definition makes it possible to introduce the ***principle of uniqueness***, saying that for any two H-units H_i and H_j is $\boldsymbol{B}^i \neq \boldsymbol{B}^j$, even if they are coinciding and equally marked. Consequently, ***each marked H-unit is unique***.

The ***two minor elements*** of $h_i(q)$ are chosen such, that by mixing the attributes, field derivatives in time and space may be obtained, so we take ***mathematical units of space and time***. Concerning the point of space, the two minor attributes are chosen as real number 1 and imaginary unit *i*. Concerning the major space, we take the ***nabla operator***, which is $\nabla = (\partial/\partial r, \partial/\partial\vartheta, \partial/\partial\varphi)$ and ***time derivative*** $\partial/\partial t$; in ∇ is r the radial distance, ϑ the polar angle and φ the azimuthal angle. The minor attributes are equal for marked H-units H_i^+ and H_i^-, so indices are not necessary.

Then the set of ***mark attributes for major space*** S^i of H_i, is:

$$h_i(q_f) = \{\boldsymbol{E}_i, \boldsymbol{B}^i, \nabla, \partial/\partial t\}, \tag{43}$$

in which q_f indicates that the set contains only marking ***fields***.

In specific cases it may be practical to use the set for a point of space (42) or for a major space (43) separately, but for completeness we will give their combination as the ***complete set of mark attributes*** $h_i(q)$ for H-unit H_i, containing numbers as well as fields, and written as:

$$h_i(q) = \{\{\tilde{Q}_i, \boldsymbol{E}_i\}\{\tilde{Q}_i \times i, \boldsymbol{B}^i\}, \{1, \nabla\}, \{i, \partial/\partial t\}\}. \tag{44}$$

Each element in this set is again a set of two elements, the first concerning P_i and the second concerning S^i. The first mark attribute of $h_i(q)$ is $\{\tilde{Q}_i, \boldsymbol{E}_i\}$, being a major determinate one; the second is $\{\tilde{Q}_i \times i, \boldsymbol{B}^i\}$, being a major indeterminate one; the third is $\{1, \nabla\}$, being a minor determinate one and the fourth is $\{i, \partial/\partial t\}$ being a minor indeterminate one.

Inserting mark attributes in the general zipper (8), we will obtain the mark zipper, but before carrying this out, the operators coherence, linking and transforming for the quality 'mark' have to be defined. Of course this will be carried out for numbers and vectorfields separately. The quality 'mark' is not governed by the extended Heisenberg principle as this is related only to time and space.

3.1. The Mark Zipper for a Point of Space

The mark operators for points of space are defined as follows:

Coherence ($\bowtie$) is multiplication of $\tilde{Q}_i$ or $\tilde{Q}_i \times i$ with one of the minor attributes 1 or i.

Linking ($\propto$) for ***distinct numbers*** is defined as numerical addition, so if $\tilde{Q}_i = -\tilde{Q}_j$ then $\tilde{Q}_i \propto \tilde{Q}_j = 0$; if $\tilde{Q}_j = 0$ then $\tilde{Q}_i \propto \tilde{Q}_j = \tilde{Q}_i$; linking for ***equal numbers*** is defined by: if $\tilde{Q}_i = \tilde{Q}_j$ then $\tilde{Q}_i \propto \tilde{Q}_j = \tilde{Q}_i$. ***Transformation*** of a real number is defined as: $[-\tilde{Q}_i] = -Q_i$ and $[\tilde{Q}_i] = Q_i$, being a real positive and negative charge, respectively, and for an imaginary numbers as: $[\tilde{Q}_i \times i] = 0$. Thus imaginary charge $\tilde{Q}_i \times i$ exists only in mathematical sense, in agreement with the absence of magnetic charges in experimental results.

For convenience's sake we repeat the ***first zip*** z_1 of the general zipper (8):

$$z_1 = \{D_i \propto D_j, (u^i \bowtie D_i) \propto (u^i \bowtie D_j) \propto (u^j \bowtie D_i) \propto (u^j \bowtie D_j)\}. \quad (45)$$

The element at the left is called the ***major chain***; the element at the right is called the ***minor chain***.

In this equation we insert the mark attributes for numbers (44), and because the minor mark attributes for H_i^+ and H_i^- are the same ($d_i = d_j = 1$ and $u^i = u^j = i$), the ***first mark zip*** $z_1(q_n)$ for two points of space is obtained as:

$$z_1(q_n) = \{\tilde{Q}_i \propto \tilde{Q}_j, (i \bowtie \tilde{Q}_i) \propto (i \bowtie \tilde{Q}_j) \propto (i \bowtie \tilde{Q}_i) \propto (i \bowtie \tilde{Q}_j)\}, \quad (46)$$

which, using the definitions given above, can be reduced to:

$$z_1(q_n) = \{\tilde{Q}_i \propto \tilde{Q}_j, (i \times \tilde{Q}_i) \propto (i \times \tilde{Q}_j)\}. \quad (47)$$

The minor chain (at the right) is zero for opposite numbers; for equal charges it is an imaginary number. Thus the transformation of the minor mark chain is zero in all cases and so the minor chain will be replaced by an empty set:

$$z_1(q_n) = \{\tilde{Q}_i \propto \tilde{Q}_j, \emptyset\}. \quad (48)$$

Similarly, the ***remaining three mark zips*** for numbers $z_2(q_n)$, $z_3(q_n)$ and $z_4(q_n)$ are obtained.
Then the ***mark zipper for a point of space*** is obtained as:

$$Z_{ij}(q_n) = \begin{Bmatrix} \{\tilde{Q}_i \propto \tilde{Q}_j, \emptyset\} \\ \{\emptyset, \emptyset\} \\ \{\{\tilde{Q}_i \propto (\tilde{Q}_j \times i)\}, \emptyset\} \\ \{\{\tilde{Q}_j \propto (\tilde{Q}_i \times i)\}, \emptyset\} \end{Bmatrix}. \quad (49)$$

In all cases the second zip for a point of space (z_{n2}) is empty.

3.2. The Mark Zipper for a Major Space

The mark operators for major spaces are defined as follows:
The coherence operator ($\bowtie$) is defined as field derivatives; coherence tests of vectorfield A are: $A \bowtie \nabla = \nabla \times \mathrm{A}$ and $A \bowtie \partial/\partial t = \partial A/\partial t$.

Linking ($\propto$) is defined as vector addition; linking for ***equal vectorfields*** is defined by: if $\boldsymbol{E}_i = \boldsymbol{E}_j$ then $\boldsymbol{E}_i \propto \boldsymbol{E}_j = \boldsymbol{E}_i$. If only the components of one vector appear, they will be collected to a complete vector.

Transformation of a vectorfield is defined as: $[\boldsymbol{E}_i] = \widehat{\boldsymbol{E}}_i$, $[\boldsymbol{B}^i] = \widehat{\boldsymbol{B}}^i$, $[\partial \boldsymbol{E}_i/\partial t] = \partial \widehat{\boldsymbol{E}}_i/\partial t$, $[\nabla \times \boldsymbol{B}^i] = \nabla \times \widehat{\boldsymbol{B}}^i$, $[\nabla \times \boldsymbol{E}_i] = \nabla \times \widehat{\boldsymbol{E}}_i$ and $[\partial \boldsymbol{B}^i/\partial t] = \partial \widehat{\boldsymbol{B}}^i/\partial t$. They are called real fields, or real field derivatives. The ***rooflet*** above the field terms indicate that the item has a physical meaning only ***inside*** the corresponding spatial object.

Inserting the mark attributes for ***fields*** (44) in the first zip of the general zipper (8), realising that the minor mark attributes for H_i^+ and H_i^- are the same ($d_i = d_j = \nabla$ and $u^i = u^j = \partial/\partial t$), we obtain the first mark zip $z_1(q_f)$ for fields as:

$$z_1(q_f) = \{\boldsymbol{E}_i \propto \boldsymbol{E}_j, (\partial/\partial t \bowtie \boldsymbol{E}_i) \propto (\partial/\partial t \bowtie \boldsymbol{E}_j) \propto (\partial/\partial t \bowtie \boldsymbol{E}_i) \propto (\partial/\partial t \bowtie \boldsymbol{E}_j)\}, \quad (50)$$

which, by using the operator definitions above, can be reduced to:

$$z_1(q_f) = \{\boldsymbol{E}_i \propto \boldsymbol{E}_j, \partial \boldsymbol{E}_i/\partial t \propto \partial \boldsymbol{E}_j/\partial t\}. \quad (51)$$

Similarly, the remaining three mark zips $z_2(q_f), z_3(q_f)$ and $z_4(q_f)$ are deduced. Then the ***mark zipper for a major space*** is obtained as:

$$Z_{ij}(q_f) = \begin{Bmatrix} \{\boldsymbol{E}_i \propto \boldsymbol{E}_j, \partial \boldsymbol{E}_i/\partial t \propto \partial \boldsymbol{E}_j/\partial t\} \\ \{\boldsymbol{B}^i \propto \boldsymbol{B}^j, \nabla \times \boldsymbol{B}^i \propto \nabla \times \boldsymbol{B}^j\} \\ \{\boldsymbol{E}_i + \boldsymbol{B}^j, \partial \boldsymbol{E}_i/\partial t \propto \nabla \times \boldsymbol{B}^j \propto \nabla \times \boldsymbol{E}_i \propto \partial \boldsymbol{B}^j/\partial t\} \\ \{\boldsymbol{E}_j + \boldsymbol{B}^i, \partial \boldsymbol{E}_j/\partial t \propto \nabla \times \boldsymbol{B}^i \propto \nabla \times \boldsymbol{E}_j \propto \partial \boldsymbol{B}^i/\partial t\} \end{Bmatrix}. \quad (52)$$

Combining the mark zipper for *a* ***point of space*** (49) with the mark zipper for *a* ***major space*** (52), the ***general mark zipper*** (for numbers as well as fields) is obtained as:

$$Z_{ij}(q) = \begin{Bmatrix} \{\{\tilde{Q}_i \propto \tilde{Q}_j, \boldsymbol{E}_i \propto \boldsymbol{E}_j\}, \partial \boldsymbol{E}_i/\partial t \propto \partial \boldsymbol{E}_j/\partial t\} \\ \{\boldsymbol{B}^i \propto \boldsymbol{B}^j, \nabla \times \boldsymbol{B}^i \propto \nabla \times \boldsymbol{B}^j\} \\ \{\{\tilde{Q}_i \propto (\tilde{Q}_j \times i), \boldsymbol{E}_i + \boldsymbol{B}^j\}, \partial \boldsymbol{E}_i/\partial t \propto \nabla \times \boldsymbol{B}^j \propto \nabla \times \boldsymbol{E}_i \propto \partial \boldsymbol{B}^j/\partial t\} \\ \{\{\tilde{Q}_j \propto (\tilde{Q}_i \times i), \boldsymbol{E}_j + \boldsymbol{B}^i\}, \partial \boldsymbol{E}_j/\partial t \propto \nabla \times \boldsymbol{B}^i \propto \nabla \times \boldsymbol{E}_j \propto \partial \boldsymbol{B}^i/\partial t\} \end{Bmatrix}. \quad (53)$$

The mark zipper is an inventory of all mathematical possibilities to mark ***already transformed*** space zips, being ***checked upon coherency***, in the given time case. If a transformed space zip contains a pointspace and the corresponding mark zip contains a charge, then the charge will be assigned to this pointspace; if not, the charge will not appear. If the transformed space zip contains a free space and the mark zip contains a magnetic field, then this field will be assigned to the free space ***as far as this space reaches*** (so outside no magnetic field appears) and the free space will be renamed a ***magnetic space***.

The ***first two laws of Maxwell***, being $\nabla \cdot \boldsymbol{E}_i = \tilde{Q}_i$ and $\nabla \cdot \boldsymbol{B}^i = 0$, are field definitions for determinate and indeterminate fields, respectively. This choice seemed rather obvious, taking into consideration that the spaces in the set of space attributes are defined as spherical. The ***third and fourth laws***, being $\partial \boldsymbol{B}^i/\partial t = -\nabla \times \boldsymbol{E}_i$ and $\partial \boldsymbol{E}_i/\partial t = \nabla \times \boldsymbol{B}^i$, can easily be deduced from the zipper by supposing that, for two interacting, equally marked H-units, coinciding in space and time, the quality 'mark' adds

no new items to the resulting H-event.[6] This is called '***identity protection***'. All together the laws can be written according to twin physics as:

$$\nabla \cdot \boldsymbol{E}_i = \tilde{Q}_i \,; \nabla \cdot \boldsymbol{B}^i = 0; \partial \boldsymbol{B}^i/\partial t = -\nabla \times \boldsymbol{E}_i; \ \partial \boldsymbol{E}_i/\partial t = \nabla \times \boldsymbol{B}^i, \quad (54)$$

in which only the tilde in $\tilde{Q}_i$ reminds us that this is mathematics, so the fields are not yet physically existing.

Three mark cases are distinguished: ***mark case 1*** for interactions with equal charges ($H_i^+ * H_j^+$ or $H_i^- * H_j^-$), ***mark case 2*** for opposite charges ($H_i^+ * H_j^-$) and ***mark case 3*** for one marked and one neutral H-unit ($H_i^+ * H_0$ or $H_i^- * H_0$). If the sign of the mark is not important, a marked H-unit may be indicated by only H_i. The mark zipper of interaction $H_i * H_0$ is obtained by simply dropping all items with index ***j*** in equations (49), (52) and (53).

Each H-unit, marked or neutral, has the same amount of potential energy. Consequently, a neutral H-unit H_0 has more potential energy available for its ***space attributes*** (the major and the minor space) and thus they are ***larger*** than those of a marked H-unit H_i. To create a mathematical bridge between atomic and astronomic phenomena, we suppose that the ***major space*** of H_0 has an ***astronomic*** size and that of H_i has a ***molecular*** size. Bear in mind that a single H-unit cannot be transformed into a phenomenon.

We did not find a mathematical reason why the neutral and the marked H-unit should have the same ratio between the radius of the major space and that of the minor space. In a neutral pellicle, an electron which is bound to a proton of type 2 may occur,[6] so the distance to the proton has to agree with atomic sizes. Consequently, a neutral pellicle p_0 should be larger than a marked pellicle $p_i(s^0 > s^i)$, but smaller than according to the ratio between the major spaces ($S^0 \gg S^i$). This implies that neutral and marked H-units are fundamentally different mathematical items and so the mark attributes are not an addition without obligation to a general H-unit, but an unremovable theoretical surgery.

Because of the difference in size of a marked and a neutral H-unit, we distinguish for mixed interactions $H_i * H_0$ twelve cases in addition to the seven already deduced cases for equal H-units (see [3] or the Appendix of [2]).

3.3. Example of a Mark Zipper

Now we are ready to describe interaction $H_i * H_j$ completely, so for time, space and mark. We will consider the example of Section 2.3 (about time and space interaction) again by adding the mark zipper to it. This interaction $H_i * H_j$, with partly overlapping major spaces, was deduced in Section 2.3 by the set of time-space aspects (41), with only the second element being non-empty. The resulting H-event $\Omega_2(t, \mathbf{r})$ was identified as a free space Θ_{ij}. Because a point of space is lacking, charge cannot appear and so, when adding the mark zipper, we have to consider only the second element of the mark zipper (see equation (52)), which is zip $z_2(q)$:

$$z_2(q) = \{\boldsymbol{B}^i \propto \boldsymbol{B}^j, \nabla \times \boldsymbol{B}^i \propto \nabla \times \boldsymbol{B}^j\}. \quad (55)$$

If both H-units H_i and H_j are marked, $z_2(q)$ will be transformed into a ***mark aspect*** as:

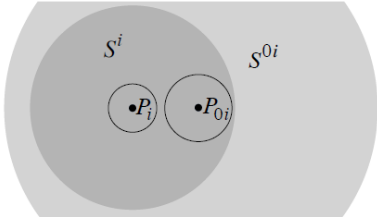

Fig. 6. Schematic mathematical representation of interaction $\underline{H_i^-} * \underline{H_{0i}}$, Point of space P_i is marked; P_{0i} is neutral.

$$\Omega_2(q) = \{\widehat{\boldsymbol{B}}^i + \widehat{\boldsymbol{B}}^j, \nabla \times \widehat{\boldsymbol{B}}^i \propto \nabla \times \widehat{\boldsymbol{B}}^j\}. \quad (56)$$

The rooflets indicate real magnetic fields. The reach of the appearing field is determined by the space aspect $\Omega_2(\mathbf{r})$ of $H_i * H_j$ (see (39)), being free space $\Theta_{ij}(S^i \cap S^j)$. The transformed minor chain in (56) contains space derivatives, but in the isolated case as we consider here, they cannot be actual and so only the transformed major chain remains. Then the complete ***set of H-events*** for $H_i * H_j$ can be written as:

$$\Omega_{ij}(t, \mathbf{r}, q) = \{\Theta_{ij}^{\boldsymbol{B}}(t, \mathbf{r}, q)\} = \left\{\Theta_{ij}^{\boldsymbol{B}}\{F^i \cap F^j, S^i \cap S^j, \widehat{\boldsymbol{B}}^i + \widehat{\boldsymbol{B}}^j\}\right\}. \quad (57)$$

containing only one H-event, usually shortened to $\Theta_{ij}^{\boldsymbol{B}}$ or $\Theta_{ij}^{\boldsymbol{B}}(S^i \cap S^j)$. This phenomenon, generated by $H_i * H_j$, is called a ***magnetic space***; its plays a central role in describing the photon.

If we consider the interaction of two neutral H-units $H_{0i} * H_{0j}$, then of course no mark attributes are provided and so the generated phenomenon will be free space $\Theta_{0i0j}(S^{0i} \cap S^{0j})$. Because these H-units have all potential energy available to generate space, the free space is in general larger than the magnetic space, so $\Theta_{0i0j} > \Theta_{ij}$; if the neutral region $S^{0i} \cap S^{0j}$ is relatively large, then even $\Theta_{0\text{i}0\text{j}} \gg \Theta_{ij}$.

4. The Photon

We will consider ***time mirrored interaction*** $\underline{H_i^-} * \underline{H_{0i}}$ of a marked and a neutral H-unit in ***space case*** *7C*. Then marked major space S^i is fully overlapped by the much larger neutral major space S^{0i} (so $S^i \cap S^{0i} = S^i$), in such a way that the pellicles are not intersecting (so $p_i \cap p_{0i} = \emptyset$) and the neutral point of space is inside S^i (so $P_{0i} \in S^i$). Fig. 6 gives a schematic representation of the relative positions of the H-units. Then the ***space zipper*** is:

$$Z_{i0i}(\mathbf{r}) = \left\{\emptyset, \{S^i, \emptyset\}, \{P_i, \emptyset\}, \{P_{0i}, \emptyset\}\right\}, \quad (58)$$

containing no minor attributes at all.

To describe a photon, we need a neutral point of space, available as P_{0i} in the fourth zip of (58) and so we choose ***mirrored time case 3*** (see equation (33)), characterized by $\tau_i \cap \tau_{0i} = \emptyset$ and $T_{0i} \notin \tau_i$. Then the mirrored ***time zipper*** is:

$$Z_{i0i}(\underline{t}) = \{\emptyset, F^i \cap F^{0i}, \emptyset, T_{0i}\}. \quad (59)$$

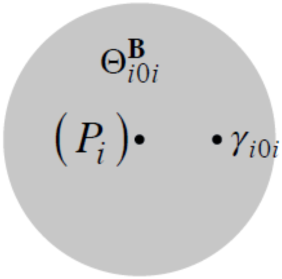

Fig. 7. Physical representation of interaction $\underline{H}_i^- * \underline{H}_{0i}$; photon γ_{i0i} in P_{0i} and magnetic space $\Theta^{\mathbf{B}}_{i0i}(S^i)$ in S^i. Marked point P_i does not appear.

Combining equations (59) and (58), the time-space zipper is obtained as:

$$Z_{i0i}(\underline{t},\mathbf{r}) = \{z_2, z_4\} = \begin{Bmatrix} \{F^i \cap F^{0i}, S^i\} \\ \{T_{0i}, P_{0i}\} \end{Bmatrix}. \tag{60}$$

To obtain the complete zipper, we have to add the 2nd and 4th elements of the general mark zipper (53) for ***mark case 3***, with H_i^- having a negative number $\tilde{Q}_i^-$ and H_{0i} having $\tilde{Q}_{0i} = 0$. In this case the ***mark zipper*** is:

$$Z_{i0i}(q) = \{z_2, z_4\} = \begin{Bmatrix} \boldsymbol{B}^i, \nabla \times \boldsymbol{B}^i \\ \{0, \boldsymbol{B}^i\}, \nabla \times \boldsymbol{B}^i \propto \partial \boldsymbol{B}^i/\partial t \end{Bmatrix}. \tag{61}$$

This has to be combined with time-space zipper (60). Because $z_4(\mathbf{r})$ contains only point of space P_{0i}, mark zip $z_4(q)$ will be reduced to one magnetic vector $\boldsymbol{b}^i$ in P_{0i}. Then the ***time-space-mark zipper*** can be written as:

$$Z_{i0i}(\underline{t},\mathbf{r},q) = \begin{Bmatrix} \{F^i \cap F^{0i}, S^i, \{\boldsymbol{B}^i, \nabla \times \boldsymbol{B}^i\}\} \\ \{T_{0i}, P_{0i}, \{\boldsymbol{b}^i, \nabla \times \boldsymbol{b}^i \propto \partial \boldsymbol{b}^i/\partial t\}\} \end{Bmatrix}. \tag{62}$$

First we will transform the space aspects and provisionally leave the transformation brackets for the mark aspect. Then the set of H-events $\{\Omega_2, \Omega_4\}$ can be written as:

$$\Omega(\underline{H}_i^- * \underline{H}_{0i}) = \begin{Bmatrix} \Theta^{\boldsymbol{B}}_{i0i}(F^i \cap F^{0i}, S^i, \{[\boldsymbol{B}^i, \nabla \times \boldsymbol{B}^i]\}) \\ \prod_{i0i}(T_{0i}, P_{0i}, \{[\boldsymbol{b}^i, (\nabla \times \boldsymbol{b}^i) \propto (\partial \boldsymbol{b}^i/\partial t)]\}) \end{Bmatrix}. \tag{63}$$

H-event Ω_2 is spherical ***magnetic space*** $\Theta^{\boldsymbol{B}}_{i0i}(S^i)$ with P_i in the center. Its time label $F^i \cap F^{0i}$ is an interval which may contain all time attributes of the two H-units, except T_i, so the movement of Ω_2 will adapt to that of Ω_4.

H-event Ω_4 is neutral point particle $\prod_{i0i}(P_{0i})$, existing asymmetrically inside $\Theta^{\boldsymbol{B}}_{i0i}(S^i)$. The time label is T_{0i}, so $\prod_{i0i}$ has a ***constant speed***, which in spherical coordinates may be straight ahead, or revolving around P_i; here we will focus on a ***straight ahead movement***. Then magnetic space $\Theta^{\boldsymbol{B}}_{i0i}(S^i)$ also moves with a constant speed. The ***static part*** of the mark aspect, being $\boldsymbol{B}^i$, cannot appear because the pointspace is moving, so this will be dropped. The ***dynamic part*** of the mark aspect, being $\nabla \times \boldsymbol{B}^i$, will be adapted to the shape of the magnetic space by adding a rooflet, saying that the magnetic field is restricted to S^i, so to $\nabla \times \widehat{\boldsymbol{B}}^i$.

In the second element in equation (63), we see a ***magnetic vector***, attached to pointparticle $\prod_{i0i}$. In this vector only indices *i* occur, indicating that it is generated by H_i^- (in interaction $\underline{H}_i^- * \underline{H}_{0i}$). Because of the time label T_{0i}, the magnetic vector is ***constant*** in direction and magnitude. Similarly as above, the ***static part*** of the mark aspect, being $\boldsymbol{b}^i$, cannot appear because the pointspace is moving, so it will be dropped. The ***dynamic part*** of the mark aspect, being $(\nabla \times \boldsymbol{b}^i) \propto (\partial \boldsymbol{b}^i/\partial t)$, is a link of 3-dimensional space derivatives and a 1-dimensional time derivative. The link operator connects items by definition in such a way, that they will occur combined in the resulting phenomenon. As in this case the two items $(\nabla \times \boldsymbol{b}^i)$ and $(\partial \boldsymbol{b}^i/\partial t)$ both concern the components of ***one vector***, the link operation can only be carried out by combining the two parts to one ***magnetic four-vector***, which will be indicated by $\Omega_4^4(\boldsymbol{b}^i)$. In spherical coordinates, this vector of four components can be written, separated by commas, as:

$$\Omega_4^4(\boldsymbol{b}^i) = \begin{pmatrix} \frac{\partial \boldsymbol{b}^i}{\partial t}\overline{t}, \\ \frac{1}{r\sin\vartheta}\left(\frac{\partial}{\partial\vartheta}(\boldsymbol{b}^i_\varphi \sin\vartheta) - \frac{\partial \boldsymbol{b}^i_\vartheta}{\partial\varphi}\right)\overline{r}, \\ \frac{1}{r}\left(\frac{1}{\sin\vartheta}\frac{\partial \boldsymbol{b}^i_r}{\partial\varphi} - \frac{\partial}{\partial r}(r\boldsymbol{b}^i_\varphi)\right)\overline{\vartheta}, \\ \frac{1}{r}\left(\frac{\partial}{\partial r}(r\boldsymbol{b}^i_\vartheta) - \frac{\partial \boldsymbol{b}^i_r}{\partial\vartheta}\right)\overline{\varphi}, \end{pmatrix}, \tag{64}$$

The time derivative is notated at the first place, as we are used to this sequence in H-events. The units of coordinates are indicated by $\overline{r}, \overline{\vartheta}$ and $\overline{\varphi}$. We use the convention that a ***vertical notation with commas*** indicates a ***vector***; without comma's it indicates a set. Then the mark aspect may be written shortly as the four-vector:

$$\Omega_4^4(\boldsymbol{b}^i) = \begin{pmatrix} \frac{\partial \boldsymbol{b}^i}{\partial t}, \\ \nabla \times \boldsymbol{b}^i \end{pmatrix}. \tag{65}$$

This is the mark aspect $\Omega_4(q)$ of interaction $\underline{H}_i^- * \underline{H}_{0i}$. It is remarkable that we obtain a four-vector in the derivation based upon 3-dimensional space and 1-dimensional time. Hence H-event Ω_4 is a neutral, massless, uncharged pointspace, moving straight ahead with a constant speed, carrying a magnetic four-vector which is constant in direction and magnitude. Thus $\prod_{i0i}$ will be identified as a photon, indicated by $\gamma_{i0i}(P_{0i})$ or shortly γ_{i0i}.

Then the ***set of H-events*** $\{\Omega_2, \Omega_4\}$, generated by $\underline{H}_i^- * \underline{H}_{0i}$ (see (63)) can finally be completed to:

$$\Omega(\underline{H}_i^- * \underline{H}_{0i}) = \begin{Bmatrix} \Theta^{\boldsymbol{B}}_{i0i}(F^i \cap F^{0i}, S^i, \nabla \times \widehat{\boldsymbol{B}}^i) \\ \gamma_{i0i}\left(T_{0i}, P_{0i}, \Omega_4^4(\boldsymbol{b}^i)\right) \end{Bmatrix}. \tag{66}$$

Altogether, time mirrored interaction $\underline{H}_i^- * \underline{H}_{0i}$ in space case 7C generates a ***photon*** $\gamma_{i0i}(P_{0i})$, existing asymmetrically inside ***magnetic space*** $\Theta^{\boldsymbol{B}}_{i0i}(S^i)$. When no other magnetic space is present, this space may also be called the ***magnetic cell*** of the photon. These two H-events are indicated in Fig. 7. Because the two H-events have equal energy *E*, we may write:

$$E(\gamma_{i0i}) = E(\Theta^{\boldsymbol{B}}_{i0i}). \quad (67)$$

If the photon-system moves straight ahead, then γ_{i0i} carries the magnetic four-vector $\Omega^4_4(\boldsymbol{b}^i)$ over a large distance, in agreement with experiments. In principle this movement is unlimited, which evokes the classical idea of unlimited space; however, the photon is accompanied by its own finite space.

The description of a ***constant*** four-vector, being composed of ***derivatives of time and space*** might be confusing, but the four-vector contains a secret. By using one of the laws of Maxwell (54), we may write:

$$\nabla \times \boldsymbol{b}^i = \partial \boldsymbol{e}_i / \partial t, \quad (68)$$

and so the time component $\partial \boldsymbol{b}^i / \partial t$ ***balances*** the spatial components of $\Omega^4_4(\boldsymbol{b}^i)$ of equation (65) in such a way that the ***four components*** together constitute an ***constant vector***. The reader may remember the well-known picture of a photon, depicted by two changing vectors, perpendicular to each other and to the propagation direction. There is a difference: according to our considerations, the photon is not carrying a 3-dimensional electromagnetic vector but a four-dimensional ***magnetic vector*** $\Omega^4_4(\boldsymbol{b}^i)$, and this cannot be depicted in two dimensions. The ***electromagnetic*** character of the photon appears only after it has been annihilated, by which action an electron will be generated by the interaction of the ***same*** marked H-unit H_i^- and ***another*** neutral or marked H-unit; this will be explained in Section 6.

In fact the photon γ_{i0i} is not a particle in the sense of an mass carrying object, or a charged object, but only a constant magnetic four-vector $\Omega^4_4(\boldsymbol{b}^i)$ inside $\Theta^{\boldsymbol{B}}_{i0i}(S^i)$, carrying ***ingrained magnetic changes***. In this way it may carry information over extremely large distances, as long as it is not disturbed. In the next section we will explain why the photon is potential instable.

5. The Potential Electron

Time mirrored interaction $\underline{H_i^-} * \underline{H_{0i}}$, being asymmetric, has a surprising feature which is hidden in its counterpart: the regular interaction $H_i^- * H_{0i}$. To explain this, we will consider $H_i^- * H_{0i}$, having the ***same space case*** 7C and ***mark case 3***, but with ***regular time case 3***, characterized by $T_i \notin \tau_{0i}$ (instead of $T_{0i} \notin \tau_i$) and given in equation (31). Then the 3rd element of the time zipper is non-empty, instead of the 4th element in (59)), and so the ***time zipper*** for $H_i^- * H_{0i}$ is:

$$Z_{i0i}(t) = \{\emptyset, F^i \cap F^{0i}, T_i, \emptyset\}. \quad (69)$$

The ***space zipper*** is the same as equation (58); for the sake of convenience we repeat it:

$$Z_{i0i}(\mathbf{r}) = \{\emptyset, \{S^i, \emptyset\}, \{P_i, \emptyset\}, \{P_{0i}, \emptyset\}\}. \quad (70)$$

Combining (69) and (70), we obtain the ***time-space zipper*** as:

$$Z_{i0i}(\underline{t}, \mathbf{r}) = \{z_2, z_3\} = \begin{Bmatrix} \{F^i \cap F^{0i}, S^i\} \\ \{T_i, P_i\} \end{Bmatrix}. \quad (71)$$

So, in the regular case we have to add the 2nd and ***3rd element*** of the mark zipper (8) (instead of the 2nd and 4th) in mark case 3 and so the ***mark zipper*** is in the mirrored time case of $H_i^- * H_{0i}$:

$$Z_{i0i}(q) = \{z_2, z_3\} = \begin{Bmatrix} \{\boldsymbol{B}^i, \nabla \times \boldsymbol{B}^i\} \\ \{\{\tilde{Q}_i^-, \boldsymbol{E}_i\}, \partial \boldsymbol{E}_i / \partial t \propto \nabla \times \boldsymbol{E}_i\} \end{Bmatrix}. \quad (72)$$

The mark zipper has to be combined with time-space zipper (71) above. Because $\boldsymbol{E}_i$ is not defined in P_i, mark zip $z_3(q)$ has to be reduced to $\tilde{Q}_i^-$. Then H-event Ω_3 appears (instead of Ω_4) and the ***set of H-events*** $\{\Omega_2, \Omega_3\}$, generated by $H_i^- * H_{0i}$, is:

$$\Omega(H_i^- * H_{0i}) = \{\Omega_2, \Omega_3\} = \begin{Bmatrix} \Theta_{i0i}(F^i \cap F^{0i}, S^i, \widehat{\boldsymbol{B}}^i) \\ e^-_{i0i}(T_i, P_i, Q_i^-) \end{Bmatrix}. \quad (73)$$

H-event Ω_2 is the same as in the mirrored time case: ***magnetic space*** $\Theta^{\boldsymbol{B}}_{i0i}(S^i)$. H-event Ω_3 is different: it is a pointspace with charge Q_i^- attached to it. This is identified as an ***electron of type 4,*** indicated by $e^-_{i0i}(P_i)$ in the center of $\Theta^{\boldsymbol{B}}_{i0i}$ (see Fig. 5), also called a ***plasma electron***. Because of time label T_i it moves with a constant speed. Note that no magnetic vector is attached to P_i, as no field vector of H_i^- is defined in that point (and H_{0i} is neutral). The electron has no spatial extension and so it has no mass.

In classical physics all electrons are supposed to have mass. However, in twin physics four types are distinguished and ***two types of electrons have no mass.***[6] In some experiments measurements of the mass of electrons did not succeed; possibly the reason was the absence of mass. Here we will give a short overview of these four types.

Type 1 has mass in the form of a cap and a spin particle along its border; it is called a ***free electron,*** as it cannot bind with a proton. Type 2 is similar to type 1, but the shape is more flattened; it is called a ***ground electron,*** as it may be bound to a proton in the lowest level. Type 3 has no mass and is asymmetrically surrounded by a magnetic space; it is called a ***chemical electron***, as it may occur in the higher atomic levels. Type 4 is similar to type 3, but the electron exists in the middle of the magnetic space; it is called a ***plasma electron***, as it may bind to protons at a large distance.

As $\underline{H_i^-} * \underline{H_{0i}}$ has the potential to generate an electron by flipping the time case, we call the electron as described in equation (73) the ***potential electron*** of the photon. Similar to equation (67), we may write for the energy:

$$E(e^-_{i0i}) = E(\Theta^{\boldsymbol{B}}_{i0i}), \quad (74)$$

and by comparing equations (66) and (73):

$$E(e^-_{i0i}) = E(\gamma_{i0i}), \quad (75)$$

so the energy has the same energy as the photon has.

The potential electron is an ***essential hidden feature*** of the photon-system, consisting of the photon and its asymmetrically surrounding, spherical magnetic space. As soon as any influence of a ***third H-unit*** causes the time case of this system to flip over to the regular version, the ***photon will be annihilated*** and an ***electron will appear***, generated by a new interaction of this third H-unit and the marked H-unit H_i^- of the previous interaction $\underline{H_i^-} * \underline{H_{0i}}$. Then the magnetic energy of the photon, stored in the magnetic four-vector inside the ***spherical*** magnetic space, will be transformed into electric charge inside a renewed, ***non-spherical*** magnetic space.

6. Decay of the Photon

The photon-system, generated by mirrored interaction $\underline{H_i^-} * \underline{H_{0i}}$, consists of ***photon*** $\gamma_{i0i}(P_{0i})$, having a magnetic four-vector $\Omega_4^4(\boldsymbol{b}^i)$, as H-event Ω_4, and ***magnetic space*** $\Theta_{i0i}^{\boldsymbol{B}}(S^i)$ as H-event Ω_2. The photon, existing asymmetrically inside the magnetic space, is generated with mirrored time label T_{0i} (equation (59)). The ***potential electron*** $e_{i0i}^-(P_i)$ could be generated as H-event Ω_3 by regular interaction $H_i^- * H_{0i}$, with regular time label T_i; it would exist in the center of the same magnetic space.

We want to find out how the potential instability of the photon might be activated and so we will consider a ***disturbing third H-unit*** in two examples. A single H-unit is a mathematical item without a physical meaning which cannot disturb a photon, so it has to be involved in another interaction to justify its existence in a physical context.

If an arbitrary H-unit H_1 is involved in interaction $H_1 * H_2$, then H_1 may start an interaction with a third H-unit H_3 if the new interaction $H_1 * H_3$ meets ***four junction rules***, which are explained in [6]. In the following of this paper, only one of them plays a role: the points of spaces P_1 and P_3 each cannot be transformed more than once (whilst major spaces S^1 and S^3 are available for more transformations).

First example: we consider ***a disturbing neutral H-unit*** H_{0j}, involved in some interaction $H_{0j} * H_{0k}$ or $H_j * H_{0j}$, with H_j being positive or negative marked. We do not focus on this interaction on its own, but only suppose that it will be such, that the neutral major space S^{0j} of H_{0j} has an uncovered part which may be used to disturb the photon by covering its magnetic space gradually, and possibly also the photon or the potential electron.

As soon as S^{0j} of the disturbing H-unit H_{0j} overlaps neutral major space S^{0i} of the photon-system, interaction $H_{0j} * H_{0i}$ starts in ***space case 7***, generating ***free space*** $\Theta_{0j0i}(S^{0j} \cap S^{0i})$. This does not disturb the photon, in accordance with the daily experience that light travels through free space. If H_{0j} moves in such a way, that pellicle p_i will be overlapped, this still does not disturb the photon. If P_{0i} will be overlapped, being the position of the photon, no interaction can start because this is already occupied.

Only as soon as S^{0j} overlaps point P_i, the position of the potential electron in Fig. 7, something happens: interaction $H_i^- * H_{0j}$ starts in ***regular time case 3***, ***space case 7C*** ($p_i \cap p_{oj} = \emptyset$ and $P_{0j} \in S^i$) and *mark case 3*.
Then the ***time zipper*** is:

$$Z_{i0j}(t) = \{\emptyset, F^i \cap F^{0j}, T_i \cup (f^i \cap \tau_{0j}), \emptyset\}, \tag{76}$$

and the ***space zipper*** is:

$$Z_{i0j}(\mathbf{r}) = \left\{\emptyset, \{S^i, p_i \cap p_{0j}\}, \{P_i, s^i \cap p_{0j}\}, \{P_{0j}, \emptyset\}\right\}. \tag{77}$$

Combining (76) and (77), the ***time-space zipper*** is obtained as:

$$Z_{i0j}(t, \mathbf{r}) = \{z_2, z_3\} = \begin{Bmatrix} \{F^i \cap F^{0j}, S^i\} \\ \{T_i, P_i\} \end{Bmatrix}, \tag{78}$$

so only the 2nd and 3rd elements of ***mark zipper*** (52) for $\underline{H_i^-} * \underline{H_{0j}}$ are relevant:

$$Z_{i0j}(q) = \{z_2, z_3\} = \begin{Bmatrix} \{\boldsymbol{B}^i, \nabla \times \boldsymbol{B}^i\} \\ \{\{\tilde{Q}_i^-, \boldsymbol{E}_i\}, \partial \boldsymbol{E}_i/\partial t \propto \nabla \times \boldsymbol{E}_i\} \end{Bmatrix}. \tag{79}$$

After having transformed the space zips in equation (78) into physical items, the mark zipper can be combined with the time-space zipper. These geometric items will be supplied with marks as far as possible, in agreement with the belonging time labels. Then we obtain the ***set of H-events*** $\{\Omega_2, \Omega_3\}$ for $\underline{H_i^-} * \underline{H_{0j}}$ as:

$$\Omega(H_i^- * H_{0j}) = \begin{Bmatrix} \Theta_{i0j}^{\boldsymbol{B}}(F^i \cap F^{0j}, S^i, \nabla \times \widehat{\boldsymbol{B}}^i) \\ e_{i0j}^-(T_i, P_i, Q_{i0j}^-) \end{Bmatrix}. \tag{80}$$

H-event Ω_2 is magnetic space $\Theta_{i0j}^{\boldsymbol{B}}(S^i)$; H-event Ω_3 is an ***electron of type 4***, written as $e_{i0j}^-(T_i)$, having no mass as it has no spatial extension. So in the ***regular time case*** the potential electron becomes actual, albeit in interaction $H_i^- * H_{0j}$, which is another one than the 'photon-interaction' $\underline{H_i^-} * \underline{H_{0i}}$. We suppose that H-unit H_i^- cannot simultaneously act in the regular ***and*** in the time mirrored case. The photon, having time label T_{0i} in the ***time mirrored case***, cannot adapt to this change and so it has to be ***annihilated***. The magnetic energy of the photon will be ***converted into the electron charge***.

Second example: we consider a ***disturbing, negative marked H-unit***, indicated by H_j^-, involved in some other interaction $H_j^- * H_{0k}$ or $H_j^- * H_k$ (H_k may be positive or negative). Just like in the first example, we do not focus on this interaction on its own, but only suppose that it will be such, that the marked major space S^j of H_j^- has an uncovered part which may be used to disturb the photon by covering the photon-system.

As soon as S^j of the disturbing H-unit H_j^- overlaps neutral major space S^{0i} of the photon-system, interaction $H_j^- * H_{0i}$ starts in ***space case 7***, generating magnetic space $\Theta_{j0i}^{\boldsymbol{B}}(S^j \cap S^{0i})$, overlapping $\Theta_{i0i}^{\boldsymbol{B}}(S^i)$. As H_j^- continues to approach P_{0i}, the magnetic space grows until it is spherical; then it can be written as $\Theta_{j0i}^{\boldsymbol{B}}(S^j)$. Also in this case, overlapping a pellicle has no effect, and if P_{0i} (being the position of the photon) will be overlapped, no interaction can occur because this point of space is already occupied.

Neutral major space S^{0i} is relatively large and S^i is close to its center (as it overlaps P_{0i}), so it will take some time before $\Theta_{j0i}^{\boldsymbol{B}}(S^j)$ will meet $\Theta_{i0i}^{\boldsymbol{B}}(S^i)$. Then interaction $H_i^- * H_j^-$ will start, in ***space case 7***, ***regular time case 1*** and ***mark case 1***, and a third magnetic space $\Theta_{ij}^{\boldsymbol{B}}(S^i \cap S^j)$ will be generated, which is non-spherical.

Next, as soon as H_i^- and H_j^- overlap each other's points of space P_j and P_i, ***space case 6*** is reached and besides the magnetic space, also an electron of type 3 will be generated.
The ***space zipper*** is:

$$Z_{ij}(\mathbf{r}) = \{\emptyset, \{S^i \cap S^j, \emptyset\}, \{P_i, \emptyset\}, \{P_j, \emptyset\}\}, \tag{81}$$

and the ***time zipper*** is:

$$Z_{ij}(t) = \{\emptyset, F^i \cap F^j, T_i, \emptyset\}. \tag{82}$$

Combining (81) and (82), the ***time-space zipper*** is obtained as:

$$Z_{ij}(t, \mathbf{r}) = \{z_2, z_3\} = \begin{Bmatrix} \{F^i \cap F^j, S^i \cap S^j\} \\ \{T_i, P_i\} \end{Bmatrix}. \tag{83}$$

To obtain the complete zipper, we have to add the 2nd and 3rd elements of mark zipper (52) for $H_i^- * H_j^-$. Then we obtain the set of H-events $\Omega(H_i^- * H_j^-) = \{\Omega_2, \Omega_3\}$ as:

$$\Omega(H_i^- * H_j^-) = \begin{Bmatrix} \Theta_{ij}^{\boldsymbol{B}}(F^i \cap F^j, S^i \cap S^j, \nabla \times \widehat{\boldsymbol{B}}^i + \nabla \times \widehat{\boldsymbol{B}}^j) \\ e_{ij}^-(T_i, P_i, \{Q_{ij}^-, \boldsymbol{b}^j\}, \nabla \times \boldsymbol{b}^j + \partial \boldsymbol{b}^j / \partial t) \end{Bmatrix}. \tag{84}$$

H-event Ω_2 is magnetic space $\Theta_{ij}^{\boldsymbol{B}}(S^i \cap S^j)$ and H-event Ω_3 is a massless ***electron*** $e_{ij}^-(P_i)$ in P_i. Similar to equation (66), the electron in P_i carries a ***magnetic four-vector*** in P_i:

$$\Omega(H_i^- * H_j^-) = \begin{Bmatrix} \Theta_{ij}^{\boldsymbol{B}}\left(F^i \cap F^j, S^i \cap S^j, \nabla \times (\widehat{\boldsymbol{B}}^i + \widehat{\boldsymbol{B}}^j)\right) \\ e_{ij}^-(T_i, P_i, \{Q_{ij}^-, \Omega_3^4(\boldsymbol{b}^j)\}) \end{Bmatrix}. \tag{85}$$

Also in this second example, the potential electron becomes actual, this time as an ***electron of type 3***, in interaction $H_i^- * H_j^-$, which is another than the 'photon interaction' $\underline{H_i^-} * \underline{H_{0i}}$. Again we suppose that H-unit H_i^- cannot simultaneously act in the regular ***and*** in the time mirrored case, so the photon has to be ***annihilated***. The magnetic energy of the photon will be ***converted into the electron charge***. The spherical magnetic space of the ***photon*** is marked by $\nabla \times \widehat{\boldsymbol{B}}^i$ (see equation (66)) and the non-spherical magnetic space of the *electron* is marked with $\nabla \times (\widehat{\boldsymbol{B}}^i + \widehat{\boldsymbol{B}}^j)$, so the latter has a higher energy density in a smaller space.

In both examples we see that a third H-unit makes the photon-system ***instable as soon as this overlaps the potential electron***. Then the photon, which is described by a ***magnetic*** four-vector, has to be annihilated and its dormant ***electromagnetic*** character appears as an electron.

Previously it was assumed that an electron, appearing after the decay of the photon, is an already existing electron, accelerated by absorbing the photon energy. However, according to twin physics, the appearing electron is a newly generated one, being potentially present in the photon-system. Thus the photon-system can be considered as an ***elementary solar cell***.

7. Conclusions

According to twin physics, a ***photon*** can be generated by the interaction of a neutral and a negative marked H-unit (H_{0i} and H_i^-). Simultaneously in the ***same*** interaction also a spherical magnetic space is generated, presumably of molecular size. The photon is ***asymmetrically*** surrounded by this finite magnetic space. The photon turns out to be a ***magnetic four-vector***, attached to a point of space inside this magnetic space. As far as we know, this is the first time that a four-vector has emerged from a theoretical treatise based upon 3-dimensional space and 1-dimensional time.

The photon-system (photon and magnetic space) is deduced by using a ***mirrored*** time zipper, saying that $T_{0i} > T_i$ is chosen, instead of $T_{0i} < T_i$ (in which T is an abstract point of time). If the ***regular*** time case is used, then instead of the photon, an electron appears in the center of the magnetic space by interacting with a disturbing third H-unit. Because the electron cannot appear simultaneously with the photon, we call it the ***potential electron*** of the photon.

The descriptions of the photon and the potential electron are closely related, in the sense that both can be described by the interaction of the ***same H-units***, which may be considered as a universe of discourse. The photon contains only magnetism and the electron only potential electricity, being complementary mark features; both are surrounded by a magnetic space. They cannot appear simultaneously, so they are mutually exclusive and they interchange their existence as soon as a disturbing phenomenon touches their joined system too closely. To sum up, we conclude that the photon and the potential electron are ***complementary phenomena***.

If a disturbing phenomenon approaches the photon-system until it overlaps the potential electron, then the ***photon will be annihilated*** and instead, the ***electron appears***. The electron may be of type 3 or 4, out of the four types of electrons we described previously.[6] In contrast to types 1 and 2, these electrons have no mass; in that aspect they are similar to the photon.

We conclude that the absorption of a photon does not accelerate an already existing electron, as is supposed in classical physics, but that during the decay the photon is replaced by an electron, a process in which the ***magnetic four-vector is converted into an elementary charge***. So the photon may be considered as an ***elementary solar cell***.

We expect that, in a similar way, a massless electron has a potential photon in its magnetic space and that, by a disturbing phenomenon, the electron annihilates and an actual photon appears. Then the electron would transform into an ***elementary electric light source***. This yet has to be elaborated. Also we have to specify in more detail which phenomena may be disturbing in one or the other direction of the transformation. This insight could provide a stimulus for efficiency studies into the production of electricity and light.

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Conflicts of Interest

The authors declare no conflict of interest.

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