

A Shift in Theoretical Attention for the Properties of Bulk Materials to Those of the Borders

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Abstract

In the previous fourteen years twin physics has been developed to reconcile descriptions of phenomena on a quantum-mechanical and astronomical scale, by considering them in a complementary way, according to the conviction of Heisenberg. The deduction of the central formula is presented in a visual way by using complementary colors, thus side-stepping theoretical difficulties and making the model more accessible. The examples are presented in a geometrical way. The obtained theoretical results have been identified with basic physical phenomena, like the forces of nature, elementary particles and neutron decay. Moreover, it is possible to describe two types of protons, three types of neutrons and four types of electrons. One type of electron is related to electricity at the border of bulk materials. It is accompanied by a finite magnetic field, restricted to a space of about molecular size.

Keywords: Twin Physics, Electricity, Magnetism, Bulk Material, Border of Material, Thin Layers, Protons, Electrons

Introduction

Originally physics was a science of observing all phenomena, including those whose existence was not proved experimentally. However, since the introduction of the laws of Newton, based upon observations of massive objects like bullets, physics became a purely **deterministic** science. If a phenomenon could not be measured, it was ignored or its very existence was called into question. Space, for instance, was considered as nothing, because the presence of space could not be scientifically established. In 1927 quantum mechanical experiments showed a **dualistic** behavior of matter, which shocked the entire scientific community, because this was not compatible with the laws of Newton. It was generally accepted that physics had become so counter-intuitive that it was going beyond human imagination. However, physicists continued to consider elementary particles as massive objects like tiny bullets, held together by a rather mysterious medium called force.

Since the discovery of nano-materials it is incomprehensible that they behave in a different way than matter in bulk materials. To be able to understand the behavior of new materials, the Newtonian way of thinking is expanded with an **indeterministic** way of thinking, based upon insights from quantum mechanics. The notion of indeterminism started with the uncertainty principle of Heisenberg in 1927 [1]. He was convinced that physics can be described entirely in a complementary way, but did not succeed in carrying this out. It was not until 1971 that he explained the main problem: the lack of complementary mathematics [2]. Three years later, Max Jammer presented a definition of complementarity, based upon the mathematical work of Weizsäcker [3,4]. Having

enhanced our comprehension with this new view and using historical ideas enriched with some new approaches, we constructed a complementary foundation for physics, called twin physics. In this model, indeterminism is considered as important as determinism, opening new perspectives on nowadays physics.

A second historical problem is the idea that physics is reigned by **mathematics**. Taking the same subject as above as an example, space was considered as **infinite** because the coordinate system that was applied, was infinite as well. On the contrary, in twin physics we consider mathematics not as defining physics, but as a tool to describe phenomena as far as we need according to the physical reality.

A third historical problem originates in the beginning of the 20th century, because the use of a **four-dimensional space** as introduced by Einstein in 1915 did not work on an atomic scale. In his later lectures Einstein suggested that this might be caused by the improper use of it on a subatomic scale and so we decided to return to 3-dimensional space and one-dimensional time [5].

Based upon the considerations above, the starting points of twin physics are: Uncertainty is as important as certainty. Spaces are finite energetic objects, as important as masses. Spaces have an extremely low energy density; they may overlap each other until some maximum density is reached. Masses have an extremely high energy density; they cannot overlap each other. Physical objects in general are expressed in 3-dimensional space and 1-dimensional time.

After having considered the definition of complementarity, we will use this to develop a complementary way of considering space

and time, written in set theory [3,6]. Also the uncertainty relation will be introduced in it. A unit of potential energy will be supplied with these sets. The interaction between two units is presented in a visual way by using complementary colors, thus avoiding theoretical difficulties. Using the resulting formula, called the zipper, basic phenomena like elementary particles and the forces of nature can be described; however, they will be represented only geometrically. The purpose of this paper is to show how the classical notion of matter can be expanded with *more types* of neutrons, protons and electrons, having deviating features, and possible consequences for the borders of bulk materials.

The theoretical details of the examples can be found in the book “Twin physics, the complementary model of phenomena” [7]. This contains an amended overview of previous publications and a few additions, with basic explanations and examples. The original development of twin physics can be found subsequently in six publications [8,9]. The fifth paper starts with a short manual for the use of twin physics; in the sixth paper, equations for all possible cases of time and space are brought together in the index. The seventh paper gives an overview of the theoretical construction [10,11].

Mathematics of complementarity

The definition of complementarity as presented by Max Jammer (1974) is:

“A given theory admits a complementary interpretation if the following conditions are satisfied:

- (a) It contains (at least) two descriptions A and B of its substance-matter;
- (b) A and B refer to the same universe of discourse;
- (c) Neither A nor B, if taken alone, accounts exhaustively for all phenomena of this universe;
- (d) A and B are mutually exclusive in the sense that their combination into a single description would lead to logical contradictions.”

Although this definition did not send shockwaves through the scientific community, as complementarity was no longer an actual subject, it did provide a *scientific gateway* to the complementary world [3,12-14].

A simple example from everyday life, to get some feeling for it, is the *production of textile*. (a) For A and B we take wool and weft; (b) they refer to the same universe of discourse which is textile; (c) if taken alone, textile cannot be produced with only wool, nor with only weft and (d) obviously they exclude each other.

To prepare our brains for physical applications, we will first apply this definition to *complementary colors*, as considered by painters:

- (a) Two descriptions are Red and Green; (b) they refer to the same subject which is colors; (c) each alone cannot describe all colors and (d) they are optimally contrasting.



Figure 1: Complementary colors represented by two colored blocks

Next we take for the universe of discourse *all physical space* (see Figure 2). For A we take *point of space P* in the middle of finite spherical space S. For B we take this same *space S, point P excluded*, written as $S \setminus P$. Both belong to all physical space, each alone cannot

describe the complete space and they exclude each other, so indeed these mathematical attributes are complementary.

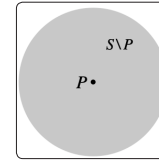


Figure 2: Two complementary space attributes

Now we want to involve the *Heisenberg principle*. This says that each observation of *certainty* implies a small amount of *uncertainty*. In colors this is expressed by gluing a small green block on the large red one (see Figure 3); the large one is called the major block, the small one the minor block. To extend the Heisenberg principle to a *complementary principle*, we have to require that also each observation of *uncertainty* implies a small amount of *certainty*, and so we add two complementary blocks, being a minor red block glued upon a major green block. We remove the glue and collect the four blocks in a set (see Figure 4). For the basics of set theory, see Kahn (1967).

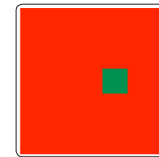


Figure 3: A minor green block glued upon a major red block



Figure 4: A set of four complementary colored blocks, two major and two minor ones

Turning back to *space*, point P and space $S \setminus P$ are considered as two *major* elements. We need two complementary minor elements to involve the extended Heisenberg principle. First we choose a tiny sphere s around point P and call it a *minor space*. Next we choose an infinitesimal skin upon the minor space and call it a *pellicle*. The minor space and the pellicle satisfy the conditions of complementarity. Now the *set of space of attributes* $h(x)$ for the H-unit can be written as:

$$h(\mathbf{x}) = \{ P, S \setminus P, p, s \} \quad (1)$$

For the geometric representation of this set, see Figure 5.

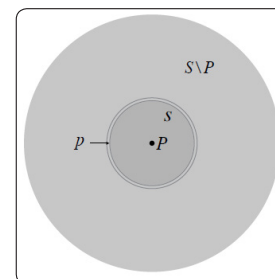


Figure 5: Geometric representation of the set of four space attributes

Now the question is whether it makes sense to use this set of **mathematical** attributes to describe **physical** items like mass and space. The answer can be found by combining two historical details. The first is: According to relativity theory, mass can be considered as a form of energy. The second is: According to the experimental reality, mass always includes some space. Combining them, space can be considered as a form of energy. Then because of the law of conservation of energy, space has to be a finite item. Indeed we have finite spatial items in the space set, so in principle it is possible to describe mass and space with them.

What shall we choose as a **unity**? Particles seem to be less and less elementary; a unit of energy is not possible, because it may exist in arbitrary small amounts. We define a **unit of potential energy**, called the **Heisenberg-unit** (H-unit or H_i). This mathematical item describes the conversion of energy from one type into another. The H-unit can be described in a complementary way by supplying it with the set of space attributes. By definition, conversion from potential to actual energy occurs only if a physical object has **interaction** with its surrounding, like for instance falling to the earth. So relativity theory is involved from scratch. We allow the H-unit to converse arbitrary small amounts into actual energy.

In the following we will deduce the formula for the **interaction** between two H-units by showing a similar consideration for complementary colors. In this way theoretical difficulties which might be an obstacle for a basic understanding are avoided. At the end we interchange the colors with the corresponding space attributes, obtaining the space zipper.

Two interacting H-units have the following sets of attributes:

$$h_i(\mathbf{x}) = \{P_i, S^i \setminus P_i, p_i, s^i\} \quad \text{and} \quad h_j(\mathbf{x}) = \{P_j, S^j \setminus P_j, p_j, s^j\}. \quad (2)$$

To describe their interaction, each H-unit will be represented by a set of complementary **colors** (see Figure 6). One unit has red and green blocks, the other violet and yellow. That is all they have, so interaction can only be expressed by these eight blocks.

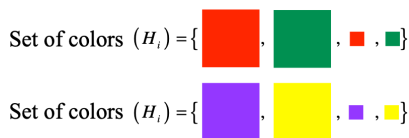


Figure 6: Two sets of colors, representing H_i and H_j .

Considering only the **major blocks**, there are 6 possible combinations. Because quantum mechanics says that the particle and wave character of one and the same particle never can be observed simultaneously, we will make a similar rule: The **rule of forbidden combinations** says that the major elements of one and the same H-unit are a forbidden combination. Consequently two combinations are forbidden (see Figure 7) and so four combinations are left. They represent four possible ways of **large scale interaction**.

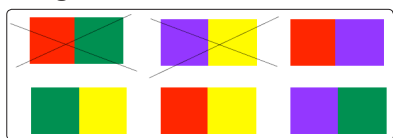


Figure 7: Four combinations of major blocks represent large scale interaction

To involve the minor blocks as well, we combine each **major** block with a **minor** one. Then there are twelve possible combinations, called **joined pairs** (see Figure 8). Small scale interaction is defined as the **linking** of these joined pairs to chains. Twelve joined pairs can be linked to chains of all possible lengths in a huge amount of ways. Fortunately we have the rule of forbidden combinations: Major red and major green cannot appear together, because they belong to one and the same unit, and the same goes for major violet and major yellow. Applying this rule, a chain of maximum length can contain only four joined pairs. Then only **four distinct chains** exist, each describing one way of **small scale interaction** (see Figure 9).

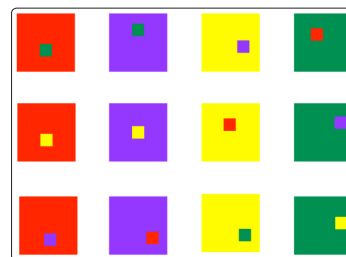


Figure 8: Twelve distinct joined pairs

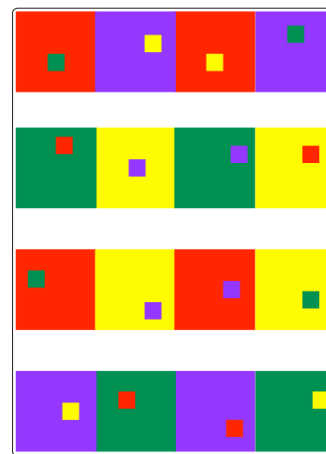


Figure 9: Four distinct chains of joined pairs

Combining the four large and the four small scale interactions two by two, we obtain four sets of two elements (see Figure 10). Collecting these four sets in one large set, we call it a **zipper**. Each element of the zipper, called **zip**, is a set of two elements, the left one describing large scale interactions and the right one small scale interactions. In this way the zipper represents a bridge between large- and small-scale phenomena.

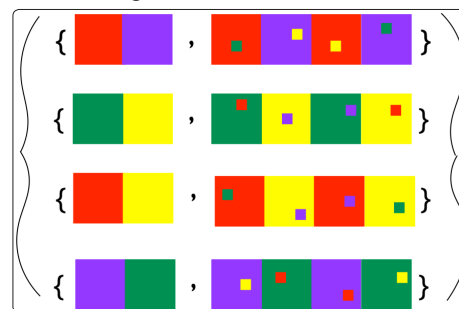


Figure 10: The color-zipper is a set of four zips, each being a set of a large and a small scale interaction

Now we will switch from colored blocks to space attributes of H-units by replacing the colored blocks by space attributes and the glue between the blocks by operators. The interaction between H_i and H_j is written as $H_i * H_j$.

Then the **space zipper**, combining all information about the space interaction of $H_i * H_j$, can be written as:

$$Z_{ij}(x) = \left\{ \begin{array}{l} \left\{ \left[P_i \cap P_j \right], \left[s^i \cap s^j \cap (P_i \supseteq s^j) \cap (P_j \supseteq s^i) \right] \right\} \\ \left\{ \left[(s^i \setminus P_i) \cap (s^j \setminus P_j) \right], \left[p_i \cap p_j \cap (s^i \setminus P_i \supseteq p_j) \cap (s^j \setminus P_j \supseteq p_i) \right] \right\} \\ \left\{ \left[P_i \cap (s^j \setminus P_j) \right], \left[s^i \cap p_j \cap (P_i \supseteq p_j) \cap (s^j \setminus P_j \supseteq s^i) \right] \right\} \\ \left\{ \left[P_j \cap (s^i \setminus P_i) \right], \left[s^j \cap p_i \cap (P_j \supseteq p_i) \cap (s^i \setminus P_i \supseteq s^j) \right] \right\} \end{array} \right\} \quad (3)$$

The square brackets indicate that these items still have to be transformed into a physical space. Usually only one or two zips are non-empty. In the examples we will represent the non-empty zips geometrically.

For the sake of completeness we will also show the time zipper. To obtain this, we use a **set of 1-dimensional time attributes** $h_i(t)$ for H-unit H_i analogous to the set of 3-dimensional space attributes (see equation (1)):

$$h_i(t) = \left\{ T_i, F^i \setminus T_i, \tau_i, f^i \right\}, \quad (4)$$

containing subsequently a **point of time**, the **future**, a flash of time **tau** (similar to the differential of time) and the **flying time** (see Figure 11). The flying time is the interval between two measurements; then no measurement is possible because each time measurement is a cyclic process, so in this interval time is indeterminate. Note that in the past the time axis is extrapolated to a continuous line, hiding this indeterminate feature.

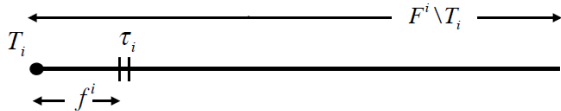


Figure 11: Geometrical representation of the set of time attributes

Replacing the space attributes in equation (3) by time attributes (4), we obtain the **time zipper**, describing the time interaction between H-units H_i and H_j , as:

$$Z_{ij}(t) = \left\{ \begin{array}{l} \left\{ \left[T_i \cap T_j \right], \left[f^i \cap f^j \cap (T_i \supseteq f^j) \cap (T_j \supseteq f^i) \right] \right\} \\ \left\{ \left[F^i \setminus T_i \cap F^j \setminus T_j \right], \left[\tau_i \cap \tau_j \cap (F^i \setminus T_i \supseteq \tau_j) \cap (F^j \setminus T_j \supseteq \tau_i) \right] \right\} \\ \left\{ \left[T_i \cap F^j \setminus T_j \right], \left[f^i \cap \tau_j \cap (T_i \supseteq \tau_j) \cap (F^j \setminus T_j \supseteq f^i) \right] \right\} \\ \left\{ \left[T_j \cap F^i \setminus T_i \right], \left[f^j \cap \tau_i \cap (T_j \supseteq \tau_i) \cap (F^i \setminus T_i \supseteq f^j) \right] \right\} \end{array} \right\} \quad (5)$$

Each time zip indicates if a geometric object described by the similar space zip is static or dynamic, moving with a constant velocity or accelerated. In the examples only the results of the time zipper are used.

Basic examples of described physical items

We will start with two basic examples of the zipper, expressing the interaction between two H-units in two different relative positions, to

obtain some feeling for the zipper. Next we will introduce one zipper more, the **mark zipper**, being the last one. This zipper describes charges and fields, connected to the described objects.

In the **first example** we have two H-units with partly overlapping major spaces (see Figure 12). The minor spaces are not overlapping at all. In that case only the **second zip** is non-empty. It describes the blue **mathematical object**, which in the next step will be transformed into a **physical object**. The grey region indicates the remaining potential energy. Removing redundant mathematics and ascribing energy to the object, we obtain a physical object having a low energy density, identified as a finite **space** (Figure 13).

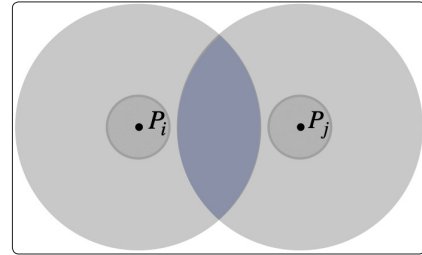


Figure 12: First example, geometrical representation of $H_i * H_j$.



Figure 13: First example, a physical finite space

In the **second example** we consider two **coinciding** H-units (see Figure 14). The **first zip** describes the green object, which will be transformed to a physical object. The grey region stays potential. Removing redundant mathematics and ascribing energy to the object, we obtain a physical object having a high energy density, identified as a **solid particle** (see Figure 15). This may be a proton or a neutron.

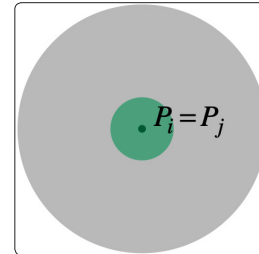


Figure 14: Second example, geometrical representation of $H_i * H_j$.



Figure 15: Second example, a physical solid particle.

To be able to describe a possible charge of the particle, we need the **mark zipper**. To **mark an H-unit**, we add a **number** to the **point of space**, indicated by Q_i (see Figure 16). After transformation into a real physical space, the number may appear as a charge. In Figure 17 the **radial field E** is shown, which is added to the **major space**; by interaction this field may transform into a real electric field. In Figure 18 the **circular field B** is shown, also added to the major

space, which may transform into a real magnetic field.

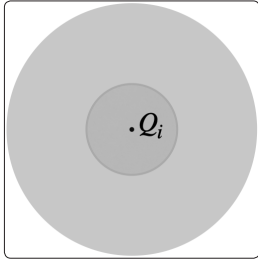


Figure 16: Number Q_p , the mathematical precursor of charge, is added to H_i

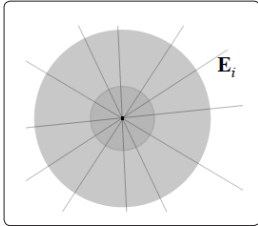


Figure 17: Radial field E_p , the mathematical precursor of an electric field, is added to H_i

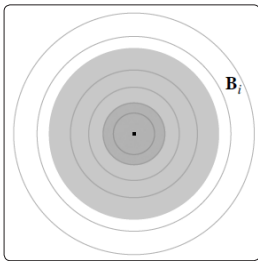


Figure 18: Circular field B_p , the mathematical precursor of a magnetic field, is added to H_i

The *set of mark attributes* of H-unit H_i will be given for the sake of completeness without explanation:

$$h_i(q) = \left\{ \{Q_i, \mathbf{E}_i\}, \{Q_i \times i, \mathbf{B}^i\}, \{1, \nabla\}, \{i, \partial/\partial t\} \right\}. \quad (6)$$

Inserting these attributes at corresponding places in the space zipper, we obtain the mark zipper:

$$Z_{ij}(q) = \left\{ \left\{ \left[\{Q_i \propto Q_j, \mathbf{E}_i \propto \mathbf{E}_j\} \right], \left[\partial \mathbf{E}_i / \partial t \propto \partial \mathbf{E}_j / \partial t \right] \right\}, \left\{ \left[\{ (Q_i \times i) \propto (Q_j \times i) \}, \left[\mathbf{B}^i \propto \mathbf{B}^j \right] \right], \left[\nabla \times \mathbf{B}^i \propto \nabla \times \mathbf{B}^j \right] \right\}, \left\{ \left[\{Q_i \propto (Q_j \times i), \mathbf{E}_i \propto \mathbf{B}^j\} \right], \left[\partial \mathbf{E}_i / \partial t \propto \nabla \times \mathbf{B}^j \propto \nabla \times \mathbf{E}_i \propto \partial \mathbf{B}^j / \partial t \right] \right\}, \left\{ \left[\{Q_j \propto (Q_i \times i), \mathbf{E}_j \propto \mathbf{B}^i\} \right], \left[\partial \mathbf{E}_j / \partial t \propto \nabla \times \mathbf{B}^i \propto \nabla \times \mathbf{E}_j \propto \partial \mathbf{B}^i / \partial t \right] \right\} \right\}. \quad (7)$$

The connection with classical physics is, that the laws of Maxwell can easily be deduced from the mark zipper by posing a few obvious limitations on it. In the examples only the results of involving the mark zipper are used.

Returning to the solid particle (see Figure 15) and supposing that the two H-unit are marked, a number is attached to the coinciding

points of space, so a charge appears and the particle can be identified as a *proton of type 1*.

In this case the *second zip* is non-empty; it describes a tiny particle upon the surface, being the transformation of the coinciding pellicles (see Figure 19). According to the second *time zip*, it moves over the surface with a constant velocity. According to the second *mark zip*, the tiny particle is magnetized, supplying the proton with a magnetic spin, so we call it a *spin particle*.

If the two H-units would deviate slightly from coinciding, then $p_i \cap p_j$ would be empty and so the mark number could not appear as a charge; then we would obtain a *neutron*.

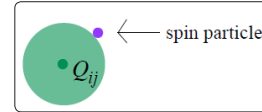


Figure 19: Second example, a proton and a spin particle at the surface

In the *third example* the two marked H-units have their points of space inside each others pellicles (see Figure 20). Then the *third zip* describes the red mathematical object having the *shape of a cap*. After transformation to a real space, the physical appearance is a thin membrane with a point in its middle (see Figure 21). According to the *time zip*, the cap turns around through the pellicle with a constant velocity and a radius of atomic size. According to the *mark zip*, a charge is attached to the point. This object is identified as an *electron of type 1*, having mass because it has a spatial extension. The *second zip* describes a tiny particle moving along the border of the cap with a constant velocity. It has a magnetic field inside, providing the electron with spin and so it is called a *spin particle*.

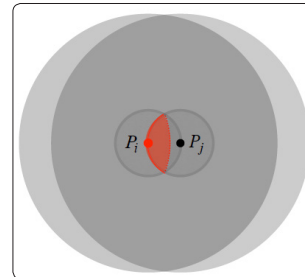


Figure 20: Third example, geometrical representation of $H_i * H_j$.

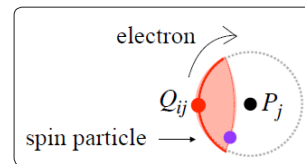


Figure 21: Third example, an electron of type 1 and a spin particle

In the *fourth example* the marked H-units are farther away from each other (see Figure 22). The *second zip* describes a *finite space* which is indicated in pink and the third zip describes only a *point of space*, indicated in red.

The second zip transforms into a space; the second mark zip describes a magnetic field, which will be restricted to this space. So the zipper transforms into two physical appearances, identified as an *electron of type 3* and a *magnetized space* of atomic size surrounding it (see

Figure 23). Together they rotate with a constant velocity around point of space P_j and so again a magnetic spin is produced.

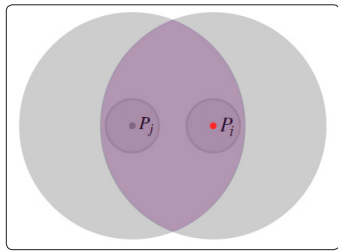


Figure 22: Fourth example, geometrical representation of $H_i * H_j$

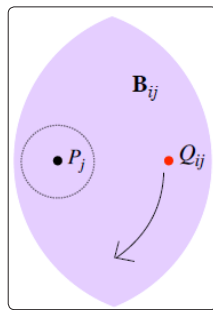


Figure 23: Fourth example, an electron of type 3 and a finite magnetized space

Comparing these two types of electrons (see Figures 21 and 23), the electron of type 1 has mass and that of type 3 not. Type 1 receives its spin from a separate particle, type 2 from the magnetized space. There is another difference. The electron of type 1 is a *free electron*, which cannot be part of a molecule. In the zipper of the electron of *type 3*, a pellicle (indicated with a dotted line) is not in use, nor the minor space inside or the point of space in the middle. This means that H_j may have a coinciding interaction with a third, positive marked H-unit, generating a proton. Then the electron of type 3 revolves around a proton, so it is a bound electron.

Advanced examples of described physical items

We do not only use marked, but also *neutral* H-units. Because a neutral H-unit does not lend potential energy to charges or fields, it can lend more to space and is therefore *larger* than a marked H-unit. By comparing our results with the experimental reality, the major space of a neutral H-unit has an *astronomical radius*; apparently the generation of charge and fields takes a lot of energy. We suppose that the minor space also is larger than that of a marked H-unit; for the moment its radius is estimated as molecular.

A *mixed interaction*, which occurs between a marked and a neutral H-unit, may also generate the previous elementary particles, but with *deviating features*. First we will explain why this is affecting especially the border of bulk material, after which we will consider these particles more close.

In Figure 24, at the left is space, dominated by *neutral* H-units. At the right bulk material is indicated schematically. Formerly not much attention was paid to the surface, but nowadays this is becoming more and more important. We suppose that there will be a transitional region, representing the border between space and mass, dominated by mixed interactions (see Figure 25). In the following we will show which types of elementary particles we can expect in this region. If we would go one step further and remove the bulk

matter at the right side, interchanging it by space, then only the transitional area remains, characterized by mixed interactions and representing nano-material (see Figure 26); however, this is not the purpose of this paper.

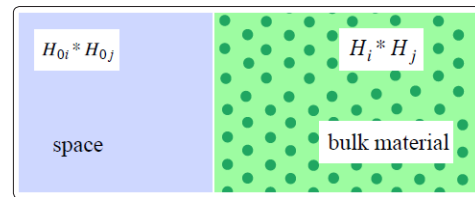


Figure 24: Space and bulk material without transitional region

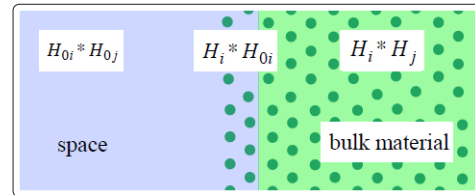


Figure 25: Space and bulk material with transitional region

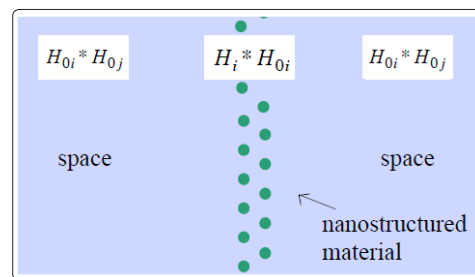


Figure 26: Space with only the transitional region

We will adapt three of the previous examples for *mixed interactions* and show the results, to see what type of deviations is obtained.

After having *adapted the second example* (see Figure 17) to a mixed interaction (see Figure 27), we obtain a *proton of type 2* and a finite *magnetized space*. Note that the mathematical infinite magnetic field is restricted to the marked major space of H_j . The same goes for a neutron. Because solid particles of type 2 are characteristic for the border of bulk material, the presence of these finite magnetized spaces is supposed to influence their magnetic features.

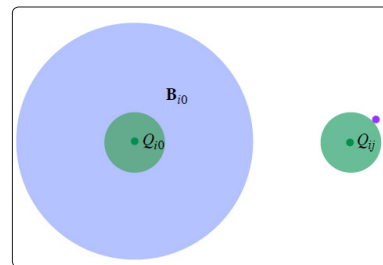


Figure 27: Left a proton of type 2 and a magnetized space, right a proton of type 1 and a spin particle

After having *adapted the third example* (see Figure 19) to a mixed interaction, we obtain the mathematical description of Figure 28. This transforms into two physical appearances, identified as an *electron of type 2* and a spin particle. Comparing the electron of

type 2 with the electron of type 1 (see Figure 29), they are similar, but the membrane of the electron of type 2 is **larger**, because of the larger neutral pellicle, so its shape is more flat and it revolves with a larger radius. Because its distance to the neutral point of space P_0 is larger, it is possible that a third, marked H-unit interacts coinciding with the neutral H-unit, generating a proton or a neutron. So the electron of type 1 is a free electron and the electron of type 2 can exist in a molecular bond.

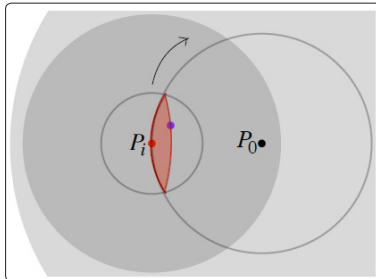


Figure 28: Adapted third example, geometrical representation of $H_i * H_0$

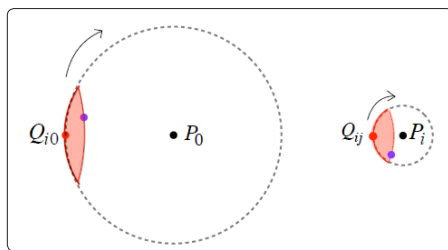


Figure 29: Left an electron of type 2, right an electron of type 1

After having **adapted the fourth example** (see Figure 23) to a mixed interaction, we obtain the geometrical representation of $H_i * H_0$ as shown in Figure 30. This transforms into two physical appearances, identified as an **electron of type 4** and a **spherical magnetized space** (see Figure 31, the left electron). Comparing the electron of type 4 with the electron of type 3, they are similar, but the electron of type 4 turns around with a larger radius; the magnetic space is spherical and slightly larger. The radius of the electron of type 4 even may have an astronomic size, as long as it exists inside the neutral major space; it is supposed to be characteristic for a plasma. However, depending on the surrounding, the radius also could be comparable with that of the electron of type 2 and so in principle it may play a similar role in a molecular bond.

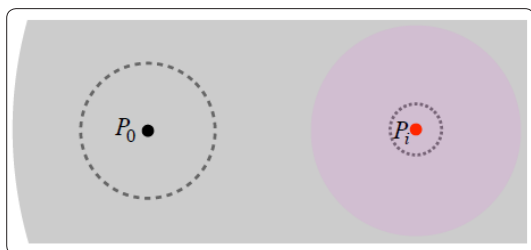


Figure 30: Adapted fourth example, geometrical representation of $H_i * H_0$

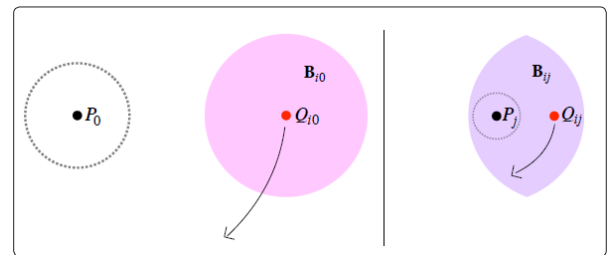


Figure 31: Left an electron of type 4, right an electron of type 3

For clarity in Figure 32 a schematic overview of the 4 possible types of electrons is given; the two at the left are generated by two marked H-units, the two at the right by mixed interactions.

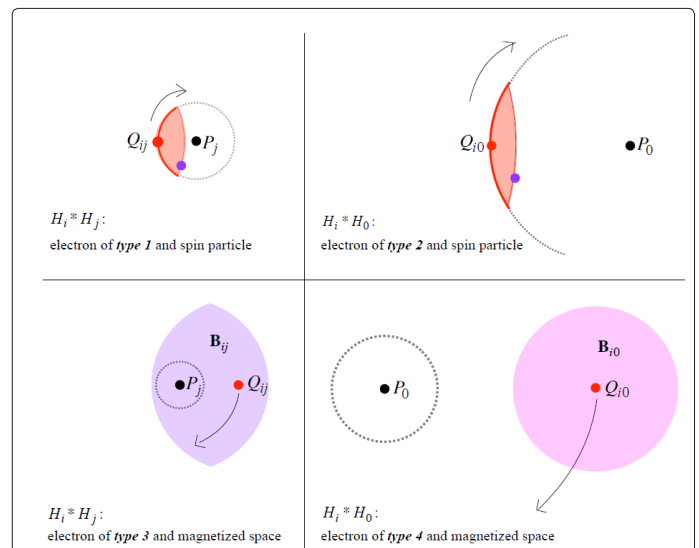


Figure 32: A schematic overview of the four types of electrons

Conclusion

Twin physics offers a method to distinguish **matter at the surface** from matter **inside** bulk material. First we described particles generated by two **marked H-units** and represented them in a geometrical way. This resulted in one type of proton, one type of neutron and two types of electrons. If the same particles are described by a **mixed interaction**, which is between a marked Heisenberg-unit (H-unit) and a neutral H-unit, then a second type of proton and a third and fourth type of electron is obtained. These particles have different spatial features, because a neutral H-unit has larger minor and major spaces. Mixed interactions are expected to dominate the border of bulk material, so their electric and magnetic features will be influenced by them. This might also be the reason for the occurrence of deviating electric and magnetic features in thin or nano materials.

The **proton or neutron of type 1** has a spin particle at the surface. The **proton or neutron of type 2** has no spin particle; instead it is accompanied by a finite magnetized space. Because the particles of type 2 are characteristic for the border of bulk material, the finite magnetized space is supposed to influence its magnetic features.

The **four types of electrons** are schematically shown above in Figure 32. The electron of type 1 is a **free** electron, having a spin particle traveling along its border. The electron of type 2 has a larger turning radius and so it is supposed to have deviating electric features; it is

supposed to be characteristic for the *border* of bulk material. The electron of type 3 occurs as bound to a molecule, accompanied by a finite magnetized field; it is characteristic for *bulk* material. The electron of type 4 has the largest radius when turning around a proton, possibly reaching to astronomic distances as long as it exists inside the neutral major space; it is characteristic for *plasma*. In principle smaller distances also may occur; then the electron of type 4 it might play a similar role as the electron of type 2.

The size of the marked minor space is about equal to the size of a proton or neutron; the size of a neutral major space is supposed to be astronomic. The size of the marked major space is roughly estimated as molecular and that of the neutral minor space as somewhat larger than that. If the dimensions and proportions of minor and major spaces of both marked and neutral H-units would be related to constants of nature, then they would be decisive for the dimensions in which phenomena appear to us.

This is only the first step in developing a new view on common elementary particles. There is a lot to explore, to find out if these descriptions can be useful to control features in new materials.

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