The Greatest Blunder of Science: „Electric Charge“ is a Synonym for „Geometric Area“. Its fundamental SI Unit „Coulomb“ is a Synonym for „Square Meter“

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Abstract

The current definition of the basic quantity „**electric charge**“ and its fundamental SI unit „**coulomb**“ in physics is, undoubtedly, the greatest blunder of modern science. When the **principles of mathematical formalism** are applied to this definition, it can be proven in an irrevocable manner that „**electric charge**“ is not an intrinsic property of matter, as is erroneously believed in physics today, but a synonym for „**geometric area**“, while its SI unit „**coulomb**“ is a synonym for „**square meter**“. The reason for this **systemic blunder** is the incomplete, and hence, formalistically wrong translation of the current definition of electric charge into a mathematical equation by physicists, from which they have subsequently derived all known laws of electricity, magnetism and electromagnetism. Thus, this formalistic blunder has been repli-

cated numerous times throughout the history of science and has biased the whole edifice of physics and natural sciences from mathematical, epistemological and cognitive point of view. This revolutionary physical and mathematical proof affects the very foundation of modern science. At the same time it opens the possibility of a full axiomatisation of physics and its development to a consistent, unified theory of the physical world.

1. Introduction

The current definition of the basic quantity „**electric charge**“ and its fundamental SI unit „**coulomb**“ in physics is, undoubtedly, the greatest blunder of science since the rejection of the geocentric Ptolemaic system of the universe in late Renaissance, when the foundation of modern science was laid by such prominent scholars as Copernicus, Galilei, Kepler and Descartes. Although since then billions of physicists, scientists, teachers and students have studied, educated and used the definition of „electric charge“ in the firm belief that it is an intrinsic property of matter, and are still doing so today in schools, universities and experimental research all over the world, they have obviously failed to realize that the current definition is, in fact, a **synonym** (tautology) of the simple geometric term „**area**“, which is known since antiquity, e.g. in Euclidean geometry. Accordingly, the SI unit „coulomb“ is a synonym for the area unit „square meter“:

$$\textbf{charge = geometric area}$$
$$\mathbf{1}\ \boldsymbol{coulomb} = \mathbf{1}\ \boldsymbol{m^2}$$

The reason, why this greatest scientific blunder could have occurred in such an „exact“ natural discipline as physics, lies solely in the fact that physicists have translated the verbal, non-mathematical definition of „electric charge“ in an incomplete, and hence, wrong way into a mathematical equation, from which they have

subsequently derived all known laws of electricity. Thus they have biased the theory of electromagnetism from an epistemological and cognitive point of view. This elementary and incomprehensible mathematical inconsistency has been grossly overlooked by educated mankind.

In the following, an impeccable and irrevocable mathematical proof will be presented that is based on the **methodological principle of mathematical formalism**, namely, the **principle of inner consistence and lack of contradiction**, also known as **Hilbert's formalism**: It will be shown that „electric charge" is not an intrinsic property of matter, as is believed in physics today, but a synonym for „geometric area", and that the SI unit „*coulomb*" is a synonym for „*square meter*".

All mathematical proofs presented in this publication are accomplished according to established physical theory and experimental evidence, and adhere diligently to currently accepted definitions in electricity and magnetism that can be found in any comprehensive textbook on physics. The new, revolutionary aspect of the present elaboration is the consistent implementation of mathematical formalism in physics and the novel interpretation of the epistemological and cognitive background of basic physical terms.

2. Mathematical Proofs

2.1 General Considerations

Physics is essentially mathematics applied to the physical world. All known physical laws are expressed as mathematical equations. All the fundamental physical constants, describing Nature as an ordered whole, are the result of mathematical equations. The SI system is, for instance, a surrogate anthropocentric system, with the help of which all the quantities and basic SI units of physics are introduced through their **method of definition and measurement**. It is a simple mathematical method of building *a priori* theoretical (numerical) relationships and their *posteriori* measure-

ment through experiments in the real physical world. Therefore, the SI system can be substituted by any other arbitrary reference system, as it does not contribute to our physical knowledge on Nature (see below).

All the SI units and their measurements are, per definition, **dimensionless quotients** (**numbers**). It is a pure convention to attach the name of SI units to a numerical result, e.g. 1*m*, 1*s*, 1*C*, 1*J*. For instance, when we say that an object has a mass of $m = 5kg$, we have actually compared its gravitational weight (force) with that of a reference object with the unit mass of $m_r = 1kg$, hence $F/F_r = mg/m_rg = m/m_r = 5kg/1kg = 5$ (dimensionless number). This method of definition and measurement is used for any other SI unit and its corresponding physical quantity. This universal method of introducing physical quantities in natural science is based on the simple mathematical **principle of circular argument** (see below).

Without the ability of presenting physical phenomena in terms of mathematical relations and equations, the physical world would be incommensurable and hence incomprehensible to human mind, and physics would not have evolved to the exact natural science, we know it today. This is basic methodological knowledge that any person with a modest understanding of physics and science should possess.

2.2 Basic Quantities and SI Units of Electricity

The above observations hold true for the two basic quantities of electricity and their SI units - **charge *Q*** with the SI unit "**coulomb**" (***C***), and **current *I*** with the SI unit "**ampere**". They are currently defined within the SI system in a circular manner, so that they can be reduced to one fundamental dimensionless quantity and unit, e.g. charge:

(I) „The SI unit of **charge** is the *coulomb*, which is defined in terms of the unit of **electric current**, the *ampere* (The ampere is defined in terms of a magnetic-force measurement...). The *coulomb* (*C*) is the *amount of charge* flowing through a *cross-sectional area* (*A*) of a wire in *one second* when the current in the wire is *one ampere*“. (1)

(II) „If ΔQ is the charge that flows through the *cross-sectional area A* in *time* Δt, the *current* is $\boldsymbol{I = \Delta Q/\Delta t}$**.** The SI unit of current is the *ampere* (*A*): $1A = 1C/s$“. (2)

This circular, tautological definition of the two fundamental quantities of electricity, charge and current, within the SI system is based on the **geometric method** of measurement of their units. Practically, it is based on the definition and measurement of the (electro)-magnetic force. This force is also called *electromotive force* (*emf*).

The classical definition of electric charge and current, as quoted above, implements mathematics in an inconsistent way and introduces a systemic flaw in electricity that extends throughout the whole edifice of physics. This has not been realized so far. When the non-mathematical, verbal definition of electric current (II) is presented in mathematical symbols in physics, the quantity “**cross-sectional area *A***“ is omitted without any reason: $\boldsymbol{I = \Delta Q/\Delta t}$. This omission in the mathematical presentation of the current is a fundamental **formalistic blunder** with grievous cognitive consequences for this discipline. This becomes evident when we express the present formula of the current in non-mathematical terms: Electric current *I* is the charge ΔQ that flows during the time Δt or alternatively “current is charge per time.“ This definition is meaningless, as physics “does <u>not</u> know what charge is“ (3).

In reality, the current is measured in relation to the **cross-sectional area *A*** of the conductor according to the *principle of circular argument*. The latter is the only operational method, with which all

known physical quantities are initially defined within mathematics and then measured in a secondary manner in the real physical world. As we have shown above for the charge and current, this procedure is the foundation of the SI system - it is the **universal method of definition and measurement** of all physical quantities and their corresponding SI units.

The principle of circular argument operates as follows: For each specific physical quantity, defined in an *a priori* mathematical manner in the mind, a real physical system is chosen as a *reference system* and its specific quantity, e.g. energy, force, space, time, etc., is assigned the number „one“ = 1. This is a basic mathematical procedure, a **primary axiom** that allows the application of mathematics to real objects. In the above definition of charge, the reference system is the cross-sectional area *A* of the wire, which can be experimentally measured. The charge is then defined as a relationship to *A*. When $A = 1$, the cross-sectional area may disappear optically as a quantity from the mathematical equation of the current, but it is still part of its theoretical definition. This fact has been grossly overlooked by all physicists so far.

Physical relationships can only be built between identical quantities. There is no exception to this rule. Relationships between heterogeneous quantities are meaningless, unless they are associated with *conversion factors* that establish the **equality of dimensions** in a physical equation. Such conversion factors are often defined in physics as *natural constants*. This is the mathematical basis of modern physics that should be the topic of any true methodology of this natural science.

The aforementioned basic formalistic considerations regarding the application of mathematics in physics are made for the first time in this theoretical clarity, although they have been intuitively followed in conventional physics, unfortunately, not in a consistent way, as has been shown for the definition of charge above. It is a basic axiomatic knowledge that it is sufficient to introduce only one wrong statement in a mathematical system to bias the whole

system. This knowledge, as proven by Gödel in 1931, has undermined *Hilbert's formalism*, with which the consistency of mathematics ought to be proven by *finite procedures* (4). This has triggered the **foundation crisis of mathematics** (Grundlagenkrise der Mathematik) as embodied by the *continuum hypothesis* and the famous *Russell's antinomy*; this crisis is still ongoing, notwithstanding the fact that nowadays all mathematicians and theoreticians prefer not to take any notice of it. Since physics is applied mathematics to the physical world, the ongoing foundation crisis of mathematics also affects the theoretical foundation of this natural science.

Gödel proved essentially that mathematics, being a hermeneutic discipline without an external object of study, cannot furnish the missing **proof of existence** (Existenzbeweis) by finite procedures and thus achieve its full axiomatisation with its own means. Each time such formalistic procedures are applied to the structure of mathematics, they lead to fundamental *antinomies* and challenge its very foundation. Gödel's theorem tells us in plain words that, in order to solve its ongoing foundation crisis, mathematics should seek its proof of existence in the real physical world.

The goal should be the establishment of an **integrated physical and mathematical axiomatics** based on finite procedures, with the help of which the proof of existence should be empirically rendered. Such an axiomatics should depart from a small number of primary axioms - ideally from a **single primary axiom** - that are valid in both physics and mathematics, so that there will no longer be any artificial theoretical separation between the two disciplines. The theoretical results of the present publication in the field of electricity and electromagnetism will show that this task can be easily achieved within the existing structure of physics by consistently implementing the principles of mathematical formalism and thereby eradicating all mathematical, formalistic blunders that have been historically introduced in this natural science.

Such mathematically inconsistent statements and definitions can often be encountered in present-day physics. Their existence and uncritical application have, so far, hindered the **unification of physics**. At present, physics, being a scientific categorical system for the physical world, cannot adequately reflect the unity of Nature - for instance, gravitation cannot be integrated with the other three fundamental forces in the standard model, and there is no theory of gravitation at all. The elimination of these mathematical inconsistencies from the theory of physics will allow the development of this natural science to a truly axiomatic system of Nature. This accomplishment will be the much endeavoured unification of physics on the basis of mathematical formalism. This theoretical elaboration is indispensable for an understanding of the subsequent analysis and mathematical proofs.

When mathematical formalism is applied to physics, respectively, to electricity in a consistent way, the correct presentation of the above definition of the *electric current* and of its SI unit *ampere* should include the *cross-sectional area A*, as this quantity is explicitly introduced as a *reference system* in the verbal definition:

$$I = \frac{\Delta Q}{A\Delta t} = 1ampere = \frac{1C}{1m^2\Delta t} \qquad (1)$$

When we set for the time $1/\Delta t = 1$, e.g. as a dimensionless number $1s/1s$, $\Delta t = 1s$, in equation (1), we obtain for the current unit $1\ ampere = 1\ coulomb/1m^2$. In this case, the fundamental SI unit „coulomb“ is defined as a relationship to „*one square meter*“; this SI unit (meter for *length* = [1*d-space*]) assesses „geometric area“ = [2*d-space*] („*d*“ for geometric **d**imension). Therefore, the definition of „electric charge“ through the definition and measurement of its SI unit „coulomb“ is a hidden, tautological definition of „geometric area“, respectively, „square meter“.

In order to fully comprehend equation (1), we must explain from a mathematical, formalistic point of view what the unit 1 *ampere*

really means. As with all physical definitions, the current definition of this unit is at the same time the method of measurement of the corresponding quantity **electric current:**

> „If two very long parallel wires *one meter* apart carry equal currents, the current in each is defined to be *one ampere* when the force per *unit length* on each wire is $2\times10^{-7}N/m$.“ (5)

The interaction between the two wires takes place at a distance of $R = 1m$ and is mediated through the magnetic fields, which occur around the two equal electric segments: $I_1\Delta l_1 = I_2\Delta l_2$, where $\Delta l_1 = \Delta l_2 = \Delta l = 1m$ and $I_1 = I_2 = 1$ *ampere*. When the currents flow in the same direction, the wires are attracted; when the currents are anti-parallel, the wires are repelled. This motion is assessed as an *electromotive force, emf***.** This interaction was first discovered by Oersted who observed the effect of a current on a compass needle and was experimentally confirmed by Ampère for parallel and anti-parallel currents:

$$F = \frac{\Delta l}{R} \times \frac{\mu_o}{2\pi} \times I_1 I_2 = \frac{\mu_o}{2\pi} = 2 \times 10^{-7} \left[Nm^{-1} \right]. \qquad (2),$$

where $\Delta l/R = 1m/1m = 1$ and $I_1 = I_2 = 1$ *ampere* $= I_1 \times I_2 = 1$. As we see, the definition of ampere resorts to the number “1“ as the universal symbol of presenting physical quantities and their dimensions as units of the SI system, e.g. 1*C*, 1*A*, 1*m*, 1*s*, etc. With such units, all actual magnitudes are measured as *relationships* in the real physical world.

In reality, equation (2) is a hidden definition of the basic constant of electricity, the **permeability of free space μ_o**,:

$$\mu_o = 2\pi F = 4\pi 10^{-7}\ [NA^{-2}] \qquad (3)$$

The experimental definition of the electric current illustrates the ubiquitous fact that electromagnetism can be adequately assessed through simple interactions between material electric systems. While classical mechanics deals with gravitational interactions, electromagnetism focuses on electromagnetic interactions. Both kinds of interactions are mediated by *fields* - they are „actions at a distance“ - so that any material system can simultaneously exhibit gravitational and electromagnetic properties.

All kinds of interactions observed in physics are **energy interactions** - physics is a science of energy interactions. Force F is a useful, mathematically defined quantity, with which any energy interaction can be properly assessed. When one speaks in physics, for instance, of the four fundamental forces, one means in reality the corresponding basic energies, such as gravitational, electromagnetic, weak or nuclear energy. Force is often used in physics as a synonym for energy, although it is a different mathematical quantity $F = E/s$. This is another common verbal (descriptive) inconsistency in mathematical definitions that biases the theory of physics and hinders its axiomatic unification.

The measurement of the electromagnetic force that is acting on the two segments is, therefore, a measurement of the *field energy* resulting from this interaction: $E = Fs = F$, when $s = 1m = 1$. According to the fundamental mathematical **axiom of reducibility** (6), this energy can be mathematically expressed as the product of the interaction of the two currents $E = I_1I_2$, the latter being formalistically regarded as energy quantities: $I_1 = E_1$ and $I_2 = E_2$. The axiom of reducibility is thus the *a priori* mathematical procedure, with which any energy interaction can be expressed with respect to *energy conservation* (1. law of thermodynamics). Departing from the principle of circular argument, we can assign this energy the primary number “1“, e.g. as 1 *joule* with respect to the SI system:

$$E = I_1I_2 = E_1E_2 = 1 = 1\ joule \qquad (4)$$

We have deduced this equation *axiomatically* from our mathematical consciousness in an *a priori* manner, without using any physical knowledge. It can be proven that it is valid for all energy interactions in the real physical world, as they obey the law of conservation of energy. The full proof is beyond the scope of the present article, but can be independently confirmed by any physicist or theoretician within modern physics.

The axiom of reducibility is thus the *universal mathematical procedure*, with which all physical laws and other mathematical equations are theoretically derived in physics and are then experimentally confirmed without any exception in a secondary manner. This is the epistemological background of physics as **applied mathematics to the physical world** - it explains for the first time, why Nature is of mathematical character, e.g., why Nature obeys natural laws that can be expressed in terms of mathematical equations. Although this knowledge has been central to Pythagoreanism, Platonism, and Neo-Platonism (e.g. Cusanus), this conclusion was made for the first time in this impeccable manner fourteen years ago, after I had consequently implemented the principles of mathematical formalism in modern physics. This elementary methodological finding, which any person with a modest knowledge of physics can easily deduce for himself, is, at present, not explicitly apprehended by scientists.

This is especially true for the mathematical definition of all SI units. As discussed above, the method of definition and measurement of the current SI unit „ampere" is entirely based on mathematics, respectively, geometry - therefore, it should confirm the above equation (4). Indeed, when we solve equation (2) for the **energy** in equation (4):

$$E = I_1 I_2 = \frac{2\pi F}{\mu_o} = \frac{2\pi 2 \times 10^{-7}}{4\pi \times 10^{-7}} = 1 Joule \qquad (5),$$

we obtain our axiomatically (a priori) anticipated result (see also equation (3)). From a formalistic, mathematical point of view, the actual definition of the current SI unit **1 ampere** can be rewritten as follows:

> When the exchanged energy between two equal, arbitrarily defined electric currents (segments) placed at a distance of 1*m* is 1 *joule* per *second* (explicit introduction of the SI system as a mathematical method of measurement, 1*m* for space, 1*s* for time and 1*joule* ($m^2 s^{-2}$) for energy (space-time)), the energy of each electric segment can be defined as the basic unit of 1 *ampere*:

$$1\ E_{electric} = 1\ ampere = 1[Js] = [m^2/s] = 1 \qquad (6)$$

When $t = 1s$, the SI unit of current is $ampere = m^2 = [2d\text{-}space] = area$ within mathematical formalism. Observe that according to the current definition, the SI unit „joule“ is not a basic SI unit, but a derivative of the two basic SI units „*meter*“ and „*second*“, which are defined in physics in a circular manner.

The current definition of „ampere“ is thus an arbitrary decision with respect to the surrogate SI system (*meter* and *second*) and can be substituted by any other definition and system of reference. It is important to observe that this definition is independent of the wire material - it holds in any kind of conductor. The implications of this well known fact have been overlooked in the theory of electromagnetism. It reveals the *a priori* mathematical character of this or any other physical definition, which can be confirmed by an experiment in a secondary manner.

Another important theoretical aspect of the conventional definition of the basic unit „ampere“ is the assumption that the interaction occurs between two very long, actually, infinitely long wires. This definition is based on the idea that the “*parallel axiom*“ of geometry is correct. However, this basic axiom could not be pro-

ven so far. This physical definition is thus a „**definition by abstraction**“ - by erroneously assuming the validity of the „parallel axiom“ within empty Euclidean space which is generally used as a reference system in physics. This becomes evident when we consider the fact that the two electric segments either attract or repel themselves. When this motion is considered, it is obvious that the real wires cannot remain parallel to each other in the infinity of real space-time that is different from empty Euclidean space. It is a well known fact that real space-time exhibits gravitational and electromagnetic forces (energies) in the form of *long-range correlations* (*fields*) at any time and point - for instance, space is bent by gravitational forces. This knowledge is basic to the theory of relativity. Precisely for this reason the parallel axiom cannot be valid in the real physical world.

If we now present the conventional circular definition of the electric current $I = \Delta Q/\Delta t$ in terms of geometry, we acquire in a logical manner the following simple statement**:**

Electric current I is geometric area Q per time t.

However, this formula is incomplete - as already said, it does not include the *cross-sectional area A*, without which the definition of the current is meaningless. When we consider this quantity, we arrive at the following consistent definition of **charge** from the point of view of mathematical formalism, as it is currently applied in physics:

Electric charge ***Q*** is a two-dimensional quantity of space [2*d-space*], which is obtained, according to the principle of circular argument, in relation to a well defined *area*, usually measured as a *cross-sectional area A* of the conductor:

$$I\Delta.t = \frac{\Delta.Q}{A} = \frac{area_Q}{area_{reference}} = \left[2d - space\right] = n \qquad (7)$$

In this case $\Delta t = 1s/1s = 1$. At this place it is very important to observe that when we compare two [2*d-space*]-quantities, we can either write [2*d-space*] or a dimensionless number for this relationship. For instance, the area of a soccer field ($100 \times 50m$) is a ratio to the arbitrary unit area of $1m^2$, which can either be expressed as a *number* $n = 5000m^2/1m^2 = 5000$ in mathematics or an *area* = [2*d-space*] = $5000\ m^2$ in geometry. Alternatively, we can substitute the meter with an *inch*, the relationship between the two areas, the soccer field and the square meter, remains the same.

We conclude: All physical quantities are **numerical, dimensionless relationships** between two real systems, one of them being usually defined as a *reference system*, and are thus independent of the choice of the reference unit. It is precisely this universal formalistic procedure, with which all kinds of numbers are introduced and defined in the theory of mathematics (in *meta-mathematics*). Purely for this reason, we can eliminate the surrogate SI system and use only dimensionless numbers without changing anything in physics. This insight affects probably the greatest simplification in science, as the application of the SI system extends throughout the whole edifice of natural sciences.

In equation (7), the *cross-sectional area A* is the reference magnitude that can be easily determined. The actual area of the "charges in motion" (e.g. the cross-sectional area of the electromagnetic waves in motion in the conductor as geometrically assessed by the *wave equation* of *classical* and *quantum mechanics*) is practically not known. It is obtained in relation to the cross-sectional area of the conductor, which we can precisely measure (principle of circular argument). Thus the measurement of the electric current is, in reality, an indirect measurement of the area of the particles or waves in motion **(**see *wave-particle dualism***)**. These can be electrons, protons, ions, or macroscopic assemblies of particles, such as solenoids of electric generators, motors, or

transformers. These devices can only operate when they are in circular motion. When there is no motion, that is, when no charge (cross-sectional area) flows (moves, rotates), there is no current and hence no visible energy interaction. This holds true for the electric current, as well as for the water current - both are distinct sources of energy.

Based on the conventional definition, we have proved that charge is area. We shall now present some fundamental derivations that confirm this conclusion. These derivations are based on well known experimental and theoretical results. In particular, we shall prove that the equivalence between one coulomb and one square meter holds for the charge of the electron, which is defined as the **fundamental unit of charge *e*** or **elementary charge *e*,** to which all other charges are set in relation $Q/e = n$.

2.3 The Charge of the Basic Photon q_p is a New Fundamental Constant

All natural constants in physics are the result of mathematical equations that can be experimentally verified in the real physical world. Some constants are defined as „fundamental“ (*fundamental constants*), others are expressed as derivatives of one or several already known constants. This discrimination is artificial and does not take into account the fact that all constants and physical quantities, being linked to each other in mathematical equations, are obtained in a *circular* mathematical manner, as already shown for the SI system above.

We shall now prove, both mathematically and physically, that the **charge (area) q_p** of the **basic photon *h*,** also known as **Planck's constant,** is the *elementary area* that builds the **charge (area) *e*** of the **electron**. In this way, we shall prove the *inhomogeneity* of electric structures, as this is observed for the electric charges of quarks. The knowledge that charge is area is very useful

in explaining the charges of quarks, which are fractions of *e*. Until now this fact cannot be explained by QCD. Thus the new correct interpretation of the quantity "charge" has a fundamental theoretical impact not only on electromagnetism, but also on QED (quantum electrodynamics) and QCD (quantum chromodynamics).

This idea is also basic to *Bohr model* of *energy quantization* of the hydrogen atom, which will be the topic of a separate publication. According to Bohr's third postulate, the *angular momentum L* of the electron that is imagined to revolve in a circular stationary orbit and to have discrete values is defined with respect to the basic photon *h* within geometry $L=mvr=nh/2\pi$, as π suggests. The subsequent *de Broglie's interpretation* of Bohr's quantization condition (3rd postulate), which has introduced the central idea of *wave-particle dualism* in quantum mechanics, is based on the assumption that the electron is a standing circular wave, so that its *circumference C* gives the stationary orbit of the electron $n\lambda/2=\pi r=C$. This equation describes the *standing wave condition* for a circular wave. We shall now depart from this well established quantum interpretation of Bohr and de Broglie, in order to obtain our new constant q_p within mathematical formalism in a similar way.

The **charge (area) of the basic photon q_p** is a new fundamental constant that can be obtained within mathematical formalism, being the universal method of definition and measurement of all physical quantities and natural constants, from the *charge of the electron e*, by introducing according to the principle of circular argument another well known natural constant - the **Compton wavelength** of the **electron** $\lambda_{c,e} = 2.426\ 310\ 58 \cdot 10^{-12}\, m$ (7), presented as **Compton frequency** $f_{c,e} = c/\lambda_{c,e} = 1.23559 \cdot 10^{20} s^{-1}$

$$q_p = \frac{e}{f_{c,e}} = 1.29669 \times 10^{-39} (C = m^2) \qquad (8)$$

The *charge of the basic photon* q_p can be, therefore, regarded as the **most elementary area of matter,** which we can measure or

discriminate at present. We shall now perform a collection of derivations within mathematics that will include some basic quantities and equations of electricity to prove this mathematical conclusion.

For this purpose, we can imagine q_p as the cross-sectional area of the basic photon *h*, when the latter is defined as a transversal electromagnetic wave that is propagated with the *speed of light c*. We can thus present the structure of the basic photon as an area integral of the basic photon, when it is considered a standing circular wave with the *wavelength* of $\lambda_A = 2.99792458\times10^8\,m$. Observe that according to the principle of circular argument the surrogate SI unit for length „*meter*" is currently defined in physics in a secondary manner as $1/\lambda_A$ with respect to the basic photon *h*, which is the initial real system of reference for space. In this case, the frequency of the basic photon is set per definition $f_A = 1$ within mathematical formalism; hence $c = f_A\lambda_A = \lambda_A$. This quantity is obtained within geometry and can be substituted by any other space quantity. As shown for the Bohr's model, this geometric procedure is very common in wave and quantum theory, notwithstanding the fact, that this has not been apprehended by physicists from a formalistic point of view. The discussion of this important theoretical aspect is, however, beyond the scope of the present publication. We use this quantity, because it is basic to the conventional geometric derivation of some important quantities of magnetism, such as **Bohr magneton** (8):

$$m_B = \frac{e\hbar}{2m_e} = \frac{q_p\lambda_A{}^2}{4\pi} = circle-area =$$

$$= \frac{circumference^2}{4\pi} = \frac{A^2}{4\pi} = 9.274\times10^{-24}\,m^2 \qquad (9)$$

In this case, $q_p\lambda_A{}^2 = n \times (3\times10^8)^2 m^2 = A^2$ is *square circumference* and Bohr magneton is defined as the "**area of a circle**". We shall

show below that this circle is attributed to the electron. We must observe on this occasion that physicists are not aware of this hidden geometric definition of Bohr magneton, which is a fundamental constant of electromagnetism and quantum mechanics. They believe that this quantity is an intrinsic property of matter, as is the case with any other physical quantity at present.

From Bohr magneton, the **atomic magnetic moments** are derived in the theory of magnetism of matter. Equation (9) confirms that any traditional quantity of material particles can only be defined in relation to the space-time of the photon level, in most cases, to the space-time of the *basic photon h*. This system appears to be the initial real reference system, to which all other basic physical quantities and SI units are compared in present-day physics (for further information see the current definition of *second* and *meter* in SI system).

Bohr magneton is a *fundamental constant* (*area*), from which the **magnetic moments** (**areas**) of the **elementary particles** are obtained within mathematical formalism and subsequently confirmed in experiments (9). Thus equations (8) and (9) include the derivation of five basic constants of physics from the new constant, the **charge (area) of the basic photon q_p**, by employing the formalistic principle of mathematics:

1) The fundamental unit of charge e
2) Bohr magneton m_B

The magnetic moments of:

3) Electron μ_e,
4) Proton μ_{pr},
5) Neutron μ_n.

The formulae and values of the last three constants can be obtained from any textbook on physics. The unification of these five basic cons-

tants was made possible for the first time in the history of physics by introducing the new basic constant q_p. This is a powerful confirmation of the validity of our methodological, formalistic approach, as the above mentioned constants can be experimentally measured. Thus, the validity of the new constant, the charge (area) of the basic photon q_p, can also be experimentally confirmed. Ultimately, the axiomatic mathematical principle of inner consistency and lack of contradictions, which we have followed in the present elaboration, is confirmed by experience in an irrevocable manner. Mathematical theory (formalism) and empiricism are hence dialectical aspects of the unity of Nature. This is true science.

In the formula of Bohr magneton (9), the *wavelength* λ_A of the basic photon is intuitively assessed as a *circumference*. This seems logical when one considers the fact that each wave is a product of rotation. As all motions are rotations, any distance, which we define as a [1*d-space*]-quantity, is, in fact, a closed path that can ideally be expressed as the circumference of a circular motion. This approach has been used for the first time by Kepler to formulate his *third law of gravitation*. It is, indeed, a very common practice in physics. Particularly in electromagnetism, it leads to the definition of *magnetic moments* (see above). The *classical* and *quantum wave equation* is entirely based on this simple geometric idea. Thus *wave theory*, in its classical and quantum version, is entirely applied geometry to real circular motions. The full proof will be presented in a separate publication.

As any straight line is a section of a circumference when it is assigned to real space-time, we can describe any *amplitude A* (maximal expansion) of a wave as a circumference. The *square circumference* A^2 is thus an abstract quantity of [2*d-space*], called "*charge*". This is the degree of freedom of mathematical consciousness - or, in the context of current physics, the degree of freedom of the „unanalysed consciousness of physicists" (Max Born). This approach is the actual method of definition of the **elementary charge *e***. Geometry is obviously the hidden method

of the current definition of this basic constant of electricity. We shall prove this fact below in detail.

2.4 The Elementary Charge *e* is Geometric Area of the Electron

In equation (9) the spatial structure of the basic photon $A^2 = q_p\lambda_A{}^2$ is presented as *square circumference* A^2; in this case $q_p = n$ (see the principle of mathematical formalism above). This geometric quantity assesses the maximal extension of this **elementary system of space-time** in terms of area. It is simple geometry applied to the real world. Although this fact has not, so far, been realized by physicists, the same mathematical approach has been used to assess the spatial structure of the electron.

In order to unveil this hidden definition, we must depart from *Pauli exclusion principle* (*Pauli-Verbot*). It postulates that no two electrons of an atom can acquire the same quantum condition that is determined by the four *quantum numbers*, *n*, *l*, *m* and m_s. Such numbers are believed to describe the spatial configuration of electrons in the atom. In fact, Pauli principle is a geometric interpretation of *Schrödinger wave equation* of quantum mechanics as presented in *Fermi-Dirac statistics.* According to it, all *fermions*, e.g. electrons, protons and neutrons, have an *asymmetric function* $\psi(x_2,x_1) = -\psi(x_1,x_2)$, that is, they have a *half-integral spin* and obey the exclusion principle, while all *bosons*, e.g. *photons*, have a *symmetric function* (10).

What is the vested knowledge behind such cryptic definitions, which are evidently of mathematical origin? We shall explain this for the first time for the basic photon and electron. The basic photon *h* is regarded as a *transversal harmonic wave* that results from a circular motion. Although the actual sources of this circular motion are not an object of study in modern physics, the basic photon is actually regarded as a *sphere* with the square circumference

of $A^2 = q_p\lambda_A{}^2$ (see equations (8) & (9)). According to Pauli exclusion principle, the **electron** is considered a *standing asymmetric wave* that acquires the form of a *hemisphere* with the **surface area S_e** of

$$S_e = S_o/2 = \pi d^2/2 \qquad (10),$$

where S_o is the area of the sphere, and d is the diameter. If we set the Compton wavelength of the electron $\lambda_{c,e}$, which is [1*d-space*]-quantity of this system, equal to the hypothetical diameter of the electron, we obtain for the *area* of the *electron hemisphere* a value that is almost equal to that of *Bohr magneton* (9):

$$S_e = 0.5S_o = 0.5\pi d^2 = 0.5\pi\lambda_{c,e}{}^2 = 9.247\times10^{-24}\, m^2 \cong$$

$$m_B = 9.274\times10^{-24}\, m^2 \qquad (11)$$

The small difference results from the fact that real systems are open and cannot have the form of ideal spheres, which are abstract closed systems, but are rather elliptical (see *Kepler's laws*). From the equivalence between the area of the electron hemisphere (10) and Bohr magneton (9), $S_e = m_B$ (11), we obtain the following equation (see also equation (7)):

$$\frac{q_p\lambda_A{}^2}{4\pi} = \frac{e}{f_{c,e}} \times \frac{\lambda_A{}^2}{4\pi} = \frac{\pi\lambda_{c,e}{}^2}{2} \qquad (12)$$

When we solve this equation for the **elementary charge *e***:

$$e = 2\pi^2 f_{c,e}\left[\frac{\lambda_{c,e}}{\lambda_A}\right]^2 = \left[2d - space\right] = 1.6\times10^{-19}\, m^2 \qquad (13),$$

we obtain the **area (charge) of the electron** in relation to the *area (charge) of the basic photon* according to the principle of circular argument: $\lambda_{c,e}^2$, λ_A^2 = *square wavelength* = [2*d-space*] = *n*; in this case, $2\pi^2 f_{c,e} = n$. Observe that π is also a length relationship $\pi = C/d$ (*C* is *circumference)*, so that it should be, strictly speaking, given in *meters* in geometry, as is done with all other length quantities. This is another basic formalistic inconsistency in physics, which has hindered scientists' understanding that this discipline is essentially **applied geometry** to the real physical world. In this case, π is a paradigm of all physical quantities that are first defined within mathematics and are then measured in physics as dimensionless relationships, e.g. as quotients and magnitudes. This simple formalistic conclusion cannot be repeated often enough, as it is not fully apprehended by physicists at present. We conclude:

> The **elementary charge *e*** is **area: $e = 1.6\times10^{-19} m^2$**. The SI unit of charge **coulomb** is identical to the square SI unit of space, **square meter**:
>
> $$\mathbf{1\ C = 1\ m^2.}$$

This irrevocable physical and mathematical result explains for the first time why coulomb is considered a very big unit when it is applied to particles and has been largely replaced with the SI unit *electronvolt* (11). This new insight affects probably the greatest simplification of our physical outlook, not only from a theoretical, but also from a practical point of view, as many motors and machines used in daily life are electrically driven. At the same time, it reveals the most awkward mistake of physics - its decision to introduce the term "electric charge" as a synonym for "geometric area" without realizing the epistemological background of this fundamental quantity of electricity.

2.5 Further Proofs

It is important to observe that the above conclusions, based on mathematical formalism, have been confirmed without any exception for all known quantities, natural constants and laws of electricity, magnetism, as well as for the famous four *Maxwell's equations of electromagnetism*, in particular, for the *permittivity* and *permeability of free space*, ε_o and μ_o, *von Klitzing constant*, etc. These mathematical proofs are beyond the scope of this presentation (12, 13).

3. Conclusions

From this disquisition, we can finally conclude that electricity and electromagnetism are **applied geometry** to the electromagnetic levels of space-time - they are simple studies of the geometric form of electric systems. The same is true for most of physics. Since this kind of Geometry has been fully developed in antiquity, it is difficult to perceive what kind of progress theoretical physics in general and the theory of electricity and electromagnetism in particular have actually accomplished in the meantime.

At the same time, this insight opens the most revolutionary perspective in science - the unification of physics and all natural sciences to a **General Theory of Nature** (12, 13). This has been the dream of Plato, Aristoteles, Descartes, Spinoza, Leibniz, and recently of Einstein, H. Weyl, A. Salam, and other theoreticians, e.g. as world field equation (Weltformel), unified field theory, theory of everything, grand unified theories, GUT, string theories, etc. - a dream that can be easily accomplished within the present structure of science by eliminating all formalistic blunders that have accumulated throughout its history and have acquired the status of an „infallible scientific stuff".

The universal method of unifying all scientific knowledge that is accessible to human mind is the full axiomatisation of physics and all natural sciences that implement mathematics. This is the continuation and extension of *Hilbert's programme* of axiomatizing mathematics, which he first announced in 1900 (14), to all natural sciences. Just as all distinct mathematical disciplines have, in the meantime, been firmly established in mathematical formalism, so do all natural sciences can be axiomatized and integrated into a General Theory of Nature by the consequent implementation of finite procedures, as this has been advocated by Hilbert and many other prominent European mathematicians in the first half of the 20th century.

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