

New Approach to the Ontology of Nature

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Abstract

This work presents an original approach to the ontology of nature, grounded in both modern physics and the philosophical insights of Ruđer Bošković. Following his vision of the fundamental interconnectedness of matter and force, the paper develops a theory of unity of the whole and its part, emphasizing the mutual dependence between the Universe and its constituents.

Key cases are examined, including neutrino helicity, quantum entanglement, and the concept of dimensional *twins*—quantities that share identical dimensional forms yet carry distinct physical meanings. Through these notions, the work explores invariance, the universality of the number “1”, and various dichotomies, from matter and antimatter to radiation and mass.

By linking mathematical structure with ontological interpretation, and by building on Bošković’s legacy, this approach highlights hidden analogies across seemingly unrelated phenomena. It suggests that dimensional analysis, invariance, and dichotomy are not just formal tools but fundamental principles, providing a pathway to new theoretical insights and a deeper understanding of natural laws.

Keywords: Bošković, neutrino helicity, entanglement, magnetic moment, invariance, dichotomy, quarks, bosons, CMB temperature

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1. The Theory of Unity of the Whole and its Parts

This theory arises from a few fundamental insights:

- *Every part depends upon the Whole (the Universe) and is simultaneously an inseparable aspect of it; thus, the Whole itself is dependent upon its parts. This thought echoes one interpretation of Mach's principle [2].*
- *The quantum character of phenomena is connected to the relations between the whole and its parts.*
- *Matter is never static; it flows in perpetual motion.*

The purpose of the present work, however, is not to overwhelm the reader with technical derivations, but rather to reveal—through a single equation—the ontological bond between the Whole and its parts. For this purpose, dimensionless forms are preferred—relations presented with utmost concision, as shown in the following table:

Quantity	Symbol	Value
Mathematical constant Cycles	$cy = e^{2\pi}$	535.4916555
Mathematical constant Cube of 2π	$8\pi^3 =$	248.0502134
Inverse fine-structure constant	$\alpha^{-1} =$	137.035999084
Proton/electron mass ratio	$\mu =$	1836.15267343
Proton/Planck mass ratio	$x = m_{pl} / m_{pr}$	1.30125647E+19

This can be further simplified through logarithmic values in the formula:

$$4 * \log_2(m) - 3 / (\mu\alpha + 2) = cy / 2 - 3 * [2 + \log(2\pi)] \quad (1)$$

<i>formula (1)</i>	$4\log_2(x) - 3/(\mu\alpha + 2)$	$cy/2 - 3[2 + \log_2(2\pi)]$
$4\log_2(x) - 3/(\mu\alpha + 2) = cy/2 - 3[2 + \log_2(2\pi)]$	253.7913393740	253.7913393740

The only term in equation (1) that can be subject to correction is the expression $3/(\mu\alpha + 2)$, since it was introduced heuristically, under the assumption that the proton—as the most stable particle—possesses the simplest relation to the universe as a whole, while the electron also participates in this relation in a certain way. To examine this, we rely, in my view, on the key mathematical and fundamental physical constants presented in the table.

Even when the formula provides only approximate agreement with experimental values, it should be kept in mind that the influence of antimatter and exotic particles, however small, has been neglected in this approach. Nevertheless, the essential goal has been achieved: the need to introduce „speculative particles“, which are merely theoretical patches, is avoided, while the quantity $\mu\alpha + 2$ can be minimally adjusted.

The results can be confirmed through the history of CODATA reports. The structure of the formula is deliberate: physical constants appear on the left, purely mathematical ones on the right. Strikingly, the relation is independent of the gravitational constant, sidestepping the uncertainties of its measurement.

Here, the connection between mathematics and physics supports a strong orientation toward the *Mathematical Interpretation of Nature*, expressed in all of my works.

Let us define that composed masses represent the "*matter-dominant Universe*", while elementary masses represent the "*radiation-dominant Universe*".

In equation (1), physical constants are equal to mathematical constants; they are not derived from one another, but exist in an immanent unity of the Whole and its parts. They simply *are*—of such magnitude as they have always been and will forever be.

Where does such harmony arise? From irrational mathematical constants. Quote: "*In mathematics, an irrational number is any real number which cannot be expressed as a fraction p/q , where p and q are integers, with q non-zero. It is therefore not a rational number.*

... Thus, space-matter consists of irrational points, so it is necessary to speak of the form and distribution of these points to produce both continuous and discrete space-matter" [4, p.2].

The results in this article have been obtained through the analysis of well-known physical relations. The methodology and principles applied are well known and have been described in my previous publications. The proton appears here as an inevitable consequence of the existence of the universe as a whole.

The analysis here relies on established physical relations, with well-known principles applied. The proton itself emerges not as an arbitrary particle, but as the necessary consequence of the Universe's existence as a Whole.

Nature does not acknowledge the boundary we impose between mathematics and physics. To Nature, they are one. This is why what we now call "science" was once known as *the philosophy of nature* [1]. The relations presented here belong to this tradition, affirming its truth.

Here, the "matter-dominant" and the "radiation-dominant" Universes are not separated in time but coexist eternally. They are not stages of a cosmic past and future, but complementary aspects of one reality, alternating in rhythm within the great Cycle. One may seem to prevail over the other, yet never in absolute exclusion, for traces of both are always present.

Matter arises gradually within this rhythm: from the simplest seeds of existence, through protons and molecules, to ever more complex structures, until the Universe reveals itself as an indivisible Whole.

In this framework, the gravitational constant G arises as the product of the relation between the Whole and its part. It follows that G and c together represent a unity. From equation (1) we are led to profound conclusions:

- *The Universe is inevitable.*
- *Universe is eternal.*
- *Mass and space are finite.*
- *The Universe has no shape.*

The applied methodology reveals simple relations between the whole and its parts, emphasizing the significance of mathematics.

2. The Minimalist Approach to Neutrino Helicity

The aim is to provide a new—although essentially already three centuries old—approach to the neutrino helicity problem, based on the teachings of Ruđer Bošković's Theory of Natural Philosophy [1]. Given that it is a monumental work of human civilization, I believe that its detailed explanation would be superfluous, since it would exceed the scope of the topic itself from the title. A key aspect relevant to this discussion is the term "*non-extended*", which is thoroughly elaborated in more than thirty places in Bošković's work [1], from which I quote:

7. The primary elements of matter are in my opinion perfectly indivisible & non-extended points; they are so scattered in an immense vacuum that every two of them are separated from one another by a definite interval; this interval can be indefinitely increased or diminished, but can never vanish altogether without compenetration of the points themselves; for I do not admit as possible any immediate contact between them.

I also quote from the book of Dragoslav Stoiljković [3, pp 4-11]:

"Also, in some of these classes (of particles), the absence of any force may be admitted; then the substance of one of these classes will pass perfectly freely through the substance of another without any collisions" /8, Section 518/. We only need to call these particles "neutrinos", and then Boscovich's idea is the same as contemporary understanding.

In short, what is known about the helicity of neutrinos is as follows:

The main reason why right-handed neutrinos are not observed in nature (i.e., why neutrinos are always left-handed, and antineutrinos right-handed) is related to the fundamental assumption of the Standard Model and the way it describes neutrinos as massless particles (or particles with extremely small mass). In the original version of the Standard Model, neutrinos were considered massless, which means they travel at the speed of light. For massless particles, helicity (the projection of spin onto the direction of motion) is equivalent to chirality (the property that

determines how a particle participates in weak interactions). Weak interactions (which involve neutrinos) only support left-handed particles and right-handed antiparticles.

If a neutrino is massless, it can only have one helicity: left-handed helicity (spin opposite to the direction of motion) for neutrinos, or right-handed helicity (spin in the direction of motion) for antineutrinos. Experiments have shown that neutrinos do indeed possess a very small mass. However, the Standard Model does not include right-handed neutrinos, as they would not participate in weak interactions. If they exist, such neutrinos would be sterile, meaning they would not interact except through gravity.

In the context of extended theories, such as the Seesaw mechanism, right-handed neutrinos would be extremely massive and practically undetectable in low-energy processes.

Here we assert: neutrinos arise from Bošković's "*non-extended*" (infinitely small point with no spatial extension), so their appearance in space-time requires only one helicity. The other helicity would represent a "collapse" back into a *non-extended* state – meaning the particle could not manifest.

Left-handed helicity (for neutrinos) and right-handed helicity (for antineutrinos) become mandatory conditions for existence in the extended world. The opposite helicity would be equivalent to a "return to nothingness." This concept provides a metaphysical basis for why the Standard Model does not account for right-handed neutrinos – they would be a "return to the *non-extended*."

There is no natural process that would generate neutrinos of the opposite helicity - which is consistent with observations. Existence requires certain boundary conditions.

Neutrinos do not "emerge from" the *non-extended*, but are manifestations of the very process of transition from the non-extended to the extended. Left helicity for neutrinos and right for antineutrinos represent the minimum condition for separation from the non-extended, while the opposite helicity would be a logical contradiction (return to non-existence).

A concept is a self-consistent logical structure that does not require additional postulates, relates metaphysical principles to observable phenomena, and offers ontological explanation instead of mere description. In this way, we understand elementary particles - not as "things" but as "boundary phenomena" between the non-extended and the extended. Neutrinos are borderline phenomena on the threshold of existence, where Left helicity is the minimum condition for stable manifestation. The concept is simple which is a sign of deep truth.

There is no need for sterile neutrinos, exotic mechanisms and space-time modifications, but nature itself imposes this asymmetry.

3. Identifier of Quantum Entanglement

Quantum entanglement poses a profound philosophical and physical dilemma, as it implies the simultaneity of changes between distant particles. The phenomenon that Einstein referred to as “*spooky action at a distance*” has now been experimentally confirmed, yet it remains only partially explained.

Let us interpret quantum entanglement solely within the framework proposed in this work. By employing the concept of transcendental identity, we argue that entanglement is grounded in an indissoluble relation between entities that together form a unified whole of the universe.

At the core of this idea lies a transcendental number — most often 2π or a number related to it, such as $2\pi * \alpha^{-1}$ from the formula for the proton–electron mass ratio. Here, however, we will remain with the simplest case: 2π regarded as the primordial structure of the universe.

Suppose two particles possess identifiers t_1 and t_2 , which represent finite approximations of the transcendental structure 2π —physical projections that preserve information about their origin, but are not themselves transcendental. Observation of one particle automatically entails observation of the other, since no other entity in the universe could be identical in this relation. Their entanglement is thus defined by the relation:

$$(t_1 * t_2)^{0.5} = T_{pair} \quad (2)$$

Where T_{pair} is the identifier characteristic of the specific pair, and this relation is unique and unrepeatable for any other pair in the universe. It is exceptionally close to 2π , yet it is not 2π .

But why 2π and not some other transcendental constant? The answer lies in physical processes: the constant 2π recurs persistently because it marks complete cycles, rotations, wavefronts, and full symmetries—in short, closed unitary forms in space and time.

Since 2π is a transcendental number, it contains within itself an infinite decimal structure that no physical system can fully process. Thus *truncation* inevitably enters, producing a *remainder*—and that *remainder* enables freedom within entanglement. If 2π were rational, the entanglement would be closed and deterministic, leaving no room for freedom or individuality of systems. Nature therefore, in approaching transcendence, operates through *truncations*—*rounded*, finite approximations that differ from one another. We may say that the universe does not employ purely transcendental values, but **rationalizes** them.

Why the square root of the product in formula (1)? Because we are considering the simplest case—a pair of particles. With more particles, the root structure would be more complex.

Why the product, and not the sum or the power? Because the product represents the middle ground between sum and power: it binds elements without their simple accumulation (as in the sum) or the domination of one over the other (as in the power).

This relation establishes ontological symmetry: the pair of particles becomes a whole, while the individual particles are its projections. When two particles arise in a quantum-mechanical event resulting in entanglement, their identifiers are not arbitrary, but mutually correlated according to relation (2). Conversely, a sufficiently strong external influence (through measurement or decoherence) can cause entangled particles, with initial identifiers t_1 and t_2 , to collapse into the common state 2π at which point the entanglement vanishes. Thus, while decoherence erases entanglement but leaves the particles intact, annihilation removes the particles themselves, transforming their mass and identity into field energy.

Since no other pair can yield the same result (because transcendental numbers are irrational and unrepeatable in finite approximation), **even the observation of one particle** inadvertently accesses the informational pattern that **includes the other**.

Entanglement does not depend on space or time—it is not the result of physical proximity, but is inscribed through transcendental identifiers. It is part of the very structure of the universe.

To be part of an entangled pair means not to exist as an isolated entity. The identity of a particle is no longer self-sufficient, but essentially relational: what makes a particle what it is lies precisely in its relation to the other particle that complements it.

This idea reaches into the core of the philosophy of identity: if a particle is defined not by itself but by its relation, then the relation is more primary than the entity. In this light, the universe is not a sum of parts, but a network of perfectly attuned pairs whose identities arise only through their mutuality.

Let us imagine 2π as an ontological substance—unchangeable, eternal, and indivisible, from which all entities of the universe emerge. In this sense, t_1 and t_2 are not arbitrary numbers but *truncations downward or upward*. For example, from

$$2\pi = 6.283185307179\dots$$

a *downward truncation* to the sixth decimal gives 6.283185, while an *upward truncation* to the eighth decimal gives 6.28318531. Thus, t_1 and t_2 are not arbitrary values, but functions of that infinite yet structured decimal expansion of 2π .

$$t_1 = f_1(2\pi), t_2 = f_2(2\pi) \tag{3}$$

This means that both particles are inseparable parts of the same entity — 2π is their common source. Yet as a transcendental number, it contains infinitely many decimals. Nature cannot process transcendence infinitely, for physical reality requires finitude.

Thus quantum entities appear as *truncations of transcendence*. Each particle, through its identifier, carries a number rounded to a certain decimal place, different for each pair. In other words, if two “*truncations*” from the transcendental source yield their quadratic geometric mean that reconstructs the source itself, then they are pairs of complete ontological complementarity. They do not merely share information — they share essence.

The very act of measurement can be interpreted as the selection of one among the possible values close to 2π thereby “focusing” the system into one of its entangled states.

The representation of entanglement between two particles is but a fragment of the universal quantum interweaving, expressed through identifiers grounded in 2π , although the interweaving itself is not explicitly addressed here.

4. Dimensional Twins

4.1. What are dimensional twins?

In the mathematical language of physics, physical quantities are expressed through the basic units of a system—meter (*m*), kilogram (*kg*), second (*s*), and others. Any given quantity can be reduced to a particular combination of these fundamental dimensions. Yet, upon deeper examination of physical phenomena, one encounters a striking occurrence: distinct quantities, originating from different domains of physics, may share identical dimensional forms. Let us call them *dimensional twins*.

Dimensional twins are physical quantities that possess the same dimensional structure but embody different meanings, functions, and roles within the physical world. Borrowing a linguistic analogy, they are like homonyms in natural languages—words that are spelled the same but signify something entirely different.

For example, mechanical energy, electrical energy, and heat all share the same dimensions in the SI system: $[L^2MT^{-2}]$. Yet they arise from entirely different processes — the motion of bodies, the flow of current, and the transfer of heat — and cannot be confused either physically or conceptually.

4.2. The phenomenology of twins

The appearance of dimensional *twins* is not accidental; it reflects something profound in the way nature organizes phenomena. Physical reality is stratified—quantum, molecular, macroscopic, and cosmological levels—each with its own laws, yet often expressed in similar mathematical forms.

Momentum and magnetic flux, for instance, share identical dimensions, though one belongs to the motion of mass and the other to the spreading of a field. Likewise, electrical resistance, inductive and capacitive reactance, and impedance all carry the same dimensional form, though they describe very different aspects of electrical circuits.

Dimensional *twins* often emerge when nature confronts analogous problems in different realms: the inertia of matter, the inertia of fields, or resistance to change over time within oscillatory systems.

4.3. Dimensional *twins*: limits and role in analysis

Dimensional analysis is a powerful tool: it can validate equations, reveal hidden relations, and enable the scaling of systems. Yet, the phenomenon of dimensional twins points to its limits. Dimensions alone do not provide context; different quantities may share the same dimensional form while serving distinct roles within theory and measurement. Precisely in this ambiguity lies their value: dimensional twins are not mere curiosities, but heuristic instruments for connecting, exploring, and predicting in physics. Mathematically identical yet physically diverse, they highlight both the hidden unity of natural law and the need for a deeper taxonomy of physical phenomena.

4.4. Multiplicity and classification of *twins*

Dimensional *twins* most often appear in pairs, but more complex families exist. The energy dimensions $[L^2MT^{-2}]$ occur in mechanical energy, electrical energy, heat, work, oscillator energy, and more. Similarly, resistance and impedance appear across multiple physical systems.

This invites a classification: *twins* can be grouped by the number of physical concepts they encompass, becoming markers of the universality of certain dimensional forms.

Twins are more frequent in complex combinations of units, where nature's richness produces overlapping dimensional identities. In simpler forms—say, pure T^{-1} or pure L —the number of meanings is limited.

4.5. Toward a dimensional periodicity

Like the periodic table of elements, a “dimensional table of *twins*” could emerge in physics. Each cell would denote a dimensional form, while its twins would signal the form's universality. Such periodicity may allow:

1. **Discovery of new *twins*** – unfilled cells pointing to yet unknown phenomena.
2. **Dimensional analogies** – shared forms revealing parallels between natural laws.
3. **Predictive heuristics** – guiding new models and exploration of the unknown.

4.6. A catalog of dimensional *twins*

The following table offers an overview of the most common groups of dimensional *twins*, arranged according to the number of different physical quantities that share the same dimensions. This catalog illustrates how the same mathematical structure can carry many distinct physical meanings.

Abundance	Dimensions	Physical quantities in the group (<i>twins</i>)
2	L^2MT^{-2}	Mechanical work, heat
2	$L^{-1}T$	Electrical resistance, inductive reactance
2	$L^{3/2}M^{1/2}T^{-1}$	Electric charge, current flux (time-integrated current)
2	$L^{1/2}M^{1/2}$	Momentum, magnetic flux
3	L^2MT^{-2}	Mechanical energy, heat, electrical energy
3	$L^{-3}MT^{-2}$	Pressure, energy density, energy–momentum tensor (T_{00})
4	L^2MT^{-2}	Work, thermal energy, electrical energy, capacitor energy ($CV^2/2$)
5+	L^2MT^{-2}	Universal energy: mechanical, electrical, luminous, thermal, work, potential, oscillator energy
5+	$L^{-1}T$	Resistance, reactances XL , XC , impedance, mechanical drag in fluids, relative resistance in superconductors

This table is not final, but rather a beginning—a first step toward a systematic classification.

5. Invariance Through the Universality of the Number '1'

We briefly outlines eight examples of invariance, all grounded in the unit '*I*' as the fundamental form of invariance. Two of these are well known, while six are original contributions derived from the author's earlier works.

Invariance denotes the property of a system or a law of nature to remain unchanged under certain transformations (e.g., temporal, spatial, or symmetric).

The number '*I*' is the universal normative form of invariance, as it represents the measure of immutability and the neutral element in many formalisms (e.g., the identity matrix, normalized probability, natural units).

The two best-known invariances are:

5.1. Special relativity – The speed of light

Lorentz factor:

$$\gamma = \sqrt{1/(1 - v^2/c^2)} \quad (4)$$

→ For a body at rest, $v = 0$, $\gamma = 1$, which is an invariant value.

5.2. Thermodynamics – Boltzmann distribution

$$\sum p_i = 1 \quad , \quad p_i = e^{-E_i/kT} / Z \quad (5)$$

→ Invariant value: the sum of probabilities = 1, regardless of temperature or energy levels.

Although not every invariance results in the value ‘ I ’, in this work attention is directed to those that do, in order to provide a clearer view of structural connections. The derived formulas originate from my earlier works; therefore, their meaning is not elaborated here, but rather adapted with the aim of emphasizing precisely this invariance.

5.3. Uncertainty principle

The most significant invariance in this work is presented here in the form below and also in the calculation given in the table.

$$3 * e^{2\pi} / 4 + 3 * \log_2(2\pi) + 1 / (2\mu\alpha + 4) - \log_2 \gamma * (1 + \alpha^{-2} * \log_2 \mu) = 1 \quad (6)$$

where e is the base of the natural logarithm, and three fundamental physical constants (α – the fine-structure constant, μ – the proton-to-electron mass ratio, γ – the neutron-to-proton mass ratio) yield the invariant value ‘ I ’. The slight inaccuracy in the result (1.00000000173) is a consequence of numerical instability in the computation due to handling extremely small and widely differing orders of magnitude of the constants.

$\alpha =$	0.0072973525693	$\mu =$	1836.15267343	$\gamma =$	1.00137841920
$q = \log_2 \gamma * (1 + \alpha^{-2} \log_2 \mu)$					404.628455364
$3 * e^{2\pi} / 4 + 3 * \log_2(2\pi) / 2 + 1 / (2\mu\alpha + 4) - q =$					1.00000000173

Thus, the combination of constants leads to the invariant value ‘ I ’, which is interpreted as an expression of the uncertainty principle.

5.4. Lepton mass relationship – Corrected Koide formula

In the corrected Koide formula, Bošković’s *non-cohesion* limits [1] for leptons (r_{mu}, r), together with the fundamental limit of nature f and the mathematical constants π and $2/3$, yield the invariant value ‘ I ’, here transformed into expression (see table):

$$\pi f * \left[\left(\xi \alpha + r_{mu}^2 + r_\tau^2 \right) / \left(\alpha^{0.5} + r_{mu} + r_\tau \right)^2 - 2 / 3 \right] = 1 \quad (7)$$

and the *non-cohesion* limits (radii) are reduced with the radius of the fundamental particle and based on the masses for the muon and the tau:

$$m_{\mu} = 1.883531627 \cdot 10^{-28} \text{ kg}, \quad m_{\tau} = 3.1674852349178 \cdot 10^{-27} \text{ kg}$$

$$r_f = 3.231309 \cdot 10^{-15} \text{ m}$$

So the resulting values are dimensionless (all given in the table):

$\alpha =$	0.0072973525693	$\mu =$	1836.15267343
$\xi = 2\pi \cdot 2^{(4/3 - 1/(1.5 \cdot \mu \alpha + 3))} / (\mu \alpha) =$	1.14669171435	$f = 2q/3$	269.7523035762
$r_{\mu} =$	1.3153700912	$r_{\tau} =$	5.3940976434
$\pi \cdot f \cdot [(\xi \alpha + r_{\mu}^2 + r_{\tau}^2) / (\alpha^{0.5} + r_{\mu} + r_{\tau})^2 - 2/3] =$			1.0000000000

where q was calculated in the previous invariance.

→ Invariant value: ‘ I ’, expressed through the *non-cohesion* limits of the second– and third– generation leptons, is not directly tied to the same limit of the electron, but rather to a quantity associated with it – the fundamental particle and the constants π , $2/3$, μ and α , as markers of the leptonic transition from the first to the second and third generation.

5.5. Gravitational invariance

I propose that the formula for gravitational acceleration (including the contribution of the “rest of the universe”) can be expressed as a sum:

$$g = g_s + g_n \quad (8)$$

By dividing, we obtain:

$$g / g_s - g_n / g_s = 1 \quad (9)$$

where:

- g_s – gravitational acceleration of the rest of the universe ($6.9581783 \cdot 10^{-10} \text{ m/s}^2$),
- g_n – Newtonian part of gravity, opposite in direction to the former,
- g – the resultant (actual) acceleration.

→ Invariant value: ‘ I ’.

For celestial bodies, the contribution of g_s in formula plays only a minor role, but for this work formula (9) is crucial. It shows that in a natural system where $g_s = I$, whenever we use Newton’s gravitational acceleration g_n instead of g , we would make an error of exactly the invariant value ‘ I ’ (in the natural system)!

5.6. Emergence of mass from the preceding mass

The quantum process of emergence the mass x_n from the preceding mass of an elementary particle x_{n-1} takes place with the preservation of invariance:

$$x_n / x_{n-1} - x_{n-1}^{-1.5} = 1 \quad (10)$$

The newly created mass x_n fully originates from the previous mass x_{n-1} through quantum action, while maintaining the invariant value 'I'. All values are reduced with respect to the mass of the fundamental limit:

$$m_f = 1.08862171145 \cdot 10^{-28} \text{ kg} = 61.06719949 \text{ MeV}/c^2.$$

This formula connects bare and constituent particles (example shown in the table).

	bare (x_0)	constituent masses	
particle	$x_0 = [m/m_f]$ [MeV/c ²]	$x_n = x_{n-1} + x_{n-1}^{-0.5}$	
		I	II
bottom	68.54368 4185.77	68.664 4193.15	68.785 4200.52
fundamental	1.000000 61.06719949	2.000 122	2.707 165
down	0.07691539 4.70	3.683 224.89	4.204 256.71

The results are presented in parallel in two systems:

1. **Unit system** – reduced to the mass of the fundamental particle, so that the formula holds;
2. **MeV/c²** – the standard unit in particle physics.

To highlight the difference in mass growth, two quarks were deliberately chosen: one “light” (down) and one “heavy” (bottom).

5.7. Transition to extensive – Neutron/proton magnetic moment ratio

The following formula, obtained heuristically by relying on Boscovich's theory and the fundamental particle, represents the establishment of volumetric structure as a transition from Boscovich's non-extensive and massless to the material and spatial.

This represents a way to arrive at the spatial-material structure, with the participation of mathematical constants 2 and π and physical constants μ , α and g_{pn} – the ratio of the magnetic moments of the proton and neutron (see table).

$$g_{pn} = -\sqrt{\frac{2 * \mu}{(1 + 4\pi * \alpha^{-1})}} * \left(1 + \frac{\alpha^2}{\sqrt{(2\pi)^3}} \right) \quad (11)$$

- Factor: $\sqrt{1/(1 + 4\pi * \alpha^{-1})}$

Shows structural similarity with the Lorentz factor from (1).

- Factor: $1 + \alpha^2 / \sqrt{(2\pi)^3}$
also contains the invariant 'I'.

Values	2018
α	0.0072973525693
μ	1836.15267343
$g_{pn} = \text{formula (7)}$	-1.45989806

5.8. Anomalous magnetic dipole moments of leptons

The relationship between anomalous magnetic moments of leptons (a_e, a_m, a_τ) involves three ratios containing the '-I', which together yield a fourth invariant 'I'.

$$\frac{1}{b * a_e - 1} + \frac{2}{b * a_m - 1} + \frac{2}{b * a_\tau - 1} = 1 \quad (12)$$

The values that enable this formula are given in the table:

$\alpha =$	$b = 2\pi/\alpha$	
0.0072973525693	861.02257599735	
a_e^{exp}	a_m^{ideal}	a_τ^{ideal}
0.00115965218128	0.001165920898844	0.00117722126026
$1/(b*a_e - 1) + 2/(b*a_mu - 1) + 2/(b*a_\tau - 1) = 1$		
1.0000000000001		

So, the second and third generations of leptons exhibit a double influence compared to the first.

The superscript „*ideal*“ indicates that the values are adjusted to satisfy formula (12) and another formula (not presented here) that, together with this one, forms an ontological unity of the anomalous lepton moments, though it is not part of this work.

6. Dichotomy Examples

We presents seven original dichotomies accompanied by precise formulas that explain them—or, more accurately, that emerge from these dichotomies.

A dichotomy denotes the division of a whole into two mutually exclusive and complementary possibilities.¹

Derivation process is not presented here, but rather the focus is on stating their existence.

6.1. Dichotomy of second- and third-generation quarks

The masses of the second- and third-generation quarks are calculated by the formulas:

$$t = K * [T * (\alpha^{-1} - 1)^4 * 2^{-1}]^{1/3} \quad (13)$$

$$b = K * (T^{-1} * \alpha^{-4} * 2^{-9})^{1/3} \quad (14)$$

$$c = K * (T * \alpha^{-1} * 2^{-1})^{1/3} \quad (15)$$

$$s = K * (T^{-1} * \alpha^{-1} * 2^{-4})^{1/3} \quad (16)$$

Where: α — the fine-structure constant, T — the ratio of the tau particle mass to the muon mass, and K — a constant dependent on proton parameters and the system of units used. All of these are shown in the following table together with the calculations and the experimentally measured values in the last column for comparison. Since the focus of this paper is on the Dichotomy, we will not elaborate on the previous parameters in detail.

	$\alpha = 0.0072973525693$		
	$T = 16.8167350604$		
	$K = 121.431978249$		
formula	quark mass by formula	[MeV/c ²]	measured
(13)	$t = K * [T * (\alpha^{-1} - 1)^4 * 2^{-1}]^{1/3}$	172759.56	172760 ± 300
(14)	$b = K * (T^{-1} * \alpha^{-4} * 2^{-9})^{1/3}$	4185.77	4180+40; -30
(15)	$c = K * (T * \alpha^{-1} * 2^{-1})^{1/3}$	1273.06	1275 +25; -35
(16)	$s = K * (T^{-1} * \alpha^{-1} * 2^{-4})^{1/3}$	96.97	95+9; -3

a. Dichotomy by generations:

- Third generation (quarks **t**, **b**) – formulas (13) and (14) use the fourth power of α , which indicates a weaker dependence on the parameters K and T .

¹ Oxford English Dictionary, s.v. *dichotomy*, Oxford University Press.

- Second generation (**c**, **s**) – formulas (15) and (16), on the contrary, show a stronger influence of the same parameters.

b. Dichotomy within the same generation (according to quark type):

- Up-types (charge $+2/3e$: **t**, **c**) – formulas (13) and (15): multiplied by **T**.
- Down-types (charge $-1/3e$: **b**, **s**) – formulas (14) and (16): divided by **T**.

This points to complementarity within generations – as if **T** represents a field that acts in opposite ways on quarks of different charges.

Although, perhaps it would be more accurate to say that the dichotomies determine the generation and type of quark rather than the other way around?

Quark generations are not arbitrary – they have precise mathematical features that reflect their role in nature.

6.2. Dichotomy in bosons – One versus all

The specificity of bosons is reflected in the principle of “*one versus all*,” whereby each key property belongs to only one boson, while all others exhibit the opposite:

- The Higgs boson is scalar, while all others are vector.
- The W boson is charged, while all others are uncharged.
- The Z boson is a neutral massive vector, while the others are not.
- The gluon is the only one that is always confined within hadrons.
- The photon is the only one that does not interact with its own kind (another photon).

6.3. Dichotomy in neutrinos – Existence / non-existence

All neutrinos are produced almost exclusively with left-handed helicity, and antineutrinos with right-handed. This clearly sets them apart from other fermions, which can have both helicities. Within the class of neutrino leptons we do not observe any dichotomies, nor can it be assumed that such exist. Neutrinos are *boundary phenomena* at the very threshold of existence, in opposition to non-existence. They represent the first physical points of the material world and the precondition of dichotomy. Within their class, however, the dichotomy does not appear, because its place is occupied by neutrino oscillations, which which prevent its manifestation.

6.4. Dichotomy at Bošković’s curve

This dichotomy is, in fact, the dichotomy of the existence of substance — **matter versus antimatter**. In contrast to conventional approaches, we interpret this fundamental dichotomy through the lens of Bošković’s theory of forces (see Figure 1 in [1]). I propose that, in this figure, antimatter is represented as a mode of existence on the left branch of the curve relative to point ‘A’, while matter is situated on the right branch. At the limit points (the intersections of the curve with the abscissa) there is neither attraction nor repulsion, which indicates that this distance alone is not sufficient to explain the existence of the universe.

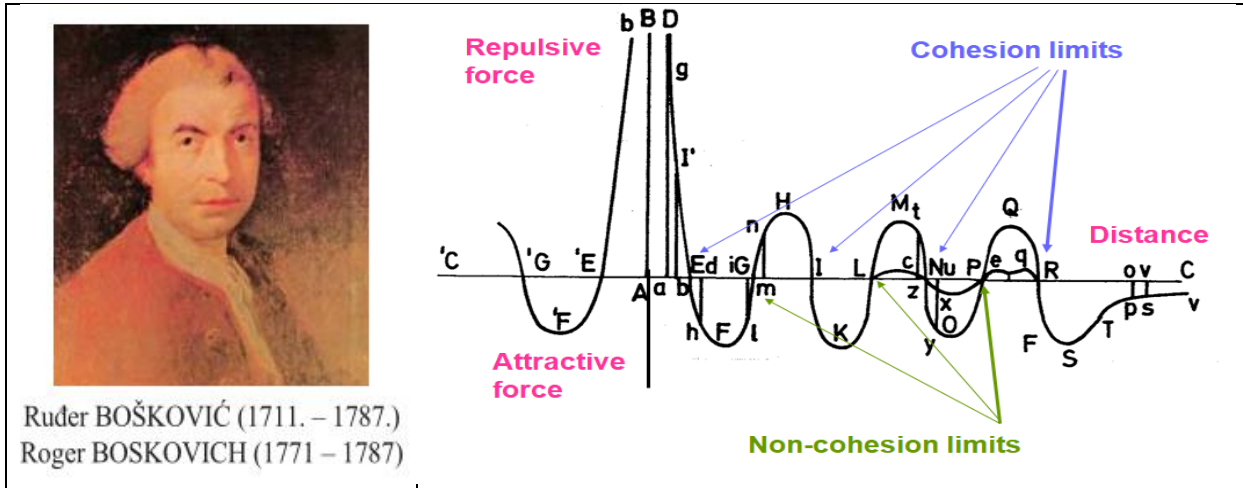


Figure 1 – Bošković and his curve of force

General form of Bošković’s curve showing the variation of attractive and repulsive forces with the change of distance (abscissa) between elementary points or particles of matter.

Therefore, it is necessary to introduce the concept of a spacing that generates excitations at the level of elementary particles. For electrons, this spacing is the *classical electron radius*:

$$r_{ce} = \alpha * \hbar / (m_{el}c) = \hat{\lambda}_{el} * \alpha = 2.81794033 * 10^{-15} m \quad (17)$$

Our conception of nature corresponds to a definition tied to Bošković’s process of generating the extended from the non-extended. Accordingly, our classical radius for the positron is, by definition, $\alpha^{\wedge-2}=18778.8650$ times larger than that of the electron:

$$r_{cp} = \hbar / (\alpha * m_{el} * c) = \hat{\lambda}_{el} / \alpha = 5.29177211 * 10^{-11} m \quad (18)$$

An analogous mechanism is expected for particles with charges $\alpha^{\wedge\pm 1/3}$ and $\alpha^{\wedge\pm 2/3}$, which explains the existence of particles and antiparticles in general.

At the level of elementary particles, symmetry is preserved. However, due to the enormous difference in radii, in complex systems the dominance of matter becomes evident, since what corresponds to the Bohr radius for atoms appears, in expression (18), as the classical radius of the positron.

This embodies the dichotomy: the original understanding of the classical radius as an excitation that manifests itself in two opposite directions—particularly significant for the complex forms arising from electrons and positrons. The quantitative asymmetry arises precisely from the difference in radii.

6.5. Duality of light and matter – Waves / particles

The wave–particle duality represents a fundamental quantum dichotomy in which one and the same entity manifests itself through two seemingly opposite, yet complementary, natures. This

dichotomy is realized at Bošković's *cohesion* limit, which is identical to the reduced Compton wavelength of the electron λ_{el} . At this characteristic length scale, matter exhibits both its particle properties and its wave nature, thereby revealing the essential unity of these two phenomena.

6.6. Cosmological dichotomy – Matter / radiation

The coexistence of matter and radiation throughout the history of the universe is explained by the very necessity of the existence of Bošković's general curve of forces. This dichotomy is dynamic and mutually conditioned: during the evolution of the universe, the material and immaterial aspects of reality exist in a state of continuous interpenetration and reciprocal sustenance. The existence of one side of this dichotomy directly implies the existence of the other, in accordance with the fundamental laws of nature.

6.7. Dichotomy of temperature – Celestial bodies / voids

The temperature of the cosmic microwave background (CMB) is not a relic of the past, but rather the geometric mean of all temperatures in the universe. Absolute zero does not exist— all temperatures lie between the lower limit (the hypothetical quantum of temperature T_{hq}) and the upper Planck limit, which together constitute an invariant temperature continuum.

This dichotomy is manifested through:

- The high temperatures of celestial bodies, where particle collisions are probable.
- The low temperatures of cosmic voids, where the probability of collisions is minimal.

In this way, the temperature dichotomy sustains the dynamic equilibrium of the universe. The dichotomy can also be applied more broadly as a methodological approach, similar to the examples in this work.

References

[1] Boscovich, R.: 1758, *Philosophiae naturalis theoria redacta ad unicum legem virium in natura existentium*, Beč (prvo izdanje; 1763, Venecija, (drugo izdanje); 1922 i 1966, *A Theory of natural philosophy*, Open Court, London i The Massachusetts Institute of Technology, M.I.T. Press, Cambridge (redom); 1974, *Teorija prirodne filozofije svedena na jedan jedini zakon sila koje postoje u prirodi*, (dvojezično: latinski i hrvatski), Liber, Zagreb, 1974.

[2] http://en.wikipedia.org/wiki/Mach%27s_principle [last modified on 24 September 2016]

[3] Stoiljković, D.: 2010, *Ruđer Bošković – utemeljivač savremene nauke*, Istraživačka stanica Petnica, Valjevo, <https://www.researchgate.net/publication/260297371> (English translation: Stoiljkovich, D.: 2014, *Roger Boscovich – The Founder of Modern Science*, LULU Publishing, <https://www.researchgate.net/publication/281489710>

[4] D. B. Semyonowich, *The Concept of Moving Space-Matter*, [http://gsjournal.net/Science-Journals/%7B\\$cat_name%7D/View/3565](http://gsjournal.net/Science-Journals/%7B$cat_name%7D/View/3565)