

Dichotomy examples

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Abstract:

This paper 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 Here they stem from my earlier works published on this portal; derivation process is not presented here, but rather the focus is on stating their existence.

1. Dichotomy of second- and third-generation quarks:

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

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

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

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

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

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

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

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/c²] | measured |
| (1a) | $t = K * [T * (\alpha^{-1} - 1)^4 * 2^{-1}]^{1/3}$ | 172759.56 | 172760 ± 300 |
| (1b) | $b = K * (T^{-1} * \alpha^{-4} * 2^{-9})^{1/3}$ | 4185.77 | 4180+40; -30 |
| (1c) | $c = K * (T * \alpha^{-1} * 2^{-1})^{1/3}$ | 1273.06 | 1275 +25;-35 |
| (1d) | $s = K * (T^{-1} * \alpha^{-1} * 2^{-4})^{1/3}$ | 96.97 | 95+9; -3 |

a. Dichotomy by generations:

- Third generation (quarks **t**, **b**) – formulas **(1a)** and **(1b)** use the fourth power of α , which indicates a weaker dependence on the parameters K and T .
- Second generation (**c**, **s**) – formulas **(1c)** and **(1d)**, 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 **(1a)** and **(1c)**: multiplied by T .
- Down-types (charge -1/3e: **b**, **s**) – formulas **(1b)** and **(1d)**: 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.

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).

3. Dichotomy in neutrinos – existence / non-existence:

All neutrinos are produced almost exclusively with left-handed helicity, and antineutrinos with right-handed helicity. 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 act as an obstacle to its manifestation.

4. Dichotomy of the existence of substance – matter / antimatter

In contrast to conventional approaches, we interpret this fundamental dichotomy through the lens of Bošković's theory of forces (Figure 1 from [1]). I consider 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 spacing alone is not sufficient to explain the existence of the universe.

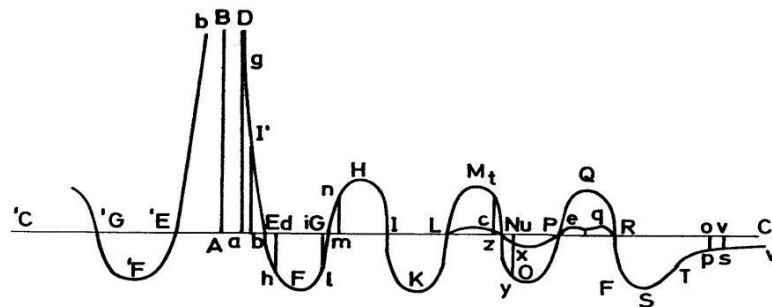


Figure 1 – General form of Bošković's curve showing the variation of attractive and repulsive forces with the change of distance (abscissa) between elementary points or particles of matter.

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*:

$$r_{ce} = \alpha * \hbar / (m_{el}c) = \tilde{\lambda}_{el} * \alpha = 2.81794033 * 10^{-15} m \quad (4a)$$

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, $\alpha^{-2}=18778.8650$ times larger than that of the electron:

$$r_{cp} = \hbar / (\alpha * m_{el} * c) = \tilde{\lambda}_{el} / \alpha = 5.29177211 * 10^{-11} m \quad (4b)$$

An analogous mechanism is expected for particles with charges $\alpha^{\pm 1/3}$ i $\alpha^{\pm 2/3}$, 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 (4b), 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.

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 property and its wave nature, thereby revealing the essential unity of these two phenomena.

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.

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 unicam 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..