Let There Be Light in Quantum Theory: A φ-Geometric Model of Relativistic and Cosmological Limits

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This paper introduces a new geometric model of spacetime, constructed from a right triangle inscribed in a circle. In this construction, the hypotenuse coincides with the diameter of the circle. From this configuration, a universal parameter naturally emerges — the angle φ, which links gravitational effects, relativistic transformations, and quantum transitions. This geometry provides a new way to interpret physical phenomena, ranging from classical cosmology to quantum mechanics. It avoids deep singularities and transforms them into "light" singularities. These milder forms open the way for further physical analysis.

Keywords: geometric model; φ-angle; spacetime; gravity; relativity; quantum theory; cosmology; singularity; Big Bang; φ-Geometric; φ-Model; v=c=0.

Introduction

Modern physics operates with a powerful mathematical apparatus for describing the phenomena of special and general relativity, quantum mechanics, and the cosmology of the early Universe. However, the complexity of formulas and the abstract nature of concepts often obscure their physical meaning. One possible way to simplify understanding is to employ geometric interpretations and visual models.

In a previous work [1], the so-called φ-geometry was proposed. In this approach, fundamental relativistic relations and gravitational effects are interpreted through a simple right triangle with the angle φ. This construction makes it possible to clearly connect time dilation, the curvature of spacetime, and relativistic dynamics within the framework of general relativity.

The aim of the present paper is to extend the scope of φ-geometry. We show that this language of visualization can be useful not only for relativistic dynamics and gravity, but also for interpreting quantum theory, for describing transitions to photon-like states, and for analyzing the earliest stages of cosmic expansion after the Big Bang [2].

We do not propose a new physical theory. Instead, we introduce an additional tool for the geometric visualization of physical processes. This approach helps to reveal limiting regimes (from rest to the photon-like state) and to make explicit the connections between different areas of physics. Even if the model is not complete, Its value lies in making key principles more transparent, intuitive, and pedagogically useful [3].

2. The Basic Idea of the φ-Triangle

The central element of the proposed approach is a right triangle inscribed in a circle, with its hypotenuse lying along the diameter — the φ-triangle. It provides a simple geometric interpretation of special relativity. As shown in the previous work [1], this construction makes it possible to connect relativistic effects with a gravitational context, naturally relating radius, spacetime curvature, and time [4].

In the normalized unit form:

- the opposite leg (Figure 1) corresponds to sin φ = v/c, which reflects the dynamic, "light-like" component;
- the adjacent leg is cos φ = 1/γ, which describes time dilation and its relation to the rest mass;
- in this case, the hypotenuse is taken as unity, since in the previous paper it was often identified with the speed of light.

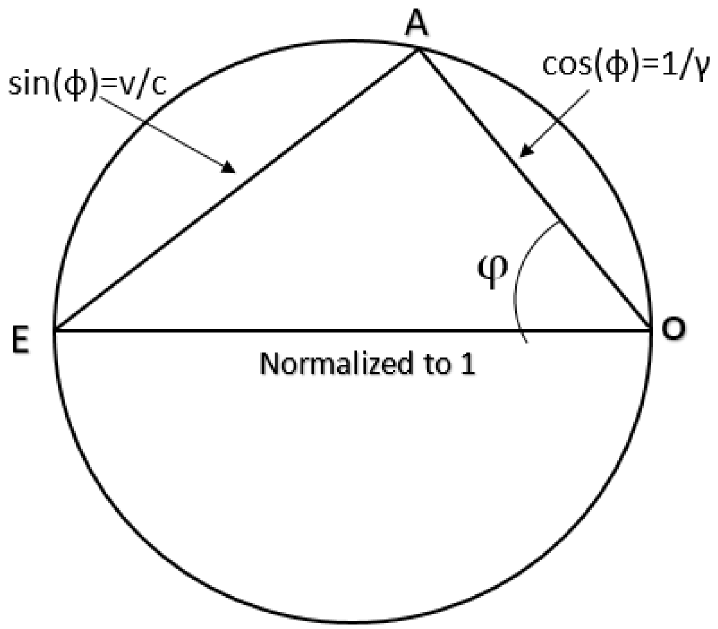

Figure 1 — *The φ-triangle (sin φ = v/c, cos φ = 1/γ) in normalized unit form*

Thus, the entire relativistic dynamics can be expressed through a cosine–sine formulation of relativistic physics, where the angle φ varies smoothly from 0° to 90°.

- At φ = 0°: sin φ = 0, cos φ = 1 — the particle is at rest.
- At φ = 90°: sin φ = 1, cos φ = 0 — the relativistic limit is reached. This regime can be described as a photon-like state, corresponding to massless particles [5].

In a deeper interpretation, the angles φ = 0° and φ = 90° do not represent two independent regimes. Instead, they describe one and the same universal phase, expressed in different coordinate projections. In this phase, mass and light coexist simultaneously, while the further evolution of the system determines which branch becomes dominant.

This construction can be regarded as a visual approach to the energy–momentum relation, where momentum and energy are **embedded in** a clear geometric scheme. It should be emphasized that this is not a literal transformation of matter into light, but rather a visual interpretation of the limiting transition. Such a perspective helps to clarify the boundary between the rest state and the light-like regime.

3. φ-Geometry and the Speed of Light Limit

In the language of φ-geometry, the relativistic limit is described very simply: as φ → 90°, sin φ → 1 and cos φ → 0. In this regime, the velocity projection approaches its maximum (v → c), while the projections of mass and time vanish.

This limiting case can be interpreted as a transition into a photon state, where the object behaves like a massless particle [6].

It is important to emphasize that this is not about a literal "transformation of matter into light." Instead, the φ-triangle serves as a visual model for describing the relativistic limit, where the concepts of rest mass and velocity are connected through simple geometry.

In a deeper interpretation, φ = 0° and φ = 90° are not to be regarded as two different states, but rather as the same phase represented in different coordinates. In the projection onto the cos φ axis, this appears as pure rest (v = 0). In the projection onto the sin φ axis, it appears as the pure light-like state (v = c).

Geometrically, this corresponds to the diameter of the φ-circle, where both ends represent different projections of one limiting state [7].

In this sense, the symbolic equality proposed earlier [1]: v = c = 0 (1) receives a natural interpretation: the velocity of rest and the velocity of light are not opposites, but two coordinate aspects of a single limiting regime in φ-geometry. Sometimes the appearance of the equality v = c in formulas is treated as an error or a paradox. However, in the φ-language it becomes a natural indicator of a phase transition: the system changes its coordinate representation, moving from the mass projection to the light projection.

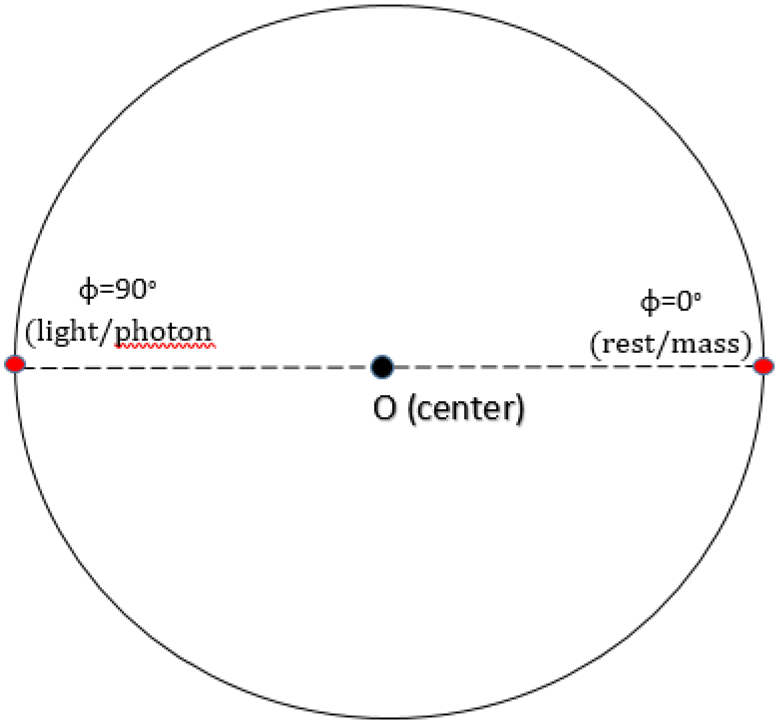

Figure 2 — *Diameter of the φ-circle: the states φ = 0° (mass projection) and φ = 90° (light*

projection) as two coordinate representations of the same phase.

Both ends of the diameter represent the same limiting state, but in different coordinate projections. At φ = 0° the mass coordinate is represented (cos φ = 1), while at φ = 90° the light coordinate is represented (sinφ = 1). This illustrates the symbolic identity v = c = 0 as the unification of rest and light within a single phase.

Philosophically, such cyclicity can also be linked to cosmology. At the beginning of the cycle (φ = 90°), the light-dominated state prevails, corresponding to the radiation-dominated era of the early Universe [8]. In the future, when photons disappear and stars burn out, the system will again return to the "rest" phase (φ = 0°).

Thus, φ-geometry provides a simple visualization of the possible alternation of states "light ↔ mass ↔ light," connecting local relativistic limits with global cosmological cycles.

In a dynamic interpretation, the limiting state φ = 0° = 90° can be interpreted asthe moment of simultaneous coexistence of mass and light. However, almost instantly the system "unfolds" into one of the coordinate projections.

In one scenario, mass disappears and only light remains — an analogue of the radiation-dominated state of the early Universe. In another scenario, light gradually fades while mass increases—corresponding to the formation of matter and structures.

Thus, mass does not vanish completely but instead pulsates, alternating with light in different φ phases.

4. φ and Gravity: Radius, Mass, and Time

One of the first applications of φ-geometry is its connection with gravity. In standard general relativity, radius, mass, and the curvature of spacetime are described by the Schwarzschild metric. In the φ-language, this relationship can be written in a simple trigonometric form [9]:

$$\cos(\varphi) = \sqrt{1 - \frac{2GM}{Rc^2}} \quad (2)$$

where G is the gravitational constant, M is the mass of the object, R is the radius, and c is the speed of light.

4.1. Example for the Sun

For the Sun's mass, M = 1.989 × 10^{30} kg, and radius, R = 696,340 km, we obtain the angle φ ≈ 0.118°.

At φ = 0°, the radius approaches the Schwarzschild radius:

$$R_S = \frac{2GM}{c^2} \approx 2.95\ km.$$

At φ = 90°, the radius rises dramatically to:

$$R \approx 7.87\ \times\ 10^{32} km,$$

which corresponds to a light-like state, where mass "dissolves" into space [10].

4.2. Symmetry of Sine and Cosine

If, instead of the cosine, we use the sine, we obtain a mirror-symmetric formula:

$$R = \frac{2GM}{c^2} \cdot \sin^2(\Phi) \ (3)$$

- At φ = 0°, the radius formally diverges to infinity, since sin0 = 0 and the denominator goes to zero.
- At φ = 90°, the radius coincides with the Schwarzschild radius.

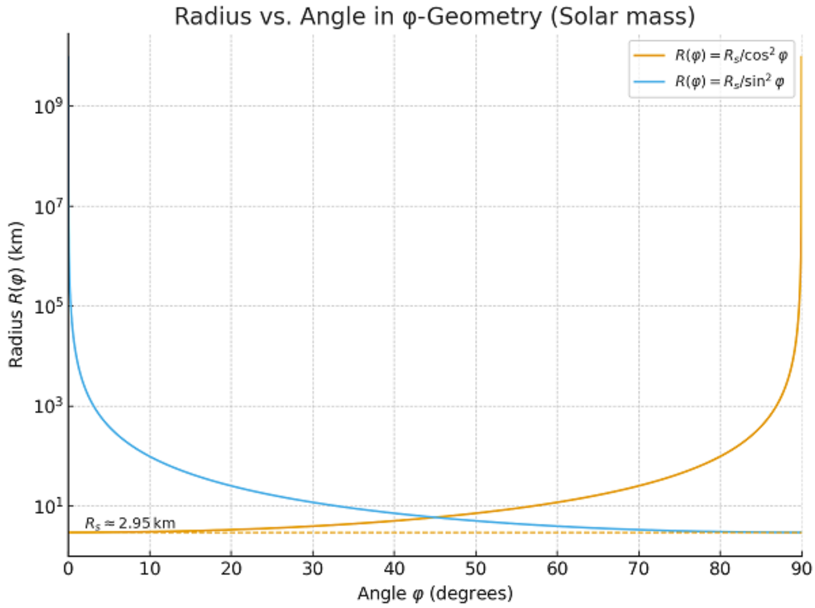

Figure 3 — *Dependence of the radius on the angle φ for the solar mass: mirror-symmetric relations are shown according to formulas (3) and (4).*

According to the cosine formula:

$$R = \frac{2GM}{c^2} \cdot \ cos^2(\Phi) \ (4)$$

At φ = 0°, it gives the Schwarzschild radius (≈ 2.95 km for the Sun), while as φ ⟶ 90° it diverges toward an extremely large value (≈ 7.87 × 10^{32} km).

According to the sine formula (3), at φ = 0° the radius is formally diverges to infinity, but at φ = 90° it also yields the Schwarzschild radius.

Thus, the cosine and sine metrics complement each other: where one produces a "singularity" or diverges without bound, the other remains finite. This highlights the fact that φ-symmetry smooths out extreme regimes and removes paradoxes, in the same way that in quantum mechanics it resolves the paradox of "rest mass diverging as v ⟶ c."

4.3. Interpretation

At small φ, the radius is small, and mass appears through strong gravitational compression.

At large φ, the radius increases, which corresponds to the "light" phase, where mass vanishes and space approaches a state of minimal curvature.

In other words, mass ↔ gravity is described in the φ-language just as clearly as mass ↔ light. In a deeper interpretation, the states φ = 0° and φ = 90° are not opposites, but rather represent different coordinate projections of the same universal phase: compact compression (Schwarzschild) and vast expansion (light-like radius).

4.4. From the Sun to the Universe

If the same formula is applied not to the mass of the Sun, but to the mass of the entire observable Universe ($\sim 10^{53}$ kg), the resulting radius is several orders of magnitude larger than the solar value of 7.87×10^{32} km. This can be interpreted as the scenario in which all the matter of the Universe could have existed in a light-like (massless) state immediately after the Big Bang.

Thus, the gravitational language expressed through φ leads directly to a cosmological interpretation [11].

5. Quantum Bridges through φ

5.1. Connection with the Big Bang

Modern cosmology states that in the first moments after the Big Bang, the Universe was in a radiation-dominated state. During this period, photons and other massless particles were the dominant components. In φ-geometry, such a state is naturally described as the limiting regime at φ = 90°, where the mass projection vanishes and only light-like dynamics remain [12].

The transition to a state with nonzero mass occurred later, when the temperature decreased and symmetries were broken. In the Standard Model, this is associated with the Higgs mechanism, which "endows" elementary particles with mass. In the φ-language, this corresponds to the gradual departure of the angle φ from 90°, which restores the cosine component (cosφ ≠ 0) and leads to the emergence of mass.

In φ-geometry, the temperature of the Universe can also be visualized. At φ = 90°, the Universe corresponds to the extremely hot radiation-dominated phase ($T \to \infty$), where all particles are massless. As φ decreases, the temperature drops, the Higgs field activates, and mass emerges. At φ → 0°, the Universe becomes cold and mass-dominated.

In the Standard Model, the Higgs mechanism is described by the potential $V(\Phi) = \mu^2\phi^2 + \lambda\phi^4$, where the position of the minimum depends on the temperature of the Universe [13].

Thus, the early cosmological evolution can be naturally interpreted as the evolution of the angle φ from the light-dominated phase (φ = 90°) toward a mixed regime, where mass and light coexist.

5.2. De Broglie through φ

In 1923, Louis de Broglie proposed a bold hypothesis: if light (the photon) behaves both as a particle and as a wave, then perhaps all matter might also possess wave-like properties. For the photon, the following relations were already known:

$$E = \hbar\omega \ (4), \qquad p = \hbar k \ (5)$$

relating energy to frequency and momentum to wavelength. De Broglie extended these formulas to all massive particles, suggesting that even the electron and the proton have their own associated waves. His idea was experimentally confirmed in 1927 by the Davisson–Germer experiment, where electrons passing through a nickel crystal produced an interference pattern, analogous to that of light waves.

In φ-geometry, these de Broglie relations emerge in a straightforward way. From the trigonometric triangle in Figure 1:

$$p = mc \cdot sin\varphi \ (6), \qquad E = mc^2 (7).$$

- The right leg (cos φ) corresponds to the rest energy: $E_{\parallel} = mc^2 \cdot cos\varphi$ (8),
- The left leg (sin φ) corresponds to the dynamic part, associated with momentum: $E_{\perp} = mc^2 \cdot sin\varphi = pc$ (9).

Substituting into the de Broglie relations, we obtain:

$$k = \frac{p}{\hbar} = \frac{mc}{\hbar} sin\varphi \ (10), \qquad \omega = \frac{E}{\hbar} = \frac{mc^2}{\hbar} \ (11).$$

From these expressions, the phase and group velocities follow directly:

$$v_{ph} = \frac{\omega}{k} = \frac{c}{sin\varphi} = \frac{c^2}{v} \ (12), \qquad v_g = \frac{d\omega}{dk} = v = c \cdot sin\varphi \ (13).$$

The well-known relation:

$$v_{ph} v_g = c^2 \ (14)$$

In quantum mechanics, it is perceived as a remarkable law: the phase velocity always "compensates" the group velocity. But in the φ-language, it appears as an elementary trigonometric identity:

$$\left(\frac{c}{sin\varphi}\right) \cdot (c \cdot sin\varphi) = c^2 (15).$$

Thus, de Broglie arrived at the wave nature of matter through an analogy with light, while φ-geometry makes it possible to obtain the very same formulas directly from a simple drawn triangle [14].

5.3. Energy and Mass in the φ-Language

In relativistic mechanics, energy and momentum are related by the equation:

$$E^2 = (pc)^2 + (mc^2)^2 \ (16).$$

In φ-geometry, this relation is expressed through the legs of the triangle (Figure 1):

- The right leg (cos φ) corresponds to the rest energy: $E_{\parallel} = mc^2 cos\varphi$, (17)
- The left leg (sin φ) corresponds to the dynamic part, associated with momentum:

$$E_{\perp} = mc^2 sin\varphi = pc \ . (18)$$

Then the total energy is described as the sum of the squares of the legs:

$$E^2 = E_{\parallel}^2 + E_{\perp}^2 \ (19)$$

Substituting (17) and (18):

$$E^2 = (mc^2 cos\varphi)^2 + (mc^2 sin\varphi)^2 \ . (20)$$

Factoring out the common term:

$$E^2 = (mc^2)(cos^2\varphi + sin^2\varphi)\,.\,(21)$$

Using the identity

$$cos^2\varphi + sin^2\varphi = 1\,,(22)$$

we obtain the standard expression:

$$E^2 = (mc^2)^2\,.\,(23)$$

Interpretation:

At small φ, the right leg ($E_{\parallel}$) dominates, corresponding to the rest mass.

As φ → 90°, the right-hand part vanishes (cosφ → 0), and only the left-hand part remains ($E_{\perp}$ = pc) — the pure photon state.

Deeper interpretation.

The states φ = 0° and φ = 90° can be regarded not as opposite limits, but as two coordinate projections of a single universal phase: in one case mass is manifested (cosφ), and in the other light is manifested (sinφ).

Thus, the standard relativistic relation reduces to a simple trigonometric identity. In the φ-language, the paradox of the "impossibility of reaching the speed of light" is removed: the particle does not encounter the problem of infinite mass, and the occasional appearance of v = c in formulas should not be treated as an error. Instead, the particle smoothly transitions into the light-like regime at φ = 90° [15].

Note

Such an interpretation in φ-geometry aligns closely with modern cosmological views. In the Standard Model of the early Universe, the first moments after the Big Bang are typically described as a radiation-dominated stage, where photons and other massless particles were the main constituents. The emergence of nonzero mass occurred later, when the temperature decreased. In the φ-language, this corresponds to the gradual departure from the limiting state φ = 90° (light) and the activation of the cosine projection (mass). Thus, φ-geometry does not replace but instead provides an elegant visualization of the accepted picture: "in the beginning there was light, and later mass arose."

6. Transformation of Photons into Mass: Physical Examples

One of the most striking confirmations of wave–particle duality and the fundamental energy–mass equivalence is the possibility of mutual conversion between light and mass. In quantum electrodynamics, this is not a hypothesis but an observed fact: photons can transform into massive particles, and particles can emit photons. In φ-geometry, such processes are interpreted as a redistribution between the sine (light) and cosine (mass) branches [16].

6.1. Laboratory Reactions

A classical example is the Breit–Wheeler process (1934):

$$\gamma + \gamma \leftrightarrows e^- + e^+$$

If the energy of the photons exceeds the threshold of $2m_ec^2 \approx 1.022$ MeV, they can produce an electron–positron pair. This process has been observed in laboratories using intense γ-sources and lasers [17].

Another channel is the Bethe–Heitler process:

$$\gamma + (Z) \rightarrow e^- + e^+ + (Z),$$

where a photon creates a pair in the vicinity of a nucleus, which absorbs part of the momentum. These reactions confirmed that the photon state can be converted into rest mass.

Even a thought experiment illustrates this: if photons are trapped in a perfectly reflecting container, the mass of the system will increase by

$$\triangle M = E_{light}/c^2.$$

This provides a clear demonstration of the equivalence of mass and energy.

6.2. Astrophysical Manifestations

Under extreme astrophysical conditions, photons can under certain conditions give rise to massive particles. Near pulsars and the accretion disks of black holes, γ-ray cascades are observed: a high-energy photon, interacting with another photon or with a strong magnetic field, generates an electron–positron pair. The new particles emit photons, which in turn can produce additional pairs, and the process becomes cascading [18].

Such phenomena explain the hard γ-radiation from neutron stars and active galactic nuclei. These phenomena offer strong observational indications that massless particles (photons) are capable of transforming into massive states.

Thus, the conversion of light into mass is not just a theoretical possibility but a well-documented physical process. The novelty of φ-geometry lies in its ability to visualize this process: as $\varphi \rightarrow 90°$, mass disappears and only light remains; as φ departs from 90°, the cosine projection grows, corresponding to the "mass branch."

6.3. Earth as a Cosmic Laboratory

The Earth receives about 174 petawatts of radiation from the Sun. A portion of this energy is stored in the atmosphere, oceans, and living organisms.

Plants use photons in photosynthesis, converting light energy into chemical bonds of molecules. The oceans and atmosphere absorb photons, transforming their energy into the thermal motion of molecules.

For estimation: in one year the Earth receives about 5.5×10^{24} J of energy from the Sun, which is equivalent to approximately 6.1×10^7 kg (61 million tons) according to the formula $E = mc^2$. On the planetary scale this is negligible, but over thousands and millions of years the accumulated amount becomes significant — comparable to the mass of asteroids or even entire mountains.

It should be noted that most of this energy is eventually re-emitted into space as infrared thermal radiation. Yet locally and temporarily, photons do transform into mass — whether in chemical bonds, in the thermal reservoir of the oceans, or in biomass. In the φ-language, the Earth acts as a natural laboratory, transferring contributions from the light branch (sinφ) into the mass branch (cosφ).

6.4. Black Holes as Gravitational Vacuum Cleaners

Perhaps the most striking example of the transformation of light into mass is provided by black holes. Their gravity is so strong that they absorb photons and prevent their escape. The captured light ceases to exist in the photon state and is fully converted into the gravitational mass of the object [19].

In φ-geometry, this process is described as a gradual departure of φ from 90°: the light projection (sinφ) disappears, while the cosine (mass) branch completely dominates. As a result, a black hole becomes a concentrator of mass and an “absorber of light,” enhancing the gravitational compression of the Universe. Such black holes are abundant in the Universe.

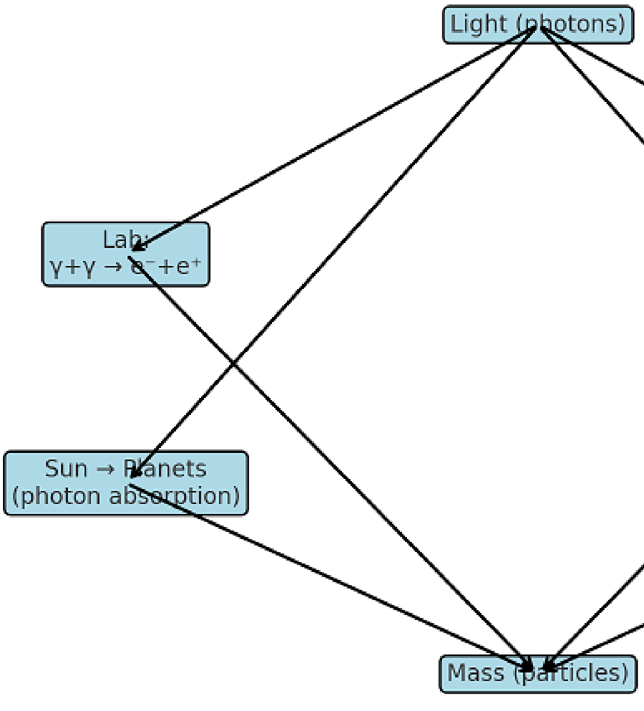

Figure 4 — *Transitions “photon ↔ mass” at different scales*

In the early Universe, these processes proceeded in both directions. While the temperature was extremely high ($kT \gg m_e c^2$), photons readily transformed into electron–positron pairs and back again.

When the Universe expanded and cooled below the energy threshold of $2m_e c^2 \approx 1.022$ MeV, the creation of pairs became rare while annihilations continued. As a result, part of the energy of light effectively 'froze' in the form of long-lived massive particles [20].

In the φ-language, this appears very clearly: at φ = 90° we have a purely light phase, and as the temperature decreases, the angle departs from 90°, the cosine branch begins to grow, and the mass projection emerges.

7. Cosmological Cycle in φ-Geometry

In the φ-language, cosmology appears as the motion of the angle φ between limiting states:

- at φ = 90°, only light remains (radiation-dominated era),
- at φ = 0°, mass and gravitational compression dominate [21].

At first glance, φ = 0° and φ = 90° appear to be opposite phases. However, in a deeper interpretation they do not represent two distinct states but rather a single universal phase. This fully agrees with the result of the previous work [1], where it was shown that the critical state v = c = 0 corresponds to one physical configuration, which can manifest either as rest (v = 0) or as the relativistic limit (v = c).

Thus, at the moment φ = 0° = 90°, mass and light coexist simultaneously in different coordinate projections. This is the threshold state — a universal phase corresponding to v = c = 0, which can be interpreted as the moment of the Big Bang.

Beginning: In the first moments after the Big Bang, the Universe was was precisely in this universal phase (φ = 0° = 90°): compression down to the Schwarzschild radius and light-like expansion. Within nanoseconds, the system "chooses" a branch — mass disappears, and a purely light state remains at φ ≈ 90° [22].

Mixed era: As cooling progresses, the angle φ shifts away from 90°, the cosine becomes nonzero, and mass returns. This marks the beginning of the era of stars and planets, where mass and light coexist with varying proportions.

Future: When the stars burn out, light will fade, φ → 0°, and gravity will prevail. But this limit is not final: since φ = 0° and φ = 90° reflect the same state v = c = 0, the contraction at φ = 0° can naturally transition into a new expansion at φ = 90°.

Thus, cosmology in the φ-language becomes cyclical: "mass ↔ light," "contraction ↔ expansion" [23].

8. Discussion and Perspectives

One of the key advantages of φ-geometry is its universality. In our previous work [1], it was shown that parameterization through the angle φ makes it possible to clearly describe the transformations of electromagnetic fields: at φ → 90°, the electric and magnetic components switch into each other (E ↔ B) while preserving Lorentz invariants. In the present paper, we have observed a similar structure: mass and light also appear as mutual projections mutual projections of one universal phase. Moreover, through φ one can describe both relativistic velocity addition and transitions in quantum mechanics $\left(\psi(x,t) = Ae^{i(kx-\omega t)} \text{ de Broglie}\right)$.

Thus, the φ-language provides a connecting bridge between mechanics, gravity, electrodynamics, quantum theory, and cosmology [24].

It is particularly important to note that, in a deeper interpretation, φ = 0° and φ = 90° do not represent two separate states but rather the same universal phase, represented in different coordinate projections. This is consistent with the conclusion about the critical state v = c = 0 [1], which unifies rest and light-like motion within one symmetry.

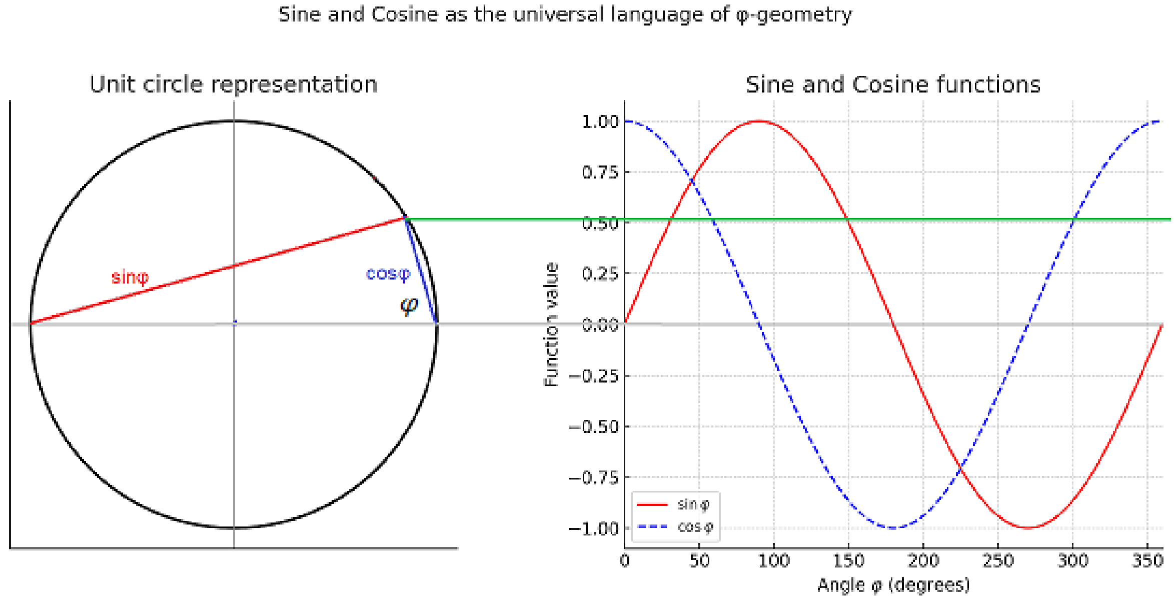

Figure 8 — *The universality of φ-geometry: sine and cosine as a bridge between different areas of physics.*

In Figure 8, the universality of the φ-language is illustrated: sine and cosine not only describe classical trigonometry but also serve as a bridge between different areas of physics. The formula for relativistic velocity addition can be written as:

$$v(OB) = \frac{c \cdot (\sin(\varphi_1) + \sin(\varphi_2))}{1 + (\sin(\varphi_1) \cdot \sin(\varphi_2))} \quad (24)$$

In this form, it is clearly seen that the fundamental limits v→0 and v→c are naturally described through the sine–cosine representation. Similarly, in gravity, the Schwarzschild radius is expressed as $\cos\varphi = \sqrt{1 - \frac{2GM}{rc^2}}$ (25) and in quantum mechanics, the wave function takes the form $\psi = Ae^{i\varphi}$, which is directly related to sinφ and cosφ.

Thus, φ-geometry serves as a universal language that connects the fundamental laws of nature.

The application of φ-geometry has a dual significance:

- **Methodological** — it suggests new ways of interpreting limiting regimes, where "infinity" and "zero values" turn out to be mirror projections of a single configuration.
- **Educational** — the model can serve as a simple tool for teaching (an educational tool for relativity and quantum theory), making the key ideas of special and general relativity, quantum mechanics, and cosmology more accessible [25].

Of course, φ-geometry does not replace the rigorous equations of general relativity or quantum mechanics. It serves a different function — to visualize paradoxes and translate them into the language of elementary trigonometry.

The The potential applications extend beyond fundamental physics. Even now, one can identify directions in engineering and education in engineering and educational technologies where simple geometric schemes help to grasp complex laws.

In the future, we plan to investigate whether the φ-language can also be applied to other levels of the physical picture of the world — such as atomic physics and string theory. If similar regularities can be identified, this would provide additional confirmation of the universality of the proposed approach and may represent a step toward a more unified view of physical laws.

At the same time, we emphasize once again that the proposed model does not claim to provide a final solution to all fundamental problems. Its primary purpose is to serve as a visual tool that helps to simplify the understanding of complex concepts and to reveal hidden symmetries. Even if the model turns out to be only a pedagogical bridge between different areas of physics, its value would still be considerable.

Conclusion

The proposed φ-geometry demonstrates that complex relativistic and quantum effects can be reduced to simple trigonometric relations, primarily for improved visualization and understanding. Using the angle φ makes it possible to describe, in a unified language, the relativistic limit, the phase transitions "mass ↔ light," and cosmological cycles.

In traditional theories (GR and SR), singularity is treated as a limit beyond which physical meaning disappears. In the proposed φ-geometry, singularity is not eliminated but transformed: the "deep" singularity of a black hole is softened into a "light" one, allowing it to be regarded as a transitional state, open to description and even experimental interpretation.

In a deeper interpretation, the limiting state $\varphi = 0° = 90°$ corresponds to a universal phase, where mass and light coexist simultaneously but in different projections. This point can be interpreted as the moment of the Big Bang — a critical configuration from which all subsequent states unfold.

Interestingly, the obtained result unexpectedly resonates with ancient symbolic imagery. The phrase "In the beginning was light" (Bible) in φ-geometry acquires a physically precise meaning: immediately after the Big Bang, space was in a purely light phase, when mass did not yet exist and everything was represented only by the photon state.

Thus, φ-geometry does not stand as an "alternative" to existing physics but as an additional language of symmetry that connects local relativistic limits, quantum states, and global cosmological cycles. Perhaps its significance will only become evident in the future, when the simplicity of this scheme is called upon to solve problems where traditional methods run into paradoxes.

We emphasize that this approach does not replace existing theories but complements them, offering a geometric visualization of quantum mechanics that resolves paradoxes and makes key ideas more accessible to a wide range of researchers and students. This is particularly important for students: the φ-visualization helps to develop intuitive understanding and demonstrates that complex phenomena can have simple geometric interpretations. Such a perspective fosters a different style of thinking, one that is more open to seeking simple solutions where traditional science tends to complicate matters.

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