Article

New Concepts of Time and Matter Supported by Fifteen Proofs

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Abstract: We introduce two symmetric concepts to physics: "distance" (space and time in one) and "wavematter" (electromagnetic wave packet and matter in one). We claim that physics has chosen the wrong concept of time: It is not aware that the time of a moving object flows in a direction other than my time. We provide 15 proofs for our claim by solving 15 mysteries of physics. For example, we prove that length contraction and time dilation are geometrical effects in a 4D manifold that we call "Euclidean spacetime". We prove that the discrepancy in calculating the Hubble constant stems from a systematic error in the redshift measurement. We prove that what I deem wave, deems itself matter, which solves wave–particle duality. We even untangle quantum entanglement without the issue of non-locality. We claim that a huge amount of energy was injected into Euclidean spacetime at a point that we take as origin. Ever since has this energy been moving radially away at the speed of light. We live in the 3D hypersurface of an expanding 4D hypersphere. Hyperspherical coordinates have the advantage that they reduce all that is ever happening to just one formula. So, it is the Theory of Everything in these coordinates: "Energy is covering radial distance which, divided by Euclidean time, is equal to the speed of light." Acceleration and force emerge from a conversion to Cartesian coordinates and are thus pure math. Matching the symmetry simplifies physics!

Keywords: theory of everything; relativity; spacetime; cosmology; background radiation; Hubble's law; Hubble constant; dark energy; wave–particle duality; quantum entanglement

1. Introduction

Here we report on new concepts of time and matter, how they give birth to a Theory of Everything, and how they solve 15 mysteries of physics. There is not only a symmetry of space and time, but also a symmetry of waves and matter! Albert Einstein's theory of special relativity (SR) [1] is taught in Minkowski spacetime (MS). Hermann Minkowski's geometrical interpretation [2] of SR was very successful in explaining effects like length contraction and time dilation. It thus became an integral part of SR. A generalized version of the Minkowski metric known as pseudo-Riemannian metric became a concept of general relativity (GR) [3]. Yet is MS giving us an undistorted view of reality?

We claim that physics has chosen the wrong concept of time. Time is a cornerstone of physics, but even cornerstones can become brittle. If a new cornerstone fits better, we must open up to it. Our main concern: In MS, space and time are considered two concepts despite the spacetime interval being an invariant. Thinking of them as "two" instead of "one" cleared the way for accepting an unfortunate asymmetry in cosmology that most of us aren't even aware of: Time is supposed to run uniformly, while space shall inflate or expand. How could there be such an asymmetry within one spacetime?

"We need a new model," [4] says cosmologist Alessandro Melchiorri from the University of Rome. We claim that our two concepts "distance" (space and time in one) and "wavematter" (electromagnetic wave packet and matter in one) are this new model and that they will revolutionize both physics and philosophy. We derive the two most striking observations in astronomy (isotropic background radiation [5], Hubble's law [6]) and the

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cosmological principle [7], but without assuming an "inflating space" [8], an "expanding space" [9], or a "dark energy" [10]. We even solve the trouble with Hubble [11,12]. If you were to choose from a theory A with redundant concepts or a theory B without them, yet more power, which one would you prefer? We are convinced that science should *always* prefer theory B! So, all that we ask for is to apply Occam's razor.

Illustrations like Fig. 1 have been released by NASA/WMAP. They are supposed to show the timeline of the universe. Just one question proves that the initial inflation and the subsequent expansion of space does not make sense: From where would an observer have the view shown in Fig. 1? The figure suggests that an observer is able to see expanding space *from outside of space*. How could someone be outside of space?

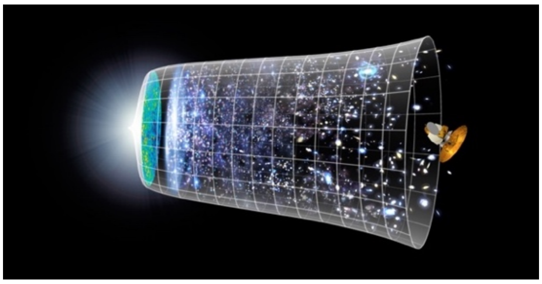

Figure 1. Timeline of the universe. Artwork illustrating the expansion of space over about 13.8 billion years. Time and space are depicted by the horizontal and vertical extent of the grid, respectively. The universe is supposed to have started in a Big Bang (left). Space is supposed to have undergone various stages of expansion, while time has been running uniformly. Credit: NASA/WMAP.

We ground our theory on three postulates: (1) The equations describing the laws of physics have the same form in all reference frames. (2) The speed of light is both absolute and universal in Euclidean spacetime (ES). (3) All energy is wavematter. Our first postulate is the same as in SR except that we do not limit our theory to inertial reference frames. Acceleration and thus gravitation turn out to be a feature of Cartesian coordinates. Our second postulate expands the second SR postulate by adding the property "universal". Our third postulate generalizes Einstein's mass–energy equivalence.

Some authors claim that everything would be moving through MS at the speed of light [13]. They multiply the dimension of time t by the speed of light c to match the unit of space. Yet moving through MS at the speed of light is a pointless concept: An "object at rest" would move in the axis ct at the speed c, that is, it would move in time at the trivial speed "one second per one second".

Our theory must not be confused with the Hypergeometrical Universe Theory [14] which hasn't passed the peer-review process: It claims five dimensions in total (3D space and 2D time) and is thus not compatible with the r^{-2} law of gravitation at all distances. In 2018, another Euclidean model of space and time was proposed [15], but again it claims five dimensions altogether (now 4D space and 1D time).

We are not the first to model Euclidean relativity in four dimensions. There have been other attempts, but [16] isn't explaining length contraction, [17] doesn't identify absolute time, [18] speaks of a "mixed spacetime", and [19] proposes even four parallel spacetimes. None of these attempts was able to overcome MS. Ultimately, they still consider space and time different concepts. Our initial report [20] wasn't complete either, as we did not yet merge space and time into "distance" nor did we merge wave and matter into "wavematter". Only with these unique concepts do we now succeed in surpassing MS.

2. Euclidean Spacetime

MS emerged from the ambition to describe a world that we perceive in daily life. Yet this concept won't let us grasp the big picture. Performance of MS is limited as it is neither absolute nor symmetric, but "egocentric" (prioritizing my own view). There is an analogy that fits quite well: MS reminds us of the geocentric model that was once surpassed by the

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heliocentric model. We found a much greater truth beyond MS, too: Euclidean spacetime (ES). Yet as with all new concepts, it does take time to convince the scientific community of their benefits. An unbiased approach is always our best choice.

Mathematically, ES is an open 4D manifold with a Euclidean metric. ES comes either in four *absolute* hyperspherical coordinates $(\phi_1, \phi_2, \phi_3, r)$ where each ϕ_i is a hyperspherical angle and r is radial distance—or in four relative, *symmetric* Cartesian coordinates (d_1, d_2, d_3, d_4) where each d_i is distance (space and time in one). Space and time are not two [21]! Full 4D symmetry is the secret to our concept of distance: Either one of the four distances can be time, but the other three must be space. The decision "space or time?" is observer-specific. MS comes in relative, *mixed* Cartesian coordinates (x_1, x_2, x_3, t) where each x_i is a dimension of space and t is "Minkowski time" (concept of time in today's physics). As we will prove, relativity in ES and MS is different: In ES, time is absolute, but the orientation of the vector "flow of time" (Sect. 5.2) is observer-specific and thus relative; in MS, time is the same dimension for all objects, but its flow rate is relative.

Hyperspherical coordinates are good for grasping the big picture as in cosmology. We claim that a huge amount of energy was injected into ES at a point that we take as origin O. Ever since has this energy been moving radially away at the speed of light. We live in the 3D hypersurface of an expanding 4D hypersphere. Hyperspherical coordinates have the advantage that they reduce all that is ever happening to just one formula. So, it is the Theory of Everything in these coordinates: *Energy is covering radial distance r which, divided by Euclidean time t_E, is equal to the speed of light c.*

$$r/t_E = c \ . \qquad \textit{(Theory of Everything)} \tag{1}$$

$$t_E = r/c \ . \tag{2}$$

Our Theory of Everything (TOE) is the reward for applying a very powerful strategy: Matching the symmetry simplifies physics! As everything is moving radially at a constant speed, there can't be any acceleration in hyperspherical coordinates. *Hence, acceleration and force must emerge from a conversion to Cartesian coordinates and are thus pure math.* Everything in (1) is absolute as we expect of a TOE: Everything is moving at the same speed c, experiences the same Euclidean time t_E, and is the same distance r away from the origin O. In hyperspherical coordinates, there is no motion within the hypersurface spanned by ϕ_1, ϕ_2, ϕ_3. So, we won't discuss these angles in detail. In Sect. 5.6, we will explain how motion within the hypersurface is enabled in Cartesian coordinates.

Cartesian coordinates are good for understanding how wavematters experience each other and how they interact with each other. We will now prove two features in Cartesian coordinates: (1) If I observe a moving object, its view of 3D space is rotated with respect to my view causing *length contraction.* (2) If I observe a moving object, its time flows in a direction other than my time causing *time dilation.* So, length contraction and time dilation are not unique to MS, but also geometrical effects in ES! We consider two identical rockets that differ in color only (r = red rocket, b = blue rocket). The reference frame of an observer R in the rear end of the red rocket has the coordinates d_1, d_2, d_3, d_4. The reference frame of an observer B in the rear end of the blue rocket has the coordinates d'_1, d'_2, d'_3, d'_4. Initially, both rockets are back-to-back at the same point P. We assume that they move in the same axis $d_4 = d'_4$ at the speed c. In all of our examples, d_4 shall be that axis which the object of focus deems time multiplied by c. For other objects, that axis can be space.

Next, we assume that the rockets are also moving against each other in 3D space. In all of our examples, the movement in 3D space shall occur in the axis d_1. In R's view of 3D space (Fig. 2 bottom left), the blue rocket shall move at a 3D speed v_{3D}. In B's view of 3D space (Fig. 2 bottom right), the red rocket moves in opposite direction, but at the same speed $v'_{3D} = v_{3D}$. According to our second postulate, our ES diagrams must fulfill these two requirements: (1) The red rocket must keep on moving in the axis d_4 at the speed c. (2) The blue rocket must keep on moving in the axis d'_4 at the speed c.

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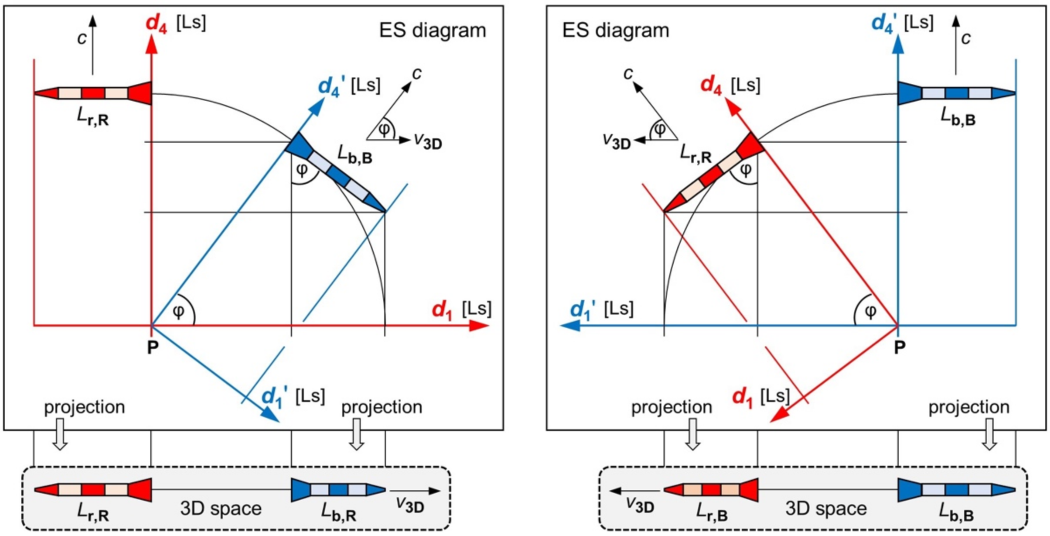

Figure 2. ES diagrams and 3D projections for two identical rockets. The coordinates are in Ls (light seconds). **Top left:** The blue rocket is moving away from the red rocket at a relative 3D speed $v_{3\mathrm{D}}$. **Top right:** The red rocket is moving away from the blue rocket at the same relative 3D speed $v_{3\mathrm{D}}$. **Bottom left:** R's view of 3D space. The blue rocket contracts to a length of $L_{\mathrm{b,R}}$. **Bottom right:** B's view of 3D space. The red rocket contracts to a length of $L_{\mathrm{r,B}}$.

Our ES diagrams must fulfill two more requirements: (3) Both rockets started at the same point P. (4) The first postulate must be satisfied. There is only one way to draw ES diagrams (Fig. 2 top left and right) that fulfill all four requirements: *We must rotate the two frames of reference with respect to each other.* Only a rotation guarantees that the situation is symmetrical, so that the equations describing the laws of physics have the same form! So now there is $d_4 \neq d'_4$. Only for clarity do we draw 2D rockets although the width of either rocket is not in the dimensions d_4 and d'_4, but in d_2 and d'_2 (or d_3 and d'_3).

We define $L_{i,J}$ as length of the rocket with color i (r = red, b = blue) as seen from the perspective of observer J (R = observer R, B = observer B). From Fig. 2, we derive

$$\sin^2\varphi + \cos^2\varphi = (L_{\mathrm{b,R}}/L_{\mathrm{b,B}})^2 + (v_{3\mathrm{D}}/c)^2 = 1 \,, \tag{3}$$

$$L_{\mathrm{b,R}} = \gamma^{-1} L_{\mathrm{b,B}} \,, \qquad \textit{(length contraction)} \tag{4}$$

where $\gamma = (1 - v_{3\mathrm{D}}^2/c^2)^{-0.5}$ is the same Lorentz factor as in MS. Hence, we calculate the same length contraction in ES as in MS regardless of their dissimilar metrics: *The blue rocket appears contracted to observer R by the factor* γ^{-1}. Yet which distances will R observe in his axis d_4? To answer this question, we mentally continue the rotation of the blue rocket (Fig. 2 left) until it points vertically down ($\varphi = 0°$) and serves as R's ruler in the axis d_4. The projection to 3D space now tells us that the length of that ruler contracts to zero. The dimension d_4 "is suppressed" (disappears) for R. He observes a 3D space and feels the dimension d_4 as "aging" (time passing by).

In Fig. 2, the angle φ is also located at the point P. Here we derive

$$\sin^2\varphi + \cos^2\varphi = (d_{4,\mathrm{B,R}}/d'_{4,\mathrm{B,B}})^2 + (v_{3\mathrm{D}}/c)^2 = 1 \,, \tag{5}$$

$$d_{4,\mathrm{B,R}} = \gamma^{-1}\, d'_{4,\mathrm{B,B}} \,, \tag{6}$$

where $d_{4,\mathrm{B,R}}$ and $d'_{4,\mathrm{B,B}}$ are the distances that B has moved in the axis d_4 (R's view) or in the axis d'_4 (B's view). Because of the symmetry in ES ($d'_{4,\mathrm{B,B}} = d_{4,\mathrm{R,R}}$), (6) turns into

$$d_{4,\mathrm{B,R}} = \gamma^{-1}\, d_{4,\mathrm{R,R}} \,. \tag{7}$$

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Upon interpreting $d_{4,\mathrm{B,R}}$ as $ct_{\mathrm{B,R}}$ and $d_{4,\mathrm{R,R}}$ as $ct_{\mathrm{R,R}}$ (we remember that d_4 always be that axis which an object deems time), (7) turns into

$$t_{\mathrm{R,R}} \;=\; \gamma\, t_{\mathrm{B,R}}\;, \qquad \textit{(time dilation)} \tag{8}$$

where $t_{\mathrm{R,R}}$ and $t_{\mathrm{B,R}}$ are the distances that observer R and observer B have moved in time from the perspective of observer R. Since we derived (5) from a projection to the axis d_4, time dilation is equivalent to "distance contraction" in the fourth dimension of ES. We just proved that geometrical effects in ES take the place of relativistic effects in MS. In MS, time dilation and length contraction are complementary effects. In ES, they both result from a rotation and a subsequent projection to the axis d_4 or 3D space. *Because of the rotation, B's time (related to* d_4'*) flows in a direction other than R's time (related to* d_4*).* Because of the projection, we better speak of a "time contraction" in ES: $t_{\mathrm{B,R}} = \gamma^{-1}\, t_{\mathrm{R,R}}$.

We now discuss three instructive problems that first-time-readers often can't solve in ES. Problem 1: A rocket moves along a guide wire at a high speed. The wire enters the rocket at its top and exits at its bottom. In ES, both rocket and wire move at the speed of light. We may assume that the wire moves in some axis d_4. As the rocket moves along the wire, it can also move in the axis d_4, but slower than the speed of light. Wouldn't the wire eventually be outside the rocket? Problem 2: In billiard, the cue ball is hit to collide with the red ball. In ES, both cue ball and red ball move at the speed of light. We may assume that the red ball moves in some axis d_4. As the cue ball covers spatial distance to the red ball, it can also move in the axis d_4, but slower than the speed of light. How can the balls ever collide if their d_4 values never match? Problem 3: An observer in the tip of a rocket sees how a mirror is passing the rocket. He sends a short light pulse to the mirror and tries to detect the reflection. In ES, rocket, mirror, and light pulse all move at the speed of light, but in different directions. We may assume that the rocket moves in some axis d_4. How can the light pulse ever hit the mirror and be reflected back to the observer?

In all problems, the fallacy lies in the assumption that there are four dimensions of space. There aren't! ES is four dimensions of distance and only three of them are space. We solve all problems by projecting ES to 3D space (Fig. 3). The projections tell us what reality is like because suppressing the axis d_4 is equivalent to "length contraction makes d_4 disappear". We easily verify in 3D space: The guide wire is always within the rocket, the cue ball collides with the red ball, and the reflected light pulse meets the observer. Theories based on 4D space instead of 4D distance can't solve any of these problems.

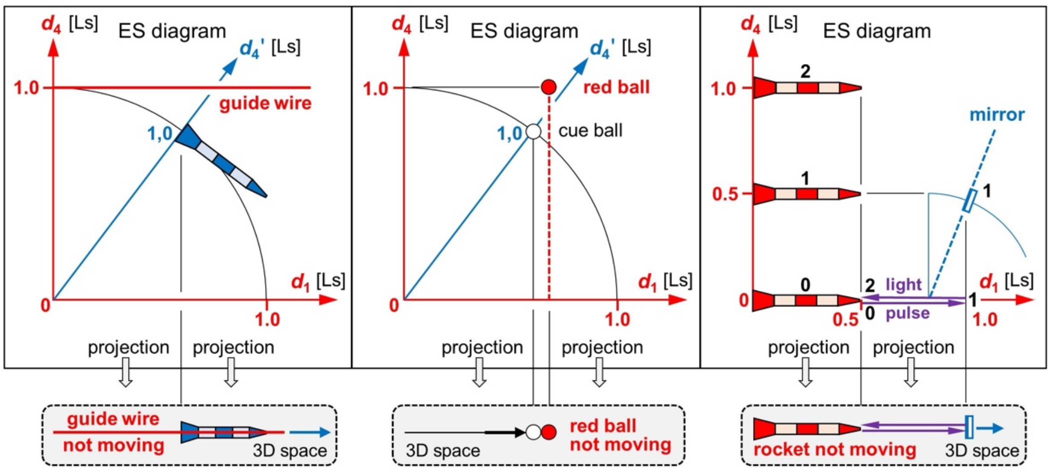

Figure 3. Graphical solutions to problems discussed in the text. **Left:** A rocket moves along a guide wire. In 3D space, the guide wire is always within the rocket. **Center:** The cue ball is hit to collide with the red ball. In 3D space, the cue ball collides with the red ball. **Right:** An observer inside a rocket sends a light pulse and tries to meet its reflection. Between two snapshots (0–1 or 1–2), rocket, mirror, and light pulse move 0.5 Ls in ES. In 3D space, the reflected light pulse meets the observer.

3. Comparing Euclidean Spacetime with Minkowski Spacetime

In order to evaluate the benefits of ES, we must understand the similarities and the differences in ES and MS. Let us begin with their similarities: (1) Either concept comes in four dimensions. (2) We can interpret either concept as 3D space and 1D time. (3) In either concept, the 3D space is observable and the fourth dimension can't be observed. This is why we can never observe the big picture, but we can at least imagine it in ES. We will now discuss the differences by means of Minkowski diagrams. These diagrams illustrate for one dimension of space how an object is moving through MS. Unlike in distance–time graphs, distance is displayed horizontally, and time vertically. Time is multiplied by the speed c, so that light is moving at $45°$ to either axis. For comparison: In an ES diagram (Fig. 3 right), light is moving horizontally.

Again, we consider two identical rockets that differ in color only (Fig. 4 left). The rockets have a length at rest of 0.5 Ls (light seconds) and move at a relative 3D speed of $v_{3\mathrm{D}} = 0.6\,c$. We use these high values to visualize relativistic effects. A Minkowski diagram (Fig. 4 right) transfers the geometry into a graph. Again, observer R is in the rear end of the red rocket (red reference frame). Observer B is in the rear end of the blue rocket (blue reference frame, yet as observed by R). The next statements are made by R and refer to the red frame only: The red rocket has moved 1.0 s in time. The blue rocket has moved $v_{3\mathrm{D}}t = 0.6$ Ls in the axis x_1. Because of *length contraction,* the length of the blue rocket contracts to 0.4 Ls. The next statement is also made by R, but refers to the blue frame (R describes from his perspective how B is observing the blue rocket): Because of *time dilation,* the rear end of the blue rocket has only moved 0.8 s in time. The tip of the blue rocket has moved even less: 0.5 s in time. The grey box shows R's view of space at $ct = 1.0$ Ls. In MS, 3D space is moving through time like an elevator. Only for clarity do we draw 2D rockets although there is just 1D space in a Minkowski diagram.

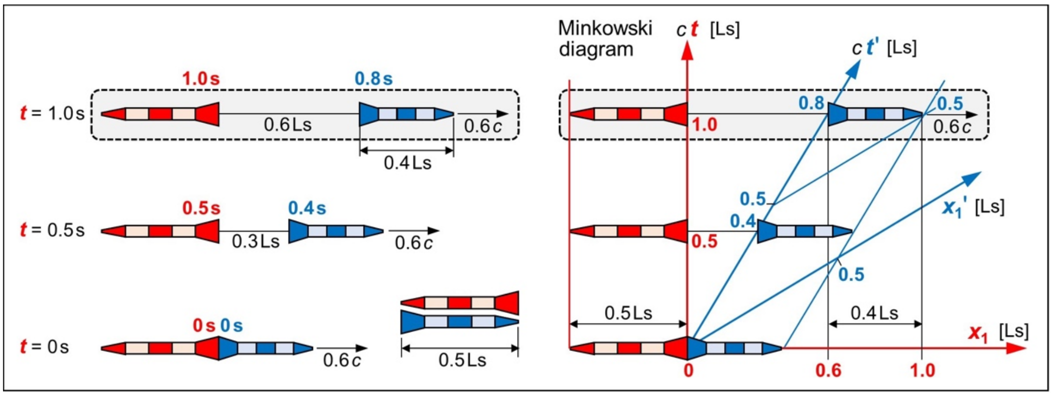

Figure 4. Two identical rockets in MS. **Left:** Both rockets have a length at rest of 0.5 Ls. Their relative speed is $0.6\,c$. At $t = 0.5$ s and $t = 1.0$ s, clocks inside the blue rocket display less time because of time dilation. The blue rocket is shorter because of length contraction. **Right:** A Minkowski diagram transfers the geometry from the left into a time–distance graph. In this diagram at $ct = 1.0$ Ls, clocks in the rear end and tip of the blue rocket display different times (0.8 and 0.5 printed in blue). This is not in line with experimental physics as observers in the blue rocket will synchronize their clocks.

Minkowski diagrams are *mathematically* correct, but not in line with experimental physics. A team of observers inside the blue rocket will synchronize all of their clocks, but a Minkowski diagram displays different times on clocks inside the blue rocket (0.8 and 0.5 printed in blue in Fig. 4 right). Here is why: The blue rocket is not aligned perpendicularly to a vector that we call "flow of time" (Fig. 5 left). In the Minkowski diagram, a moving rocket is drawn horizontally as if its time were flowing into the same direction as the observer's time. This is why we call MS egocentric! We already know: If I observe a moving object, its time flows in a direction other than my time. To display time correctly, the blue rocket must be rotated (Fig. 5 right).

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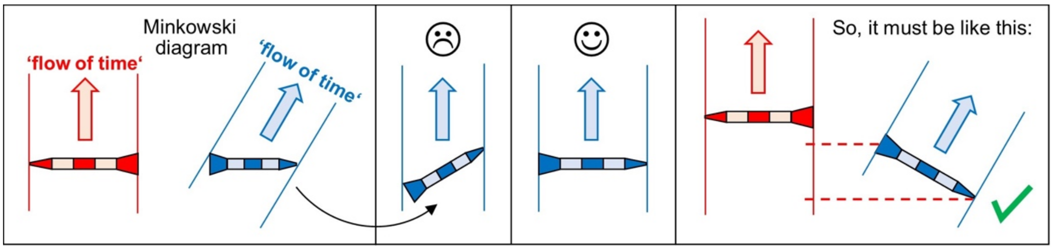

Figure 5. How to proceed from a Minkowski diagram to an ES diagram. **From left to right:** A Minkowski diagram is mathematically correct, but not in line with experimental physics. Clocks display equal time only if the rocket is aligned perpendicularly to its flow of time. This isn't the case for the blue rocket. A rotation (physical repairment) leads to an ES diagram that is physically correct, too.

A cartoon gives us an instruction of how to draw a correct diagram: We must replace the asymmetric dimensions in a Minkowski diagram (Fig. 6 top) with four symmetric dimensions of distance *to enable a rotation* of the blue rocket. We call it "physical repairment". We then end up with an ES diagram (Fig. 6 center). Here the values 0.8 Ls and 0.5 Ls are printed in red on the axis d_4 where they should be: They refer to the time flow in the red frame of reference! Due to the rotation, ES diagrams are *both mathematically and physically* correct: (1) No reference frame is prioritized. There is full symmetry of the two rockets. Only in the projection to 3D space does the blue rocket contract (Fig. 6 bottom). (2) In the blue frame, odometers inside the blue rocket are synchronized. In ES, we use odometers measuring light seconds (Ls) instead of clocks measuring seconds.

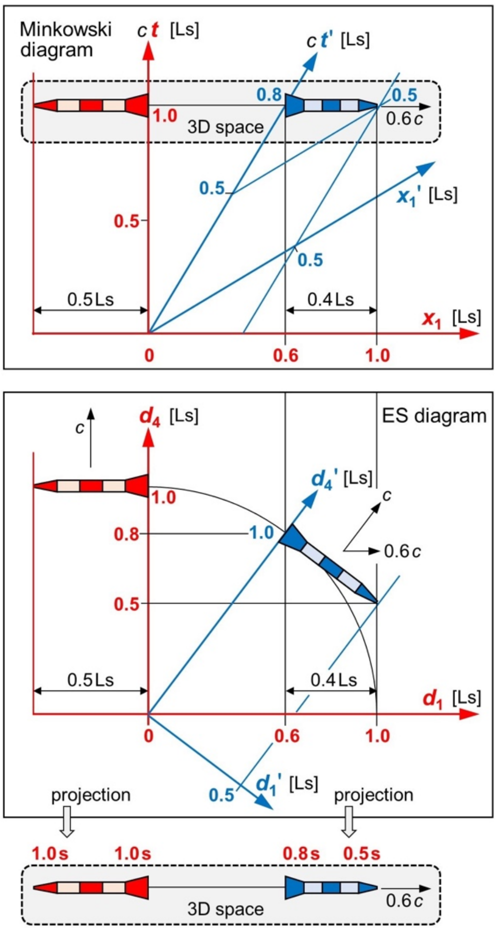

Figure 6. Comparing a Minkowski diagram with an ES diagram. **Top:** A Minkowski diagram can't display the time of the blue rocket correctly in both the red and the blue frame. In the blue frame, clocks inside the blue rocket display different times. **Center:** In an ES diagram, no frame is prioritized. All distances are displayed correctly in both frames. **Bottom:** R's view of 3D space.

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There are evident differences in the diagrams: (1) In a Minkowski diagram, the vertical axis is time, yet the horizontal axis is space. The 4D symmetry is broken. A moving object must not be drawn rotated as its length can't be a mix of space and time. In an ES diagram, both axes are distance. Here a moving object can and must be drawn rotated to keep the 4D symmetry. (2) In a Minkowski diagram, the reference frame of a moving observer is sheared. We would have to draw a second diagram if we wish to see reality from his view. In an ES diagram, the reference frame of a moving observer is rotated only. We can simply rotate the entire diagram to see reality from his view.

Beside these differences in the diagrams, there are also other, more profound differences: (3) *The way of storytelling is different.* In Fig. 6 top, R describes from his perspective how B is observing the blue rocket. In Fig. 6 center, R is observing the blue rocket himself. Because of the two ways of storytelling, the concepts of time in MS and ES are completely different. In MS, time is related to an observer: R measures his time in the variable t; and in the primed variable t', R measures *in his flow of time* how observer B is measuring time. So, t' isn't the time that B is measuring himself. In ES, time itself is absolute, but the flow of time is relative: R measures absolute time in the variable d_4; B measures absolute time in the variable d'_4. Because of $d_4 \neq d'_4$, the flow of time is different for R and B.

(4) In MS, we always compare two frames of reference with each other: One frame is "at rest", the other frame is moving at a constant speed relative to the frame at rest. In a Minkowski diagram, the observer at rest describes from his perspective how he himself and a "moving observer" are measuring space and time. Yet the problem is: There is no real observer who deems himself moving at a constant speed relative to a system at rest! The "moving observer" will tell us that he is at rest. So, Minkowski diagrams are not only physically incorrect, but physical nonsense. Physics should describe reality, and not what space and time are like for an unreal observer. ES gives us two descriptions of reality: the big picture from the perspective of the origin O (in hyperspherical coordinates) or the big picture from the perspective of any point P (in Cartesian coordinates).

(5) In MS, the proper time $t'_{\mathrm{B,B}}$ is an invariant. In ES, the distance d_4 (which relates to Euclidean time t_{E} in ES and to the coordinate time $t_{\mathrm{R,R}}$ in MS) is an invariant. Choosing the proper time of an object as invariant has been very unfortunate, especially in cosmology. Cosmology must not be anchored in single objects, but in absolute time! This is why cosmology couldn't solve all those mysteries that we solve in Sect. 5.

(6) Because of the broken 4D symmetry, MS comes with a not positive semidefinite, that is, an indefinite Minkowski metric. The spacetime interval in MS is defined as

$$\mathrm{d}s^2 \;=\; -\,\mathrm{d}x_1^2 \,-\, \mathrm{d}x_2^2 \,-\, \mathrm{d}x_3^2 \,+\, c^2\,\mathrm{d}t^2 \;. \tag{9}$$

ES comes with a beautiful Euclidean metric. Total distance in ES is defined as

$$\mathrm{d}s^2 \;=\; \mathrm{d}d_1^2 \,+\, \mathrm{d}d_2^2 \,+\, \mathrm{d}d_3^2 \,+\, \mathrm{d}d_4^2 \;. \tag{10}$$

Minkowski diagrams seem to be easy to comprehend, but their geometry is pseudo-Euclidean. ES diagrams shine with symmetry and beauty: Lines of simultaneity turn into circles centered around the origin. Objects on one circle are the same distance away from that origin. MS wasn't Einstein's idea. He is said to have quipped: "Since mathematicians have assaulted the theory of relativity, I do not understand it anymore." [22]

4. Physics Has Chosen the Wrong Concept of Time

Einstein's two SR postulates [1] are physically reasonable, yet not complete as the speed of light is not only absolute, but also universal. The tragedy began when his teacher Minkowski imposed a pseudo-Euclidean geometry on Einstein's theory. As there is no norm in MS, moving frames of reference are oblique and the 4D symmetry is lost. We now address the root of this tragedy. Our claim: Physics could have avoided choosing a wrong concept of time by evaluating what *synchronized clocks* are all about.

To synchronize clocks at both ends of a red rocket, we equip them with a photosensor and fire a short light pulse from the center of that rocket. Each clock starts running when its photosensor detects the light pulse. An observer C in the center of that rocket will now confirm that the clocks are "synchronized" (displaying the same time). Observer R in the rear end of that rocket receives the time signal from the distant clock with a delay, but he can be assured by C that the clocks are synchronized and deduct an offset to compensate for the delayed reading. We now assume that a blue rocket with observer B is constantly moving away from the red rocket and that B has also synchronized his clocks. For C and R, the clock in the rear end of the blue rocket was triggered ahead of the other clock as it moved towards the synchronizing light pulse. So, these clocks aren't synchronized for C and R. Since the time difference is immanent and not due to a delayed reading, C and R can't fix it with an offset! We learn from that: Synchronized clocks in my reference frame display the same time; moving synchronized clocks *must* display different times.

Physics chose the wrong path: Ever since have physicists kept on defining a "system at rest" in which an observer R measures *his* Minkowski time t. Often this "system at rest" is even linked to Earth. Then these physicists wanted to calculate time in a system that is moving at a constant speed relative to their "system at rest". Yet they made a fatal mistake: In MS, the primed variable t' in the equation for time dilation doesn't reflect how a moving observer B is measuring time (in ES, the primed variable $d'_{4,\mathrm{B,B}}$ in (6) does!), but how R is measuring in his flow of time how B is measuring time. The consequences are: Moving clocks are running slower, and a moving observer measures different times with his own clocks. This is absurd! Of course, he would also synchronize all his clocks.

The rest of the story is straightforward: It was found that Lorentz transformations are good for converting one inertial system into another. Hence, all equations were written in a Lorentz covariant form. Minkowski diagrams were developed in which a moving object (Fig. 6 top) is on the same horizontal line as the "object at rest". Now all clocks display the same time in the red frame, but in the blue frame clocks inside the blue rocket aren't synchronized anymore. Physicists accepted without protest that a moving observer measures different times with his own clocks. They accepted that C and R in our example are prioritized over B. Yet, of course, physics must be the same for C, R, *and* B. For more than 100 years, physics has followed MS blindly. It is time, to wake up!

Retrospectively, the tragedy took its course when physicists assumed that there is a "system at rest". This assumption destroys the 4D symmetry and makes MS egocentric. *We claim that this assumption also rules out the compatibility of GR with quantum physics as there is nothing at rest at the microscopic level.* Our second postulate makes sure that there is nothing at rest in ES. It was bad luck for physics that Minkowski time is not deemed wrong in daily life, that (4) and (8) have the same form in ES and MS, and that (4) and (8) even keep their form upon replacing observer R with observer B.

5. Fifteen Proofs

Before proving our theory by solving 15 mysteries, we will first explain why ES is compatible with most of physics even though its concept of time is not the same as in MS. We already proved that geometrical effects in ES take the place of relativistic effects in MS. Statement S1: The two equations for length contraction and time dilation have the same form in ES and MS. So, spatial distances and temporal distances transform alike in ES and MS. Statement S2: Most theories of physics do not depend on how space and time are related to each other. There are space-related operators (Nabla, Laplace, integration) and time-related operators (derivatives, integration), but no spacetime-related operators. Statement S3: It is the mathematical operators that determine the predictions of a theory. From S1–S3, we conclude: The different concepts of time in ES (time itself is absolute, but the flow of time is relative) and MS (time is related to an observer) do not affect theories that consider space and time separate concepts, like electrodynamics or thermodynamics. Yet our new concept of time is disputing MS and the Lambda-CDM model of cosmology as they do focus on how space and time are related to each other.

5.1. Solving the Mystery of Time

There is absolute Euclidean time t_{E}. It is radial distance r from the origin O of ES divided by the speed of light c. In Cartesian coordinates with origin O, t_{E} is the square root of the sum of all four distances d_i squared—and then divided by the speed of light. In Cartesian coordinates with any point P as origin and some object moving in the axis d_4, this object deems differences in d_4/c differences in t_{E}. All these definitions refer to a 4D reference frame in ES. In my view of 3D space, I can add a fourth dimension in which I feel t_{E} as aging. For comparison: There is no physical definition for the concept of time in today's physics (Minkowski time). It is observer-specific and barely defined as "what I read on my watch". This egocentric definition is attributed to Albert Einstein.

5.2. Solving the Mystery of Time's Arrow

The first definition of time in Sect. 5.1 can be rewritten this way: Euclidean time is the absolute value $|\boldsymbol{r}/c|$ of a vector $\boldsymbol{r}/c$ that we call "flow of time". The vector $\boldsymbol{r}/c$ is pointing from the origin O to some object. Euclidean time is absolute, but the orientation of the vector "flow of time" is observer-specific and thus relative. Speaking of "time's arrow" is equivalent to saying that the flow of time can't be reversed. It can't be reversed because radial momentum provided by the Big Bang drives all energy away from the origin O. In ES, an object can't return to a position because it is steadily moving away from O. In MS, an object can eventually return to a location in 3D space, but only at a later time.

5.3. Solving the Mystery of Length Contraction

MS tells us that there is length contraction, but it doesn't give us any clue of *why* it is. In ES, we learn that length contraction is a geometrical effect: It is due to a rotation! If the blue rocket in Fig. 2 moves relative to the red rocket, the blue frame of reference is rotated with respect to the red frame. Hence, B's view of 3D space is rotated with respect to R's view. Hence, R observes a rotated blue rocket. In a subsequent projection to 3D space, this rotation causes length contraction. It is well known in MS that fast objects appear rotated to an observer [23]. In MS, this rotation is virtual and attributed to the travel time of light: Light from the tip of an approaching rocket reaches the observer earlier than light from its rear end. It is the same rotation that we describe in ES because travel time is encoded in the variable d_4' of the moving rocket. Yet in ES, the rotation is real.

5.4. Solving the Mystery of Time Dilation

MS tells us that there is time dilation, but again it doesn't give us any clue of *why* it is. In ES, time dilation is also due to a rotation! If the blue rocket in Fig. 2 moves relative to the red rocket, the time of the blue rocket flows in a direction other than the time of the red rocket. In a subsequent projection to the axis d_4, this rotation causes time dilation.

5.5. Solving the Mystery of mc^2

The total energy of an object in ES must be equal to the total energy γmc^2 in MS as the fourth dimension can't take up or give away any energy. In MS, we are familiar with

$$\gamma\, m\, c^2 \;=\; E_{\mathrm{kin,3D}} + m\, c^2 \;, \tag{11}$$

where $E_{\mathrm{kin,3D}}$ is the kinetic energy of an object in 3D space and mc^2 is the object's "energy at rest". MS doesn't give us any clue of *why* there is a c^2 in both the total energy and the energy at rest for material objects that in MS never move at the speed c. ES now gives us the missing clue: $E_{\mathrm{kin,3D}}$ is the kinetic energy in the three dimensions d_1, d_2, d_3 only. That is to say: mc^2 is the kinetic energy in the fourth dimension d_4. Generally speaking, *mc^2 is the kinetic energy of moving through Euclidean time.* The multiplicator c^2 in (11) tells us that everything in ES is steadily moving at the speed of light even if it is at rest in MS. c^2 is handed down from ES to 3D space.

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5.6. Solving the Mystery of Isotropic Background Radiation

Now we are ready for our model of cosmology based on ES. It explains the two most striking observations in astronomy (isotropic background radiation [5], Hubble's law [6]) and the cosmological principle [7]. There is no need to create ES. Distances exist like numbers. Because of some reason that we don't know, there was a Big Bang somewhere in ES. So, the Big Bang wasn't the cause of ES, but it took place inside a given ES. In MS, it doesn't make sense to ask *where* the Big Bang occurred: As space and time started as a singularity and space inflated thereafter, the Big Bang occurred "everywhere" in today's space. In ES, it is indeed possible to localize the Big Bang at an origin O. We claim that it was a sudden incident that injected a huge amount of energy into ES at once. The word "sudden" allows for metaphysical speculations that are not subject of this report.

During the initial stage after the Big Bang, there was a huge amount of concentrated energy inside ES. In the projection to 3D space, this energy created a very dense and hot plasma. While the plasma was expanding, it cooled down. During the recombination of plasma particles, radiation was emitted that we observe as background radiation today. At a temperature of about 3,000 K, neutral hydrogen atoms were formed [24]. According to the Lambda-CDM model, this stage was reached 380,000 years "after" (in terms of MS) the Big Bang or 380,000 light years "away from" (in terms of ES) the Big Bang. The value 380,000 still needs to be recalculated if the universe is expanding at a constant speed. Ever since has this energy been moving radially away in ES at the speed c.

Yet how can the background radiation be so isotropic? For the answer, we must understand what is really going on in ES. We first consider a wrong approach: "Background radiation is emitted from some point in space, and we watch it from some other point in space. Shouldn't we then observe radiation from one direction only?" No, we should not as we need to correct two false assumptions here: (1) Background radiation is not emitted; it was emitted. (2) We never stand still; we are also moving at the speed c.

Here is the correct approach: A 3D hypersurface containing all background radiation and all matter is expanding radially from the origin O at the speed of light (Fig. 7 left). We live in the 3D hypersurface of an expanding 4D hypersphere. So, we always remain *within* that background radiation. The word "within" solves our mystery! Background radiation is not approaching us from one direction. It is so isotropic because it has been "swinging" (rotating) equally into all three dimensions of the hypersurface. To grasp the 4D process of swinging, we again mentally continue the rotation of the blue rocket (Fig. 2 left) until it points vertically down. We then replace that rocket with a photon. From this thought experiment, we learn: In each photon, I observe an original object from ES whose 4D motion "swings completely" (rotates by an angle of 90°) into my view of 3D space.

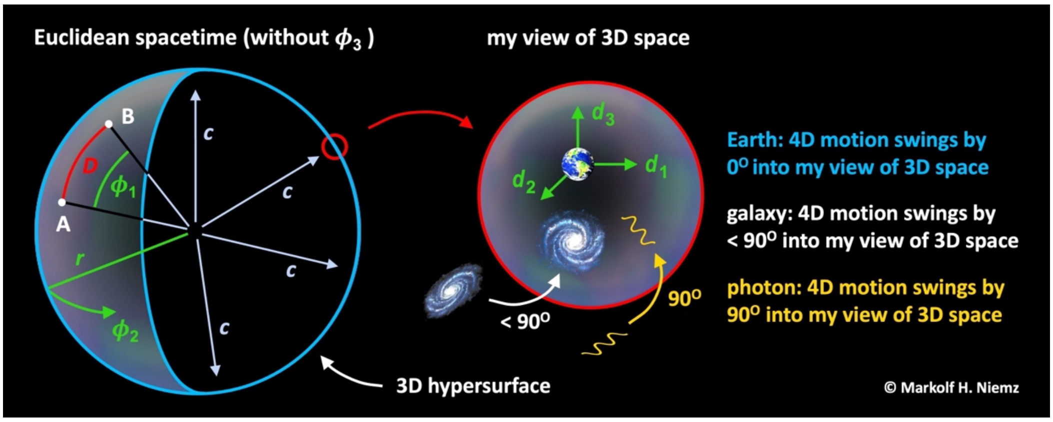

Figure 7. Model of cosmology based on ES (not to scale). Artwork illustrating how a hypersurface is expanding in ES. **Left:** Non-observable ES in hyperspherical coordinates $(\phi_1, \phi_2, \phi_3, r)$. ϕ_3 can't be displayed. Hubble's law is derived from the geometry of the hypersurface. **Right:** My view of 3D space in Cartesian coordinates (d_1, d_2, d_3). d_4 disappears because of length contraction. The right red circle doesn't only show an enlargement of the left red circle, but also another set of coordinates.

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Since we can't draw 4D figures, we can only sketch the process of swinging (Fig. 7 right). We just learned that the 4D motion of photons swings completely into my view of 3D space. The 4D motion of matter like galaxies only "swings partly" (rotates by an angle $< 90°$) into my view of 3D space. Photons and matter can swing into any dimension of 3D space. Earth swings by an angle of $0°$ since it isn't moving relative to myself.

The process of swinging also explains how motion within the hypersurface is enabled in Cartesian coordinates: For each observer inside the hypersurface, all photons and all matter swing into his view of 3D space by various angles. Acceleration (deceleration) in 3D space relates to an increasing (decreasing) swing angle. So, he observes how all objects are moving uniformly, accelerated, or decelerated in his view of 3D space.

Photons are *moving* within my view of the hypersurface at the speed c, whereas the entire hypersurface is *expanding* at the speed c. Someone might ask: "Doesn't a photon then exceed the speed c?" No, it does not. Speeds in my view of the hypersurface *must not be added* to the speed of the hypersurface. What I deem photon, is an original object from ES whose 4D motion swings completely into my view of 3D space. So, in the speed c of each photon I already see the speed c of the hypersurface!

5.7. Solving the Mystery of Hubble's Law

The speed v_{3D} at which a galaxy A (Fig. 7 left) is moving away from another galaxy B or Earth relates to their distance D as c relates to the radius r of the hypersurface

$$v_{3D} = D\,c/r = H_0\,D\ , \tag{12}$$

where $H_0 = c/r$ is the Hubble constant, c is in km/s, and r is in Mpc. There it is! (12) is Hubble's law: *The farther a galaxy, the faster it is moving away from Earth.* We derived it from the geometry of an expanding hypersurface. Because of (2), there is $H_0 = 1/t_E$. Hence, the Hubble constant isn't a constant at all. We also must be careful with the metaphor of an inflating balloon. The hypersurface isn't the shell of a 3D sphere even if we have no other choice to draw it. A typical fallacy is deeming r part of the hypersurface. In a 3D sphere, too, the radial dimension isn't part of the sphere's surface.

5.8. Solving the Mystery of the Cosmological Principle

The cosmological principle states that our universe is both homogeneous and isotropic when viewed on a large enough scale [7]. Our model confirms both properties: (1) The initial distribution of energy in the very early hypersurface was homogeneous. So, the spatial distribution of matter in today's hypersurface is homogeneous. (2) The spatial distribution of matter is isotropic because matter, too, has been swinging equally into all three dimensions of the hypersurface like the background radiation.

5.9. Solving the Mystery of the Flat Universe

We can even solve another mystery of cosmology: the flatness of the universe. As the entire hypersurface is expanding at the speed of light (Fig. 7 left), the radial dimension disappears for any observer inside the hypersurface. Together with this dimension, the 4D curvature of the 3D hypersurface disappears, as well. He observes a flat 3D universe. Our situation compares to that of an ant: Since it observes two dimensions of space only, the 3D curvature of Earth's 2D surface disappears for the ant! And here is a rough estimate of the volume of our universe

$$V_{\text{universe}} = V_{\text{hypersurface}} = 2\,\pi^2\,r^3\ , \tag{13}$$

where r is today's radius of the hypersurface. With the definition of the Hubble constant $H_0 = c/r$ and its value $H_0 = 67.66$ km/s/Mpc (we will confirm this value in Sect. 5.10), we calculate $r = 4431$ Mpc and $V_{\text{universe}} = 1.7 \times 10^{12}\ \text{Mpc}^3 = 5 \times 10^{79}\ \text{m}^3$.

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5.10. Solving the Mystery of the Hubble Constant

There are several methods of calculating the Hubble constant H_0, but unfortunately the results vary from method to method. We consider measurements of background radiation made with the Planck space telescope [11] and compare them with calibrated distance ladder techniques (measurement of distance and redshift of celestial objects) using the Hubble space telescope [12]. Based on the ES geometry, we will now explain why the values of H_0 calculated with either method don't match. They don't even match within the specified error margins

$$H_0 = 67.66 \pm 0.42 \text{ km/s/Mpc according to team A [11]},$$

$$H_0 = 73.52 \pm 1.62 \text{ km/s/Mpc according to team B [12]}.$$

Team B made efforts to minimize the error margin by optimizing the distance measurement. Yet as we will prove now, team B's value of H_0 is wrong *because of a systematic error in the redshift measurement.* Let us assume that 67.66 km/s/Mpc would be today's correct value of H_0. We simulate a supernova at a distance of $D = 400$ Mpc from Earth. From (12), we calculate

$$v_{3\mathrm{D}} = H_0\, D = 27{,}064 \text{ km/s} \,, \tag{14}$$

$$z = \Delta\lambda/\lambda_0 \cong v_{3\mathrm{D}}/c = 0.0903 \,, \tag{15}$$

where $v_{3\mathrm{D}}$ is the 3D speed at which the supernova is moving away from Earth. The redshift parameter z measures how an *expanding space* (team B) or an *expanding hypersurface* (our theory) stretches the wavelength of the supernova's light.

In the next paragraphs, we demonstrate that team B will measure a higher value of z and thus calculate a higher value of $v_{3\mathrm{D}}$ and thus calculate a higher value of H_0. Fig. 8 left shows the geometry of the supernova and Earth in hyperspherical coordinates. We define one circle called "past" where the supernova occurred and a second circle called "present" where its light is observed on Earth. Today, that supernova has turned into a neutron star. Fig. 8 right shows the same geometry, but in Cartesian coordinates. Because both light and matter are moving at the speed of light, Earth has moved the distance D in the axis d_4 when the supernova's light arrives. We easily verify from $H_0 = c/r$ that each radius r comes with a distinct value of H_0. Because of $H_0 = 1/t_{\mathrm{E}}$ according to (2), team B is receiving data from a time $1/H_0'$ when there was a different radius r' and a different Hubble constant H_0'

$$1/H_0' = r'/\,c = (r - D)\,/\,c = 1/H_0 - D/c \,, \tag{16}$$

$$H_0' = 74.37 \text{ km/s/Mpc} \,. \tag{17}$$

Because of this higher value of H_0' and (12), *all data* measured by team B are related to a higher 3D speed of the past $v_{3\mathrm{D}}' = 29{,}748$ km/s for the same D. So, team B will measure a redshift of $z = 0.0992$ according to (15) which is indeed higher than 0.0903. Team B isn't aware of (16) and (17) and the geometry shown in Fig. 8. Yet because of that too high value of z, team B will calculate $v_{3\mathrm{D}}' = 29{,}748$ km/s from (15) and $H_0' = 74.37$ km/s/Mpc from (12). So, team B will conclude that 74.37 km/s/Mpc would be the correct value of *today's* Hubble constant. In truth, team B ends up with a Hubble constant *from the past* as it has been relying on redshift data from the past! A short calculation confirms that for distances up to 500 Mpc the value of H_0' is on average 6–7 km/s/Mpc higher than H_0. We advise team B to improve its value of H_0 by eliminating the systematic error in the redshift measurement. All that team B has to do is correct the measured redshift parameter z by means of ES geometry.

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We thus conclude that the redshift is not due to an expanding space, but to an expanding hypersurface: The redshift is caused by the Doppler effect of receding galaxies! Since team B is calculating a Hubble constant from the past, we prefer the method of team A. Accordingly, the value of today's Hubble constant is very likely to be 67–68 km/s/Mpc. Supposing that the universe is expanding at a constant speed c, the age of the universe in Euclidean time t_E is equal to $1/H_0$. It is approximately 14.5 billion years, and not those 13.8 billion years [25] as claimed today by the Lambda-CDM model. Our value would even explain that there are stars out there as old as 14.5 billion years [26].

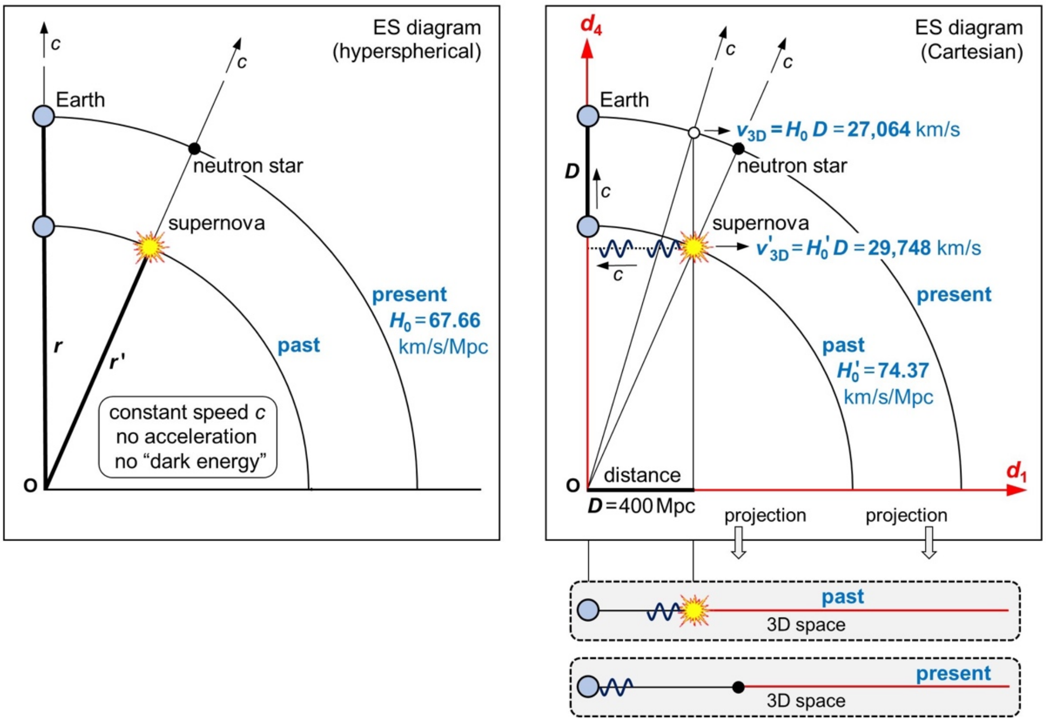

Figure 8. ES diagrams for team B's calculation of the Hubble constant H_0. The location of the Big Bang serves as the origin O. **Left:** We suppose that 67.66 km/s/Mpc is the correct value of today's Hubble constant H_0 ("present"). The supernova occurred in the "past" when the radius r' of the hypersurface was smaller than today's radius r. **Right:** Team B observes the supernova at a distance of 400 Mpc. Since the occurrence of the supernova, Earth has also moved a distance of 400 Mpc, but in the axis d_4. Because H_0' (and not H_0) is inherent to all data measured by team B, it calculates a Hubble constant from the past (74.37 km/s/Mpc). If a supernova occurred today in the same distance (small white circle), it would recede significantly slower (27,064 km/s) from Earth than the supernova in the past (29,748 km/s).

Be aware that we can't draw the path of the supernova's light into Fig. 8 left. Here is why: In hyperspherical coordinates, there is no motion within the hypersurface. Motion within the hypersurface appears by the process of swinging in Cartesian coordinates only (Fig. 8 right). Also be aware that light moves horizontally in Fig. 8 right. We sketched the same horizontal movement of light in Fig. 3 right.

Of course, team B is also aware of the fact that the supernova's light was emitted in the past. Yet in the Lambda-CDM model, all that counts is the timespan Δt during which light is traveling from the supernova to Earth thereby continuously stretching its wavelength. Hence, the total redshift is only developing during the journey to Earth. We can put it this way: For team B, the initial redshift parameter z is zero, and during the journey to Earth it increases continuously. z is an indicator for the expansion of space during the timespan Δt. The Hubble constant H_0 is just a parameter that indicates an average value of this expansion. The fact that the supernova itself occurred long ago in the past at some time t_s is irrelevant for team B's calculation.

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In ES, on the other hand, the moment t_s when the supernova occurs is significant, yet the timespan Δt is irrelevant. The farther t_s is in the past, the higher is the recession velocity v'_{3D}, and the higher are both the redshift parameter z due to the Doppler effect and the Hubble constant H'_0 from the past. In ES, there is no expansion of space. Each supernova and all its light are moving radially and "actively" (not moved by space) away from the origin O. Each supernova is moving away from Earth, too, but in Cartesian ES coordinates its light is traveling towards Earth. During all this journey, the parameter z remains constant and will be measured with its initial value when the light arrives on Earth. In ES, we can put it this way: The redshift of a supernova is tied up at the moment t_s in a package and sent to Earth where it is measured.

5.11. Solving the Mystery of Expanding Space

In order to explain the distance-dependent recession of galaxies, the concept of an expanding space has become an integral part of the CDM model. It was believed that space must expand so that galaxies can recede the faster, the farther they are away from Earth. We proved that an expanding hypersurface can readily explain this observation. So, the concept of an expanding space is redundant. Space is neither inflating nor expanding, but the universe is expanding in ES. Be aware that universe is not the same as space! "Universe" is the *finite* 3D hypersurface that is permeated by objects. "Space" is an *infinite* manifold. This is another reason why we disapprove of that NASA illustration in Fig. 1: It claims to display an infinite manifold which is impossible. Our Fig. 7 displays a finite hypersurface which is possible.

Meanwhile, the CDM model was extended to the Lambda-CDM model: Cosmology is now favoring an accelerated expansion over a uniform expansion of space. This is because the measured speeds v_{3D} of galaxies deviate from the values predicted by Hubble's law: v_{3D} is higher than predicted, and the deviations increase with distance D. An acceleration would stretch the wavelength even more and thus increase v_{3D} according to (15). We criticize that the assumption of an accelerated expansion was added only to keep the underlying concept of MS alive.

We propose a much simpler way to explain the deviations from Hubble's law. As we can see from $H_0 = 1/t_E$, the Hubble constant is not a constant at all: The Hubble parameter H'_0 from "every past" is higher than today's value H_0. The "older" the considered redshift data are, the more will H'_0 deviate from today's value H_0, and the more will v'_{3D} deviate from v_{3D}. Until today, these deviations have been attributed to an accelerated expansion of space. Yet now we understand that they are due to ES geometry: relying on redshift data from the past. Since ES geometry alone explains the deviations from Hubble's law, there is no accelerated expansion of space either. We conclude: Any kind of expansion of space is virtual only!

5.12. Solving the Mystery of Dark Energy

The term "dark energy" [10] was coined to account for an accelerated expansion of space. Since there is no accelerated expansion, the concept of dark energy (which has never been observed anyway) is redundant, too. We request Occam's razor to be applied even if a Nobel Prize was given "for the discovery of the accelerating expansion of the universe through observations of distant supernovae" [27]. The universe is not driven by any dark energy, but by *intrinsic energy:* Radial momentum provided by the Big Bang drives the hypersurface away from the origin O. In short: Space is not expanding at all; the universe is expanding at the constant speed c.

5.13. Solving the Mystery of the Wave–Particle Duality

We can't tell which solved mystery is the most important one. Yet the wave–particle duality has certainly kept physicists busy since it was first discussed by Niels Bohr and Werner Heisenberg [28]. The Maxwell equations tell us that electromagnetic waves are oscillations of an electromagnetic field that move through 3D space at the speed of light. In some experiments, objects behave like "waves" (electromagnetic wave packets). In other experiments, the same objects behave like particles. In MS, an object can't be both at once because waves distribute their energy in space over time, while the energy of particles is localized in space at a given time. In ES, we first merge space and time into distance. And within that concept of distance, our third postulate ("all energy is wavematter") gives us the clue of where the wave–particle duality stems from: Waves are likewise material particles. They are the same thing, yet seen from two different perspectives!

Fig. 9 illustrates in Cartesian ES coordinates what our concept of wavematter is all about. Each wavematter comes in four dimensions: It oscillates in two orthogonal dimensions (electric field, magnetic field), and it propagates in a third orthogonal dimension; both oscillating and propagating are occurring in a fourth dimension (Euclidean time). For the wavematter itself ("internal view"), the last two dimensions coincide because each wavematter is moving in its own flow of time. As the axis d_4 disappears because of length contraction, the wavematter observes neither time nor propagation: It deems itself matter at rest. Yet if it is observed by some other wavematter ("external view"), its propagation is visible: It is deemed "wave" (electromagnetic wave packet). Be aware that "wavematter" is not just another word for the wave–particle duality. It is an ES concept of its own that explains why there is wave–particle duality in 3D space.

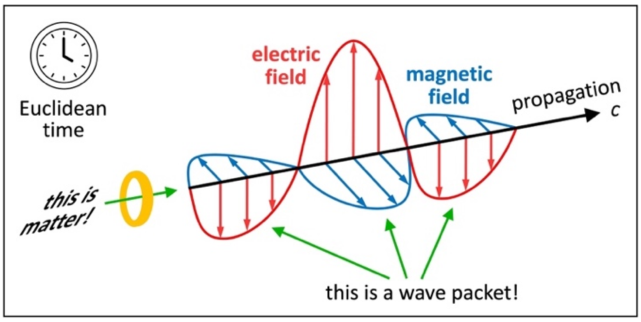

Figure 9. Concept of wavematter in Cartesian ES coordinates. Artwork illustrating how the same object can be deemed wave or matter. Wavematter comes in four dimensions: electric field, magnetic field, propagation, Euclidean time. Each wavematter deems itself matter (internal view). If it is observed by some other wavematter (external view), it is deemed electromagnetic wave packet.

We will now investigate the symmetry in an example of three wavematters WM_1, WM_2, and WM_3. We assume that they are moving away from the same point P in ES and at the speed of light, but in different directions (Fig. 10 top left). d_1, d_2, d_3, d_4 are Cartesian coordinates in which WM_1 moves in d_4 only. d_4 is what WM_1 deems time multiplied by c, and d_1, d_2, d_3 span its view of 3D space (Fig. 10 bottom left). As the axis d_4 disappears because of length contraction, WM_1 observes neither time nor propagation: It deems itself matter at rest (M_1).

WM_3 shall move orthogonally to WM_1. d_1', d_2', d_3', d_4' are Cartesian coordinates in which WM_3 moves in d_4' only (Fig. 10 top right). Here d_4' is what WM_3 deems time multiplied by c, and d_1', d_2', d_3' span WM_3's view of 3D space (Fig. 10 bottom right). As the axis d_4' disappears because of length contraction, WM_3 observes neither time nor propagation: So, it also deems itself matter at rest (M_3).

Yet how do WM_1 and WM_3 move in each other's view? Again, we must fulfill our postulates and the requirement that all wavematters started at the same point P. There is only one way to draw ES diagrams (Fig. 10 top left and right) that fulfill all requirements: We must rotate the two frames of reference with respect to each other. Only a rotation guarantees that the situation is symmetrical, so that the equations describing the laws of physics have the same form! Because of the rotation, WM_3's 4D motion swings completely into WM_1's view of 3D space: WM_3 moves at the speed c in d_1, d_2, d_3 and is deemed wave (W_3) by WM_1. Vice versa is WM_1 deemed wave (W_1) by WM_3.

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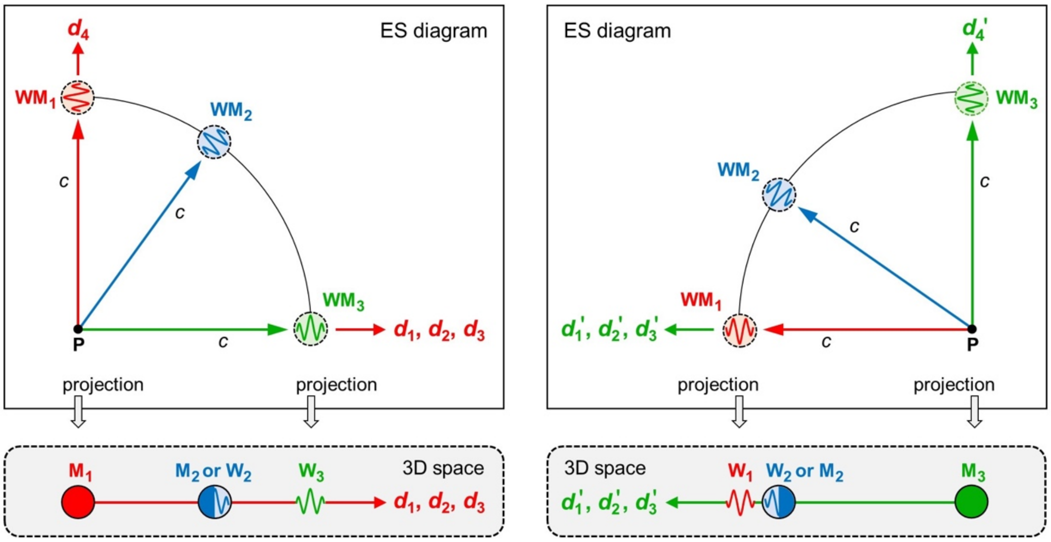

Figure 10. ES diagrams and 3D projections for three wavematters WM_1, WM_2, WM_3. They are all moving away from the point P at the speed of light c. **Top left:** ES in the coordinates d_1, d_2, d_3, d_4 in which WM_1 moves in d_4. **Top right:** ES in the coordinates d_1', d_2', d_3', d_4' in which WM_3 moves in d_4'. **Bottom left:** WM_1's view of 3D space. It deems itself matter at rest (M_1) and WM_3 wave (W_3). **Bottom right:** WM_3's view of 3D space. It deems itself matter at rest (M_3) and WM_1 wave (W_1).

And what is WM_2 deemed by WM_1 and WM_3? For the answer, we split WM_2's 4D motion into a motion parallel to WM_1's motion (here WM_1 is viewing WM_2 internally) and a motion orthogonal to WM_1's motion (here WM_1 is viewing WM_2 externally). WM_1 can thus deem WM_2 either matter (M_2) or wave (W_2), but not both at once. WM_3 can likewise deem WM_2 either matter or wave, but not both at once.

The secret to understanding our two new concepts "distance" and "wavematter" is all in Fig. 10. Here we see how they go hand in hand: We claim the symmetry of all four Cartesian coordinates in ES and—on top of that—the symmetry of all objects in ES. *What I deem wave, deems itself matter.* I conceive of waves as "energy passing by", and each object that I deem wave conceives of me as "energy passing by". Just as distance is space and time in one, so is wavematter wave and matter in one. Wave and matter are not two! The decision "wave or matter?", too, is observer-specific. Here is a compelling explanation for this unique claim of our theory: Einstein taught that energy is equivalent to mass. *Full symmetry of matter and waves is a consequence of the mass–energy equivalence.* As the axis d_4 disappears because of length contraction, energy in a propagating wave condenses to mass in matter at rest. There is no such symmetry in MS.

With all this insight, we are now able to bring light into the concept "photon". It actually stems from a misinterpretation of the wave–particle duality. The term "photon" was coined to explain this duality from the perspective of an observer, that is, from just one perspective: An observer can—depending on the experiment—confirm that electromagnetic radiation is either wave or photon. In MS, there is no perspective of a photon. Yet the wave–particle duality is a matter of two perspectives. In ES, each wavematter (each photon, too) has a perspective of its own. We repeat one statement from above, but replace "matter" with "particle": *What I deem wave, deems itself particle.* We will now break the spell on the wave–particle duality in those two experiments that have meanwhile become its flagships: the double-slit experiment and the outer photoelectric effect.

In a double-slit experiment, someone observes coherent waves passing through a double-slit and producing some pattern of interference on a screen. We already know that he observes original objects from ES whose 4D motion swings completely into his view of 3D space. He deems these wavematters waves because he isn't tracking through which slit each wavematter is passing. If he did, the interference pattern would disappear immediately. So, he is a typical external observer. Experiments with low-noise video cameras

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instead of a screen have also been performed [29]. Their results confirm our theory: There is interference of waves if we don't track single photons. Yet once we discuss the experiment from the internal view of each wavematter ("Which CCD pixel will detect me?"), it behaves like a particle.

The outer photoelectric effect is quite different. Of course, we can externally witness how one photon is releasing one electron from a metal surface. But the physical effect itself ("Do I have enough energy to release one electron?") is all up to the photon's view. Only if its energy exceeds the binding energy of an electron is that electron released. Hence, we *must* interpret this experiment from the internal view of each wavematter. Here its view is crucial! It behaves like a particle which we nowadays call "photon".

The wave–particle duality has been observed in matter like electrons, too [30]. How can they behave like waves in a double-slit experiment? According to our third postulate, an electron is wavematter, too. From the internal view, each electron is a particle ("Which slit will I go through?"). From the external view, when they aren't tracked, electrons are waves. We need both concepts (wavematter and distance in ES) to understand the wave–particle duality of matter: Only in ES are waves and matter alike as they are all moving at the speed c. Fig. 10 even tells us why we deem macroscopic wavematters matter: Their speed in 3D space is low compared with the speed of light thus favoring the internal view. This argument justifies drawing solid rockets and celestial bodies in our ES diagrams.

5.14. *Solving the Mystery of Quantum Entanglement*

The term "entanglement" [31] was coined by Erwin Schrödinger when he published his comment on the Einstein–Podolsky–Rosen paradox [32]. The three authors argued in a thought experiment that quantum mechanics wouldn't provide a complete description of reality. Schrödinger's word creation couldn't solve the paradox, but demonstrates up to the present day how difficult it is to grasp quantum mechanics in MS. John Bell set up an inequality [33] that any theory must fulfill to be compatible with quantum mechanics. Bell proved that local hidden variables violate the inequality. Ever since has entanglement been considered a non-local effect in MS.

We will now untangle quantum entanglement without the issue of non-locality. All we need to do is discuss quantum entanglement in ES! Fig. 11 illustrates two wavematters that were created at once in a point P and move away from each other in opposite directions at the speed c. We assume that they are entangled. For example, they were created in a non-linear crystal in P or in an annihilation process in P. One wavematter is moving in the positive axis d_4, the other one in the negative axis d_4. If they are observed by a third wavematter in its view of 3D space spanned by d'_1, d'_2, d'_3, they are deemed two objects (wave or matter), especially if they already moved far away from each other. That third wavematter can't understand how the entangled wavematters communicate with each other in no time. This is again the "external view".

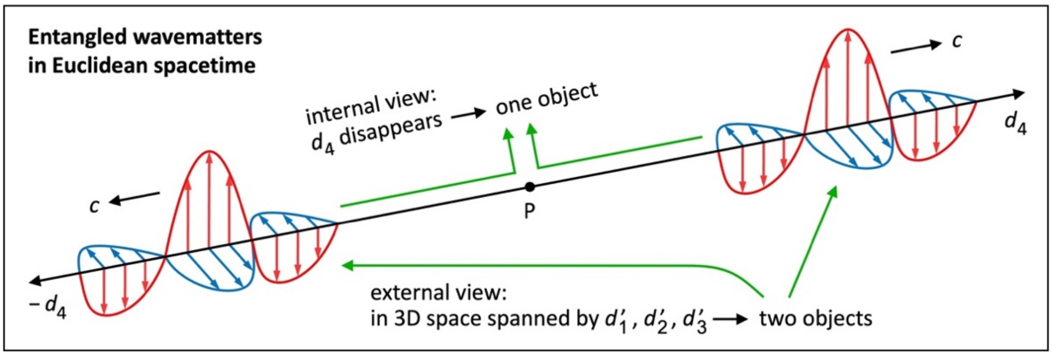

Figure 11. Quantum entanglement in ES. Artwork illustrating external view and internal view. For each wavematter (internal view), the axis d_4 disappears because of length contraction. It deems its twin and itself one object. For a third wavematter (external view), they are two objects.

And here comes the "internal view": For each wavematter, the axis d_4 disappears because of length contraction at the speed of light. That is to say: In the projection to its own view of 3D space spanned by d_1, d_2, d_3, either wavematter deems itself at the same position as its twin. *From their common perspective, they have never been separated.* This is why they exchange information with each other in no time! Our solution to quantum entanglement isn't limited to photons. According to our second postulate, everything is moving at the speed c. So, electrons or atoms can be entangled, too. They move at a speed $v_{3D} < c$ in my view of 3D space, but in their axis d_4 they also move at the speed c.

We claim that any two wavematters are entangled if they are created at once and move away from each other in opposite directions at the speed c. Hence, the two gamma photons emitted in the annihilation of an electron and a positron should be entangled, too. Originally, we planned asking experimental physicists to verify their entanglement. We were very pleased to read that the verification has already been performed [34]. We are confident that this verification is even another proof for our theory.

5.15. Solving the Mystery of Spontaneity

Our theory even explains spontaneous effects in particle physics. In *spontaneous emission,* a photon is emitted from an excited atom. Prior to the emission, the photon's energy was moving with the atom. After the emission, it is moving by itself. MS can't explain how that energy is boosted to the speed c in no time. In ES, both atom and photon are already moving at the speed of light. Hence, there is no need to boost any energy to the speed c. All it takes is a photon that swings its 4D motion into an observer's view of 3D space, and the photon is able to speed off immediately.

In *absorption,* a photon is spontaneously absorbed by an atom. Here MS can't explain how the energy of that photon is slowed down in no time to become part of an atom. In ES, both photon and atom are moving at the speed of light. Hence, there is no need to slow down any energy to the speed of an atom.

In *pair production,* two gamma photons convert into an electron and a positron. Here MS can't explain how the energy of the two gamma photons is slowed down in no time to form an electron and a positron. In ES, all these objects are moving at the speed of light. Hence again, there is no need to slow down any energy.

Finally, in *annihilation* one electron and one positron convert into two gamma photons. In ES, all these objects are moving at the speed of light. Hence, there is no need to boost any energy to the speed c in no time. Fig. 12 sketches the process of swinging again: Electron and positron rotate by an angle $< 90°$ into my view of 3D space. The two gamma photons (entangled in 3D space) deem themselves one object in ES. Spontaneity is another clue that matter, too, is moving through ES at the speed of light.

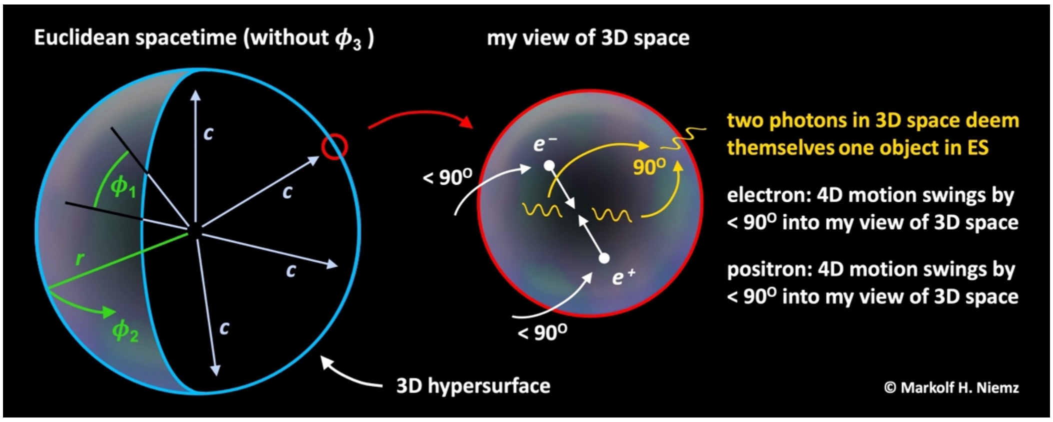

Figure 12. Annihilation process in ES. Artwork illustrating how an electron and a positron convert into two gamma photons. **Left:** Non-observable ES in hyperspherical coordinates. **Right:** My view of 3D space in Cartesian coordinates. The two entangled photons deem themselves one object in ES.

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6. Conclusions

For the very first time on Earth, living things understand what time is all about. And the clue is ... symmetry! We live in the 3D hypersurface of an expanding 4D hypersphere. Its radius, divided by the speed of light, is time. We—two physicists—felt spontaneously that our discovery is a paradigm shift in both physics and philosophy. It felt like "wow!" Just imagine: *The human brain is able to grasp the idea that we are all moving through Euclidean spacetime at the speed of light.* With this in mind, conflicts among mankind become all so small. A "system at rest" is the catch in Einstein's theories. General relativity is not compatible with quantum physics as there is nothing at rest at the microscopic level.

By discovering that physics has chosen the wrong concept of time, we solved 15 mysteries. Hence, we provided 15 proofs for our theory: (1) time, (2) time's arrow, (3) length contraction, (4) time dilation, (5) mc^2, (6) isotropic background radiation, (7) Hubble's law, (8) the cosmological principle, (9) flat universe, (10) the Hubble constant, (11) expanding space, (12) dark energy, (13) the wave–particle duality, (14) quantum entanglement, and (15) spontaneity. We had some advantage in setting up our theory because we as non-cosmologists aren't caught up in concepts related to Minkowski spacetime. For a quantum leap in understanding, we must overcome traditional thinking. Albert Einstein sacrificed the absoluteness of space and time. We merge space and time into distance and sacrifice the absoluteness of waves and matter. Quantum leaps can't be planned. They happen like the spontaneous emission of a photon. ☺

We are convinced that our theory is another major quantum leap in understanding the universe that we live in. Two new symmetrical concepts are the clue for our success: "distance" (space and time in one) and "wavematter" (electromagnetic wave packet and matter in one). Thousands of textbooks must be rewritten: (1) There is absolute Euclidean time. (2) Space and time are not two, but one [21]. (3) Wave and matter are also not two, but one. We owe Einstein a great debt of gratitude for his theories of relativity, yet even he could not overcome the thinking in both space and time. We explained our new concepts and confirmed how powerful they are. We can even tell the source of their power: symmetry and beauty! It is not by chance that we solved so many mysteries at once: Only a true Theory of Everything has the power to do so. The evidence for our theory is overwhelming. We are confident that even further proofs will be given in the near future and that—based on our pioneering work—there will be new approaches to a Grand Unified Theory in Cartesian coordinates of Euclidean spacetime.

About the Authors

We are two physicists with a strong passion for symmetry, relativity, and cosmology. Markolf has a Ph.D. in physics and is a full professor at Heidelberg University, Germany. He studied in Frankfurt, Heidelberg, at UCSD, and Harvard. He is working on "light and matter" [35], biosignals, and philosophy based on physics. He contributed the concepts "distance" and "wavematter", absolute Euclidean time, and the Theory of Everything. Siegfried taught physics and mathematics at the Waldorf School in Darmstadt, Germany. He contributed that Minkowski diagrams are not in line with experimental physics and the correct Hubble constant. Everything else was solved together.

Conflicts of Interests

The authors declare no conflict of interest.

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