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Special and general relativity (SR/GR) describe nature "subjectively", that is, from the perspective of just *one observer at a time* (one group of observers, to be exact). Mathematically, SR/GR are correct. I show: (1) Physically, SR/GR have an issue. Despite the covariance of SR/GR, there is always just one active perspective. Because of this constraint, there is no holistic view of nature. The issue shows itself in unsolved mysteries. Still, the Lorentz factor and gravitational time dilation are correct. This is why the concepts of spacetime in SR/GR work well except for cosmology and quantum mechanics. (2) Euclidean relativity (ER) describes nature "objectively", that is, from the perspectives of *all objects at once*. An object's (!) proper space d_1, d_2, d_3 and proper time τ span 4D Euclidean spacetime (ES), where d_1, d_2, d_3 and $d_4 = c\tau$ are treated the same. All energy moves through ES at the speed c. An observer's reality is created by projecting ES orthogonally to his proper space and to his proper time. In SR, these concepts are considered coordinate space and coordinate time. Neither their reassembly to a non-Euclidean spacetime nor the parameterization in SR/GR provides a holistic view. The scalar τ, in particular, cannot factor in an object's 4D vector "flow of proper time" $\boldsymbol{\tau}$. The SO(4) symmetry of ES is incompatible with waves. This is fine because waves and particles are subjective concepts. A master reality (described by ER) is beyond each observer's reality (described by SR/GR). ER solves 15 mysteries at once, such as time's arrow, the Hubble tension, dark energy, and non-locality.

Keywords: time; cosmology; Hubble tension; dark energy; quantum mechanics; non-locality

This paper is not about a minor issue. It is about a reformation of physics. There are two approaches to describing nature: "subjectively" (from the perspective of just one observer or one group of observers at a time) or "objectively" (from the perspectives of all objects at once). Special and general relativity (SR/GR) take the first approach (Einstein, 1905b; Einstein, 1916). SR/GR are mathematically correct, but they lack a holistic view of nature. Euclidean relativity (ER) takes the second approach. ER is mathematically and physically correct because it provides a holistic view. My theory was rejected by several top journals in physics. I was told that manuscripts are not considered if they challenge SR/GR. Many attempts to challenge SR/GR failed, but we must not reject all attempts. Scientific theories must always be falsifiable (Popper, 1935). This is why I now submit to a journal in philosophy. May the cradle of physics give physicists a hand! Subjectively, we live in a curved, non-Euclidean spacetime. Objectively, we live in a flat, Euclidean spacetime.

Six pieces of advice: (1) *Do not take SR/GR as the ultimate truth.* Correct predictions do not prove SR/GR. ER predicts the same relativistic effects as SR/GR. Some reviewers made a systematic error when they evaluated ER with the concepts of SR/GR. ER is different. In ER, all energy moves at the speed of light c. (2) *Be patient and fair.* I cannot address all of physics in one paper. SR/GR have been tested for 100+ years. ER deserves the same chance. (3) *Do not reject ER on a knee-jerk reaction.* What is wrong with describing nature objectively rather than subjectively? (4) *Do not be prejudiced against a theory that solves many mysteries.* New concepts often do so. (5) *Appreciate illustrations.* Geometric derivations are as good as equations. (6) *Consider that you may be biased.* Some concepts of today's physics are obsolete in ER. If you are an expert in such a concept, you may feel offended.

To sum it all up: Predictions made by SR/GR are correct, but ER penetrates to a deeper level. I apologize for my many preprints, but I received almost no support. The final version is all that is needed. Earlier versions document how I got there. It was tricky to figure out why the concepts of spacetime in SR/GR work so well despite an issue. Sect. 2 is about this issue. Sect. 3 describes the physics of ER. Sect. 4 recovers the Lorentz factor and gravitational time dilation. In Sect. 5, ER solves 15 mysteries of physics at once.

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1. Introduction

Today's concepts of space and time were coined by Albert Einstein. In SR, he merges them into a flat spacetime described by an indefinite distance function. SR is often presented in Minkowski spacetime because it illustrates the invariance of the spacetime interval very well (Minkowski, 1910). Predicting the lifetime of muons (Rossi & Hall, 1941) is an example that supports SR. In GR, curved spacetime is described by a pseudo-Riemannian metric. Predicting the deflection of starlight (Dyson et al., 1920) and the high accuracy of GPS (Ashby, 2003) are examples that support GR. Quantum field theory (Ryder, 1985) unifies classical field theory, SR, and quantum mechanics (QM) but not GR.

Two postulates of ER: (1) All energy moves through 4D Euclidean spacetime (ES) at the speed of light c. (2) The laws of physics have the same form in each "observer's reality", which is created by projecting ES orthogonally to his proper space and to his proper time. To improve readability, I refer to each observer as "he". To make up for it, I refer to nature as "she". My first postulate is stronger than the second SR postulate: c is absolute and universal. My second postulate refers to realities rather than to inertial frames. I also introduce a generalized concept of energy: All energy is "wavematter", which may appear as a wave packet or as a particle depending on the perspective (see Sect. 5.12).

Newburgh and Phipps (1969) pioneered ER. Montanus (1991) described an absolute Euclidean spacetime with a "preferred frame of reference" (a pure time interval is a pure time interval for all observers). Montanus (2023) claims: Without the preferred frame, we would face the twin paradox, non-contact collisions, and a "character paradox" (confusion of photons, particles, and antiparticles). I will show that the preferred frame is obsolete. Whatever is time for me, it may be space for you. There is no twin paradox. There are no non-contact collisions. The character paradox is reasonable. Montanus (2001) used the Lagrange formalism to set up the kinematic equations in proper time. Montanus (2023) even tried to formulate Maxwell's equations in ER but wondered about a wrong sign. He overlooked that the SO(4) symmetry of ES is incompatible with waves.

Almeida (2001) investigated geodesics in ES. Gersten (2003) showed that the Lorentz transformation is an SO(4) rotation in a "mixed space" (see Sect. 3). van Linden (2023) runs a website about various ER models. Physicists are still opposed to ER because dark energy and non-locality make cosmology and QM work, waves are excluded, and paradoxes may turn up if ER is not interpreted correctly. *This paper marks a turning point:* I disclose an issue in SR/GR. I justify the exclusion of waves. I avoid paradoxes by projecting ES.

It is instructive to contrast Newton's physics, Einstein's physics, and ER. In Newton's physics, all energy moves through 3D Euclidean space as a function of independent time. The speed of matter is $v_{3D} \ll c$. In Einstein's physics, all energy moves through 4D non-Euclidean spacetime. The speed of matter is $v_{3D} < c$. In ER, all energy moves through ES. The 4D speed of all energy is $u_{4D} = c$. Newton's physics (Newton, 1687) influenced Kant's philosophy (Kant, 1781). Will ER reform both physics and philosophy?

2. Disclosing an Issue in Special and General Relativity

In SR (Einstein, 1905b), there are two concepts of time: coordinate time t and proper time τ. The fourth coordinate in SR is t. In § 1 of SR, Einstein provides an instruction on how to synchronize two clocks at P and Q. At "P time" t_P, a light pulse is sent from P to Q. At "Q time" t_Q, it is reflected. At "P time" t_P^*, it is back at P. The clocks synchronize if

$$t_Q - t_P = t_P^* - t_Q \ . \tag{1}$$

In § 3 of SR, Einstein derives the Lorentz transformation. The coordinates x_1, x_2, x_3, t of an event in a system K are transformed to the coordinates x_1', x_2', x_3', t' in K′ by

$$x_1' = \gamma\,(x_1 - v_{3D}\,t) \ , \quad x_2' = x_2 \ , \quad x_3' = x_3 \ , \tag{2a}$$

$$t' = \gamma\,(t - v_{3D}\,x_1/c^2) \ , \tag{2b}$$

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where K′ moves relative to K in x_1 at the constant speed v_{3D} and $\gamma = (1 - v_{3D}^2/c^2)^{-0.5}$ is the Lorentz factor. *Mathematically,* Eqs. (1) and (2a–b) are correct for an observer R in K. There are covariant equations for an observer B in K′. *Physically,* SR and also GR have an issue. They describe nature from the perspective of just one observer at a time (one group of observers, to be exact). In SR, a group consists of observers who do not move relative to each other. In GR, a group consists of observers who share the same gravitational field. The physical issue lies in the fact that there is always just one *active* perspective. Because of this constraint, there is no holistic view of nature. In particular, observers do not always agree on what is past and what is future. Physics paid a very high price for surrendering simultaneity as a general concept: By replacing SR/GR with ER, we will solve not less than 15 fundamental mysteries of physics. Thus, the issue is real.

The issue in SR/GR is very similar to the issue in the geocentric model: In either case, there is no holistic view but just one *active* perspective. In the old days, it was natural to believe that all celestial bodies would revolve around Earth. Only the astronomers wondered about the retrograde loops of planets and claimed: Earth revolves around the sun. In modern times, engineers have improved the precision of rulers and clocks. Eventually, it was natural to believe that it would be fine to describe nature as accurately as possible but from just one *active* perspective. The human brain is very powerful, but unfortunately it often deems itself the center/measure of everything in the universe.

The analogy is strong: (1) It holds despite the covariance of SR/GR. After a transformation (or else after replacing the center Earth), there is again just one *active* perspective. (2) SR/GR miss the big picture just like the geocentric model. Retrograde loops are obsolete but only in the holistic view of the heliocentric model. Dark energy and non-locality are obsolete but only in the holistic view of ER. (3) In the old days, alternatives to the geocentric model were not taken seriously. Today, alternatives to SR/GR are not taken seriously. *Have physicists not learned from history? Does history repeat itself?*

3. The Physics of Euclidean Relativity

The indefinite distance function in SR (Einstein, 1905b) is usually written as

$$c^2\,\mathrm{d}\tau^2 \;=\; c^2\,\mathrm{d}t^2 \;-\; \mathrm{d}x_1^2 \;-\; \mathrm{d}x_2^2 \;-\; \mathrm{d}x_3^2\;, \tag{3}$$

where $\mathrm{d}\tau$ is an infinitesimal distance in proper time τ, while $\mathrm{d}t$ and $\mathrm{d}x_i$ $(i = 1, 2, 3)$ are infinitesimal distances in coordinate spacetime x_1, x_2, x_3, t. This spacetime is *construed* because coordinate space x_1, x_2, x_3 and coordinate time t are subjective concepts: They are not immanent in rulers and clocks but construed by an observer. Rulers measure proper distance. Clocks measure proper time. I introduce ER by defining its metric

$$c^2\,\mathrm{d}t^2 \;=\; \mathrm{d}d_1^2 \;+\; \mathrm{d}d_2^2 \;+\; \mathrm{d}d_3^2 \;+\; \mathrm{d}d_4^2\;, \tag{4}$$

where $\mathrm{d}d_i = \mathrm{d}x_i$ $(i = 1, 2, 3)$ and $\mathrm{d}d_4 = c\,\mathrm{d}\tau$ are infinitesimal distances in 4D Euclidean spacetime (ES). In ER, the roles of t and τ are switched: *The fourth coordinate is an object's proper time τ. The invariant line element is cosmic time t. The metric tensor is the identity matrix.* Because of the identity matrix, the math of ER is much simpler than the one of GR. I retain the symbol t because it is the preferred symbol for cosmic time. I prefer the indices 1–4 over 0–3 to stress the symmetry. An object's (!) proper space d_1, d_2, d_3 and proper time τ span ES, where d_1, d_2, d_3 and $d_4 = c\tau$ are treated the same. This spacetime is *natural* because all d_μ $(\mu = 1, 2, 3, 4)$ are objective concepts: They are immanent in rulers and clocks. Do not confuse Eq. (4) with a Wick rotation (Wick, 1954), where time is imaginary.

For each object, we are free to label the four axes of ES. We always take d_4 as the axis in which it *currently* moves at the speed c. The d_4 axis is not observable by the object but experienced as proper time. Another object may move in d_4' at the speed c. It experiences d_4' as proper time. Since proper time τ may flow in different 4D directions, there is a 4D vector "flow of proper time" $\boldsymbol{\tau}$. This vector $\boldsymbol{\tau}$ is missing in SR/GR! An "object's reality" is created by projecting ES orthogonally to its proper space and to its proper time.

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$$\tau = d_4/c \,, \quad \tau' = d_4'/c \,, \tag{5}$$

$$\boldsymbol{\tau} = d_4\,\boldsymbol{u}/c^2 \,, \quad \boldsymbol{\tau}' = d_4'\,\boldsymbol{u}'/c^2 \,, \tag{6}$$

where $\boldsymbol{u}$ is the 4D velocity of an object in ES. For all objects, there is $u_\mu = \mathrm{d}d_\mu/\mathrm{d}t$, where t is cosmic time. Thus, Eq. (4) is equivalent to my first postulate.

$$u_1^2 + u_2^2 + u_3^2 + u_4^2 = c^2 \,. \tag{7}$$

My second postulate revises the principle of relativity and defines an "observer's reality", which is created by projecting ES orthogonally to his proper space and to his proper time. In SR, these concepts are considered coordinate space and coordinate time. Neither their reassembly to a non-Euclidean spacetime nor the parameterization in SR/GR provides a holistic view. The scalar τ, in particular, cannot factor in an object's 4D vector $\boldsymbol{\tau}$. Since replacing coordinate time with cosmic time is a discontinuous operation, there is no continuous transition between SR and ER. In SR, an object is described by the four coordinates $x_1(\tau), x_2(\tau), x_3(\tau), t(\tau)$, where τ is the parameter and t is coordinate time. In ER, an object is described by the four coordinates $d_1(t), d_2(t), d_3(t), d_4(t)$, where cosmic time t is the parameter and d_4 relates to τ according to Eq. (5).

It is instructive to contrast three concepts of time. Coordinate time t is a subjective measure of time: It is equal to $\tau = |\boldsymbol{\tau}|$ for the observer only. Proper time τ is an objective measure of time: It is independent of observers. Cosmic time t is the total distance covered in ES (length of a geodesic) divided by c. By taking cosmic time as the parameter, all observers agree on what is past and what is future. Since cosmic time is absolute, there is no twin paradox in ER. Twins share the same age in cosmic time! However, ER also seems to have an issue (I will explain in Sect. 6 why it is not an issue): Only in proper coordinates can we access ES, but the proper coordinates of other objects cannot be measured. This is why I introduced ER in Eq. (4) by defining its metric in proper coordinates. Be aware that ER is not a physical problem that we could solve using a Lagrangian or Hamiltonian. ER is an innovative description of nature that is based on a Euclidean metric. I like to call ES the "master reality" because it is "beyond" (prior to) the projections.

Let us compare SR with ER. We consider two identical clocks "r" (red clock) and "b" (blue clock). In SR, "r" shall be "at rest": It moves only in the ct axis at $x_1 = 0$. Clock "b" starts at $x_1 = 0$, but it moves in the x_1 axis at a constant speed of $v_{3D} = 0.6\,c$. Fig. 1 left shows the instant when either clock moved 1.0 s in the coordinate time of "r". Clock "b" moved 0.6 Ls (light seconds) in x_1 and 0.8 Ls in ct'. Thus, "b" displays "0.8". In ER, no clock is at rest: Fig. 1 right shows the instant when either clock moved 1.0 s in cosmic time. Both clocks display "1.0". Clock "b" moved 0.6 Ls in d_1 and 0.8 Ls in d_4.

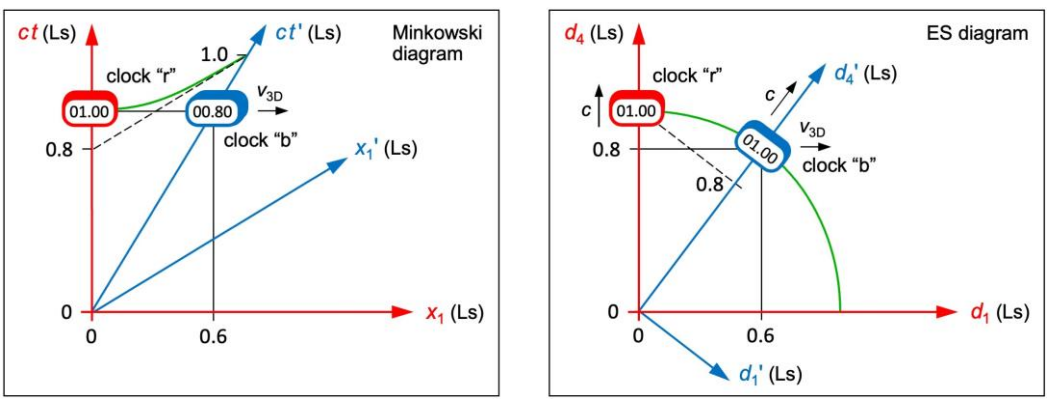

Fig. 1 Minkowski diagram and ES diagram for two clocks "r" (red) and "b" (blue). **Left:** In SR, "b" is slow with respect to "r" in t'. Coordinate time is relative ("b" is not at the same positions in ct and ct'). **Right:** In ER, "b" is slow with respect to "r" in d_4. Cosmic time is absolute ("r" is in d_4 at the same position as "b" in d_4'). Only the ES diagram is rotationally symmetric

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Let "r" (or "b") be the clock of an observer R (or else B). In the red frame of Fig. 1 left, "b" displays $t' = 0.8$ s at the instant when "r" displays $t = 1.0$ s (solid line). In SR, time dilation with respect to "r" thus occurs in t' of B. In the red frame of Fig. 1 right, "b" is at $d_4 = 0.8$ Ls at the instant when "r" is at $d_4 = 1.0$ Ls (this is the same axis d_4). In ER, time dilation with respect to "r" thus occurs in d_4 of R. *In SR and ER, "b" is slow with respect to "r".* But why does ER provide a holistic view? Well, the Euclidean metric in Eq. (4) is very special: All four coordinates have the same sign. Thus, all dimensions are treated the same. Thus, describing nature in ER does not depend on which axis is considered proper time! This is why ES diagrams are rotationally symmetric and why they provide a holistic view: The ES diagram in Fig. 1 works for R and B *at once.* In SR, we would have to draw a second Minkowski diagram for B, in which x_1' and ct' are orthogonal.

Montanus (2001) used the Lagrange formalism to set up the kinematic equations in proper time τ. I will not repeat the derivation. The reader is referred to his paper. My task is to turn ER into an accepted theory by solving 15 mysteries. Gersten (2003) showed that the Lorentz transformation is an SO(4) rotation in a "mixed space" x_1, x_2, x_3, ct', where ct' is the only primed coordinate. A "mixed space" is physical nonsense. It is another hint that SR has an issue. A Lorentz transformation rotates mixed x_1, x_2, x_3, ct' to x_1', x_2', x_3', ct. In ER, unmixed d_1', d_2', d_3', d_4' rotate with respect to d_1, d_2, d_3, d_4 (see Sect. 4).

There is also a big difference in the synchronization of clocks: In SR, each observer is able to synchronize a uniformly moving clock to his clock (same value of ct in Fig. 1 left). If he does, the two clocks are not synchronized from the perspective of the moving clock. In ER, clocks with the same 4D vector $\boldsymbol{\tau}$ are always synchronized, while clocks with different $\boldsymbol{\tau}$ and $\boldsymbol{\tau}'$ are never synchronized (different values of d_4 in Fig. 1 right).

4. Geometric Effects in 4D Euclidean Spacetime

We consider two identical rockets "r" (red rocket) and "b" (blue rocket). Let observer R (or B) be in the rear end of rocket "r" (or else "b"). We use 3D space and proper space as synonyms. The 3D space of R (or B) is spanned by d_1, d_2, d_3 (or else d_1', d_2', d_3'). The proper time of R (or B) relates to d_4 (or else d_4'). Both rockets started at a point P and move relative to each other at the constant speed v_{3D}. We are free to label the axis of motion in 3D space. We label it d_1 (or d_1'). In the ES diagrams shown in Fig. 2, we draw the d_4 (or d_4') axis vertically. The ES diagrams must fulfill my two postulates and the initial condition (same starting point P). We accomplish this by rotating the red and the blue frame with respect to each other. Fig. 2 bottom shows the projection to the 3D space of R (or B). We draw 2D rockets but are aware that their width is in d_2, d_3 (or d_2', d_3').

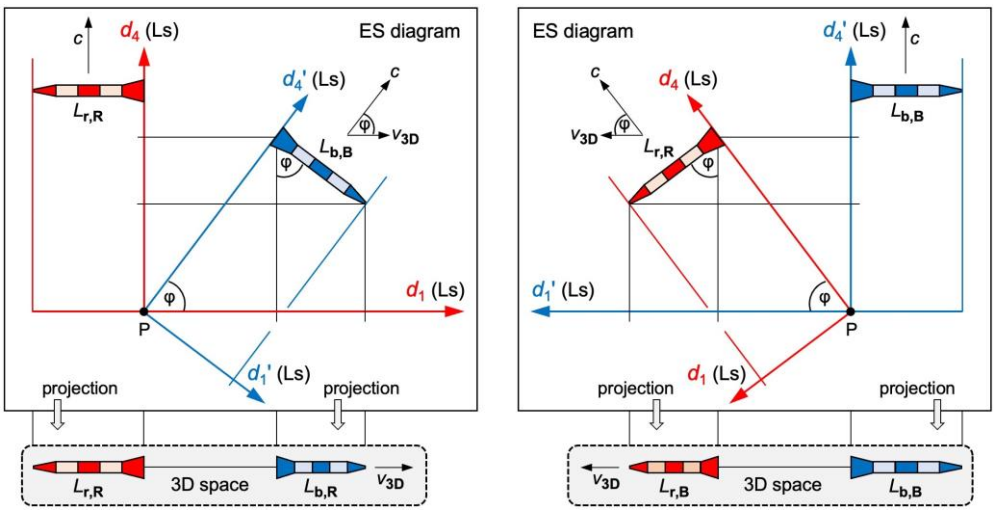

Fig. 2 ES diagrams and 3D projections for two rockets "r" (red) and "b" (blue). **Top:** Both rockets move in different 4D directions at the speed c. **Bottom left:** Projection to the 3D space of R. Rocket "b" contracts to $L_{b,R}$. **Bottom right:** Projection to the 3D space of B. Rocket "r" contracts to $L_{r,B}$

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We now verify: (1) The fact that the red and the blue frame are rotated with respect to each other causes length contraction. (2) The fact that proper time flows in different 4D directions for R and for B causes time dilation. Let $L_{i,j}$ be the length of rocket i for observer j. In a first step, we project the blue rocket in Fig. 2 top left to the d_1 axis.

$$\sin^2\varphi + \cos^2\varphi = (L_{\mathrm{b,R}}/L_{\mathrm{b,B}})^2 + (v_{3\mathrm{D}}/c)^2 = 1\ , \tag{8}$$

$$L_{\mathrm{b,R}} = \gamma^{-1} L_{\mathrm{b,B}} \qquad \text{(length contraction)}, \tag{9}$$

where $\gamma = (1 - v_{3\mathrm{D}}^2/c^2)^{-0.5}$ is the same Lorentz factor as in SR. For R, rocket "b" contracts by the factor γ^{-1}. Which distances will R observe in his d_4 axis? We mentally continue the rotation of "b" in Fig. 2 top left until it points vertically down and serves as R's ruler in the d_4 axis. In the projection to the 3D space of R, this ruler contracts to zero: The d_4 axis disappears for R because of length contraction at the speed c.

In a second step, we project the blue rocket in Fig. 2 top left to the d_4 axis.

$$\sin^2\varphi + \cos^2\varphi = (d_{4,\mathrm{B}}/d'_{4,\mathrm{B}})^2 + (v_{3\mathrm{D}}/c)^2 = 1\ , \tag{10}$$

$$d_{4,\mathrm{B}} = \gamma^{-1} d'_{4,\mathrm{B}}\ , \tag{11}$$

where $d_{4,\mathrm{B}}$ (or $d'_{4,\mathrm{B}}$) is the distance that B moved in d_4 (or else d'_4). With $d'_{4,\mathrm{B}} = d_{4,\mathrm{R}}$ (R and B cover the same distance in ES but in different directions), we calculate

$$d_{4,\mathrm{R}} = \gamma\, d_{4,\mathrm{B}} \qquad \text{(time dilation)}, \tag{12}$$

where $d_{4,\mathrm{R}}$ is the distance that R moved in d_4. Eqs. (9) and (12) tell us: SR works so well because γ is recovered if we project ES to d_1 and to d_4. This is not a surprise. Weyl (1928) showed that the Lorentz group is generated by 4D rotations.

To understand how an acceleration manifests itself in ES, we return to our two clocks "r" and "b". We assume that "r" and Earth move in the d_4 axis of "r" at the speed c and that "b" accelerates in the d_1 axis of "r" toward Earth (Fig. 3). Because of Eq. (7), the speed $u_{1,\mathrm{b}}$ of "b" in d_1 increases at the expense of its speed $u_{4,\mathrm{b}}$ in d_4.

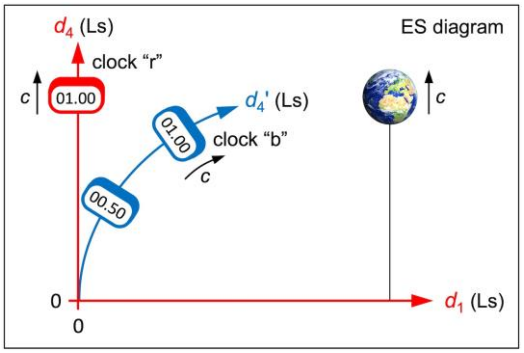

Fig. 3 ES diagram for two clocks "r" (red) and "b" (blue). Clock "r" and Earth move in the d_4 axis of "r" at the speed c. Clock "b" accelerates in the d_1 axis of "r" toward Earth

Gravitational waves support the idea of GR that gravitation is a feature of spacetime (Abbott et al., 2016). Like classical physics, ER takes gravitation as a force that has not yet been unified with the other forces. I claim that curved geodesics in flat ES replace curved spacetime in GR. To support my claim, I now show in ER: Clock "b" is slow with respect to "r" if "b" experiences the gravitational force of a mass M—whether or not "b" is in free fall toward M. It is the same equivalence that motivated Einstein to formulate GR. Let the mass M be Earth. Initially, "r" and "b" move in d_4 far away from Earth. Eventually, "b" is sent in free fall toward Earth in d_1 (Fig. 3). The kinetic energy of "b" in d_1 is

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$$\frac{1}{2}mu_{1,\mathrm{b}}^2 = GMm/r \ , \tag{13}$$

where m is the mass of "b", G is the gravitational constant, and r is the distance of clock "b" to Earth's center. By applying Eq. (7), we obtain

$$u_{4,\mathrm{b}}^2 = c^2 - u_{1,\mathrm{b}}^2 = c^2 - 2GM/r \ . \tag{14}$$

With $u_{4,\mathrm{b}} = \mathrm{d}d_{4,\mathrm{b}}/\mathrm{d}t$ ("b" moves in the d_4 axis at the speed $u_{4,\mathrm{b}}$) and $c = \mathrm{d}d_{4,\mathrm{r}}/\mathrm{d}t$ ("r" moves in the d_4 axis at the speed c), we calculate

$$\mathrm{d}d_{4,\mathrm{b}}^2 = (c^2 - 2GM/r)\,(\mathrm{d}d_{4,\mathrm{r}}/c)^2 \ , \tag{15}$$

$$\mathrm{d}d_{4,\mathrm{r}} = \gamma_{\mathrm{gr}}\,\mathrm{d}d_{4,\mathrm{b}} \qquad \text{(gravitational time dilation)}, \tag{16}$$

where $\gamma_{\mathrm{gr}} = (1 - 2GM/(rc^2))^{-0.5}$ is the same dilation factor as in GR. Since γ_{gr} does not depend on $u_{1,\mathrm{b}}$, clock "b" is slow with respect to "r"—whether or not "b" is in free fall toward Earth. In ER, gravitational time dilation stems from projecting curved geodesics to the d_4 axis of an observer. Eq. (16) tells us: GR works so well because γ_{gr} is recovered if we project ES to d_4. Since γ and γ_{gr} are recovered, the *Hafele–Keating experiment* (1972) also supports ER. GPS satellites work in ER as well as in GR! In SR/ER, a moving clock is slow with respect to an observer. In GR/ER, a clock in a stronger gravitational field is slow with respect to an observer. In SR/GR, an observed clock is slow in its own flow of proper time. In ER, an observed clock is slow in the observer's flow of proper time.

Three instructive problems demonstrate how to draw and how to read ES diagrams correctly (Fig. 4). Problem 1: In billiards, the blue ball is hit toward the red ball. In ES, both balls move at the speed c. We assume that the red ball moves in its d_4 axis. As the blue ball covers distance in d_1, its speed in d_4 must be less than c. How can the two balls ever collide if their d_4 values do not match? Problem 2: Some rocket moves along a guide wire. In ES, rocket and wire move at the speed c. We assume that the wire moves in its d_4 axis. As the rocket covers distance in d_1, its speed in d_4 must be less than c. Doesn't the wire escape from the rocket? Problem 3: Earth orbits the sun. In ES, they both move at the speed c. We assume that the sun moves in its d_4 axis. As Earth covers distance in d_1 and d_2, its speed in d_4 must be less than c. Doesn't the sun escape from the orbital plane?

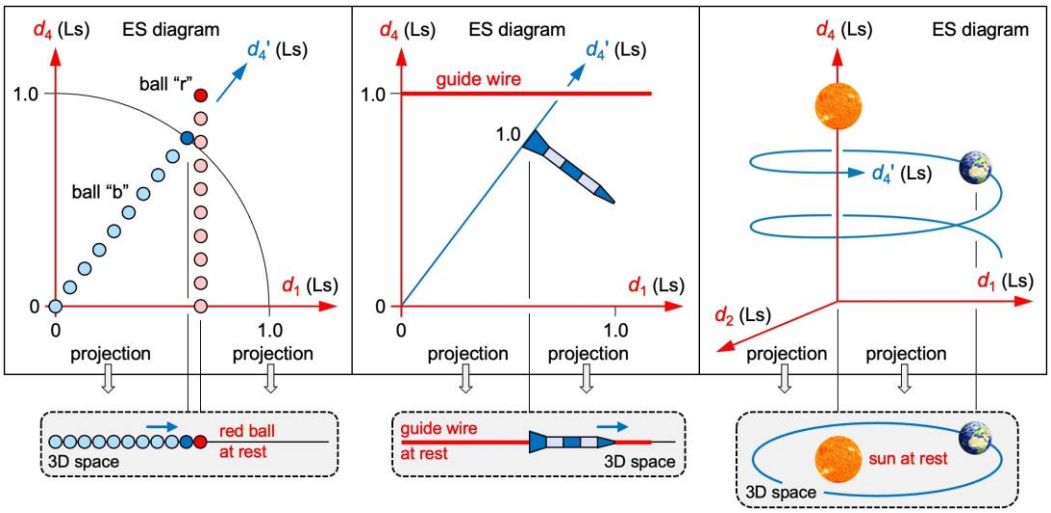

Fig. 4 Solving three instructive problems. Each snapshot shows one instant in cosmic time, which serves as the parameter in ER. The left ES diagram shows ten snapshots at once. **Left:** The blue ball "b" is hit toward the red ball "r". In the projection, the two balls collide. **Center:** Some rocket moves along a guide wire. In the projection, the wire does not escape from the rocket. **Right:** Earth orbits the sun. In the projection, the sun does not escape from the orbital plane

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The questions in the last paragraph only seem to disclose geometric paradoxes in ER. The fallacy lies in the assumption that all four axes of ES would be spatial. According to Eq. (5), d_4 relates to proper time. In ES, each object moves in the direction of its own flow of proper time. Thus, an object moving in d_4' covers less distance in d_4. In Fig. 4, we solve all problems by projecting ES to the 3D space of the object that moves in d_4 at the speed c. In its 3D space, it is at rest. We can see the solutions in the ES diagrams if we read them correctly: For instance, the two balls in the left ES diagram collide if $d_{i,\mathrm{r}} = d_{i,\mathrm{b}}$ $(i = 1, 2, 3)$ and if the same proper time has elapsed for both balls ($d_{4,\mathrm{r}} = d_{4,\mathrm{b}}'$). Here we must take into account that proper time flows in a unique direction for each ball.

5. Solving 15 Fundamental Mysteries of Physics

We recall: (1) An observer's reality is created by projecting ES orthogonally to his proper space and to his proper time. (2) There is a unique 4D vector $\boldsymbol{\tau}$ for each object. (3) Cosmic time t is the correct parameter for a holistic view. In Sects. 5.1 through 5.15, ER solves 15 mysteries and declares five concepts of today's physics obsolete.

5.1. Solving the Mystery of Time

Proper time τ is what clocks measure (d_4 divided by c). Cosmic time t is the total distance covered in ES divided by c. For each clock, its own proper time is always equal to cosmic time. An observed clock is slow in the observer's flow of proper time $\boldsymbol{\tau}$.

5.2. Solving the Mystery of Time's Arrow

The arrow of time is a synonym for "time moving only forward". The arrow of cosmic time emerges from the fact that the total distance covered in ES is steadily increasing.

5.3. Solving the Mystery of the Factor c^2 in mc^2

In SR, if forces are absent, the total energy E of an object is given by

$$E = \gamma mc^2 = E_{\mathrm{kin,3D}} + mc^2 , \tag{17}$$

where $E_{\mathrm{kin,3D}}$ is its kinetic energy in an observer's 3D space and mc^2 is its energy at rest. SR does not tell us why there is a factor c^2 in the energy of objects that in SR do not move at the speed c. ER provides the missing clue: The object is never at rest, but it moves in its d_4' axis. From its perspective, $E_{\mathrm{kin,3D}}$ is zero and mc^2 is its kinetic (!) energy in d_4'. The factor c^2 is a hint that it moves through ES at the speed c. In SR, there is also

$$E^2 = p^2 c^2 = p_{3\mathrm{D}}^2 c^2 + m^2 c^4 , \tag{18}$$

where p is the total momentum of an object and $p_{3\mathrm{D}}$ is its momentum in an observer's 3D space. Again, ER is eye-opening: From its perspective, $p_{3\mathrm{D}}$ is zero and mc is its momentum in d_4'. The factor c is a hint that it moves through ES at the speed c.

5.4. Solving the Mystery of Length Contraction and Time Dilation

In SR, length contraction and time dilation can be derived from the Lorentz transformation, but their physical cause remains in the dark. ER discloses that length contraction and time dilation stem from projecting ES to an observer's reality.

5.5. Solving the Mystery of Gravitational Time Dilation

In GR, gravitational time dilation stems from a curved spacetime. ER discloses that gravitational time dilation stems from projecting curved geodesics in flat ES to the d_4 axis of an observer. Eq. (7) tells us: *If an object accelerates in his proper space, it automatically decelerates in his proper time.* Curved geodesics in flat ES replace curved spacetime in GR. More studies will be necessary to understand other gravitational effects in ER.

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5.6. Solving the Mystery of the Cosmic Microwave Background

In this section, I outline an ER-based model of cosmology. There is no need to create ES. Distances exist like numbers. For some reason, there was a Big Bang. In the GR-based Lambda-CDM model, the Big Bang occurred "everywhere" because space inflated from a singularity. In the ER-based model, we can locate the Big Bang: It injected a huge amount of energy into a *non-inflating* and *non-expanding* ES all at once at what I call "origin O", the only natural reference point. The Big Bang occurred at the cosmic time $t = 0$ and was a singularity in terms of providing energy and radial momentum. Initially, all this energy receded radially from O at the speed c. Because of physical interactions (scattering, transversal acceleration, spontaneous emission), some energy departed from its radial motion. Today, all energy is confined to a *4D hypersphere* expanding in ES, while a lot of energy is confined to its *3D hypersurface*. Be aware that only three axes of ES are spatial.

Shortly after the Big Bang, energy was highly concentrated in ES. In the projection to any 3D space, a very hot and dense plasma was created. While the plasma was expanding, it cooled down. Cosmic recombination radiation (CRR) was emitted that we still observe as cosmic microwave background (CMB) today (Penzias & Wilson, 1965). At temperatures of 3,000 K, hydrogen atoms formed. The universe became increasingly transparent for the CRR. In the Lambda-CDM model, this stage was reached about 380,000 years "after" the Big Bang. In the ER-based model, these are 380,000 light years "away from" the Big Bang. The number needs to be recalculated if there was no cosmic inflation.

In the ES diagrams shown in Fig. 5, Earth moves vertically at the speed c. The ER-based model must be able to answer these questions: (1) Why do we still observe the CMB today? (2) Why is the CMB nearly isotropic? (3) Why is the temperature of the CMB very low? Here are some possible answers: (1) The CRR has been scattered multiple times in d_1, d_2, d_3. Some of the scattered CRR reaches an observer on Earth as CMB (in the projection to his 3D space) after having covered the same distance in d_1, d_2, d_3 as Earth in d_4. The cross section for scattering is low, but the fluence of the CRR is high. (2) The CMB is nearly isotropic because the CRR was created and scattered equally in d_1, d_2, d_3. (3) The temperature of the CMB is very low because the plasma particles had a very high recession speed v_{3D} (see Sect. 5.7) shortly after the Big Bang.

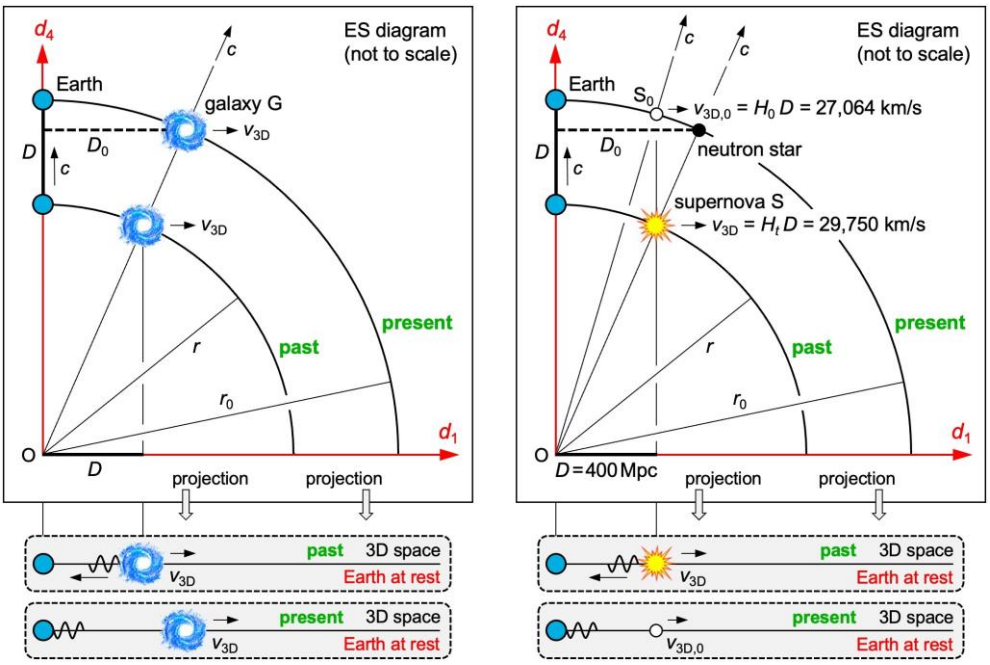

Fig. 5 Solving the mysteries 5.6, 5.7, 5.10, and 5.11. The circular arcs are part of an expanding 3D hypersurface. **Left:** The galaxy G recedes from Earth at the 3D speed v_{3D}. **Right:** The supernova of a star S occurred at a distance of $D = 400$ Mpc from Earth. If another star S_0 happens to be at the same distance D today, S_0 recedes more slowly from Earth than S

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5.7. Solving the Mystery of the Hubble–Lemaître law

According to my first postulate, all celestial bodies move through ES at the speed c. Let v_{3D} be the 3D speed at which a galaxy G recedes from Earth in 3D space. Fig. 5 left tells us: At the cosmic time t (the time elapsed since the Big Bang), v_{3D} relates to the 3D distance D of G to Earth as c relates to the radius r of the 4D hypersphere.

$$v_{3D} = Dc/r = H_t D , \tag{19}$$

where $H_t = c/r = 1/t$ is the Hubble parameter. If we observe G today at the cosmic time $t = t_0$, the recession speed v_{3D} and c remain unchanged. Thus, Eq. (19) turns into

$$v_{3D} = D_0 c/r_0 = H_0 D_0 , \tag{20}$$

where D_0 is today's 3D distance of G to Earth, r_0 is today's radius of the 4D hypersphere, and $H_0 = c/r_0 = 1/t_0$ is the Hubble constant. Eq. (20) is the Hubble–Lemaître law (Hubble, 1929; Lemaître, 1927): *The farther a galaxy is, the faster it recedes from Earth.* Cosmologists are aware that H_t is a parameter. They are not yet aware of the 4D Euclidean geometry shown in Fig. 5 left. Only ER tells us that Eqs. (19) and (20) stem from this simple geometry and that we must consider $D_0 = r_0 D/r$ in Eq. (20) rather than D.

5.8. Solving the Mystery of the Flat Universe

For each observer, ES is projected orthogonally to his proper space and to his proper time. Thus, he experiences two seemingly discrete structures: flat 3D space and time.

5.9. Solving the Mystery of Cosmic Inflation

Most cosmologists believe that an inflation of space shortly after the Big Bang (Linde, 1990; Guth, 1997) would explain the isotropic CMB, the flatness of the universe, and large-scale structures (inflated from quantum fluctuations). I just showed that ER explains the first two effects. ER also explains the third effect if the impacts of the quantum fluctuations have been expanding at the speed c. ***In ER, cosmic inflation is an obsolete concept.***

5.10. Solving the Mystery of the Hubble Tension

There are various methods for calculating H_0. I explain why the calculated values do not match (also known as the "Hubble tension"). I compare CMB measurements (Planck space telescope) with distance ladder measurements (Hubble space telescope). According to team A (Aghanim et al., 2020), there is $H_0 = 67.66 \pm 0.42$ km/s/Mpc. According to team B (Riess et al., 2018), there is $H_0 = 73.52 \pm 1.62$ km/s/Mpc. Team B made efforts to minimize the error margins in the distance measurements, but assuming a wrong cause of the redshifts gives rise to a systematic error in team B's calculation of H_0.

Let us assume that team A's value of H_0 is correct. We simulate the supernova of a star S that occurred at a distance of $D = 400$ Mpc from Earth (Fig. 5 right). The recession speed v_{3D} of S is calculated from measured redshifts. The redshift parameter $z = \Delta\lambda/\lambda$ tells us how each wavelength λ of the supernova's light is either *passively stretched* by an expanding space (team B)—or else how each wavelength λ is redshifted by the Doppler effect of *actively receding* objects (ER-based model). The supernova occurred at the cosmic time t (arc called "past"), but we observe the supernova at the cosmic time t_0 (arc called "present"). While the supernova's light was moving the distance D in the d_1 axis, Earth moved the same distance D but in the d_4 axis (first postulate). Thus, team B receives redshift data from a cosmic time $t < t_0$ when there was $r < r_0$ and $H_t > H_0$. There is

$$1/H_t = r/c = (r_0 - D)/c = 1/H_0 - D/c . \tag{21}$$

For a very short distance of $D = 400$ kpc, Eq. (21) tells us that H_t deviates from H_0 by just 0.009 percent. However, when plotting v_{3D} versus D for distances from 0 Mpc to

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500 Mpc in steps of 25 Mpc (red points in Fig. 6), the slope of a straight-line fit through the origin is roughly 10 percent greater than H_0. Since team B calculates H_0 from similar plots (magnitude versus z), its value of H_0 is roughly 10 percent too high. *This solves the Hubble tension.* Team B's value is not correct because, according to Eq. (20), we must not plot v_{3D} versus D. We must plot v_{3D} versus D_0 (blue points in Fig. 6) to get a straight line.

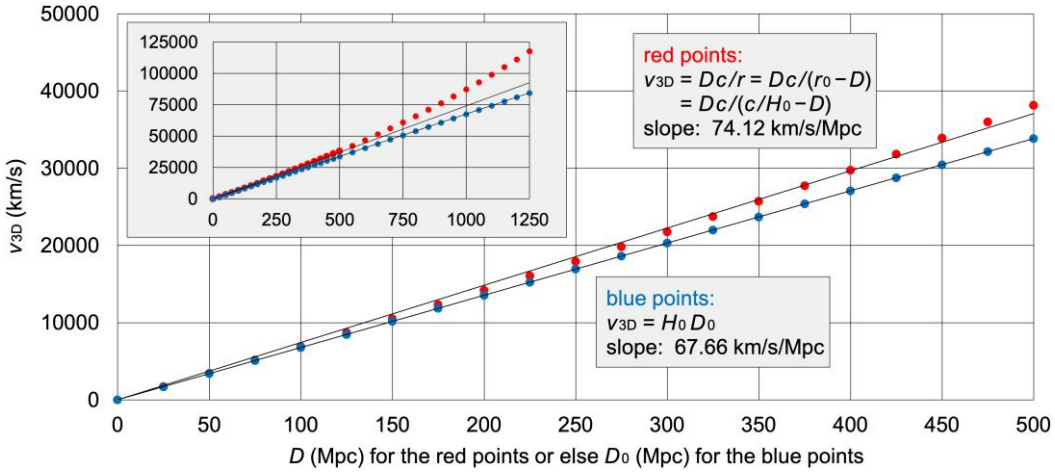

Fig. 6 Hubble diagram for simulated supernovae at distances up to 1250 Mpc. The horizontal axis is D or else D_0. Only Eq. (20) yields a straight line. Eq. (19) does not because H_t is not a constant

Since we are not able to measure D_0 (observable magnitudes relate to D rather than to D_0), the easiest way to fix the calculation of team B is to rewrite Eq. (20) as

$$v_{3D,0} = D\,c/r_0 = H_0\,D\ , \tag{22}$$

where $v_{3D,0}$ is today's 3D speed of another star S_0 (Fig. 5 right) that happens to be at the same distance D today at which the supernova of star S occurred. I kindly ask team B to recalculate H_0 after converting all v_{3D} to $v_{3D,0}$. Eq. (21) tells us how to do so.

$$H_t = H_0\,c\,/\,(c - H_0\,D) = H_0\,/\,(1 - v_{3D,0}/c)\ , \tag{23}$$

$$v_{3D,0} = v_{3D}\,/\,(1 + v_{3D}/c)\ . \tag{24}$$

By applying Eq. (24), all red points in Fig. 6 drop down to the points marked in blue. Of course, team B is well aware that the supernova's light was emitted in the past, but all that counts in the Lambda-CDM model is the timespan during which the light is moving to Earth. Along the way, each wavelength is continuously stretched by expanding space. The parameter z increases during the journey. In the ER-based model, all that counts is the moment when the supernova occurred. Each wavelength is initially redshifted by the Doppler effect. The parameter z remains constant during the journey: It is tied up when the supernova occurs. Space is not expanding. A 3D hypersurface made up of energy (!) is receding in ES. ***In ER, expansion of space is an obsolete concept.***

5.11. Solving the Mystery of Dark Energy

Team B can fix the systematic error in its calculation of H_0 by converting all v_{3D} to $v_{3D,0}$ according to Eq. (24). I now reveal another systematic error, but it is inherent in the Lambda-CDM model itself. It stems from assuming an accelerating expansion of space. It can be fixed only by replacing GR with ER unless we insist on the existence of dark energy. Perlmutter et al. (1998) and Riess et al. (1998) advocate an accelerating expansion of space because the calculated recession speeds deviate from Eq. (20) and the deviations increase with distance. An acceleration would stretch each wavelength even further.

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In ER, these deviations are much easier to understand: The older the redshift data are, the more H_t deviates from H_0, and the more v_{3D} deviates from $v_{3D,0}$. If another star S_0 (Fig. 5 right) happens to be at the same distance of $D = 400$ Mpc today at which the supernova of star S occurred, Eq. (24) tells us that S_0 recedes more slowly (27,064 km/s) from Earth than S (29,750 km/s). As long as cosmologists are not aware of the 4D Euclidean geometry, they attribute the deviations from Eq. (20) to an accelerating expansion of space caused by dark energy, but dark energy has never been observed. It is a stopgap for an effect that the Lambda-CDM model cannot explain.

For $D > 500$ Mpc, the data marked red in Fig. 6 run away from any straight line. The Hubble tension and dark energy are solved with the same clue: In Eq. (20), we must not confuse D_0 with D. The parameter $H_t = c/(r_0 - D)$ in Eq. (19) helps us understand the illusion of an accelerating expansion: The recession speed v_{3D} is not proportional to D but to $D/(r_0 - D)$. Any expansion of space—uniform or else accelerating—is only virtual. There is no accelerating expansion of space even if the Nobel Prize in Physics 2011 was given "for the discovery of the accelerating expansion of the Universe through observations of distant supernovae" (The Nobel Foundation, 2011). There are two misconceptions in these words of praise: (1) The term "Universe" in the Lambda-CDM model does imply space, but space is *not expanding at all.* (2) There is receding energy, but it recedes *uniformly.* ***In ER, dark energy is an obsolete concept.***

Radial momentum provided by the Big Bang drives all galaxies away from the origin O of ES. They are driven by themselves rather than by dark energy. Table 1 compares two models of cosmology. Be aware that "Universe" (uppercase) in the Lambda-CDM model is not the same as "universe" (lowercase) in the ER-based model. In the next two sections, I show that ER is compatible with QM. Since quantum gravity is meant to make GR compatible with QM, I also conclude: ***In ER, quantum gravity is an obsolete concept.***

Lambda-CDM model based on GR	Model of cosmology based on ER
The Big Bang was the beginning of the Universe.	The Big Bang was an injection of energy into ES.
The Big Bang occurred "everywhere".	The Big Bang can be localized (origin O of ES).
There are two competing values of H_0.	H_0 is approximately 67–68 km/s/Mpc.
The Universe: all space, all time, and all energy.	The universe: proper space of an observer.
Space is inflating and expanding.	Galaxies are receding radially in ES.
Space is driven by dark energy.	Galaxies are driven by radial momentum.
Spacetime is curved.	Trajectories of objects are curved in ES.
Time is what I read on my clock.	Time is distance covered in ES divided by c.
GR is not compatible with quantum mechanics.	ER is compatible with quantum mechanics.

Table 1 Comparing the Lambda-CDM model with the ER-based model of cosmology

5.12. Solving the Mystery of the Wave–Particle Duality

The wave–particle duality was first discussed by Bohr and Heisenberg (Heisenberg, 1969) and has bothered physicists ever since. Electromagnetic waves are oscillations of an electromagnetic field, which propagate through an observer's 3D space at the speed c. In some experiments, objects behave like waves. In other experiments, the very same objects behave like particles (also known as the "wave–particle duality"). In today's physics, one object cannot be wave and particle at once because waves distribute energy in space over time, while the energy of particles is localized in space at a given time.

Up next, we solve the duality. All we need is ER and a generalized concept of energy: *All energy is "wavematter", which may appear as a wave packet or as a particle depending on the perspective.* In an observer's reality (external view, Fig. 7), a wavematter may appear as a wave packet or as a particle. As a wave, it propagates in his x_1 axis at the speed c and it oscillates in his axes x_2 (electric field) and x_3 (magnetic field). Propagating and oscillating occur as a function of coordinate time t. In its own reality (internal or in-flight view), the axis of the wavematter's 4D motion disappears because of length contraction at the

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speed c. It deems itself particle at rest. Be aware that "wavematter" is not just a new word for the duality. It takes into account that there is an internal view of photons. There is no such view in SR/GR because four dimensions are required that are treated the same.

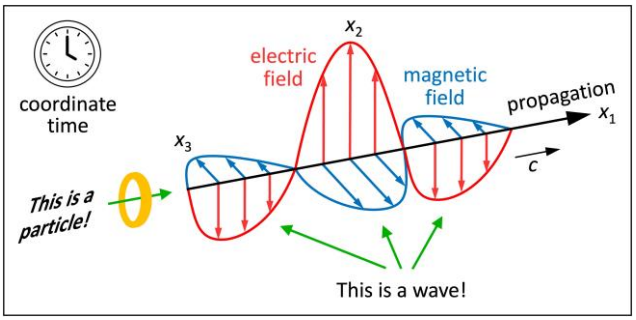

Fig. 7 Illustration of a wavematter. In an observer's reality (external view, coordinate spacetime!), a wavematter may appear as a wave packet or as a particle. As a wave, it propagates and oscillates as a function of coordinate time. In its own reality (internal view), the axis of the wavematter's 4D motion disappears because of length contraction at the speed c. It deems itself particle at rest

Like coordinate space and coordinate time, waves and particles are subjective concepts construed by an observer: *What I deem wave, deems itself particle at rest.* Albert Einstein (1905c) taught that energy is equivalent to mass. The equivalence shows itself in the wave–particle duality: Since each wavematter moves through ES at the speed c, the axis of its 4D motion disappears for itself. From its perspective (that is, in its own reality), all of its energy "condenses" to what we call "mass" in a particle at rest.

In a double-slit experiment, wavematters pass through a double-slit and produce an interference pattern on a screen. An observer deems them wave packets as long as he does not track through which slit each wavematter is passing. Here the external view applies. The photoelectric effect is different. Of course, one can externally witness how one photon releases an electron from a metal surface. However, the physical effect—do I have enough energy to release an electron?—is all up to the photon. Here its internal view applies. Only if the photon energy exceeds the binding energy of an electron is this electron released. In this case, both wavematters behave like particles.

The duality is also observed in matter, such as electrons (Jönsson, 1961). An electron is a wavematter too. From the external view (if the electron is not tracked), it behaves like a wave. From the internal view (if the electron is tracked), it behaves like a particle: Which slit will it pass through? Since an observer automatically tracks all objects that are slow in his 3D space, he deems macroscopic objects matter rather than waves. All material objects in my ES diagrams are actually wavematters that are projected to material objects.

5.13. Solving the Mystery of Non-Locality

The term "entanglement" was coined by Schrödinger (1935) in his comment on the Einstein–Podolsky–Rosen paradox (Einstein et al., 1935). These three authors argued that QM would not provide a complete description of reality. Schrödinger's word creation did not solve the paradox but demonstrates our difficulties in comprehending QM. Bell (1964) showed that local hidden-variable theories are not compatible with QM. In experiments (Freedman & Clauser, 1972; Aspect et al., 1982; Bouwmeester et al., 1997), entanglement violates locality. Ever since, entanglement has been considered a non-local effect.

Up next, we untangle entanglement without the concept of non-locality. All we need is ER: *Four dimensions that are treated the same make non-locality obsolete.* Fig. 8 illustrates two wavematters that were created at once at a point P. They move away from each other in opposite directions $\pm d_4'$ at the speed c. It turns out that these wavematters are automatically entangled. For an observer moving in any direction other than $\pm d_4'$ (external view), the two wavematters are spatially separated objects. The observer cannot understand how they are able to communicate with each other in no time.

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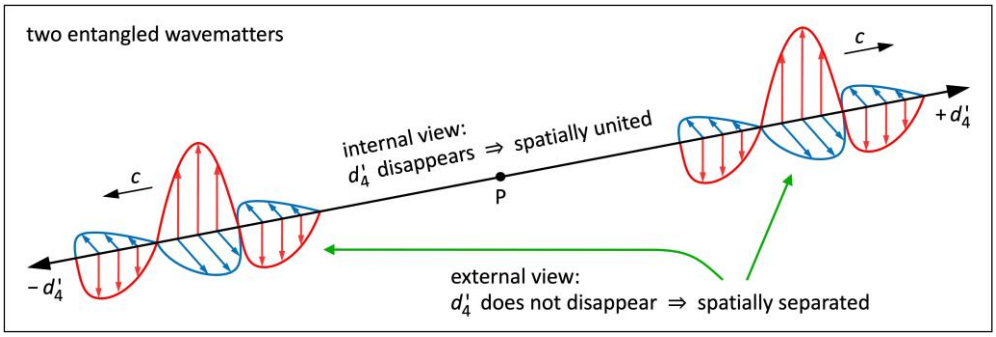

Fig. 8 Two wavematters moving in $\pm d_4'$ are spatially separated objects for an observer who moves in any direction other than $\pm d_4'$ (external view). For each wavematter (internal view), the $\pm d_4'$ axis disappears. In their common proper space, both wavematters are spatially united

For each wavematter (internal view), the $\pm d_4'$ axis disappears because of length contraction at the speed c. In their common (!) proper space spanned by d_1', d_2', d_3', either of them is at the same position as its twin. From the internal view, the twins have never been separated, *but their proper time flows in opposite 4D directions.* The twins communicate with each other in no time because they remain spatially united in their proper space. There is a "spooky action at a distance" from the external view only. Entanglement occurs because an observer's proper space may be different from an observed object's proper space. This is possible only if four dimensions are treated the same. ER also explains the entanglement of electrons or atoms. In an observer's proper space, they move at a speed $v_{3D} < c$. In their $\pm d_4'$ axis, they move at the speed c. Any measurement tilts the axis of 4D motion of one twin and destroys the entanglement. ***In ER, non-locality is an obsolete concept.***

5.14. Solving the Mystery of Spontaneous Effects

In *spontaneous emission,* a photon is emitted by an excited atom. Prior to the emission, the photon energy moves with the atom. After the emission, this energy moves by itself. Today's physics cannot explain how this energy is boosted to the speed c in no time. In ES, both atom and photon move at the speed c. Thus, there is no need to boost any energy to the speed c. All it takes is energy whose 4D motion at the speed c rotates completely into an observer's 3D space. In *absorption,* a photon is spontaneously absorbed by an atom. Today's physics cannot explain how this energy is slowed down to the atom's speed in no time. In ES, both photon and atom move at the speed c. Thus, there is no need to slow down any energy. Similar arguments apply to pair production and annihilation. Spontaneous effects are another clue that all energy moves through ES at the speed c.

5.15. Solving the Mystery of the Baryon Asymmetry

In the Lambda-CDM model, almost all matter was created shortly after the Big Bang. Only then was the temperature high enough to enable pair production. However, baryons and antibaryons should have annihilated each other again because the energy density was also very high. Since we observe more baryons than antibaryons today (also known as the "baryon asymmetry"), it is assumed that more baryons were created shortly after the Big Bang (Canetti et al., 2012) even if each pair production should create one pair.

ER tells us a different story: Since each wavematter deems itself particle at rest, the Big Bang injected a huge number of particles into ES. *Thus, the baryon asymmetry was caused by the Big Bang.* Antiparticles are created in pair production only. This process has no effect on the baryon asymmetry. But why do wavematters not deem themselves antiparticles? Well, antiparticles are not the opposite of particles. They have the opposite electric charge and seem to flow backward in time because proper time flows in opposite 4D directions for wavematters created in pair production. There is a reasonable character paradox: *What I deem antiparticle, deems itself particle.* Here is a possibility of how to falsify ER: According to ER, any two wavematters created in pair production should be entangled.

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6. Conclusions

ER solves mysteries that have not been solved in 100+ years or that have been solved but with concepts that are obsolete in ER: cosmic inflation, expansion of space, dark energy, quantum gravity, non-locality. Today's physics needs these concepts to make cosmology and QM work, but Occam's razor shaves them off. I advise physics to let go of all obsolete concepts by accepting ER. I demonstrated that waves and particles are subjective concepts construed by an observer. A master reality with wavematters (described by ER) is beyond each observer's reality with waves and particles (described by SR/GR). Electrodynamics is a theory of an observer's reality. It is not a theory of the master reality.

Unfortunately, most physicists consider SR/GR two of the greatest achievements of physics just because they have been confirmed many times over. I showed that SR/GR do not provide a holistic view, and I suspect that the stagnation in today's physics is due to this constraint. Physics got stuck in its own concepts. 15 solved mysteries tell us that there is a lot more physics beyond SR/GR. It is very unlikely that 15 solutions in various (!) fields of physics are just 15 coincidences. Only in 4D Euclidean spacetime does Mother Nature disclose her secrets. If we think of each observer's reality as an oversized stage, the key to understanding cosmology and QM is beyond the stage curtain.

It was a wise decision to award Albert Einstein the Nobel Prize for his theory of the photoelectric effect (Einstein, 1905a) and not for SR/GR. ER penetrates to a deeper level. Einstein—one of the most brilliant physicists ever—failed to realize that the fundamental metric chosen by Mother Nature is Euclidean. Nature chose a simple but beautiful setting for life: 4D Euclidean spacetime. Einstein sacrificed absolute space and time. I sacrifice the absoluteness of waves and particles, but I restore absolute, cosmic time. For the first time, mankind understands the nature of time: Cosmic time is the total distance covered in ES divided by c. *The human brain is able to imagine that we move through 4D Euclidean spacetime at the speed of light.* With that said, conflicts of mankind become all so small.

Is ER a physical or a metaphysical theory? This is a very good question because only in proper coordinates can we access ES, but the proper coordinates of other objects cannot be measured. Physics is the science of describing and modeling the universe and its interior. The source of knowledge is observing. However, an observer cannot describe nature objectively. *He always has a subjective perspective that may give rise to mysteries.* Unlike SR/GR, ER takes all perspectives into account at once. By taking the perspectives of the past and the present into account at once, ER solves the Hubble tension and dark energy. By taking the perspectives of the observer and the entangled objects into account at once, ER solves non-locality. ER explains what we observe. Thus, ER is a physical theory.

Final remarks: (1) I addressed gravitation only briefly, but I ask you once more to be patient and fair. We should not reject ER just because gravitational effects are not yet fully understood. It is promising that ER predicts the same gravitational lensing and the same perihelion precession of Mercury's orbit as GR (Montanus, 2023). (2) To cherish the beauty of ER, we must give ourselves a push and accept that an observer's reality is a projection. We must not ask in physics: Why is it a projection? Nor must we ask: Why is it a probability function? In my opinion, an inflating or expanding space is at least as speculative as a projection. (3) It looks like Plato was right with his *Allegory of the Cave* (see Politeia, 514a): Mankind experiences a projection that is blurred—because of QM.

It is not by chance that the author of this paper is an experimental physicist. It seems to me that SR and GR are not suspicious to theorists. Several prominent theorists told me that ER would be nonsense. I laid the groundwork for ER and showed how powerful it is. Paradoxes are only virtual. *The true pillars of physics are ER and QM.* Together, they describe the very large and the very small. Requesting a holistic view of nature is what I consider the most innovative part of this paper. Now everyone is welcome to solve even more mysteries in ER! May ER get the broad acceptance that it deserves.

Comments: It takes open-minded, courageous editors and reviewers to evaluate a theory that comes with a paradigm shift. Whoever adheres to established concepts is paralyzing the scientific progress. I did not surrender when my paper was rejected by several journals. Interestingly, I was never given

conclusive arguments. Rather, I was asked to try a different journal. Were the editors dazzled by the success of SR/GR? Did they underestimate the benefits of ER? Even friends refused to support me. However, each setback inspired me to work out the benefits of ER even better. Finally, I succeeded in disclosing an issue in SR/GR and in formulating a new theory that is even more general than GR. These comments shall encourage young scientists to stand up for promising ideas, but be aware that opposing the mainstream is exhausting. Here are some statements that I received from top journals: "Unscholarly research." "Fake science." "Too simple to be true." The editor-in-chief of a top journal replied: "Publishing is for experts only." A well-known preprint archive suspended my submission privileges. *Simple and true are not mutually exclusive. Beauty is when they go hand in hand.*

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