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FUNDAMENTALLY ANISOTROPIC LIGHT-VELOCITY AT THE FOUNDATION OF CLASSICAL PHYSICS

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"… any two clocks of [accelerated system] Σ are synchronous with respect to [nonaccelerated reference system] S at the time t = 0, and undergo the same motion, they remain continuously synchronous with respect to S.

On the other hand, we must not consider the [same-motion] local time σ as simply the "time" of Σ, because, in fact, two [clocks] at two different points of Σ are not [synchronous] in the sense of [special relativity] when their local times σ are equal to each other." Quotations in reversed order. (Albert Einstein, Principle of Relativity and Gravitation, 1907, p. 900)

ABSTRACT

While it is certainly true that Einstein's special and general theories of relativity are insightful and useful models of physical reality, they are interim theories destined to be contained within a deeper understanding. An examination of Einstein's 1907 essay *Principle of Relativity and Gravitation* reveals "same motion" acceleration within his "nonaccelerated reference system *S* " as the basis for an alternative transformation as foil or counterpoint to the standard Lorentz transformation. Using this alternative transformation − closely related to the recently substantiated optically-anisotropic *Selleri gauge* (Rizzi et al., 2008) − Einstein's *progressive time-shift* due to linear, first-order acceleration is re-derived at the deeper anisotropic level, thereby further validating the Selleri gauge. This same-motion transformation is again employed within Einstein's reference system *S* − but now in a *two-phase* procedure − to establish Selleri's optical anisotropy as a fundamental condition of space-time. Indeterminate space-time of relativistic-classical physics is also established in a similar (two-phase) procedure, by showing Schrödinger's cat to be (briefly) both alive and dead in the determination and conclusion of a removed observer. The traditional postulates—i.e., relativity principle and isotropic light-speed—are accordingly revised. These advances define a new *neoclassical paradigm* midway between the relativistic-classical and quantum-mechanical paradigms, and recommend *singularly* unbounded (i.e., one-way infinite) light-speed as the empirically-promoted basis for resolving the Bell-EPR impasse and ending the divide between classical physics and quantum theory. .

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(Rev 1 clarified the Schrödinger cat alive-and-dead discussion in Section 6.2; no changes in the mathematical development. Rev 2 changed the title and edited the Abstract and Conclusion. Rev 3 corrects a Section 3.2 misstatement (page 9)).
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1.0 Introduction

Notwithstanding Einstein's rejection of "spooky action at a distance", science has increasingly recognized space-time as, if not spooky, at least profoundly counter-intuitive. In addition to his conviction that quantum theory lacks realism—as Einstein put it, "God does not roll dice"—superluminal "influence" in quantum mechanics theory and experiment contradicts our long-standing belief in constant/invariant light-speed in vacuum. In the present work we introduce a new *neoclassical* paradigm that shifts relativity to a deeper level in much the same sense that relativity deepened Newtonian theory. More to the point, while orthodox relativity set aside absolute space and time in favor of relative simultaneity we will advance *absolute* simultaneity by promoting *fundamentally-anisotropic* light-speed—that is, superluminal photon speed in one direction and subluminal in the reverse direction—while complying with the *round-trip axiom*. We will additionally establish *indeterminate* space-time—where the conjunction of fundamentally unbounded light-speed and indeterminate space-time yields the deeper paradigm.

If we are to achieve the new paradigm, which resides between the relativistic-classical and quantum theories, it would be on the basis of a new consideration. This consideration emerges from Einstein's 1907 essay "Principle of Relativity and Gravitation" wherein he observes "any two clocks of [accelerated reference system] Σ are synchronous with respect to *S* at the time $t = 0$, and undergo the same motion, they remain continuously synchronous with respect to *S*." This is in reality an alternative Einstein-synchronization, which may be immediately seen: while same-motion acceleration preserves clock-synchronization, orthodox Einstein synchronization must be continually reset. This dichotomy at the basic level of relativity physics is the foundation for the present paper. It allows the conclusion that light-speed is (again) *fundamentally* anisotropic. And from this we may conclude, as will be shown herein, that not only is light-speed (one way) unbounded in non-quantum theory but space-time is indeterminate—two principal conclusions in the paper.

That light-speed is anisotropic in contrast to the optically-isotropic c=constant understanding has been effectively advanced by Rizzi et al. (2008) in "Synchronization Gauges and the Principles of Relativity". A most noteworthy observation therein is that the Lorentz gauge is but a "particular case" (Rizzi, p. 14) of the more comprehensive Selleri gauge (1994, 1998, 2004, 2008), where the latter, crucially, naturally accommodates anisotropic light-speed. Where the present work goes beyond this important contribution is by holding anisotropic light-speed to be <u>fundamental</u>, rather than simply a "conventional assumption" within "alternative formalisms of a unique physical theory" (i.e., special relativity theory) (Rizzi, p. 22). From this follows, as noted, the "unbounded" light-speed and indeterminate space-time conclusions.

Deepening relativity into a new paradigm is of course a "tall hurdle", in that it requires a deeper conception of an already profound subject. This consideration determined, to a significant degree, the scope of the material covered in the paper. As a particular, rather than go directly to Einstein's same-motion acceleration and from there to the neoclassical paradigm with the aim of "to the point" brevity, which may be judged possible, the alternative of adding-on explanatory treatments is chosen. Hence the sections on the (quite relevant) Selleri gauge and (also quite relevant) derivations of progressive time-shift, which can be defined as *remote-time divergence* effected or caused by acceleration. In later sections we will, for the same reasons, recall the Scheidl et al. Bell test (2010) and Schrödinger's cat (1935) to help both conceptualization of, and confidence in, the new paradigm.

In the following sections we first address classical relativity-physics with the primary intent of introducing and (further) substantiating the Selleri synchronization gauge. After defining the Selleri gauge and briefly discussing its mathematical and conceptual attributes, the development shows how anisotropic light-speed emerges within the Selleri gauge while complying with the round-trip axiom. Einstein's 1907 derivation of "progressive time-shift" is then reproduced at a more detailed level followed immediately by a repeat derivation employing the Selleri gauge instead of the Lorentz transformation, also within same-motion acceleration. These derivations, within which the two distinct modes of *same-motion transformation* are defined—one integral with the Lorentz transformation and the second with the Selleri gauge—promote, as its intent, the legitimacy of the Selleri gauge.

Having given these initial discussions in Sections 2.0 and 3.0 the paper proceeds to Section 4.0 defining the special-case *conformed (same-motion) transformation*—i.e., "conformed" because it exactly duplicates the original configuration. This transformation will then be employed in Sections 5.0 and 6.0 in developing the two principal conclusions of the paper—fundamentally unbounded light-speed and indeterminate space-time. The two developments in turn define the neoclassical paradigm midway between the relativistic-classical and quantum paradigms (Section 7.0). These several advances point to and recommend empirically supported *one-way infinite light-speed* for resolving the long-standing Bell-EPR conflict and closing the relativity-quantum theory divide.

2.0 Selleri versus Einstein Synchronization

Special relativity does not, of course, extinguish the possibility of anisotropic light-speed. After all, this space-time condition cannot be categorically dismissed inasmuch as the idea is not contrary <u>in any way</u> to the entire body of empirical relativity-physics. It is contrary to orthodox relativity theory, but here we may keep in mind that relativity, emergent itself from scientific progress, must eventually be integrated within a deeper theory.

Notwithstanding this valid consideration isotropic light-speed has held firm, and for the good reason Einstein stated over eighty years ago:

> "The basic concepts and laws which are not logically further reducible constitute the indispensable and not rationally deducible part of the theory. It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience." (Einstein, 1934)

Nevertheless, highly important theoretical and experimental developments over the past fifty years—e.g., Bell's inequality rule (1964), and the growing number of follow-on quantum mechanical tests—call for reassessment. A proper place to begin is with the Selleri synchronization gauge, which has a more general validity than the Lorentz gauge due to its inherent or natural recognition of light-speed anisotropy.

2.1 Selleri Synchronization Gauge

One way to define and discuss the Selleri gauge is to directly address its departure from the Lorentz transformation. This may be resolved into two parts—mathematical and conceptual:[1]

Mathematical. The mathematical difference and its significance become evident when "time shift" in the time equation is set to zero. In showing this we start with the Lorentz transformation—where the nomenclature text-box is inserted next to transformations to minimize confusion:[2]

x,y,z,t	Einstein's "Nonaccelerated Reference System S "
x',y',z',t'	Einstein's "Nonaccelerated Reference System S' "

$$\begin{cases} x' = (x - \beta ct)/\gamma \\ t' = (t - (\beta/c)\, x)/\gamma \\ y' = y \\ z' = z \end{cases} \tag{1}$$

with $\beta = v/c$ and $\gamma = (1 - \beta^2)^{1/2}$. After substituting x from $(1)_1$ into $(1)_2$ and some revisions using the Lorentz factor we obtain

$$t' = \gamma t - (\beta/c\gamma)(x - \beta ct) \tag{2}$$

where $(\beta/c\gamma)(x - \beta ct)$ is the abovementioned time shift. Setting $-\beta/c\gamma \rightarrow e_1(\beta)$ gives the Selleri synchronization gauge:

x,y,z,t	Einstein's "Nonaccelerated Reference System S "
x_S,y_S,z_S,t_S	Selleri's Nonaccelerated Reference System S_S

$$\begin{cases} x_S = (x - \beta ct)/\gamma \\ t_S = \gamma t + e_1(\beta)(x - \beta ct) \\ y_S = y \\ z_S = z \end{cases} \tag{3}$$

where $e_1(\beta)$ is the "Selleri synchronization parameter". Notice that the moving system designation is changed from S' to S_S with coordinates x',y',z',t' changed to x_S,y_S,z_S,t_S. Both systems, however, have the same optically-isotropic base-system, $S{:}x,y,z,t$.

It may be judged remarkable that despite the profound *mathematical* difference between the two gauges they are equally compliant with all empirical challenges to date (Rizzi, p. 22). There are, however, quite salient *conceptual* differences.

Conceptual. Absolute synchrony of events irrespective of reference system may be considered the *signature condition* of the Selleri gauge, where simultaneity of events is a *relative condition* in orthodox theory.

Essentially tied to absolute simultaneity are the corresponding relativistic length and time transformations. Here again we see profound differences. Contrary to the consistency of time slow-down and length contraction made by relatively moving observers when both choose

[1] Since Einstein's 1907 paper is the foundation for the present contribution, and in the interest of minimizing confusion, we typically employ his nomenclature when possible and appropriate.
[2] Einstein used the phrase "reference system" in his 1907 essay while the modern phrase "reference frame" is typically employed. With the purpose of avoiding confusion over even minor considerations we will employ Einstein's wording.

Einstein synchronization, the second *relatively-moving* observer, when using Selleri synchronization, obtains reversed measurements. In particular, the moving observer measures time speed-up (i.e., of at-rest clocks in the stationary/base system) and length extension.

Here we may note, as an important point germane to the developments in this paper, that the measurements within the Selleri gauge by the two observers moving past each other are consistent—that is, the two observers agree that standard time is slower and standard length is shorter in the "moving" (i.e., assumed non-stationary) reference frame. These conclusions of course defy our standard or orthodox relativistic-classical understanding of the world, and suggest, or point to, a deeper understanding. We have not yet, however, arrived at the deeper understanding—this step is taken when we recognize *same-motion synchronization* advanced by Einstein in his 1907 essay.

2.2 Anisotropic Light-speed

The first step in introducing the neoclassical paradigm is to recognize anisotropic light-speed as mathematically germane within relativity physics.[3] Anticipating the round-trip axiom we first write

$$\Delta t_S = \Delta t^F{}_S + \Delta t^R{}_S$$

for the round-trip elapsed time Δt_S for a photon to fly from point A to point B along the x_S-axis and back. In this expression $\Delta t^F{}_S$ is the elapsed photon-flight time from A to B in Selleri-system S_S and $\Delta t^R{}_S$ is the elapsed time from B to A. Substituting for $\Delta t^F{}_S$ and $\Delta t^R{}_S$ using (2) allows:

PHOTON DIRECTION: **FORWARD** **REVERSE**

x,y,z,t Einstein's "Nonaccelerated Reference System S"

Δt_S Selleri's "Nonaccelerated Reference System S_S"

$$\left\{\begin{aligned} \Delta t_S &= \overbrace{\gamma\Delta t^F + e_1(\beta)\,\Delta x}^{} + \overbrace{\gamma\Delta t^R - e_1(\beta)\,\Delta x}^{} \\ &= \gamma\Delta x/(c-v) + e_1(\beta)\Delta x + \gamma\Delta x/(c+v) - e_1(\beta)\,\Delta x \\ &= \Delta x/[c/(1+\beta)] + \Delta x/[c/(1-\beta)] \end{aligned}\right. \qquad (4)$$

after some algebra. Notice that the synchronization terms "$e_1(\beta)\Delta x$" and "$-e_1(\beta)\Delta x$" cancel out, while the terms simply disappear when the Selleri parameter $e_1(\beta)$ is set to zero.

The light-speed components along the x_S-axis *for the anisotropic condition* are immediately evident in (4) by inspection:

$$c^+{}_S = c/(1+\beta) \qquad (5)$$

in the positive-x direction and

$$c^-{}_S = c/(1-\beta) \qquad (6)$$

in the negative-x direction.[4] The corresponding forward and reverse elapsed times are "$(1+\beta)\Delta x/c$" and "$(1-\beta)\Delta x/c$", which add to $2\Delta x/c$ after cancellation of the beta terms.[5] Photon round-trip elapsed time between A and B is accordingly invariant—this being of course the round-trip axiom.

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[3] Rizzi et al. provide a more substantive treatment in their 2008 paper.

[4] In the general condition, $\underline{c}(\theta)=c/(1+\beta\cos\theta)$ where θ is the angular displacement of the photon velocity from the x-axis. (See Rizzi 2008, p. 20 Eq. (9).)

3.0 Progressive Time-Shift

Progressive time shift of a clock positioned "higher than" another in an acceleration field may be compared to time dilation of a clock moving relativistically past a stationary clock. In the former case the seconds of the "higher" clock tick faster as measured by an observer "lower" in the field, and in the latter case the seconds of the moving clock tick slower as measured by an observer at rest in the stationary system. As indicated in the foregoing section, the latter time-dilation is predicted by both the Selleri and Lorentz gauges, despite their profoundly different mathematical and conceptual attributes. And the two gauges also predict the same progressive time-shift within a given acceleration field, as will be demonstrated below.

This two-fold compatibility between the two gauges supports Rizzi et al. in their conclusion that the Selleri gauge (as one of numerous transformations) is "wholly equivalent to SRT in predicting empirical facts" (Rizzi, p. 1; emphasis added)—a correct conclusion until we recognize Einstein's same-motion synchronization. Then, as shown by way of Gedankenexperiments later in the paper, certain (telescopically-inferred) "empirical evidences" are revealed which go beyond the received "empirical facts". In particular, different remote-clock states or "face-times" depending on synchronization choice following same-motion acceleration are revealed. But before performing these (thought) experiments we first derive Einstein's progressive time-shift (employing the Lorentz gauge) following his original approach (with more detail) and, secondly, employing his same-motion accelerating system Σ with its integral or inherent Selleri gauge.

3.1 Einstein's Progressive Time-Shift Derivation (In Greater Detail)

Einstein imposed a number of conditions in his derivation and we will carry all forward in the present re-derivation—the reader is invited to read Einstein's 1907 essay, Part III, for the complete development.

Following Einstein we first define his "…reference system Σ which is uniformly accelerated relative to the nonaccelerated reference system *S* in the direction of the x axis of the latter.":

x,y,z,t Einstein's "Nonaccelerated Reference System *S*"

ξ,η,ζ,σ Einstein's Same-Motion "Reference System Σ" ($t \geq 0$)

$$\begin{cases} \xi = (x - \beta ct)/\gamma = X/\gamma \\ \sigma = \gamma t + f(t) \\ \eta = y \\ \zeta = z \end{cases} \qquad (7)$$

where we see $x{-}\beta ct$ is replaced by *acceleration-independent* X, as required by the physics and mathematics of same-motion acceleration. Note also that the function $f(t)$ is appended to the time equation. This is necessary to account for the *time-history* of the same-motion acceleration, the effect of which is to alter the σ versus t relationship from the direct $\sigma{=}\gamma t$. ...We may further note at this point that

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[5] Beta=0.99 is a particular case that provides a sense or feeling for light-speed magnitudes in the forward and reverse directions. For this case, forward and reverse photon speeds along the x_S-axis are 0.5025c (Approx.) and −100c, respectively.

(7) is an alternative transformation as foil or counterpoint to the standard Lorentz transformation, which alternative we may name the (Einstein) "same-motion transformation".

Here it is important to state that Einstein did not explicitly define Σ in its same-motion acceleration relative to S as shown above, but did so indirectly, by way of "If a point-event … has the coordinates ξ,η,ζ with respect to Σ" and "…the readings of the clocks of Σ so set, shall be called the "local time" σ of the system Σ." Notice also that the time-shift term "$-(\beta/c)X/\gamma$" is absent in order to comply with Einstein's principle that "any two clocks of [accelerated system] Σ are synchronous with respect to S at the time $t = 0$, and undergo the same motion, they remain continuously synchronous with respect to S." And, as noted above, the function $f(t)$ is appended in $(7)_2$ to account for time-shift attending the specific history of same-motion acceleration.

Next we define Einstein's non-accelerated reference system S', in accordance with: "There exists at every instant a nonaccelerated reference system S', whose coordinate axes $[x',y',z']$ coincide with the coordinate axes [ξ,η,ζ] of Σ." This definition is incomplete since the time coordinate has not been addressed, and S' accordingly remains optically-anisotropic. An intermediate step is required.

In taking this intermediate step we recognize Einstein's assuming that S' is optically-isotropic—in accordance with the constant speed-of-light principle. This adapts (7) into a corresponding optically-isotropic same-motion system, also relative to S, which we will call Σ_E:

x,y,z,t	Einstein's "Nonaccelerated Reference System S "	
$\xi_E,\eta_E,\zeta_E,\sigma_E$	Same-Motion Accelerated System Σ_E (t≥0)	

$$\begin{cases} \xi_E = X/\gamma \\ \sigma_E = \gamma t + (\beta/c)X/\gamma + f(t) \\ \eta_E = y \\ \zeta_E = z \end{cases} \tag{8}$$

where we see that the time-shift term "$(\beta/c)X/\gamma$" is *added* to $(7)_2$ because all same-motion clocks along the ξ=axis rise above the now orthodox-synchronous ξ-axis (as determined by an observer co-moving with the origin of Σ_E) during acceleration. Non-accelerated reference system S' is implicit in (8) by way of its instantaneous congruence with Σ_E: $\xi_E,\eta_E,\zeta_E,\sigma_E$ at one point during the same-motion acceleration.

Einstein then made what we may conclude is an unnecessary statement: "Let us imagine further that at this time t' of S' the clocks of $[\Sigma_E]$ are so adjusted that their reading at this instant is t'." The reason why this statement is unnecessary is that he subsequently stipulated: "We restrict ourselves … to the consideration of such short times, that all terms containing second or higher powers of $[\sigma_E]$ and [velocity] v can be discarded." This in effect *reverses* the progressive time-shift that occurred during same-motion acceleration of Einstein's "reference system Σ" in his "nonaccelerated reference system S", thereby placing all same-motion clocks at t=0 on the x and ξ axes. In other words, we're back to t=0 in the same-motion acceleration of Σ with respect to S except that instead of optically-anisotropic Σ being same-motion accelerated it is now optically-isotropic Σ_E that is same-motion accelerated. Here we may conclude that the point of the entire exercise was to (in effect) arrive at an optically-isotropic (c=constant) system wherein (what I've termed) progressive time-shift becomes mathematically evident during same-motion acceleration with respect to S.

Having formulated Einstein's optically-anisotropic accelerated "reference system Σ" and defined the new *optically-isotropic* same-motion accelerated reference system Σ_E we may proceed with duplicating Einstein's derivation of progressive time-shift. On the basis of "We restrict ourselves … to the consideration of such short times, that all terms containing second or higher powers of [σ_E] and [velocity] v can be discarded" we may employ (8) to express the (infinitesimal) degree of time-shift $\Delta\sigma_E$ at ξ=X as

$$\Delta\sigma_E = \sigma_E(X,0,0, \delta t) - \sigma_E(0,0,0,\delta t)$$
$$= (\beta/c)X$$

where δt has been substituted for t in recognition of the first-order restriction. Performing the time-derivative—remembering that body shape does not change, i.e. X is invariant (to first order)—yields the Einstein relation for progressive time-shift

$$\mathrm{d}(\Delta\sigma_E)/\mathrm{d}t = aX/c^2$$
$$= a\xi/c^2 \tag{9}$$

that is, the *additional* rate at which time advances relative to an observer at the origin, ξ=0, is proportional to the magnitude of acceleration in product with the distance forward along the axis of acceleration divided by nominal light-speed squared.

We may conclude that Einstein was mistaken in retaining the original same-motion system Σ designation while verbalizing his development and also in "Let us imagine further that at this time t' of S' the clocks of [Σ_E] are so adjusted that their reading at this instant is t'", and the above has provided a resolution. These errors did not affect or diminish his result for the progressive time-shift.

In the next section we again derive Einstein's progressive time-shift relation—but this time, however, employing the Selleri gauge in place of the Lorentz transformation.

3.2 Derivation of Progressive Time-Shift Relative to the Selleri Gauge

Derivation of the Einstein progressive time-shift relation while recognizing the Selleri gauge is given immediately below. In the derivation, slow clock transport synchronization defines the descending *baseline* (within Einstein's system S) relative to which progressive time-shift occurs. The derivation, as has been noted, produces the equivalent result obtained by Einstein in his 1907 essay.

Because the Selleri gauge has an essentially anisotropic character, the corresponding derivation is particularly significant in that it helps to validate his (i.e., Selleri's) gauge as deeper and more-general than the Lorentz transformation—a primary reason for the derivation.

Time-Shift Baseline. As has been noted, Einstein began his development of the progressive time-shift relation with "We consider now a reference system Σ which is uniformly accelerated relative to the non-accelerated reference system S in the direction of the x axis of the latter" which we have formulated as (7). We started our repeat of his derivation in the same reference system Σ and then switched or moved to a new reference system Σ_E to complete the derivation. Now we again derive the same progressive time-shift relation, but this time remaining in Σ. However before the equation can be employed it is necessary to address time-shift in system S in greater depth.

In more deeply considering progressive time-shift in Einstein's system S we again recall Einstein's definition of clock-synchrony under *same-motion* acceleration—in particular, "any two clocks of [accelerated system] Σ are synchronous with respect to *S* at the time t = 0, and undergo the same motion, they remain continuously synchronous with respect to *S*." At any instant during the same-motion acceleration, however, Einstein also noted "Two [clocks] at two different points of Σ are not [synchronous] in the sense of [special relativity] when their local times [i.e., *same-motion* times] σ are equal to each other." There is accordingly a time-shift between the two "forward" (or "rearward") clocks (i,e., equally displaced from a central clock) that progressively increases as the same-motion acceleration proceeds.

The degree or extent of time-shift during acceleration is measured from the (downward-sloping) orthodox-synchronization baseline as evident to a stationary observer in Einstein's system *S* (see (3)). This downward sloping orthodox-synchronization baseline is in effect the "common denominator" between the orthodox and same-motion clock synchronizations. In either case, the orthodox-synchronous line-of-clocks falls progressively below Einstein's same-motion synchrony (as same-motion acceleration proceeds), as viewed and determined by an observer at rest in *S*. The two cases are, however, profoundly different when viewed and determined by the observer moving at $v=\beta c$ relative to *S*. In optically-anisotropic Σ the observer views and determines the orthodox-synchronization clocks falling progressively below the ξ-axis with distance, while in optically isotropic Σ_E the <u>same</u> observer <u>while seeing exactly the same view</u> concludes all clocks remain (instantaneously) synchronous.

Derivation. In deriving the progressive time-shift employing the integral or inherent Selleri gauge ((3) with e_1=0) we begin with an optically-anisotropic same-motion system Σ (i.e., (7)). We now recognize that acceleration of a body—a clock in this case—in system *S*, being operationally imposed, may in principle be suspended at will. Assume the clock reaches a relativistic speed when acceleration is suspended, and it then moves along the x-axis at a constant speed (e.g., 0.5*c*). We now imagine that the body-CG speed along the *x*-axis is given an incremental increase $\delta\beta \bullet c$.

Because the body now moves slightly faster in system *S* its associated time-dilation is (slightly) greater. A perturbation of $(7)_2$ for the small velocity increase yields, to first order:

$$\begin{aligned}\delta\sigma &= (\gamma + \delta\gamma)\delta t - \gamma\delta t\\ &= \delta\gamma\delta t\\ &= -(\beta\delta\beta/\gamma)\delta t\\ &= -(\beta/c\gamma)\delta x\ .\end{aligned}$$

Recalling the baseline for time-shift as orthodox Einstein synchrony observed from the non-accelerated base reference system *S*, we may write

$$\begin{aligned}\Delta\underline{\sigma} &= -\Delta\sigma\\ &= (\beta/c\gamma)X\end{aligned}$$

for the time-shift over *same-motion invariant X* in *S*.

At this point, following Einstein—i.e., "We restrict ourselves … to the consideration of such short times, that all terms containing second or higher powers of [σ_E] and [velocity] *v* can be discarded"—we recognize that γ and *X* are invariant (to first order). Taking the time-derivative of $\Delta\underline{\sigma}$ accordingly gives

$$\begin{aligned}d(\Delta\underline{\sigma})/d\sigma &= aX/c^2\\ &= a\xi/c^2\end{aligned}$$

for the progressive time-shift integrated with the Selleri gauge, which is seen to agree with Einstein's expression (9).

Having derived Einstein's progressive time-shift within his same-motion synchrony principle employing the Selleri gauge we now proceed to demonstrations of fundamentally unbounded light-speed (Section 5.0) and indeterminate space-time (Section 6.0) leading to promotion of the neoclassical paradigm (Section 7.0). A recent Bell test (Scheidl et al.) and Schrödinger's famous cat are modeled in Gedankenexperiments for this purpose. A particular form of same-motion transformation—given the (extended) name "conformed same-motion transformation"—will be employed, as defined in the following section.

4.0 Conformed Transformation

In order to strengthen or render more robust the *neoclassical* paradigm of fundamentally unbounded light-speed in an indeterminate space-time, we will next describe two closely related Gedankenexperiments which employ a *particular mode* of same-motion transformation—given the name *conformed same-motion transformation*—or "conformed transformation". The two signature features of this transformation are: (i) distributed clocks originally Einstein-synchronized—and Selleri-synchronized—at zero speed remain Selleri-synchronized at all non-zero speeds; and (ii) the original configuration of all entities, clocks or otherwise (i.e., prior to the full transformation) is recovered. Because Einstein's *Principle of Relativity and Gravitation* comprises the foundation for the transformation (indeed, for the results in general), the development is presented within his "nonaccelerated reference system S ".

Definition. The conformed transformation is defined as a two-phase procedure: first, all displacements between the centers-of-gravity of distinct or separate bodies along the x-axis are contracted by a specified factor (i.e., the Lorentz factor); and second, the centers-of-gravity of the bodies comprising the configuration are then uniformly (same-motion) accelerated along the x-axis, forward or backward. The contraction factor is determined by the speed of the "target" system into which the configuration is to be accelerated. For the target speed $v=\beta c$ the contraction (Lorentz) factor is $\gamma=(1-\beta^2)^{1/2}$, as may be immediately seen from $(1)_1$. The end-result of the conformed transformation thus defined is that the configuration arrives at the "target" speed having the original dimensions but markedly different, anisotropic light-speed.

Here it is important to note that no individual or separate body is uniformly accelerated inasmuch as its dimension or length parallel to acceleration would thereby expand. We accordingly accelerate (in a suitable manner) each body's center-of-gravity, relying on internal stresses to accelerate the body generally. Furthermore, because no individual body is uniformly accelerated, it necessarily follows that progressive time-shift has its effect, with "leading" body material gaining time and "trailing" material losing time (i.e., relative to the CG time).

5.0 Same-Motion Unbounded Light-speed

The evidence for superluminal influence across space-like separations has been growing for decades—first from QM theory and more recently from QM experiments. Well before the experiments, Einstein, Podolsky, and Rosen (1935) argued that quantum theory was incomplete and, because of superluminal "influence", also contradicted special relativity, and that (in effect) a background or hidden variable must exist. Bell (1964), however, derived an "inequality rule" based on EPR realism which subsequent tests violated.

Over the years since Bell's contribution a continuing effort has been to close all loopholes whereby the EPR understanding might have some validity after all. Then what? We would still be left with physics in crisis, with "spooky" quantum theory in fundamental conflict with orthodox special/general relativity. At some point it becomes appropriate to turn the investigative eye on relativity, asking if the subject at a deeper level could resolve the impasse. This is a prime endeavor of the present work.

In deepening relativity into a new paradigm we first demonstrate *one-way unbounded light-speed* (this section), on which basis, in conjunction with Einstein's c=constant postulate, *indeterminate space-time* is established (next section, 6.0). The conformed transformation is employed in both developments with, however, a significant difference: in the first development (demonstrating unbounded light-speed) the Scheidl Bell-test setup is duplicated whereas in the second development (establishing indeterminate space-time) the displacement between the La Palma setup—the "*transmitter*"—and Tenerife setup—the "*receiver*"—is greatly expanded, to one standard length (i.e., 3E05 km—in order to give Schrödinger's cat a nearly one second "alive and dead" interval). …Note that while the primary goal of the Scheidl Bell-test Gedankenexperiment is to establish unbounded light-speed, employment of the same experiment—albeit with a greatly expanded length scale—is secondary or "complimentary" in that it mainly serves to help or facilitate conceptualization.

5.1 Bell Test Gedankenexperiment

We initially describe the recent Bell-QM experiment by Scheidl et. al. (2010), in which they close the locality and freedom-of-choice loopholes. The entire Bell-test setup is then conformed-transformed (i.e. contracted, and then same-motion accelerated) into a new system moving at a 0.938c "boost" in the direction from receiver towards transmitter, with anisotropic light-speed at 0.516c in the forward direction and 16.1c in the backward direction. Concomitantly, via Einstein's light-pulse synchronization, optical-isotropy obtains. This dichotomy leads to the fundamentally-unbounded light-speed conclusion.

5.1.1 Scheidl et al. Bell-Test Description

It is important to note that the Scheidl Bell test serves only as the means to achieve a deeper paradigm of relativity physics. We could in this regard proceed independently of the test and revise orthodox relativity theory as a stand-alone investigation. However, there are benefits from performing the investigation within the context of the Scheidl Bell test. A prime benefit results from conformed transformation of the Scheidl Bell test setup within the source reference system into the conformed transformation reference system wherein the Bell test and its results are duplicated (in the Gedankenexperiment) to further promote and establish fundamentally anisotropic light-speed.

Figure 1 shows a "snapshot" of the Scheidl Bell experiment that "violates Bell's inequality while simultaneously closing the locality loophole and addressing the freedom-of-choice loophole, also closing the latter within a reasonable set of assumptions." (Rizzi, Abstract.) In each of the nearly 20,000 measurements, a polarization-entangled photon pair was produced on La Palma and the photons separately processed such that one passed through a 6 km long glass fiber loop and returned next to the emission source (transmitter) and the second was sent through open air 143.6 km to Tenerife for its measurement (receiver). Measurement polarity settings at each location were fixed by corresponding quantum random number generators (QRNG), one displaced 1.2 km from the La Palma measurement (and emission source) and the second 1.2 km from the Tenerife measurement, where each QRNG sent random bits to the corresponding electro-optical modulator for switching between polarization settings ahead of photon arrival. A "moving reference frame" was adopted at speed 0.938c from La Palma toward Tenerife for the purpose of a Lorentz transformation of the asynchronous "A" and "B" measurements (at La Palma and Tenerife, differing by 454 μs) into simultaneous measurements (in the newly defined system).

5.1.2 Scheidl Bell-Test Replication (Gedankenexperiment)

We have previously noted that Einstein introduced or indicated the basis for the Selleri transformation in his 1907 essay by observing "any two clocks of Σ are synchronous with respect to *S* at the time t = 0, and undergo the same motion, they remain continuously synchronous with respect to *S*." In Section 3.0 we re-derived Einstein's progressive time-shift to promote the legitimacy of the Selleri gauge in relativity physics. In the following we again employ Einstein's same-motion principle—and do so within his "nonaccelerated reference system *S*"—to establish light-speed anisotropy as a *fundamental* condition of space-time. This will be accomplished in two steps—comprising the previously introduced *conformed transformation* (Section 4.0).

In the first step, the Scheidl Bell-test components are positioned such that their center-of-gravity displacements from each other along the *x*-axis of the (original) source reference frame are contracted by the Lorentz factor $\gamma = (1-\beta^2)^{1/2} = (1-0.938^2)^{1/2} = 0.347$—i.e., contracted by the same factor defined by Scheidl et al. to yield simultaneous entangled photon measurements in their moving reference frame. For example, the 143.6 km displacement of the receiving telescope and polarization analyzer from the photon emission-E location is reduced to 49.6 km, and the 1.2 km displacement of the setting-a QRNG from emission-E is reduced to 0.412 km. Note that the coiled optical fiber retains its 6 km length since it is co-located with the entangled-photon source.

In the second step, we same-motion accelerate the contracted setup along the x-axis in the direction from the receiver toward the transmitter, until the "target" speed v=−0.938c is achieved. In this step the original element-to-element displacements are recovered thereby completing the conformed transformation.

The salient or novel distinction in the conformed transformation is the "pre-contraction" of the original Bell-test configuration by the Lorentz factor 0.347 (for β=0.938). It is, of course, the nature of same-motion acceleration, as Einstein observed in his 1907 essay, that synchronized clocks remain synchronized (even when, as now, components and their clocks are slow-moved prior to the acceleration.) It follows that not only is the original configuration recovered at the end of the same-motion acceleration but that all clocks remain synchronized—as the consequence of optical anisotropy attending same-motion acceleration.

Having reproduced the original Scheidl Bell-test configuration in the conformed transformation system (at $v=-0.938c$) we now seek to repeat the test—albeit with some challenges. An immediate challenge is to maintain time synchrony among the several elements of the test configuration. In the original La Palma-Tenerife test, synchrony was aided by GPS. Now however, recognizing advancing technology, we assume that the several clocks around the setup maintain acceptable synchrony, once established (prior to contraction/acceleration) in the standard manner. There are other challenges, of course—e.g., profoundly delayed communication over vast distances at high relativistic speeds—but we will assume that these are also surmountable.

At this point we ask if the original Scheidl Bell test can be repeated, achieving the same Bell-rule violations—notwithstanding the highly anisotropic light-speed resulting from the conformed transformation. The answer is yes because we can certainly Einstein resynchronize all clocks using the original (light-pulse) convention and then repeat the "nearly 20,000 measurements" obtaining the same results. However, this in effect "side steps" the main question, as to whether the same results obtain for anisotropic light-speed.

The answer is again yes, because the optically-isotropic condition (Einstein system) and the optically-anisotropic condition (Selleri system) "…are wholly equivalent … in predicting empirical facts."[6] (Rizzi et al. 2008, p. 1) And this means, as a particular, that the entangled photon performance or behavior empirically demonstrated in the optically-isotropic Scheidl Bell-test obtains equally in the optically-anisotropic (conformed-transformed) Scheidl Bell-test. (Nevertheless, certain "empirical evidences", given legitimacy by same-motion synchronization, point to deeper theory, as addressed later in the paper.) (Rizzi, p.14)

As another particular, the optically-anisotropic condition may be judged more fundamental than the optically-isotropic condition when we recognize "Einstein's [synchronization] procedure is nothing but a particular case of [a multiplicity of synchronization procedures]. It is, however, a highly important *symmetry condition* for performing tests and analyses where the potential effects of the dichotomy between orthodox and same-motion synchrony can be neglected.

5.2 Unbounded Light-Speed

The principal conclusion from the foregoing development based on Einstein's same-motion acceleration is that light-speed must be *fundamentally* anisotropic—that is, superluminal in any given direction through a point and subluminal in the opposite direction while exactly complying with the round-trip axiom. We may then determine that optical anisotropy is *unbounded*, since the conformed-transformed system with its corresponding degree of optical anisotropy may be arbitrarily specified. In

[6] The complete quotation is: "Once correctly and explicitly phrased, the principles of SRT allow for a wide range of 'theories' [including the Selleri synchronization gauge] that differ from the standard SRT only for the difference in the chosen synchronization procedures, but are wholly equivalent to SRT in predicting empirical facts."

the Scheidl Bell-test, for example, the 6-km optical coil physically adjacent to the entangled-photon source could be reduced to 0.6-km, thereby increasing the conformed transformation system speed from 0.938*c* to 0.99*c* (in principle). From (5) and (6) the corresponding "forward" and "reverse" photon speeds are 0.5025c and 100c.

It is of course a major step to conclude that light-speed is *singularly* unbounded—i.e., one-way infinite—but the developing theoretical evidence (derived of quantum theory) and experimental evidence (the growing number of Bell and QM non-locality tests) increasingly point to this conclusion. Given the theoretical evidence (including the developments within the present paper) and the empirical support from the tests, along with a view to deeper theoretical investigation of long-standing problems in physics, the one-way infinite light-speed conclusion may be judged appropriate.

6.0 Same-Motion Indeterminate Space-Time

Having just applied the same-motion Gedankenexperiment to establish unbounded light-speed as a fundamental condition, we now proceed to a similar Gedankenexperiment to establish the indeterminate nature of space-time.

6.1 "Schrödinger's Cat" Gedankenexperiment

The principal difference between the following Gedankenexperiment and the preceding Gedankenexperiment demonstrating unbounded light-speed is that Schrödinger's cat is carried along, in the transmitter setup, to help the argument that space-time is indeterminate. Other differences are less important, but still considered helpful. One is that the length scale of the Scheidl Bell-test is greatly increased (by over four orders of magnitude) to correspondingly increase the both alive-and-dead time-interval (to just under one second). A second difference, also not strictly necessary, is to employ "radioactive clocks", in order to emphasize the *provisional* character of standard Einstein synchronization during and after the same-motion acceleration.[7]

An overview of the Gedankenexperiment is first provided followed by the "experiment" per se, leading to the indeterminate space-time conclusion.

6.1.1 Cat Gedankenexperiment Overview

As noted above, we repeat the Scheidl Bell test Gedankenexperiment with several changes. The major change is to arrange for Schrödinger's cat to travel along with the transmitter setup. A second change is to more widely separate the transmitter and receiver test equipment as the "phase one" step prior to same-motion acceleration. More specifically, the separation is increased from γ143.6 km to γ3E05 km, where γ=0.347 as before and 3E05 km is the widely or generally accepted "standard length".

[7] Selleri briefly mentioned "irreversible" radioactive clocks in his paper "The Zero Acceleration Discontinuity and Absolute Simultaneity" in *Einstein, Relativity and Absolute Simultaneity* (2008), wherein he employed Bell's (same-motion) rocket ships (1997) in his development—without, notably, recognizing Einstein's 1907 essay.

During the acceleration to the "target" velocity = −0.938c the separation will increase to the desired standard length (in accordance with $(1)_1$). This extraordinarily greater separation—3E05 km versus the original 143.6 km—is not strictly necessary for proving the indeterminate nature of space-time. It just helps conceptualization by increasing the time span over which the cat is both alive and dead (i.e., from a fraction of a millisecond to almost one second).

A few additional details require attention. Exactly how Schrödinger's (unfortunate) cat expires in the following Gedankenexperiment is not important—we only require that the "transition" be (very) quickly accomplished. What is important is *when* it happens. Standard clocks, such as employed by Einstein in his 1905 paper, could be used to "trigger" the demise of our cat. However, we will employ (properly shielded) "radioactive clocks", where the level of radioactivity of highly localized material is intense enough to allow precision counts/second by an adjacent Geiger counter to an almost unlimited degree of accuracy. We also require a sufficiently short half-life of radioactive emission to allow highly accurate measurements of radioactivity rate-of-decline. Given the satisfaction of these two requirements we may relate time to radioactivity in the relation $t=\lambda\ln(R_0/R)$ where R is the measured radioactivity at time t, R_0 is the same at $t=0$, and λ is the decay time constant. Time determined in this manner can be either digitally or "clock-face" displayed after suitable processing of the Geiger counter output.

An immediate question concerns why we resort to natural radioactive clocks rather than any of the usual mechanical or electronic clocks. The reason is that we will demonstrate the *provisional character* of the orthodox synchrony—"provisional" because it must be updated from one instant to the next during same-motion acceleration. This is, of course, contrary to Selleri synchronization, which is preserved from one instantaneous system to the next during same-motion acceleration. Here the radioactive clocks naturally conform to same-motion synchronization, and thereby place the provisional nature of the orthodox procedure in sharper contrast.

The need for observers in our Schrödinger's cat Gedankenexperiment is another detail. Here we may simply enlist the assistance of Scheidl Bell test physicists who ride along and perform their duties at both ends of the experimental setup. And we may conclude they will successfully repeat the Bell test, in that doing so—notwithstanding the (greatly) increased length scale—is, in principle at least, feasible.

6.1.2 Schrödinger's Cat—Simultaneously Alive and Dead.

The Gedankenexperiment we now explore consists of two parts: (i) repeat of the preceding Gedankenexperiment which allowed the unbounded light-speed conclusion; and (ii) demonstration of Schrödinger's cat as simultaneously alive and dead over a finite time period. The first part is not strictly necessary—and is offered to provide a more conceptually robust context for the "alive and dead" demonstration. The second part provides the basis for the indeterminate space-time conclusion.

As one of the "details" noted above we are assuming that the scientists who are accelerated along with the Bell-test setup are willing to help perform our experiment upon arriving in the "target" system moving at $v=\beta c=-0.938c$ relative to Einstein's "nonaccelerated reference system S ". All of the scientists are observers in the experiment, and those located at the receiver setup are tasked with deciding when, to within a fraction of a second, the cat at the transmitter setup expires. Of these "receiver" observers one is asked to credit same-motion synchronization of the transmitter and receiver clocks, a second observer is asked to credit orthodox Einstein-synchronization of the transmitter and receiver clocks, and a third observer is asked to consider both synchronizations as potentially valid but withhold judgment one way or the other.

The observer at the receiver setup asked to recognize same-motion synchronization will conclude the cat expired 0.062 seconds prior to witnessing the event through a nearby auxiliary (very) high power telescope—the 0.062 seconds being the interval for the image-photons to travel from transmitter to receiver. However, the observer at the receiver setup asked to recognize Einstein's c=constant synchronization will conclude the cat expired one second prior to witnessing the event (*concurrently* through the same telescope)—i.e., 0.938 seconds earlier than the "same-motion" conclusion. And the third observer, now asked to reach a decision on the question, will admit he or she can't tell—either result is possible.

All three conclusions are correct. To be more precise, the three different conclusions are correct within the paradigmatically deeper understanding now permitted by Einstein's 1907 same-motion synchronization.

6.2 Indeterminate Space-time

At this point we go to the core or heart of the matter as to how Schrödinger's cat may be both alive and dead over a finite interval (0.938 seconds in our Gedankenexperiment), and why this gives the indeterminate space-time conclusion. First we again recognize the disagreement or dichotomy between Einstein's two modes of synchronization within relativity physics—namely, between his original (1905) "ray of light" procedure and his (1907) same-motion basis.

Same-motion synchronization between all (radiation-based) clocks in the transmitter and receiver setups prevails by virtue of the conformed transformation. On the other hand the original Einstein synchronization is readily achieved by the orthodox synchronization procedure (Rizzi et al. 2008, p. 11). In this latter procedure a (very) short light-pulse is directed from receiver toward transmitter at, say, 12:00 noon exactly, with the understanding that an observer at the transmitter setup adjusts/sets one of the nearby (radiation-based) clocks at 12:00 noon plus one second upon receiving the pulse. This produces the salient dichotomy wherein the orthodox *turn-the-dials* Einstein-synchronized clock not only stands alone, by a negative 0.938 seconds, among the remaining clocks at the transmitter setup but exhibits a face-time in disagreement, by the same 0.938 seconds, with its own radiation-based time. And there is another equally significant consideration.

We could, in addition to light-ray synchronization, employ slow-clock transport from receiver to transmitter:

> *Let us stress that accepting the geometrical structure of Minkowski spacetime is equivalent to accepting SRT, regardless of its formal look. Therefore we completely agree with the following* [R. Anderson, I. Vetharaniam, and G.E. Stedman, Phys. Rep. 295, 93 (1998)] *claim: "any experimental divergence between Einstein synchronization and slow clock transport would constitute an experimental violation of special relativity*". (Emphasis added.) (Rizzi et al., (2008), pg 6).

Because the slow-clock time (radiation-based or otherwise) retreats 0.938 seconds during transit it arrives having a "radiation-time" in agreement with the orthodox light-pulse time. This immediately presents the essential dichotomy: side-by-side at the transmitter setup are the ostensibly equivalent synchronizations within orthodox relativity—one via light pulse and the other via slow clock transport—which show the same face-times but different radiation-based times.[8] We accordingly reach the crucial conclusion that Einstein's same-motion synchronization, when credited as a true alternative to his original light-pulse synchronization, points to not just deeper relativity physics but to paradigmatically new relativity physics.

How does the above relate to the simultaneously dead and alive states of Schrödinger's cat? First, to be more specific regarding the foregoing discussions, we program one of the radiation clocks at the transmitter setup to cause the cat's near instantaneous demise at a specific time, 12:00 noon. Given same-motion synchrony, all observers at the receiver agree at noon plus 0.062 seconds that the cat died at noon. However, the same observers at the receiver must equally credit Einstein's light pulse (optically isotropic) synchronization and agree at noon plus 0.062 seconds (when the image arrives) that the cat died one second earlier—at 12:00 noon minus 0.938 seconds. For all observers at the receiver setup this means that the cat is both alive and dead between noon minus 0.938 seconds and noon. Over a nearly one second interval—in the presently considered scenario—we are led to conclude, given the true significance of Einstein's same-motion synchronization, that the cat is alive and dead—where we of course assume that the demise of the cat occurs as planned.

7.0 *Intermediate* Neoclassical Paradigm

> *The basic concepts and laws which are not logically further reducible constitute the indispensable and not rationally deducible part of the theory. It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience*. (Einstein, 1934, p. 165)

Is *fundamentally* anisotropic light-speed a legitimate condition of space-time? We can say that it is at least an *implicit* condition. Here we may note that anisotropic light-speed is naturally accommodated in the Michelson-Morley round-trip axiom. The condition furthermore is implicit in Einstein's 1905 paper originating special relativity. And in very recent time, Rizzi et al. (2008) have prominently recognized anisotropic light-speed as an implicit property of space-time:

> *In particular, we do not think that the one-way speed of light is a meaningless concept because it is not measurable; we simply think that the lack of observability allows a multiplicity of conventional assumptions, encapsulated in some synchronization gauge, which are consistent with any possible experimental evidence.* (Rizzi et. al., 2008, p.45)

In addition to their conclusion we recall the further demonstrations in this paper.

Regarding empirical evidence for light-speed anisotropy—i.e., "representation of a single datum of experience"—we may point to the growing number of quantum mechanics "action at a distance" experiments indicating superluminal "influence" (e.g., J.F. Clauser and A. Shimony (1978); G. Weihs et

[8] Within orthodox relativity exclusive of same-notion synchrony the explanation is, of course, that forward clocks (at the transmitter setup) gain 0.938 seconds during acceleration to $v = -0.938c$.

al. (1998); T. Scheidl et al. (2010); and J. Yin et al. (2013)), where the 16.1c light-speed in the Scheidl Bell test has been far exceeded by Yin et al. at over 10,000c light-speed.

7.1 Neoclassical Paradigm

Considering that logical reduction of “the basic concepts and laws” of relativity physics is practicable (as shown herein, and by Rizzi et. al.) and, further, that the deeper space-time condition provides a “representation of [empirical] experience”, we may conclude that one-way unbounded light-speed and indeterminate space-time indeed reflect physical reality, non-quantum interpreted, thereby defining the *neoclassical paradigm* midway between the relativistic-classical and quantum mechanical paradigms.

7.2 Revised System Postulates

The traditional postulates of SRT—i.e., relativity principle and invariance of the velocity of light—resulted from recognizing optically-isotropic space-time as fundamental within the *scientific* understanding of nature, subject to theory and empiricism at that time. Now, however, Einstein’s same-motion synchronization is recognized as more fundamental than his original c=constant convention. And this alternative receives increasing *empirical validation*, not only from the growing number of “non-locality” experiments but also the continuing successes of general relativity of which it is an integral part. Qualification of the traditional postulates of relativity physics is accordingly appropriate.

7.2.1 Relativity Principle

Rizzi et al. (2008, p. 11) expressed the original/traditional relativity principle as:

> All physical laws are the same in any [system]. No inertial reference frame is ‘privileged’, i.e. distinguishable from the other [systems] by means of ‘internal’ empirical evidences.

This statement is valid for the system assumed or stipulated to be optically isotropic. However, having recognized Einstein’s same-motion synchronization, it is no longer automatically or immediately true that the system is optically-isotropic. More to the point, while it is true that the optically-anisotropic <u>image</u> of the “out there” world is visually identical to its isotropic counterpart there can now be predictable and meaningful “‘internal’ empirical evidences” that distinguish any given (optically anisotropic) Selleri-system from its base Einstein-system. As a particular, using the same (very powerful) telescope referred to earlier in the paper, observers at the receiver in the conformed transformation of the Scheidl Bell test would see two side-by-side clocks at the transmitter showing different face-times, one same-motion synchronized and the other slow clock synchronized (or, equivalently, orthodox light-ray synchronized)—where, in this example, the same-motion synchronized clock would exhibit the later time.

The revised relativity principle may be expressed as follows:

All physical laws are the same in any optically-isotropic Einstein base-system. However, each optically-anisotropic Selleri-system is distinguishable from its base Einstein system by means of 'internal' Selleri system versus Einstein base-system empirical evidences.

Besides the different "face times" of two side-by-side clocks which are same-motion versus slow-clock synchronized as indicative of " 'internal' empirical evidences", we may recognize the growing number of "faster than light" empirical evidences, now understood as superluminal photons rather than quantum mechanical "influences". And we have the consideration that the Selleri gauge, in its normal or authentic place in the same-motion (and "conformed") transformations, duplicated Einstein's empirically-validated (Vessot et al., 1980) progressive time-shift expression, thereby imparting additional (empirical) legitimacy to anisotropic light-speed.

7.2.2 Photon Velocities

The traditional statement of light velocity within SRT is (e.g., Rizzi et al. 2008, p. 11):

The velocity of light in empty space is the same in any [system]. Its value is given by the universal constant c.

This statement follows from Einstein's philosophy of science (previously given):

It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience. (Einstein, 1934)

We now recognize however, from Einstein's same-motion synchronization and the revised relativity principle given above, that each (same-motion "accelerated")[9] Selleri-system can be distinguished from its Einstein base-system by way of differently synchronized remote clocks, and it is appropriate to recognize the attending light-speed anisotropy. A revised statement is accordingly necessary:

The velocity of light $\underline{c}(\beta,\theta)$ in empty space is given by $\underline{c}(\beta,\theta)=c/(1+\beta\cos\theta)$ where θ is the rotation angle of the photon velocity from the Selleri-system velocity at $v=\beta c$ within the Einstein base-system.

We see in this statement the multi-valued character of light-velocity, where β and θ are independently variable.

8.0 Conclusion

The *neoclassical paradigm* midway between relativistic-classical and quantum physics introduced herein is entirely consistent or "as one" with the relativistic-classical side … with a crucial exception: light-speed is *fundamentally* anisotropic, having a superluminal speed in one direction through any given point and a subluminal speed in the opposite direction. This conclusion was available to

[9] It is important to emphasize that neither the Selleri nor Einstein systems are literally same-motion accelerated, but each instantaneously matches or conforms-to the corresponding Σ or Σ_E system as it "passes by".

Einstein throughout the time from his great contributions of special and general relativity to his passing in 1957. His philosophy, however—of course correct within science—was, as noted, "to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience." The requisite new empirical experience has become available, in the form of increasing quantum mechanical experiments pointing to faster-than-light "influence" along with (inferentially) Gedankenexperiment telescope-observation of remote time-shift between orthodox and same-motion synchronized clocks. And now Einstein's early work "Principle of Relativity and Gravitation (1907)" provides the foundation for taking orthodox relativity deeper into the new paradigm.

The late Franco Selleri was progressing toward this deeper paradigm in his strong devotion to recovering Lorentz's ether theory thereby preserving a more "common sense" understanding of physical reality. More to the point, his inherently anisotropic "Selleri gauge" exhibited superluminal light-speed now recognized in the neoclassical paradigm. Selleri's vision could not, however, exhibit or accommodate indeterminate space-time—the reason being, as developed by Rizzi et al. (2008), that his (Selleri's) gauge offered within the ether hypothesis did not resolve existing theoretical or empirical problems beyond the reach of standard relativity theory. The crucial theoretical attribute to accomplish this step was provided by Einstein himself, in his "same-motion" synchronization within his "nonaccelerated reference system *S*." This synchronization mode "diverges" from the (orthodox) Einstein synchronization convention, thereby leading, as demonstrated herein, to the new paradigm.

Besides advancing unbounded light-speed and showing Schrödinger's cat to be both (briefly) alive and dead, the neoclassical paradigm points to, or recommends, empirically-supported *singularly* unbounded—i.e., one-way infinite—light-speed. Immediate gains include prospective resolutions of the long-standing Bell-EPR impasse and relativity/quantum theory incompatibility. Beyond these gains the present deeper understanding of space-time casts potentially "new light" across the range of existing problems of micro- and macro-physics.

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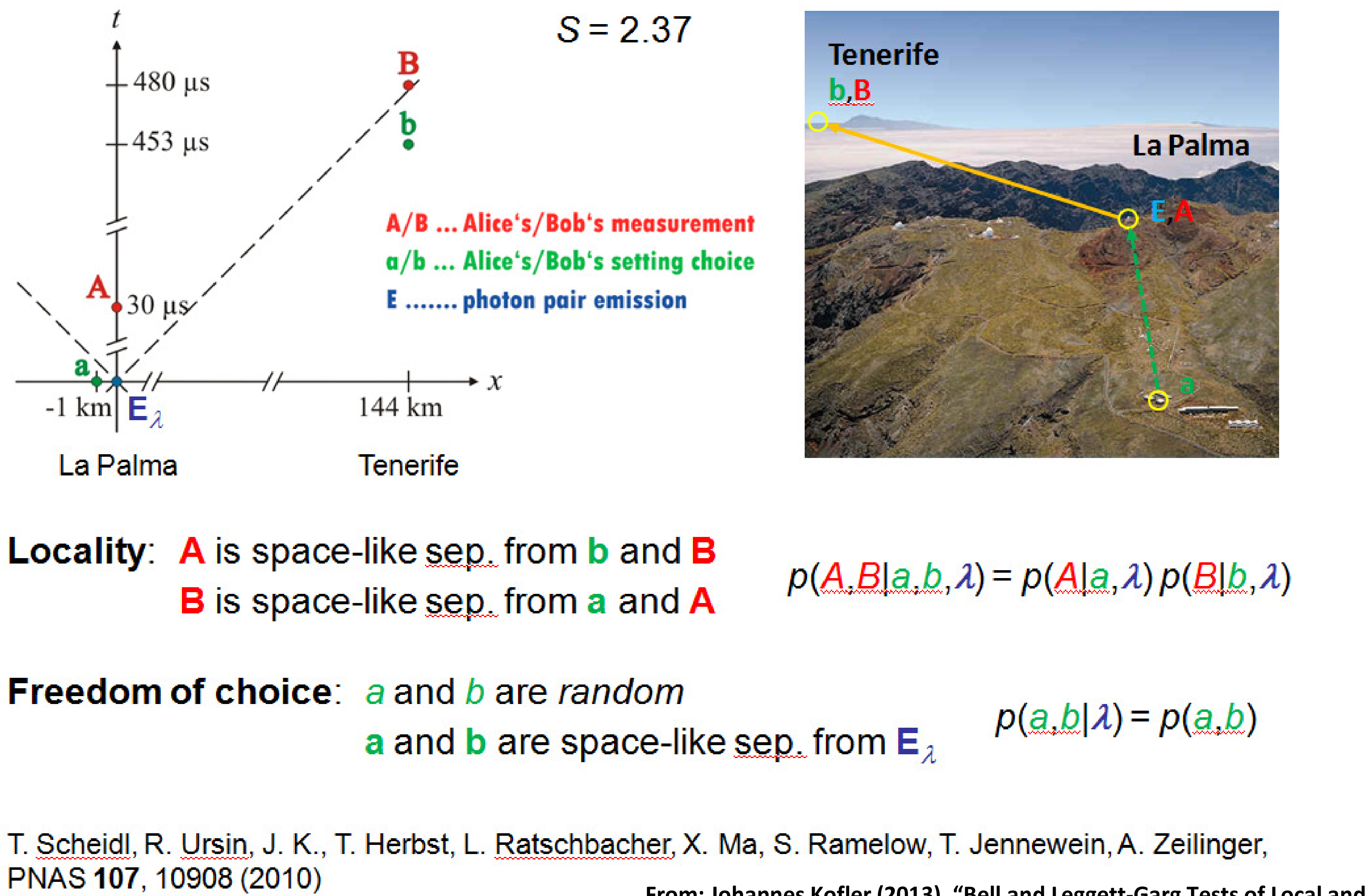

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Figure 1. Scheidl et al. Bell Test Description.