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# Errors of the Wheeler School, the Distortions to General Relativity and the Damage to Education in MIT Open Courses in Physics

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# Errors of the Wheeler School, the Distortions to General Relativity and the Damage to Education in MIT Open Courses in Physics

C. Y. Lo

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**Keywords:** *einstein's equivalence principle; einstein's covariance principle; einstein's theory of measurement; principle of causality;  $E = mc^2$ ; dynamic solution; repulsive gravitational force; charge-mass interaction; pioneer anomaly. 04.20.-q, 04.20.cv*

**"Unthinking respect for authority is the greatest enemy of truth." – A. Einstein**

## I. INTRODUCTION

The difficulty to understand general relativity can be illustrated by the dialogue between a Journalist and Eddington: Journalist: Professor Eddington, is it really true that only three people in the world understand Einstein's theory of general relativity?

Eddington: Who is the third?

The response of Eddington would be correct. If one assumes that both Einstein and Eddington understand general relativity, the third person would be Zhou Pei-Yuan [1, 2], who was born in 1902. Zhou is probably the first theorist who correctly understood that

there is an inconsistency between Einstein's equivalence principle and his covariance principle [3]. Unfortunately, misunderstandings on general relativity and errors continued as shown in the press release of 1993 Nobel Committee in Physics [4]. General relativity was proposed almost 100 years ago, but still there is no expert in this field so far. In fact, there are at least a dozen of Nobel Laureates who made errors in general relativity (see Appendix).

In this paper, we shall concentrate on the basics such as Einstein's equivalence principle and his covariance principle, the principle of causality, misunderstandings on the Einstein equation, and related consequences. Among sources of misinterpretations, the Wheeler School [5-8] is probably the most influential. This group has members occupying key positions, and the backing of the Princeton University [9]. They made and insisted on errors in physics, mathematics and logic [10, 11]. Moreover, they seem to lose their ability of self-rectification as scientists.<sup>1)</sup> For example, they failed to respond to the challenge of Bondi, Pirani, & Robinson [12, 13]; and were unable to rectify their error on local time shown in their eq. (40. 14); <sup>2)</sup> and made invalid claims on dynamic solutions and physical principles [10].

Wheeler started his career as an accomplished nuclear physicist. After the project of the hydrogen bomb, he picked up the abandoned theory of Oppenheimer; and proposed the formation of the black holes after a test of simulation was passed [14]. Thus, the theory of black holes is based on the unverified implicit assumptions in the simulation.

Wheeler was leading the school at Princeton, while their associates, Sciama and Zel'dovich (another H-bomb maker) developed the subject at Cambridge University and the University of Moscow. However, their speculations remain without conclusive observational supports [10]. Noticeably, Wheeler, Misner, and Thorne wrote the *Gravitation* that collects an exceptionally rich literature on gravitation. However, Einstein's 1916 crucial paper [15] and his comprehensive book [16] on general relativity are not included. Their book distorted general relativity, in particular Einstein's equivalence principle; but also exposes their shortcomings in physics, mathematics, and logic (see Sections 2 - 6).

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Moreover, some theorists would play the role of being the obstacle to other sciences. This has happened towards the NASA's discovery of the pioneer anomaly [17-19]. Some attempted to shut down the Super Collider in Europe. Clearly they need help from the community of sciences [10, 11]. It is for facilitating such assistance that this paper is written.

Since the accurate predictions created a faith on Einstein's theory, a critical analysis was over due [10]. Moreover, as time goes by, misinterpretations from the well known were accepted as part of the faith. Thus, to rectify the errors, a systematic analysis of the whole theory is necessary. This paper would serve essentially as a road map to their errors. Evidences with details that require considerable deliberation are provided in the references.

Einstein [20] once remarked, "If you want to find out anything from the theoretical physicists about the methods they use, I advise you stick to one principle, don't listen to their words, fix your attention on their deeds." In this paper, Einstein's advice is proven to be useful.

Since it is commonly agreed that Einstein's equivalence principle is crucial [15, 16, 21], we would start with discussions on the equivalence principle. It is amazing that while many admire Einstein's intelligence, they were convinced that the 1916 Einstein's equivalence principle that Einstein insists as crucial were the same 1911 assumption of equivalence that has been proven invalid by the light bending experiments. The following sections illustrate the errors related to distortions of Einstein's equivalence principle.

## II. THE DIFFERENCE BETWEEN EINSTEIN'S 1911 ASSUMPTION OF EQUIVALENCE AND EINSTEIN'S EQUIVALENCE PRINCIPLE

Although many agree with Einstein that his equivalence principle is the foundation of general relativity, there is no book or reference, other than Einstein's own work, that state and explain this principle correctly [22, 23]. In particular, they failed to see the physical contents of Einstein's equivalence principle; and often confused this principle with Einstein's invalid 1911 assumption of equivalence [24]. Thus, it is useful to clarify first what is his 1911 assumption.

In 1911 Einstein assumed the equivalence of a uniformly accelerated system K' and a stationary system of coordinate K with a uniform Newtonian gravitational potential  $\phi$ . Currently many assume the Newtonian metric form,

$$dt^2 = (1 + 2\phi) dt^2 - dx^2 - dy^2 - dz^2, \quad (1)$$

that later Fock [25] has proved to be impossible. From this metric (1), Einstein derived the correct gravitational redshifts, but an incorrect light velocity that leads to only one half of the observed light bending angle [24].

In 1916, however, Einstein assumed the equivalence of a uniformly accelerated system K' and a stationary system of coordinate K with an *unspecified* metric form that generates a uniform gravitation. In his book, Einstein [16] wrote:

'Let now K be an inertial system. Masses which are sufficiently far from each other and from other bodies are then, with respect to K, free from acceleration. We shall also refer these masses to a system of co-ordinates K', uniformly accelerated with respect to K. Relatively to K' all the masses have equal and parallel accelerations; with respect to K' they behave just as if a gravitational field were present and K' were unaccelerated. Overlooking for the present the question as to the "cause" of such a gravitational field, which will occupy us latter, there is nothing to prevent our conceiving this gravitational field as real, that is, the conception that K'; is "at rest" and a gravitational field is present we may consider as equivalent to the conception that only K is an "allowable" system of co-ordinates and no gravitational field is present. The assumption of the complete physical equivalence of the systems of coordinates, K and K', we call the "principle of equivalence;" this principle is evidently intimately connected with the law of the equality between the inert and the gravitational mass, and signifies an extension of the principle of relativity to coordinate systems which are non-uniform motion relatively to each other.'

Later, Einstein made clear that a gravitational field is generated from a space-time metric, but is not a Newtonian potential. (However, the latter was not explicitly stated.) Moreover, concurrent with Einstein's equivalence principle of 1916, Einstein makes the claim of the Einstein-Minkowski condition as a consequence [15].

However, in the press release of the 1993 Nobel Committee [4], the equivalence principle was claimed as the identity between gravitational and inertial mass (due to Galileo and Newton), but not as Einstein's equivalence principle although it has been confirmed by experiments (see eq. [3'd]).<sup>3)</sup> A problem is that since Einstein did not provide an example to illustrate his equivalence principle, a careless reader could mistake the 1911 assumption of equivalence as the 1916 equivalence principle.<sup>4)</sup> It is not until 2007 that a metric for uniform gravity [23] was published as follows:

$$ds^2 = (c^2 - 2U) dt'^2 - (1 - 2U/c^2)^{-1} dx'^2 - (dy'^2 + dz'^2), \quad (2)$$

where  $c^2/2 > U(x', t') = (at)^2/2$ , "a" is the acceleration of system K'(x' y' z') with respect to K(x, y, z, t) in the x-direction. Metric (2) shows the time dilation and space contractions clearly. Here, dt' is defined locally by  $cdt' = cdt - (at/c)dx'[1 - (at/c)^2]^{-1}$ . Moreover, metric (2) is equivalent to the metric

$$ds^2 = (c^2 - a^2 t^2) dt^2 - 2at dt dx' - dx'^2 - (dy'^2 + dz'^2) \quad (2')$$

that was derived by Tolman [26]. It was a surprise that U is actually time dependent, and this explains the earlier failed derivation of such a metric [27]. Now, clearly the 1916 principle is different from the 1911 assumption.

To avoid the usual association of an elevator with the gravity of Earth, the equivalence of accelerated frame and uniform gravity is best described, as Einstein did, in terms of a uniformly accelerated chest [29]. Nevertheless, due to the popular "Einstein's elevator" of Bergmann [28], Einstein was often falsely accused of ignoring the tidal force [14].<sup>5)</sup>

To illustrate the equivalence principle further, consider a disk K' uniformly rotating w. r. t. an inertial system (x, y, z, t), a metric for the disk of space K' (x', y', z') is derived [30]. According to Landau & Lifshitz [31], the metric is

$$ds^2 = (c^2 - \Omega^2 r^2) dt^2 - 2\Omega r^2 d\phi' dt - dr^2 - r^2 d\phi'^2 - dz'^2, \quad (3)$$

where  $\Omega$  is an angular velocity relative to an inertial system K (x, y, z, t), z and z' coincide with the rotating axis, and  $r^2 = x^2 + y^2 = x'^2 + y'^2$ . Metric (3) is equivalent to its canonical form,

$$ds^2 = (c^2 - \Omega^2 r'^2) dt'^2 - dr'^2 - (1 - \Omega^2 r'^2/c^2)^{-1} r'^2 d\phi'^2 - dz'^2, \quad (3'a)$$

where

$$cdt' = cdt - (r\Omega/c)rd\phi'[1 - (r\Omega/c)^2]^{-1}. \quad (3'b)$$

Then it is clear that the local light speed cannot be larger than c. However, (3'b) is not integrable [30] because local time dt' is related to different inertial systems at different r or time t. Thus, to obtain the correct space contractions, one must first transform the metric to a canonical form such that the space contractions are clear.

The fact that the local time t' is not a global time was a problem that leads to the rejection by the editorial of the Royal Society [30]. This rejection is incorrect since validity of metric (3') can be derived theoretically with special relativity. Experimentally, the time dilation from metric (3'a) for the local metric,  $ds^2 = c^2 dT^2 - dX^2 - dY^2 - dz^2$ , is

$$dT = [1 - (r\Omega/c)^2]^{1/2} dt'. \quad (3'c)$$

From (3'b) the local clock resting at K', if observed from K, would have

$$dt' = dt. \quad \text{and} \quad dT = [1 - (r\Omega/c)^2]^{1/2} dt. \quad (3'd)$$

Moreover, as Kundig [32] has shown, the time dilation (3'd) is valid for a local clock fixed at K' <sup>6)</sup>. Hence, Einstein's equivalence principle has experimental supports although his claim [15] on this dilation was invalid. Therefore, the 1993 Nobel

Committee press release should not frivolously reject this principle; especially since it was done implicitly [4].

### III. MATHEMATICAL FOUNDATION OF EINSTEIN'S EQUIVALENCE PRINCIPLE AND ITS MISLEADING PRESENTATIONS

An earlier source of confusion is that Pauli's invalid version [33] has been mistaken as Einstein's equivalence principle although Einstein has made clear it is a misinterpretation [21]. Since Pauli was an outstanding physicist, and was often critical to theoretical errors, many still rely on his version, instead of the necessary supporting evidences.

For instance, in the book "Gravitation" [5] of Misner, Thorne and Wheeler, there is no reference to Einstein's equivalence principle (i. e. [15] and [16]). Instead, they misleadingly refer to Einstein's invalid 1911 assumption [24] and Pauli's invalid version [33] (see the subsequent theorems). Like Pauli, they also did not refer to the related mathematical theorems [34]. Apparently they failed to understand them - if they are aware of them.<sup>7)</sup> In addition, as shown in their Eq. (40.14), they even failed to understand the local time of a particle at free fall [5], a basic of general relativity. Nevertheless, due to their influence, Einstein's equivalence principle was often mistakenly regarded the same as the invalid 1911 assumption. The failure of understanding Einstein's equivalence principle is a major source of current errors.<sup>8)</sup>

Note that since the 1911 assumption has been proven invalid by observations in 1919, that Fock [25] misidentified it in 1955 as Einstein's equivalence principle of 1916, *is beyond just incompetence but a deliberate unethical distortion to discredit Einstein*. Unfortunately, many universities, research institutes, as well as the 1993 Nobel Committee are victims of such a distortion.<sup>4)</sup> This illustrates that a human folly can happen to Sciences, not just politics.

Moreover, many cannot tell the difference between the principle of 1916 and the assumption of 1911 [23, 35-37].<sup>4)</sup> Although Einstein's equivalence principle is inadequate [38], it is generally valid because a uniform gravity in the equivalence principle is generated by acceleration but not mass. However, experiments on the equivalence of inertial mass and gravitational mass have not been up-dated beyond the case when the mass-charge interaction is absent [39].

The mathematical theorems related to Einstein's equivalence principle are as follows:

**Theorem 1.** Given any point P in any Lorentz manifold (whose metric signature is the same as a Minkowski space) there always exist coordinate systems (x<sup>μ</sup>) in which  $\partial_{\mu\nu} \chi^\lambda = 0$  at P.

**Theorem 2.** Given any time-like geodesic curve  $\Gamma$  there always exists a coordinate system (the so-called



Fermi coordinates)  $(x^\mu)$  in which  $\partial g_{\mu\nu}/\partial x^\lambda = 0$  along  $\Gamma$ .

In these theorems, the local space of a particle is locally constant, but not necessarily Minkowski.

However, after some algebra, a local Minkowski metric exists at any given point and along any time-like geodesic curve  $\Gamma$ . In a uniformly accelerated frame, the local space in a free fall is a Minkowski space according to special relativity. What Einstein added to these theorems is that physically such a locally constant metric must be Minkowski. Such a condition is needed for the case of special relativity [22, 23]. This is also the theoretical basis of the Einstein-Minkowski condition that Einstein uses to derive the bending of light rays and the gravitational redshifts [15, 16].

Thus, Pauli's version [33] is a simplified but corrupted version of these theorems as follows:

"For every infinitely small world region (i.e. a world region which is so small that the space- and time-variation of gravity can be neglected in it) there always exists a coordinate system  $K_0 (X_1, X_2, X_3, X_4)$  in which gravitation has no influence either in the motion of particles or any physical process."

Pauli regards the equivalence principle as merely the existence of locally constant spaces. Then, Pauli's version is only a corrupted mathematical statement which may not be physically realizable because of the theorems.

A crucial error is that Pauli extended the removal of uniform gravity to the removal of gravity in a small region. This is simply incorrect in mathematics. Because he does not understand mathematical analysis, he did not recognize that the removal of gravity in a small region, no matter how small, would be very different from a removal of gravity at one point. The correct statement should replace "no influence" with "approximately little influence". Then, the removal of gravity would be limited to essentially an isolated point as the mathematical theorems allow.

Moreover, Pauli [33], and Will [6, 39], overlooked Einstein's [15; p.144] remark, "For it is clear that, e.g., the gravitational field generated by a material point in its environment certainly cannot be 'transformed away' by any choice of the system of coordinates..." Apparently, neither Pauli [33] nor the Wheeler School [5-8] understands the mathematics of the above theorems [34]. Misner et al. [5] claimed that Einstein's equivalence principle is as follows: -

"In any and every local Lorentz frame, anywhere and anytime in the universe, all the (nongravitational) laws of physics must take on their familiar special-relativistic form. Equivalently, there is no way, by experiments confined to infinitesimally small regions of spacetime, to distinguish one local Lorentz frame in one region of spacetime frame from any other local Lorentz frame in the same or any other region."

They claimed this as the Einstein's principle in its strongest form.<sup>8)</sup> However, this version makes essentially another form of the misinterpretation of Pauli [33]. They do not seem to understand or to be aware of the related mathematics [34], and their followers probably have similar problems. *This version of the Wheeler School combines errors of Pauli and the 1911 assumption, but ignores the Einstein-Minkowski condition that is the physical essence of Einstein's principle.*

In fact, their phrase, "must take on" should be changed to "must take on approximately". The phrase, "experiments confined to infinitesimally small regions of spacetime" does not make sense since experiments can be conducted only in a finite region. Moreover, in their eq. (40.14) they got an incorrect local time of the earth, in disagreement with Einstein.<sup>2)</sup> Thus, clearly these three theorists [5] failed to understand Einstein's equivalence principle [15, 16].

Furthermore, Thorne [14] criticized Einstein's principle with his own distortion as follows:

*"In deducing his principle of equivalence, Einstein ignored tidal gravitation forces; he pretended they do not exist. Einstein justified ignoring tidal forces by imagining that you (and your reference frame) are very small."*

However, Einstein has already explained these problems in his letter of 12 July 1953 to Rehtz [21] as follows:

*"The equivalence principle does not assert that every gravitational field (e.g., the one associated with the Earth) can be produced by acceleration of the coordinate system. It only asserts that the qualities of physical space, as they present themselves from an accelerated coordinate system, represent a special case of the gravitational field."*

Perhaps, Thorne did not know that *the term "Einstein elevator" of Bergmann [28] is misleading.*

As Einstein [21] explained to Laue, "What characterizes the existence of a gravitational field, from the empirical standpoint, is the non-vanishing of the  $\Gamma^l_{jk}$  (field strength), not the non-vanishing of the  $R_{ijkl}$ ," and no gravity is a special case of gravity. This allows Einstein to conclude that the geodesic equation is also the equation of motion of a massive particle under gravity, which made it possible to conceive a field equation for the metric.

Although Einstein's equivalence principle was clearly illustrated only recently [10, 22, 23], the Wheeler School should bear the responsibility of their misinformation on this principle [5] by ignoring both crucial work of Einstein, i.e., references [15] and [16], and related theorems [34], and giving an invalid version of such a principle. *A main problem is that the Einstein-Minkowski condition [15, 16], which plays a crucial role in measurement, is eliminated.* As shown by Zhou [1, 2],

Einstein's equivalence principle is actually inconsistent with his covariance principle.

Einstein [15, 16] uses the satisfaction of his equivalence principle as an assumption to calculate the bending of light in the harmonic and the Schwarzschild gauges. From the latter, in 1916 Einstein obtains, to the first approximation,

$$\left. \begin{aligned} g_{\rho\sigma} &= -\delta_{\rho\sigma} - \alpha \frac{x_\rho x_\sigma}{r^3} \quad (\rho, \sigma = 1, 2, 3) \\ g_{\rho 4} &= g_{4\rho} = 0 \quad (\rho = 1, 2, 3) \\ g_{44} &= 1 - \frac{a}{r} \end{aligned} \right\}$$

where,  $\alpha = \frac{\kappa M}{4\pi}$ ,  $\kappa = 1.87 \times 10^{-27}$ , (4)

$\delta_{\rho\sigma}$  is 1 or 0, respectively accordingly as  $\rho = \sigma$  or  $\rho \neq \sigma$ , and  $r$  is the quantity  $(x_1^2 + x_2^2 + x_3^2)^{1/2}$ .

$$ds^2 = c^2 \left(1 - \frac{K}{4\pi} \int dV_0 \frac{\sigma}{r'}\right) dt^2 - \left(1 + \frac{K}{4\pi} \int dV_0 \frac{\sigma}{r'}\right) (dx^2 + dy^2 + dz^2), \quad (7)$$

where  $r'^2 = x^2 + y^2 + z^2$ . Based on an assumed validity of his equivalence principle again, Einstein obtained

$$\left\{ \begin{aligned} \sqrt{dX^2 + dY^2 + dZ^2} &= \left(1 + \frac{\kappa}{8\pi} \int \frac{\sigma dV_0}{r'}\right) \sqrt{dx^2 + dy^2 + dz^2} \\ dT &= \left(1 - \frac{\kappa}{8\pi} \int \frac{\sigma dV_0}{r'}\right) dt \end{aligned} \right. \quad (8)$$

since the local metric is  $ds^2 = c^2 dT^2 - dX^2 - dY^2 - dZ^2$ . Then the light speed is

$$\frac{\sqrt{dx^2 + dy^2 + dz^2}}{dt} = \left(1 - \frac{\kappa}{8\pi} \int \frac{\sigma dV_0}{r'}\right) c \quad (9)$$

From (9), Einstein obtain

$$B' = \frac{2\alpha}{\Delta'} = \frac{\kappa M}{2\pi\Delta'}, \quad (10)$$

where  $\Delta'$  is the shortest distance from the sun center to the light ray. Since  $\Delta'$  is interpreted as the distance according to the harmonic gauge,  $\Delta'$  and  $\Delta$ , which is interpreted according to the Schwarzschild gauge, are actually different. (According to Weinberg [40], we have  $r = r' + \kappa M$ .) Nevertheless, Einstein [16] incorrectly concluded that the deflection angle is gauge invariant [3]. Thus, Einstein also inadvertently created an error in favor of Pauli's version.

Since time dilation and space contractions should be unique because they can, in principle, be obtained from measurements. Thus, for a given frame of reference, only one gauge can be valid in physics; but the covariance principle implies otherwise. Furthermore,

Then, based on an assumed validity of his equivalence principle, and the velocity of light to be

$$\sqrt{\left(\frac{dx_1}{dx_4}\right)^2 + \left(\frac{dx_2}{dx_4}\right)^2 + \left(\frac{dx_3}{dx_4}\right)^2} = \gamma, \quad (5)$$

he obtains the deflection angle to be

$$B = \frac{2\alpha}{\Delta} = \frac{\kappa M}{2\pi\Delta} \quad (6)$$

that has good agreement with observation. Using assumed satisfaction of his equivalence principle again in 1921, Einstein [16] derived the bending of light with harmonic gauge. He obtained the metric, to the first approximation,

the calculation of the bending of light is also inconsistent with Einstein's theory of measurement that necessitates the covariance principle. In fact, it has been proven that both of them are invalid in physics [10]. Nevertheless, due to inadequate understanding of Einstein's equivalence principle and physics, many theorists make the incorrect choice of accepting the covariance principle.

#### IV. INVALIDITY OF EINSTEIN'S COVARIANCE PRINCIPLE

Einstein's covariance principle is a source of errors that sustains misinterpretations [1, 2, 10, 41]. Starting from this "principle", Einstein implicitly assigns different physical meaning to coordinates for different gauges [3, 42, 43].

The principle of general relativity states "The law of physics must be of such a nature that they apply to systems of reference in any kind of motion. Einstein extended this principle to unrestricted covariance and called it as the "principle of covariance" [15, 16]. He stated, "The general laws of nature are to be expressed by equations which hold good for all systems of coordinates, that is, are co-variant with respect to any substitutions whatever (generally co-variant)."

However, as Einstein [16] pointed out, the time coordinate must be distinct from a space coordinate. Moreover, the gauge conditions are known to be not tensor conditions. Einstein failed to see that different gauges would lead to different physical interpretations of the coordinates, but Zhou did [1, 2]. Based on that both the Schwarzschild and the harmonic solution produced the same first order deflection of a light ray,

Einstein [16] prematurely remarked, "It should be noted that this result, also, of the theory is not influenced by our arbitrary choice of a system of coordinates."

In Einstein's arguments for this principle, he emphasized that a physical theory is about the coincidences of the space-time points, but the meaning of measurements is crucially omitted [15]. Eddington [44] commented, "space is not a lot of points close together; it is a lot of distances interlocked." To describe events, one must be able to relate events of different locations in a definite manner [45]. Moreover, as pointed out by Morrison, the "covariance principle" is invalid because it disrupts the necessary physical continuity from special relativity to general relativity [30, 45].

Note that Einstein's "principle of covariance" has no theoretical basis or observational support beyond allowed by the principle of general relativity [45]. To start with, the covariance principle was proposed as a remedy for the deficiency of Einstein's adaptation of the notion of distance in a Riemannian space. Such an adaptation has been pointed out by Whitehead [46] as invalid in physics. However, Einstein does not know how to modify the mathematics [15]. Recently, it is found that his justifications are due to invalid applications of special relativity [10].

Moreover, his calculation for the bending of light has actually proved that his theory of measurement is experimentally invalid. If one defines the distance as in the Riemannian space, one would get only half of the observed value of light bending [22]. It turns out, however, that the correct theory of measurement [43] is just what Einstein practiced in his calculation of the bending of light [10].

$$\frac{d\vec{S}}{d\tau} = -2(\vec{v} \cdot \vec{S})\vec{V}\Phi + v(\vec{S} \cdot \vec{V}\Phi) + \vec{S}(\vec{v} \cdot \vec{V}\Phi) = \vec{v} \times (\vec{S} \times \vec{V}\Phi) + \vec{S} \times (\vec{v} \times \vec{V}\Phi), \text{ where } \phi = -\kappa M/r \quad (12a)$$

$\mathbf{v}$  is the velocity of the gyroscope, and  $\mathbf{S}$  is the spin. From the Kerr metric, one has a different formula [3] as follows:

$$\frac{d\vec{S}}{d\tau} = -3(\vec{v} \cdot \vec{S})\vec{V}\Phi + 3\hat{r}(\vec{S} \cdot \hat{r})(\vec{v} \cdot \vec{V}\Phi), \quad (12b)$$

where  $\hat{r}$  is the unit vector in the r-direction. For a circular orbit, since  $(\vec{v} \cdot \vec{V}\Phi) = 0$ , we have

$$\frac{d\vec{S}}{d\tau} = -2(\vec{v} \cdot \vec{S})\vec{V}\Phi + v(\vec{S} \cdot \vec{V}\Phi) \quad (12a')$$

$$(\vec{v} \cdot \vec{S})\vec{V}\Phi + \vec{v}(\vec{S} \cdot \vec{V}\Phi) = \frac{\kappa M}{r^2} \left[ \hat{y}(-S^y \sin 2\omega t + S^z \cos 2\omega t) + \hat{z}(S^y \cos 2\omega t + S^z \sin 2\omega t) \right] \quad (12c)$$

where  $\omega$  is the circular frequency of the orbiting gyroscope. Thus, gravity Probe-B is designated to accomplish little beyond the bending of light because of inadequate theoretical understanding. It seems a

Nevertheless, many still believe in this invalid "principle", in part, because gauge invariance has a long history starting from electrodynamics. The notion of gauge invariance has been developed to non-Abelian gauge theories such as the Yang-Mills-Shaw theory [47, 48].<sup>9)</sup> They naively extended the invariance of the Abelian gauge to the cases of the Non-Abelian gauges in terms of mathematics. However, subsequently as shown by Aharonov & Bohm [49], the electromagnetic potentials actually are physically effective; and, as shown by Weinberg [50], all the physical non-Abelian gauge theories are not gauge invariant such that masses can be generated. These facts support the view that gauge invariance of the whole theory would be a manifestation that there are some deficiencies [51, 52].

It has been shown by Bodenner & Will [53] and Gérard & Piereaux [54] that the deflection angle is gauge invariant to the second order. However, upon examining the physical meaning of the impact parameter  $b$  of the light ray and the shortest distance  $r_0$  from the light ray to the center of the sun, it is clear that these physical quantities cannot be both gauge invariant. From the Schwarzschild gauge and the harmonic gauge, one has respectively

$$b \approx \kappa M + r_0, \quad (11a)$$

but

$$b \approx 2\kappa M + r_0. \quad (11b)$$

Thus, Einstein's covariance principle is clearly invalid.

Another counter example for the covariance principle is the formulas for the de Sitter precession. For instance, from the Maxwell-Newton Approximation [55, 56], one would obtain a formula [45] as follows:

$$\text{and} \quad \frac{d\vec{S}}{d\tau} = -3(\vec{v} \cdot \vec{S})\vec{V}\Phi, \quad (12b')$$

that is, formula (12a) and (12b) are reduced to (12a') and (12b') respectively.

One may ask whether the difference between (12'a) and (12'b) can be detected experimentally. In principle, they should be distinguishable. However, they cannot be distinguished by the Stanford experiment, gravity Probe-B because this experiment detects only the time average. The time average of the difference is essentially zero since

feasible simple experiment to show the broken down of gauge invariance is still the experiment on local light speeds [43] pioneered by Zhou [2].

Nevertheless, Misner et al. [5, p. 430] claimed that the covariance principle can be verified experimentally, but provided the opposite evidence. For instance, Will [5; p. 1067] claimed Whitehead's theory is invalid; but the solution of Whitehead is diffeomorphic to Einstein's [57]. Their motivation seems to justify such a "principle" because it is often used in arguments of their theory of black holes. One may wonder why nobody corrected their mistake [5]? The answer would be that that many theorists often failed to distinguish the difference between physics and mathematics.<sup>10)</sup>

Moreover, since the covariance principle is necessary to remedy the shortcomings of Einstein's theory of measurement [16], which was justified with applications of special relativity, many would still believe in the covariance principle even though counter examples have been found [41]. *Thus, to understand the issue of the covariance principle thoroughly, one must examine also Einstein's justification for "measurement" with applications of special relativity.*

In the book of Misner et al., their errors in physics, mathematics and logic are exposed, but were not recognized. This supports the claim of Feynman [58] that many theorists in gravitation are just incompetent. To see all these errors clearly, it is necessary to understand also the principle of causality.

## V. THE PRINCIPLE OF CAUSALITY AND THE EINSTEIN EQUATION

The time-tested assumption that phenomena can be explained in terms of identifiable causes is called the principle of causality [55, 56]. This principle is the basis of relevance for all scientific investigations, and thus is always implicitly used [59]. This principle is commonly used in symmetry considerations in electrodynamics.

In general relativity, Einstein and other theorists have used this principle implicitly on symmetry considerations [55] such as for a circle in a uniformly rotating disk and the metric for a spherically symmetric mass distribution. Nevertheless, this principle is often neglected [55, 60] because the confusion on physical coordinates created by the invalid covariance principle that would make it almost impossible to justify the symmetry used. *Applications of the principle of causality become clear after Einstein's equivalence principle is understood* [10, 11].

Because of the "covariance principle", the coordinates were ambiguous, and thus it is often difficult to apply the principle of causality in a logical manner other than implicitly as Einstein did. Since the covariance principle is necessary to remedy the shortcomings of Einstein's theory of measurement [16], many would give up only after it was found recently that the justifications of Einstein's theory of measurement actually were based on invalid applications of special

relativity [10, 61],<sup>11)</sup> in addition to being in disagreement with observed bending of light rays.

There are other useful consequences of the principle of causality. For instance, the weak sources would produce weak gravity is the theoretical foundation of Einstein's requirement on weak gravity [59].<sup>12)</sup> The unbounded "weak waves" of Bondi, Pirani, & Robinson [12] are not valid because it cannot be reduced to the flat metric when gravity is absent. Parameters unrelated to any physical cause in a solution are not allowed. For instance, Penrose [62] accepted the metric with an electromagnetic plane-wave as a source, but it actually is not valid in physics because unphysical parameters are involved [13]. Moreover, a dynamic solution must be related to appropriate dynamic sources [63].

One might argue that a gravitational plane-wave would have no source. For the fact that a plane-wave is intrinsically unbounded, there is no valid explanation until the principle of causality is recognized. A plane wave is not real, but a local idealization of a section of the wave. For a cylindrical symmetric wave, however, appropriate sources must be present. The Einstein-Rosen type waves are invalid because it is impossible to have physically appropriate sources [63]. However, due to inadequate understanding in mathematics and physics, the principle of causality can be misunderstood.

For instance, 't Hooft naively claimed [64], "Dynamical solutions means solutions that depend non-trivially on space as well as time. Numerous of such solutions are being generated routinely in research papers ..." Thus, he has different, but invalid understanding of the principle of causality. He [64] claimed, "To me, causality means that the form of the data in the future,  $t > t_1$ , is completely and unambiguously dictated by their values and, if necessary, time derivatives in the past,  $t = t_1$ . So, I constructed the complete Green function for this system and showed it to Mr. L. This function gives the solution at all times, once the solution and its first time derivative is given at  $t = t_1$ , which is a Cauchy surface." However, his data actually are calculated values only [63] and this unequivocally confirms his confusion.

Thus, his causality only means that a Maxwell-type equation, which produces the Green function, is satisfied. This is inadequate because a solution of the Maxwell equation could violate the principle of causality. For instance, the electromagnetic potential  $A_0[\exp(t - z)^2]$  ( $A_0$  is a constant), is invalid in physics. Although a plane-wave can be considered as an idealization of a field generated by sources, this function cannot be considered as such an idealization [63].

Many relativists recognize the light speed as the speed limit of physical influence, but failed to understand the principle of causality. Moreover, the covariance principle would confuse applied mathematicians such as 't Hooft,<sup>13)</sup> to fail in



distinguishing physics from mathematics [63]. In fact, journals such as the Physical Review also do not understand the principle of causality adequately, and accept unbounded solutions [63]. However, since a bounded dynamic solution is needed for the calculation of radiation, *the non-existence of a bounded dynamic solution remains an unsolved issue.*

## VI. THE EINSTEIN EQUATION AND ITS MISINTERPRETATIONS

Based on his field equation, Einstein [15, 16] made three predictions namely: 1) the gravitational redshifts, 2) the perihelion of Mercury, and 3) the deflection of light. Observations accurately confirm and create a faith in his theory. However, these confirmations are actually inflated and explained as follows:

- 1) The gravitational redshifts were first derived from the invalid 1911 assumption of the equivalence between acceleration and Newtonian gravity. This shows that the gravitational redshifts can be derived from an invalid theory.
- 2) The observed bending of light is inconsistent with Einstein's theory of measurement [65], <sup>14)</sup> but is consistent with the measurement based on the Euclidean-like structure if his equivalence principle is valid for the metric [16].
- 3) As Gullstrand [66] suspected, in 1995 it has been proven impossible to have a bounded dynamic solution.<sup>15)</sup> Thus, the perihelion of Mercury, in principle, is still beyond the reach of the Einstein equation [56]. *This fundamental mistake in calculation, as will be shown, has far reaching influences to other important errors in astrophysics.*

Also, Einstein's controversial notion of gravitational energy-stress being a pseudo-tensor has been proven incorrect [56]. Since Einstein's covariance principle is proven to be invalid [3], and diffeomorphic solutions with the same frame of reference are not equivalent in physics. Therefore, actually none of the predictions had a solid theoretical foundation yet.

An urgent issue is to find a valid physical gauge for a given problem. Fortunately, the Maxwell-Newton approximation has been proven to be an independently valid first order approximation for gravity due to massive sources [59], so that the binary pulsar radiation experiments can be explained satisfactorily [55, 56]. Thus, Einstein's notion of weak gravity (including gravitomagnetism and gravitational radiation [67]) is valid [13, 59]. Moreover, calculations of the Hulse-Taylor experiments of the binary pulsars necessitate that the coupling constants have different signs [56]. Thus, the assumption of a unique coupling sign for the singularity theorems [7] of Penrose and Hawking is proven invalid.<sup>16)</sup>

Moreover, this leads to the investigation that Lo [68] discovered the static charge-mass neutral repulsive force, and thus further confirms the famous formula  $E = mc^2$  being only conditionally valid. Nevertheless, as shown in the 1993 press release of the Nobel Committee for the Physics Prize [4], the "experts" failed to see that the Einstein equation does not have a dynamic solution for a two-body problem. The root of this problem is a failure in mathematics to see that the linearization to obtain an approximate solution is not valid for the dynamic case [10, 11, 56]. Physically, this is due to a failure to recognize that, for the dynamic case, the Einstein equation violates the principle of causality because the absence of an energy-stress tensor in vacuum. Such a tensor is necessary, according to Hogarth [69].

Nevertheless, to counter the claims of Gullstrand [66], the Princeton University published a book [9] by Christodoulou & Klainerman. They claimed that bounded dynamic solutions have been constructed,<sup>17)</sup> due to errors in mathematics such as forgotten to prove a set is non-empty [70-72].<sup>18)</sup> Misner et al. [5] invalidly claimed that their eq. (35.31) has a bounded plane-wave solution [11]; and Wald [7] invalidly claimed that his eq. (4.4.52) has a solution for the second order [55]. Wald [7; p. 183] also incorrectly extended the process of perturbation approximation to the case that the initial metric is not flat. These show that a biased belief can absurdly lead to collective mistakes in mathematics.

Consequently, they also failed to see that the electromagnetic energy is not equivalent to mass [6-8], can be proven even if the electrodynamics of Maxwell were only approximately valid [73, 74]. As a result, not only they incorrectly insisted that the formula  $E = mc^2$  is unconditional [60] but also over-looked that, in contrast to the implicit assumption of Wheeler's simulation, the Einstein equation necessitates the existence of a repulsive charge-mass interaction [75, 76].

In 2005 the effect of such a repulsive force was inadvertently detected by Tsipenyuk & Andreev [77]. They discovered that the weight of a metal ball is reduced after it is irradiated with high energy electrons. However, they could not explain this phenomenon because it was believed that gravity would increase as energy increases. The static charge-mass repulsive force was discovered in 1997 because Lo [68] had already known that  $E = mc^2$  may be invalid.<sup>19)</sup>

The neutral repulsive force derived by Lo [68, 76] is: *For a charge  $q$  and a mass  $m$  separated by a distance  $r$ , the charge-mass repulsive force is  $mq^2/r^3$*  (in the units, light speed  $c = 1$ , and Newtonian coupling constant  $\kappa = 1$  [5]). Further experimental verifications for the details are important because it is the only confirmation of general relativity with a non-massive source, and thus is beyond the Maxwell-Newton Approximation.

In short, for the dynamic case, the Einstein equation is proven invalid. For the static case, verification of the Einstein equation beyond the Maxwell-Newton Approximation depends on the experimental confirmation of the static charge-mass repulsive force. However, the discovery of such a repulsive force casts a strong doubt on a current belief that gravity is always attractive. The explosion of a super nova is a frequently observed phenomenon, but a black hole remains a conjecture that has never been confirmed by observation.

Einstein believed that he has proved the famous formula  $E = mc^2$  for the electromagnetic energy because he has mistaken that the photons have only electromagnetic energy. In 1997, it has been proven that  $E = mc^2$  is conditionally valid, and this explains the failure of Einstein's several attempts to prove this formula for other types of energy [78]. This error on  $E = mc^2$  is the root that the charge-mass interaction is not only overlooked but denied by other theorists earlier.

## VII. MIT OPEN COURSE PHY. 8.033, FALL 2006, LECTURE 16 -- MAX TEGMARK<sup>20)</sup>

To illustrate the influence of the Wheeler School, an open course MIT phys. 8.033 is chosen since it is accessible to everybody. If a reader checks MIT 8.962 general relativity, similar errors can be found although its contents were not very clear. These courses were established in 2006 after P. Morrison passed away.

Some course contents are out-dated at least 25 years since the Wheeler School does not read broadly. Notably, the formula  $E = mc^2$  is still incorrectly considered as unconditionally valid.

In general relativity, the course addresses three issues:

- Principle of equivalence
- Light bending, gravitational redshift
- Metrics

Since the course was prepared in 2006, the influence of Institute Professor P. Morrison disappeared. In this course, the invalid 1911 assumption of equivalence is mistaken as Einstein's equivalence principle of 1916.

The course proclaimed the "weak equivalence principle" as no local experiment can distinguish between a uniform gravitational field  $g$  and a frame of accelerated with  $a = g$ . This error is due to the Wheeler School since the ambiguous notion of local experiment is invented by the Wheeler School. First, according to Einstein's equivalence principle, the effect of an accelerated frame is not equivalent to a uniform Newtonian gravitational field [23, 25]. Second, the Einstein-Minkowski condition [15, 16], which is the physics of Einstein's equivalence principle, is ignored. Also, there are local experiments that can distinguish the

effect of an accelerated frame from an approximately uniform field [79].

The claim of the "strong equivalence principle" that the laws of physics take on their special relativistic form in any local inertial frame is due to the Wheeler School. The correct statement should be that the laws of physics take on the approximate special relativistic form in any local inertial frame. The claim of considering that a free falling elevator is a locally inertial frame so the strong version says that special relativity applies in all such elevators anywhere and any time in the universe, is copied from the Wheeler School and manifests of ignorance on Einstein's equivalence principle. The course incorrectly claimed

- EP implication 1: Gravity bends light
- EP implication 2: Gravitational redshift.
- EP implication 3: It is all geometry (learn how to work with metrics!)

First their version of EP, as already known, cannot lead to the correct light bending. Second, although it does lead to gravitational redshift, the argument has been proven invalid in physics since gravity is not generally equivalent to acceleration. The claim, "It is all geometry" has no meaning since the issue of the physical gauge is ignored.

Since the instructor does not understand Einstein's equivalence principle, he is unable to address how the issue of length related to the metric that Whitehead [46] criticized. In particular, he also did not know that the Newtonian metric,  $d\tau^2 = (1 + 2\phi)dt^2 - dx^2 - dy^2 - dz^2$ , is not valid in general relativity [25] although the Wheeler School knows this well.<sup>21)</sup>

It is also clear that the instructor does not understand Einstein's covariance principle. He considered this naively as only the validity of coordinate transformation in mathematics. However, the essence of the covariance principle leads to conflicts because the physical meaning of the coordinates is related to the gauge [1-3, 40].

Another important issue is the perihelion of Mercury that Einstein claimed to have been fully explained in general relativity. On the other hand, Gullstrand [66] suspected that Einstein's claim is invalid. Since the perihelion is actually calculated in term of the perturbations of other planets, a central issue is whether the perturbation approach is valid for the Einstein equation. In most textbooks, for instance reference [67], it is claimed that linearization would give a valid approximate solution.<sup>22)</sup> However, it has been proven that the Einstein equation does not have a bounded solution for a two-body problem [55, 56]. Many insisted on that the approach of linearization is valid. However, sciences are based on evidences not just the opinion of majority. Nevertheless, many just do not have the mathematical background [63].

In short, Tegmark also fails to tell the difference between mathematics and physics and in addition has an inadequate background in mathematics and is essentially an applied mathematician such as 't Hooft [63]. This is further supported by the fact that Tegmark has also formulated the "Ultimate ensemble theory of everything", whose only postulate is that "all structures that exist mathematically exist also physically". This idea is formalized as the "Mathematical universe hypothesis" in his paper *The mathematical universe*, a short version of which was published as *Shut up and calculate* (Wikipedia). A suggestion for him would be "Shut up, think, and then calculate".<sup>23)</sup>

Also, the Wheeler School actually provides a simple evidence for their own down fall. They claim [5] that there is a bounded wave solution for their equation (35.31). However, it is not difficult to show that such a claim is incorrect with mathematics at the undergraduate level [10, 11]. Since everybody would understand mathematics at such a level, the claim of authority would no longer work for them. This is also a problem for the Nobel Committee to consider.

E. Bertschinger and S. A. Hughes of MIT studied the linearized equation of the Einstein equation. However, they do not understand that for the dynamic case, the non-linear Einstein equation and its linearized equation do not have any compatible solutions [55, 56]. In fact, the linearized equation is compatible with a modified Einstein equation with an additional gravitational energy-momentum tensor in the source with an anti-gravity coupling [55, 56]. In other words, in the Physics Department of MIT, nobody understands the basic essence of general relativity.

## VIII. CONCLUSIONS AND REMARKS

The Wheeler School continues Einstein's error on the principle of covariance; and made new errors in misinterpreting Einstein's equivalence principle and the principle of causality. Moreover, they maintain even obvious errors by ignoring work of others, including Einstein [15] and Weinberg [40]. Their ambition is manifested in naming their book "Gravitation" instead of general relativity like others.<sup>24)</sup> *However, to justify Einstein's covariance principle as if valid, it is necessary to distort Einstein's equivalence principle for consistence; and thus created more errors.*

Wheeler started by picking up the abandoned work of Oppenheimer [14]. The Wheeler School gained their reputation as the advocate of general relativity<sup>1)</sup> by distorting Einstein's equivalence principle to a combination of the errors of Pauli [33] and also Fock [25], but ignored Einstein's [15, 16] and related mathematics [34]. Nevertheless, they managed to convince the 1993 Nobel Committee to adopt their version [4]. In 1994 they [8] openly rejected Einstein's equivalence principle, which they [5] do not understand

as shown by their erroneous eq. (40. 14).<sup>2)</sup> Also the MIT Open Course phys. 8.033 has been changed to their views the next year after MIT Institute Professor P. Morrison passed away.<sup>25)</sup> Thus, in defense of the honor of Morrison, it is necessary to point out their distortions and related errors [30].

The acceptance of the Wheeler School is due to the publicity skills of Wheeler in spite of inadequacy in mathematics and physics [43, 56].<sup>1)</sup> However, there is no conclusive hard evidence to support any of their speculations. They [5] rely essentially on the covariance principle to create confusion to substantiate their claims. The Wheeler School invents the term "standard theory" for their status. However, such a notion was challenged by the editorial of the Royal Society. They failed to meet such a challenge [13] because they do not understand the principle of causality adequately. However, they simply ignore the challenge. Members of the Wheeler School help each other to maintain and re-enforce their errors by ignoring criticisms and/or with invalid arguments.<sup>1)</sup> However, their incompetence illustrates their errors. They claimed that their eq. (35.31) has a bounded solution is due to errors at the undergraduate level [11, 80]; and there are no bounded plane-wave solutions [81]. Another basic problem of the Wheeler School is that they are unable to recognize any new physics from observation; and those in the position of editors would reject a paper according to just their opinion instead of evidence. For instance, the fact that a charged capacitor has reduced weight [82] was ignored as experimental errors without adequate deliberation.

Einstein's equivalence principle has a foundation in mathematics [38] and also experimental supports [32]. Nevertheless, many instead believe in errors related to the covariance principle [10]. They failed to see that the notion of general gauge invariance is actually invalid (see Section 4). *Due to inadequacy in mathematics and physics, the Wheeler School mistakenly chooses the covariance principle; and thus it becomes necessary for them to distort Einstein's equivalence principle.* However, the problem is that both mathematics and physics do not allow such distortions.

Unfortunately, there are prominent theorists who also made similar errors as the Wheeler School.<sup>26)</sup> For instance, Eric J. Weinberg, editor of the "Physical Review D", claimed that the difference between these two versions of Einstein and Pauli is not physical [22], and rejected any paper claimed otherwise. *Thus, he failed to see that eq. (40. 14) in reference [5] is incorrect.* He rejected proofs for the conditional validity of  $E = mc^2$  based on existing theories [68, 83, 84].<sup>27)</sup> He also won prizes (1992, 1995, 2000) from "Gravity Research Foundation" that always keeps her judges undisclosed.

In general relativity, the fundamental issues are: Einstein's equivalence principle, Einstein's covariance principle, the principle of causality, invalidity of linearization, and measurements of the distance.

However, the Wheeler School and associates manage to make errors in all five issues because of their inadequacy in mathematic and physics.

Moreover, there are three more related issues: 1) the formula  $E = mc^2$  is conditionally valid since the electromagnetic energy is not equivalent to mass; 2) the coupling signs have been found not unique, and thus the singularity theorems are irrelevant; and 3) the photons include non-electromagnetic energy because they are equivalent to mass. The errors on these issues are due to inadequacy in mathematics, and earlier immature physical concepts. The photon was proposed as including only electromagnetic energy before general relativity. Moreover, the photons including energy other than the electromagnetic energy imply that current quantum mechanics is not a final theory.

Nevertheless, after general relativity is rectified, the necessity of unification between gravitation and electromagnetism is clear since the charge-mass interaction is discovered. Then the discovery of NASA's pioneer anomaly would be understandable in physics. Einstein actually leaves us a far greater treasure to be explored [73, 74].

Great scientists such as Einstein also made mistakes. (Einstein's justifications for measurement [15, 16] are based on invalid applications of special relativity [10] and lead to difficulties in defining physical quantities [65]. His simple adaption to Riemannian geometry [15, 16] created a problem of incompatibility to the rest of physics.) *However, after his errors are rectified, general relativity is no longer incompatible with other theories in physics; and Einstein emerges as an even better physicist since his conjecture of unification is proven necessary.* Whitehead [46] had remarked, "But the worst homage we can pay to genius is to accept uncritically formulations of truths which we owe to it."

Modern physics has been developed to such a stage that frontier physicists can no longer afford to ignore physical principles, and/or to leave all pure mathematics to mathematicians. Einstein did not understand mathematical analysis, and thus he could not modify the mathematics for the need of physics [43]. Pauli and the Wheeler School do not understand the related mathematics, and thus failed to see that there are restrictions to the equivalence principle that cannot be changed at will. *The distortion of Einstein's equivalence principle is the root that is related to all other errors.* Now, the importance of Einstein's equivalence principle has been firmly re-established [10]. Note also that only when the principle of causality is better understood, can we succeed in proving the non-existence of dynamic solutions.

Nevertheless, because the Field medalists do not understand the restriction in physics,<sup>28)</sup> they also failed to see this. Thus, in 2011 Christodoulou was absurdly awarded a half Shaw Prize for his errors in general relativity [3, 9] against the honorable Gullstrand

[66].<sup>29)</sup> Note that, as Whitehead [46] pointed out, *Physics is not just a branch of geometry as the Wheeler School advocated.* Some theorists claim if there are more experiments, the situation in general relativity would be better. However, the realistic situation is, for instance, experiments of the binary pulsar are misinterpreted because of theoretical errors.<sup>30)</sup> Now, it is the time for the US to get rid of the theoretical obstacles<sup>31)</sup> and get the benefits from extensively invested experiments in return. Then, new theoretical research and experiments would start.

It is hoped that this paper, together with the quotation of Weinberg, would be helpful to physicists, including those who used to work on out-dated theories.<sup>32)</sup> Also, one would see errors, if one works out explicit specific examples for the claims and reads the original papers carefully. Moreover, it is time to do some meaningful work related to experiments together with reliable mathematics and logic [3, 10, 79, 85].<sup>33)</sup> An interesting issue would be how to prevent errors of such a magnitude and duration in the future. Many of the current problems are due to irrational confidence because of early widely spread ignorance and error; and thus it would be helpful if the education of mathematics is strengthened.

## IX. ACKNOWLEDGMENTS

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### a) Appendix: Summary of Misrepresentations and Errors in General Relativity

For the convenience of the readers, the errors and misinterpretations in general relativity are summarized in this Appendix. The first error, suspected by Gullstrand [66], is the non-existence of dynamic solutions. However, this error lasts for more than 95 years; and in 2011 half of a Shaw Prize for mathematics was awarded to Christodoulou [86] for his errors against Gullstrand.<sup>34)</sup> This error has been firmly well-established because it can also be illustrated with examples understandable at the undergraduate level. The fundamental issues that historically relate to errors are:

- 1) Einstein's 1911 assumption of equivalence between acceleration and Newtonian gravity [24]: It was used to derive the correct gravitational redshifts, but the so-obtained light bending deflection disagrees with observation.
- 2) Einstein's equivalence principle [15]: The effects of an accelerated frame are equivalent to a uniform



- gravity (generated by a metric). In physics, the local metric of a particle under the influence of gravity is a local Minkowski metric [15]. This principle can be illustrated with explicit examples and is supported by experiments. Since the local metric of the earth is only a locally constant metric at one point, Einstein pointed out that the gravity cannot be transformed away by using an accelerated frame. Thus, gravity and acceleration are not generally equivalent.
- a) Pauli's misinterpretation [33]: Pauli claimed that the gravity of an infinitesimal region can be transformed away; but the local metric of a particle need not be locally Minkowski.
  - b) The misinterpretation of Misner, Thorne & Wheeler [5]: They agree with Pauli and incorrectly claimed that gravity is equivalent to acceleration in a small region of the local metric. What they referred to is the Newtonian gravity (since they agree with Fock [25] and reject the principle). Moreover, they claimed that in such a small region the local metric is necessarily Minkowski (the so-called Lorentz invariance). However, their notion of Lorentz invariance is incorrect in mathematics and is not favored by the 2009 experiment of Chu et al. [87].
  - c) Fock [25] misinterpreted that Einstein's equivalence principle as the 1911 assumption. He shows that it is impossible to have a metric for the Newtonian gravity in general relativity; and invalidly rejected the principle.
- 3) Einstein's covariance principle: Einstein extended his principle of general relativity to unrestricted mathematical covariance and called it as the "principle of covariance". The motivation of this principle is a remedy of his theory of measurement [15, 16]. Since different gauges would lead to different physical interpretations of the coordinates [1, 3], this is in conflict with his equivalence principle which implies the local time dilation and space contractions are unique. These are the experimental support of Einstein's equivalence principle.
  - 4) Einstein's measurement of the distance [15]: Einstein's adaptation of the notion of distance in a Riemannian space. Such an adaptation has been pointed out by Whitehead [46] as invalid in physics. Also, it is found that his justifications for his adaptation are due to invalid applications of special relativity [10]. It turns out that the correct theory of measurement [43] is just what Einstein practiced in his calculation of light bending. Then, the measurement of distance is consistent with the observed bending of a light ray [22]. Thus, it becomes clear that to regard the Hubble redshifts as due to the Doppler effects is invalid [88], as Hubble himself also disagrees.
  - 5) The question of a physical gauge: The invalidity of the covariance principle exposed an urgent issue, i.e., to find a valid physical gauge for a given problem. Fortunately, the Maxwell-Newton approximation has been proven to be an independently valid first order approximation for gravity due to massive sources [59], so that the binary pulsar radiation experiments can be explained satisfactorily [55, 56]. Thus, Einstein's notion of weak gravity (including gravitomagnetism and gravitational radiation [67]) is valid [13, 59].
  - 6) The principle of causality is implicitly used in any scientific research. In general relativity, this principle is implicitly used by Einstein in symmetry considerations [15]. However, theorists such as Penrose [62] and 't Hooft [63, 64] do not understand this principle adequately. The Physical Review also failed to understand the principle of causality adequately and thus mistakenly believed that the non-linear Einstein equation has wave solutions [63]. In particular, this journal still falsely considered their editors are better than anybody else in the field of physics.
  - 7) Invalidity of linearization [10]: Currently, to obtain an approximation through linearizing the Einstein equation is incorrectly believed as generally valid because linearization has been successful for the static case of massive source. However, this process of linearization for the dynamic cases is invalid since the Einstein equation actually has no bounded dynamics solutions [55, 56]. The physical reason is that such an Einstein equation has no source tensor in the vacuum and thus, the principle of causality is violated since a wave carries energy in vacuum.
  - 8) Bounded dynamic solutions: The Einstein equation has no bounded dynamic solution. Thus the perihelion of Mercury is beyond the reach of Einstein's theory as Gullstrand [66] suspected; and the calculation for the gravitational radiation of binary pulsars is actually invalid. A conclusion from this result is that all the coupling constants cannot have the same sign, and thus the physical assumption of the space-time singularity theorems [7] is invalid.
  - 9) The sign of coupling constants being unique was accepted since  $E = mc^2$  was considered as unconditional. However, the electromagnetic energy cannot be equivalent to mass since the trace of an electromagnetic energy-stress tensor is zero. In fact, for several years, Einstein had tried and failed to prove this formula for other type of energy [78].
  - 10) The photons must have non-electromagnetic energy because the meson  $\pi_0$  decays into two photons. The immature assumption that the photons have

only electromagnetic energy was proposed before general relativity.<sup>35)</sup> Since a charged particle is massive, it is not surprising that the photons should also include gravitational energy.

- 11) The static Einstein equation with the source of a charged particle implies the existence of a static repulsive force between a charge and a massive particle. Moreover, such a repulsive effect has been inadvertently observed by Tsipenyuk & Andreev [77]. Thus, unification of gravitation and electromagnetism is actually necessary.

Note that all the errors are directly or indirectly related to distortions of Einstein's equivalence principle. The invalid speculation of unconditional validity of  $E = mc^2$  is the source of many errors in general relativity, and thus Einstein's general relativity is not yet complete. Its completion would be crucial to explain the Hubble redshifts and the pioneer anomaly discovered by NASA [17-19], and may even be needed to explain problem of renormalization.

### ENDNOTES

- 1) The editorial of General Relativity and Gravitation considers the claims of the Wheeler School as "well-established science", but were unable to provide evidence to support such claims [March 8, 2012]. Note that since there is no bounded dynamic solution for the Einstein equation [56], the thesis of A. Ashtekar (editor-in-chief), "*Asymptotic Structure of the Gravitational Field at Spatial Infinity*", seems to just inherit the errors of Wald [7]. Moreover, in his quantum gravity, he failed to see that the photons must include gravitational energy [10, 83]. C. M. Will, editor-in-chief of Classical and Quantum Gravity, continues to ignore the errors of the Wheeler School [6, 68, 84].
- 2) Eddington [44], Liu [36], Straumann [89], Wald [7], and Weinberg [40] did not make the same mistake.
- 3) This experimental fact is ignored by the Wheeler School or they simply were unaware of this.
- 4) In fact, this author had made the same mistake [90] that was discovered in our discussions with Morrison.
- 5) It is surprising that "expert" Thorne [14] also made such a factual error.
- 6) Nevertheless, the 1993 Nobel Committee was unaware of that Einstein's equivalence principle has been verified.
- 7) Like other theoretical physicists, Pauli [33] and Misner et al. [5] also did not have adequate training in pure mathematics.
- 8) The misinterpretation of Misner et al. [5] creates the so-called Lorentz invariance, being tested by Chu et al. [87].
- 9) A footnote of Part II of reference [48] reads: "The work described in this chapter (ch.III) was completed, except for its extension in Section 3, in January 1954, but was not published. In October 1954, Yang and Mills adopted independently the same postulate and derived similar consequences." Yang-Mills-Shaw made only a crude proposal that cannot explain things [50]. Moreover, the underlying idea of total gauge invariance has been proven invalid.
- 10) Being a student of Oppenheimer, Morrison has a very sharp ability in distinguishing the physics from mathematics.
- 11) Experimentally, based on Thorne's calculation [91], invalidity of such a measurement can be further proven [92].
- 12) The Wheeler School failed to defend the requirement for weak gravity to meet the challenge of Bondi et al. [12].
- 13) In his 1999 Nobel Speech, 't Hooft also showed misunderstandings of the notion of mass and special relativity. 't Hooft [64] claimed that many of his colleagues agree with him, but this only means they make the same error.
- 14) Such an inconsistency has been discovered, and Einstein's derivation was not repeated in most textbooks.
- 15) A main error of Einstein, Infeld, & Hoffmann [93], Damour [94], Misner et al, [5], Wald [7], Will [6] and etc. is that they are unaware of that the mathematical existence of a bounded dynamic solution needs to be proved. It should be noted that Wald [7] failed to see that his eq. (4.4.52) cannot be satisfied for the dynamic case [55, 56].
- 16) The unique sign of couplings was accepted because the formula  $E = mc^2$  was believed to be unconditional.
- 17) Understandably, because of totally unexpected, it was difficult for Princeton graduates such as Frank Wilczek to see such mathematical errors from Princeton University although he has a M. Sc. degree in mathematics.
- 18) Christodoulou & Klainerman [9] were unaware of that their set of solutions may have only static physical solutions [70-72]. Obviously, Christodoulou was still not aware of this when he received his half Shaw Prize in 2011.
- 19) This is a case that the static Einstein equation can predict beyond the Maxwell-Newton Approximation [95].
- 20) The research of Tegmark has focused on cosmology, combining theoretical work with new measurements to place constraints on cosmological models and their free parameters, often in collaboration with experimentalists (from Wikipedia, the free encyclopedia). He has developed data analysis tools based on information theory and applied them to Cosmic Microwave Background

- experiments such as COBE, QMAP, and WMAP, and to galaxy redshift surveys such as the Las Campanas Redshift Survey, the 2dF Survey and the Sloan Digital Sky Survey.
- 21) Fock [25] showed that it is impossible to express a Newtonian uniform gravity with a spacetime metric.
  - 22) Nobel Laureate 't Hooft [63] and Hehl [96] also believe that linearization is unconditionally valid as Bertschinger did [67]. However, the error is probably originated from the book of Christodoulou & Klainerman [9].
  - 23) In cosmology, as C. N. Yang [97] pointed out, it is rather speculative and difficult to be rigorous. This inevitably would make some of them to argue speculatively, and occasionally to use questionable logic without noticing it.
  - 24) Misner et al. [5] combined the 1911 assumption [24] and the errors of Pauli [33] as their version of the equivalence principle. Another problem is that they [5] maintain mistakes that others [15, 40] have clearly shown.
  - 25) Under the leadership of Weisskopf, the tradition of MIT is that general relativity must be understood in terms of physics. However, the Wheeler School started to take over after Morrison past away.
  - 26) Because the 1911 assumption is well-known to be incorrect after the 1919 British expeditions, in a book of 1973, there is no rational reason to take the 1911 assumption of equivalence between acceleration and Newtonian gravity as the reference for Einstein's equivalence principle, instead of his statements in his 1916 paper and his book. Such acts support the suspicion that the Wheeler School had planned to get rid of Einstein's equivalence principle.
  - 27) His demand for experimental supports helps discovering of the charge-mass interaction. However, due to inadequacy in mathematics, Eric J. Weinberg believes that there are dynamic solutions for the Einstein equation [98].
  - 28) Before 1993 mathematicians (including the Field Medalists E. Witten (1990), and S. T. Yau (1982) whose works have been closely related to general relativity) also failed to discover their work is misleading in physics [99]. Note also that there are at least a dozen of Nobel Laureates who had made errors in general relativity.
  - 29) A. Gullstrand won a Nobel Prize in 1911, was a member of the Nobel Physics Committee of the Swedish Academy of Sciences in 1921, and was the Chairman of the committee (1922-1929).
  - 30) Morrison had discussed with Taylor, but he clarified that Damour is responsible for the calculations [30].
  - 31) In spite of the fact that many errors in general relativity were generated in Princeton University, this does not diminish my respect to this institute as a whole. Many of my respected teachers were graduated from Princeton University; such as Prof. A. J. Coleman and Prof. I. Halperin, who was my advisor for my degrees in mathematics.
  - 32) The invalid speculation  $E = mc^2$ , misinterpreted as mass and energy unification, is prevailing in university courses such as MIT's Phys. 8.033, and Stanford's open lectures on Einstein's Theory of Relativity by Prof. L. Susskind. While giving very clear lectures, he also does not seem to have the background in mathematics to see the errors of Pauli and the Wheeler School on Einstein's equivalence principle and other prevailing errors.
  - 33) Currently MIT has just changed the presidency from the hand of Hockfield to. Reif. While they both are competent administrators, they may have different styles in their leadership, in part, because of differences in background. Hockfield is a scientist and she tends to put more weight to considering evidence instead of a theory; and Rief is an engineer and thus would have an opposite attitude. Both presidents are enthusiastic about basic research extended into new areas. However, in terms of judging a field beyond one's expertise, a person who is more evidence oriented would have a better advantage. Thus, it is expected to be a tough job for Reif, if he wants to go to the bottom of matter for the field of general relativity.
  - 34) Members of the selection committee seem to be very careless. Had the Selection Committee tried to find an example of the dynamic solution that could support the claims of Christodoulou, they would have found his errors.
  - 35) Although the initial proof for the non-equivalence of mass and electromagnetic energy has used general relativity [68], this non-equivalence is independent of general relativity. In fact, this nonequivalence comes from the electromagnetism alone because the electromagnetic energy-stress tensor has a zero trace. Thus, the assumption that the light (or photon) includes only electromagnetic energy is incorrect [10, 85].

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