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Comments on Errors of "A simplified two-body problem in general relativity" by S Hod And Rectification of General Relativity

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ABSTRACT

Hod claimed to have a method to deal with a simplified two-body problem. The basic error of Hod and the previous researchers is that they failed to see that in general relativity there is no bounded dynamic solution for a two-body problem. A common error is that the linearized equation is considered as always providing a valid approximation in mathematics. However, validity of the linearization is proven only for the static and the stable cases when the gravitational wave is not involved. In a dynamic problem when gravitational wave is involved, since it is proven in 1995 that there is no bounded dynamic solution, the process of linearization is not valid in mathematics. This is the difference between Einstein and Gullstrand who suspected that a dynamic solution does not exist. In fact, for the dynamic case, the Einstein equation and the linearized equation are essentially independent equations, and the perturbation approach is not valid. Note that the linearized equation is a linearization of the Lorentz-Levi-Einstein equation, which has bounded dynamic solutions but not the Einstein equation, which has no bounded dynamic solution. Because of inadequacy in non-linear mathematics, many had made errors without knowing them.

Key words

Einstein's equivalence principle; dynamic solution; gravitational wave; principle of causality.

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

1. Introduction.

In Newtonian gravity, the two-body problem has a well-defined compact analytic solution [1]. However, in general relativity, the problem is recognized that it cannot be solved analytically [2-8]. However, many believed that the two-body problem could be solved in the perturbation approach. Their confidence is based on that the linearized Einstein equation has a bounded dynamic solution. However, including the recent paper of Hod [9], they failed to see that the linearized equation provides an approximate solution that is verified only for the static and stable solutions [2-9]. For the dynamic case when gravitational waves are involved, it has been proven in 1995 that the Einstein equation does not have any bounded dynamic solution [10-12]. This has far reaching consequences.

Thus, Einstein is wrong in claiming his calculation of the perihelion of Mercury is valid, but Gullstrand [13], Chairman (1922-1929) of the Nobel Prize Committee for Physics is right who suspected that Einstein's calculation is invalid because it cannot be derived from the approach of a solution for many-body problems.

Moreover, to have a dynamic solution of massive sources, the Einstein equation [14, 15],

$$G_{\mu\nu} \equiv R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = -KT(m)_{\mu\nu}, \qquad (1)$$

where $G_{\mu\nu}$ is the Einstein tensor, $R_{\mu\nu}$ is the Ricci curvature tensor, $T(m)_{\mu\nu}$ is the massive energy-stress tensor, and K (= $8\pi\kappa c^{-2}$, and κ is the Newtonian coupling) is the coupling constant, must be modified to the Lorent-Levi-Einstein equation, 1) which has the gravitational energy-momentum tensor of waves with the antigravity coupling as follows:

$$G_{\mu\nu} \equiv R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = -K[T(m)_{\mu\nu} - t(g)_{\mu\nu}], \qquad (2)$$

where $t(g)_{\mu\nu}$ is the gravitational energy-stress tensor for waves [12]. Note that the linearized Einstein equation is a valid linearization of eq. (2), but not of the Einstein equation, which has no bounded dynamic solution [16].

In fact, for the dynamic case, the Einstein equation and Einstein's linearized equation are independent equations that have no compatible solutions [10-12, 17].

2. Conditionally Validity of Linearization of the Einstein Equation

It is believed that the linearized Einstein equation would give a first order approximation of the solution for the Einstein equation (1). The linearized equation [15] with the linearized harmonic gauge condition $\partial^{\mu}\bar{\gamma}_{\mu\nu} = 0$ 2) is

$$\frac{1}{2}\partial^{\alpha}\partial_{\alpha}\bar{\gamma}_{\mu\nu} = \kappa T(m)_{\mu\nu} \qquad \text{where} \quad \bar{\gamma}_{\mu\nu} = \gamma_{\mu\nu} - \frac{1}{2}\eta_{\mu\nu}\gamma \quad \text{and} \quad \gamma = \eta^{\alpha\beta}\gamma_{\alpha\beta}. \tag{3}$$

Note that we have

$$G_{\mu\nu} = G_{\mu\nu}^{(1)} + G_{\mu\nu}^{(2)} \text{ and } G_{\mu\nu}^{(1)} = \frac{1}{2}\partial^{\alpha}\partial_{\alpha}\bar{\gamma}_{\mu\nu} - \partial^{\alpha}\partial_{\mu}\bar{\gamma}_{\nu\alpha} - \partial^{\alpha}\partial_{\nu}\bar{\gamma}_{\mu\alpha} + \frac{1}{2}\eta_{\mu\nu}\partial^{\alpha}\partial^{\beta}\bar{\gamma}_{\alpha\beta} \tag{4}$$

where $G_{\mu\nu}^{(2)}$ represents the second order terms. This linearized equation is obtained by neglecting the second order terms in the non-linear Einstein equation with a harmonic gauge. An implicit assumption is that the solution is weak.

Thus, it is expected that a solution of the linearized equation is the first order approximation of a solution of the Einstein equation. However, this result has been verified only for the stable cases [15]. Many believed that the linearized equation would give the first order approximation for other circumstances although such a conjecture has never been verified. In fact, there is no bounded dynamic solution when gravitational waves are involved [10-12].

For a linear equation such as the Maxwell equation, a weak solution always exists for weak sources. However, for a non-linear equation, there is no compelling reason that a bounded weak solution exists for a weak source.

Since a linearized equation such as eq. (3) always produces a bounded solution, if the non-linear Einstein equation has only unbounded solutions, the Einstein equation and its linearized equation would have no compatible solutions. Thus, if a bounded weak solution does not exist, then the procedure of "linearization" is not valid. Then, the non-linear Einstein equation and its "linearization" are essentially independent equations.

In the literature, there are explicit examples [18, 19] that show the non-linear Einstein equation and the linearized equation are independent equations that have no compatible solutions. We shall illustrate such characteristics such that the readers, who do not want to read lengthy proofs, can readily accept the fact that Einstein was wrong and there is no dynamic solution for the Einstein equation.

3. Some Examples of no Bounded Dynamic Solutions

Many believed that it would be very difficult to show that there is no dynamic solution for the Einstein equation. However, it is possible to have remarkable evidence. Here, we will show two examples.

3.1. The metric obtained by Bondi, Pirani, & Robinson [18]

The metric is as follows:

$$ds^2 = e^{2\varphi}\left(d\tau^2 - d\xi^2\right) - u^2\begin{bmatrix}\cosh 2\beta\left(d\eta^2 + d\varsigma^2\right) \\ +\sinh 2\beta\cos 2\theta\left(d\eta^2 - d\varsigma^2\right) \\ -2\sinh 2\beta\sin 2\theta\, d\eta\, d\varsigma\end{bmatrix} \tag{5a}$$

where ϕ, β and θ are functions of u ($= \tau - \xi$). It satisfies the differential equation (i.e., their Eq. [2.8]),

$$2\phi' = u\left(\beta'^2 + \theta'^2\sinh^2 2\beta\right) \tag{5b}$$

which is a special case of $G_{\mu\nu} = 0$. They claimed this is a wave from a distant source. The metric is irreducibly unbounded because of the factor u^2. Thus, for this case, there is no bounded dynamic solution.

Moreover, when gravity is absent, it needs to have $2\phi = \sinh 2\beta = \sin 2\theta = 0$. These reduce (5a) to

$$ds^2 = \left(d\tau^2 - d\xi^2\right) - u^2\left(d\eta^2 - d\zeta^2\right) \tag{5c}$$

And thus this metric is not equivalent to the flat metric. Thus, metric (5c) violates the principle of causality again. Moreover, unlike the Schwarzschild solution, in (5a) there is no physical parameter to be adjusted such that metric (5a) becomes equivalent to the flat metric. Clearly, metric (5) is not a bounded dynamic solution, and thus this illustrates that the non-linear Einstein equation and the linearized equation are independent equations.

Moreover, linearization of (5b) does not make sense since variable u is not bounded.

Thus, many claim that Einstein's notion of weak gravity invalid. However, they overlooked that for this case, there is no bounded dynamic solution. This challenges the view that both Einstein's notion of weak gravity and his covariance principle are valid. These conflicting views are supported respectively by the editors of the "Royal Society Proceedings A" and the "Physical Review D". The Royal Society correctly pointed out [20, 21] that Einstein's notion of weak gravity is inconsistent with his covariance principle.

Moreover, Einstein's weak gravity is supported by the principle of causality [11].

3. 2. The Metric of Misner, Thorne, & Wheeler.

The general Einstein equation is complicated. However, Misner, Thorne, and Wheeler [19] inadvertently give a simple example that illustrates the non-existence of a dynamic solution.

The “wave” form considered by Misner, Thorne, & Wheeler [19] is as follows:

$$ds^2 = c^2 dt^2 - dz^2 - L^2\left(e^{2\beta}dx^2 + e^{-2\beta}dy^2\right) \tag{6}$$

where $L = L(u)$, $\beta = \beta(u)$, $u = ct - z$, and c is the light speed. Then, the Einstein equation $G_{\mu\nu} = 0$ becomes

$$\frac{d^2L}{du^2} + L\left(\frac{d\beta}{du}\right)^2 = 0 \tag{7}$$

Misner et al. [19] claimed that Eq. (7) has a bounded solution, compatible with a linearization of metric (6). Such a claim is clearly in conflict with the non-existence of dynamic solutions.

Apparently, they incorrectly believe this is a case different from the metric of Bondi et. al [18]. It will be shown that such a claim is due to a blind faith on Einstein’s claim on the existence of the dynamic solution together with a careless calculation at the undergraduate level.

They further claimed [19],

“The linearized version of Eq. (7) is L’’ = 0 since $(\beta')^2$ is a second–order quantity. Therefore the solution corresponding to Linearized theory is

$$L = 1, \quad \beta(u) \quad \text{arbitrary but small.} \tag{8}$$

The corresponding metric is

$$ds^2 = (1 + 2\beta)dx^2 + (1 - 2\beta)dy^2 + dz^2 - dt^2, \qquad \beta = \beta(t\text{-}z).\text{”} \tag{9}$$

However, careful calculation shows that these claims are also incorrect. In fact, Eq. (7) does not have a physical solution that satisfies Einstein’s requirement on weak gravity. In fact, $L(u)$ is unbounded even for a very small $\beta(u)$.

Linearization of (7) yields $L'' = 0$, and in turn this leads to $\beta'(u) = 0$. Thus, this leads to a solution $L = C_1 u + C_2$ where C_1 & C_2 are constants. Therefore, the requirement $L \approx 1$ implies $C_1 = 0$. *However*, $\beta'(u) = 0$ *implies* $\beta(u)$*=constant, i.e. no waves. Thus, metric (9) is not derived, but only claimed.*

To prove Eq. (7) having no wave solution, it is sufficient to consider the case of weak gravity since a reduction of source strength would lead to weak gravity. For weak gravity of metric (6), one would have

$$L^4 \cong 1, \qquad e^{\pm 2\beta} \cong 1 \qquad \text{and} \qquad L(u) >> |\beta(u)|. \tag{10}$$

L’(u) cannot be a monotonic function of u, unless L’−> 0. Thus, there is an interval of *u* such that the average,

$$\langle L'' \rangle = 0. \tag{11}$$

On the other hand, the average of the second term of equation (7) is always larger than zero unless $\beta'(u) = 0$.

From eq. (10), one would obtain $L\ (\cong 1) > 0$, and one has $0 > L''(u)$ *if* $\beta'(u) \neq 0$. Thus, $-L'(u)$ is a monotonic increasing function in any finite interval of u since $\beta'(u) = 0$ means $L'' = 0$, i.e., no wave. In turn, *since* $\beta'(u)$ *is a “wave factor”,* this implies that $L(u)$ is an unbounded function of u. Therefore, this would contradict the requirement that L is bounded. In other words, Eq. (7) does not have a bounded wave solution. Moreover, the second order term L'' would give a very large term to L, after integration. Also, linearizing Eq. (7) to $L'' = 0$ leads to no wave.

Now, let us investigate the errors of Misner et al. [19; p. 958]. Their assumption is that the signal $\beta(u)$ has duration of $2T$. For simplicity, it is assumed that definitely $|\beta'(u)| = \delta$ in the period $2T$. Before the arrival of the signal at $u = x$, one has

$$L(u) = 1, \qquad \text{and} \qquad \beta(u) = 0 \tag{12}$$

If weak gravity is compatible with Eq. (6), one would have $L(u) \cong 1$. It thus follows from Eq. (7), one has

$$L'(u) = 0 - \int_x^u \beta'^2 dy \approx -\int_x^u \delta^2 dy = \delta^2(u - x) \quad \text{for} \quad x + 2T > u > x,$$

$$\text{or} \quad \approx -\delta^2 2T \qquad \text{for} \quad u > x + 2T \tag{13}$$

Hence

$$L(u) = 1 + \int_x^u L' dy \approx 1 - \int_x^u \delta^2 (y-x) dy = 1 - \frac{\delta^2 (u-x)^2}{2} \quad \text{for} \quad x + 2T > u > x$$

or

$$\approx 1 - \int_x^{x+2T} \delta^2 (y-x) dy - \delta^2 2T \int_{x+2T}^u dy = 1 - \delta^2 2T(u - T - x) \quad \text{for} \quad u > x + 2T \qquad (14)$$

Thus, independent of the smallness of $2\delta^2 T$ (or details of $|\beta'(u)|^2$), L could be approximately zero and violates the condition for weak gravity. Thus, Eq. (7) has no weak wave solution. Moreover, $|L(u)|$ is not bounded since it would become very large as u increases. Thus, restriction of $2\delta^2 T$ being small [19] does not help.

Thus, one can get a no wave solution through linearization of Eq. (7), which has no bounded solution. The assumption of metric form (6) is bounded [19], and has a weak form (9), is not valid. Thus, there is no bounded wave solution for the non-linear Einstein equation, which violates the principle of causality.

The root of their errors was that they incorrectly assumed that a linearization of the Einstein non-linear equation would produce a valid approximation. Thus, they implicitly and incorrectly assume the existence of a bounded wave solution without the necessary verification, and thus obtain incorrect conclusions.

On the other hand, from the linearization of the Einstein equation (the Maxwell-Newton approximation) in vacuum, Einstein [22] independently obtained a solution as follows:

$$ds^2 = c^2 dt^2 - dz^2 - (1+2\phi)dx^2 - (1-2\phi)dy^2 \qquad (15)$$

where ϕ is a bounded function of u $(= ct - z)$. Note that metric (15) is the linearization of metric (6) if $\phi = \beta(u)$, but it cannot be obtained through the non-linear Einstein equation. This illustrates that the Einstein equation and its linearization are essentially independent equations.

Thus, the problem of waves illustrates that the linearization is not valid for the dynamic case when gravitational waves are involved since Eq. (7) does not have a bounded wave solution. In other words, the Einstein equation and its linearization are essentially independent equations.

4. Errors in the Non-existence of a Dyanmic Solution.

Since the error of the non-existence of dynamic solution was made by Einstein, other theorists also made errors by having unverified faith on Einstein. Wald [23] is the better known among them.

According to Einstein [15], in general relativity weak sources would produce a weak field, i.e.,

$$g_{\mu\nu} = \eta_{\mu\nu} + \gamma_{\mu\nu}, \quad \text{where} \quad 1 >> |\gamma_{\mu\nu}| \qquad (16)$$

and $\eta_{\mu\nu}$ is the flat metric when there is no source. However, this is true only if the equation is valid in physics. Many did not see this because they failed to see the difference between physics and mathematics clearly [24]. When the Einstein equation has a weak solution, an approximate weak solution can be derived through the approach of the field equation being linearized. However, the non-linear equation may not have a bounded solution.

The linearized Einstein equation with the linearized harmonic gauge $\partial^\mu \bar{\gamma}_{\mu\nu} = 0$ is eq. (3). Then, the linearized vacuum Einstein equation means

$$G^{(1)}_{\mu\nu}[\gamma^{(1)}_{\alpha\beta}] = 0 \qquad (17)$$

Thus, as pointed out by Wald [23], in order to maintain a solution of the vacuum Einstein equation to second order we must correct $\gamma^{(1)}_{\mu\nu}$ by adding to it the term $\gamma^{(2)}_{\mu\nu}$, where $\gamma^{(2)}_{\mu\nu}$ satisfies

$$G^{(1)}_{\mu\nu}[\gamma^{(2)}{}_{\alpha\beta}] + G^{(2)}_{\mu\nu}[\gamma_{\alpha\beta}] = 0, \qquad \text{where} \quad \gamma_{\mu\nu} = \gamma^{(1)}_{\mu\nu} + \gamma^{(2)}_{\mu\nu} \qquad (18)$$

which is the correct form of eq. (4.4.52) in Wald's book. (In Wald's book, he did not distinguish $\gamma_{\mu\nu}$ from $\gamma^{(1)}_{\mu\nu}$) This equation does have a solution for the static case. However, detailed calculation shows that this equation does not have a solution for the dynamic case [10-12]. However, the Chinese Physics also failed to see this.

The fact that, for a dynamic case, there is no bounded solution for eq. (18) means also that the Einstein equation does not have a dynamic solution. The examples are the metric of Bondi, Pirani, & Robinson [18] and the metric of Misner et al. [19]. Nevertheless, Abhay Ashtekar, Editor-in-Chief of General Relativity and Gravitation, still insists that linearization of the Einstein equation is always valid in mathematics [25]. This is not surprising since his thesis, "*Asymptotic Structure of the Gravitational Field at Spatial Infinity*", also inherits the errors of Wald [23]. [3)]

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Due to confusion between mathematics and physics, Wald [23] made errors at the undergraduate level. The principle of causality requires the existence of a dynamic solution, but Wald did not see that the Einstein equation can fail this requirement [24]. Thus, his theory does not include the dynamic solutions.

There are others who also make errors on the issue of dynamic solutions. Christodoulou & Klainerman [26], and 't Hooft [27, 28] claimed to have explicit examples of bounded dynamic solutions. However, it turns out that these are also due to errors in calculation and or misconceptions as the case of Misner et. al [19]. Christodoulou and Klainerman [26] claimed to have constructed dynamic solutions, but their construction is actually incomplete [29].[4]

In defense of the errors of the 1993 Nobel Prize Committee for Physics, 't Hooft [27, 28] comes up with a bounded time-dependent cylindrical symmetric solution as follows:

$$\Psi(t,r) = A\int_0^{2\pi} d\varphi\, e^{-\alpha(t - r\cos\varphi)^2}, \qquad (19)$$

where *A* and α (> 0) are free parameters. For simplicity, take them to be one. |Ψ| is everywhere bounded.

Then, 't Hooft [27] claimed that his solution, Ψ is obtained by superimposing plane wave packets of the form $exp[-\alpha(x - t)^2]$ rotating them along the z axis over angle φ, so as to obtain a cylindrical solution. Note that since the integrand $exp[-\alpha(t - r\cos\varphi)^2] = exp[-\alpha(t - x)^2]$, there is no rotation along the z axis. The function $exp[-\alpha(t - x)^2]$ is propagating from x = – ∞ to x = ∞ as time t increases.

Note, however, that in a superimposition the integration is over a parameter of frequency ω unrelated to the x-axis; whereas the solution (19) is integrated over φ(x, y). Since, (19) is a combination that involves the coordinate φ (x, y), it is not a superimposition of plane waves propagating along the x-axis. Furthermore, the integration over all angles φ is a problem that would violate the requirement of the idealization because it requires that the plane wave is valid over the whole x-y plane. Thus, function (19) is not valid as an idealization in physics.

Therefore, in solution (19), two errors have been made, namely: 1) the plane wave has been implicitly extended beyond its physical validity, and 2) the integration over dφ is a process without a valid physical justification. Moreover, it has been shown that there are no valid sources that can be related to solution (19) [28]. Thus, since the principle of causality is also violated, his solution is not valid in physics.

5. Problems in Mathematics due to a Failure in Understanding the Physics

In mathematics, a theorem need not be right or wrong, but can be misleading because of some invalid implicit assumptions. Such misleading theorems could be very damaging because of its superficial validity in mathematics. In fact, such an error can be made by top mathematicians such as M. Atiyah. Thus, such misleading results from the positive mass theorem of Yau and Scheon [30, 31] were cited as a main reason to award the 1982 and the 1990 Fields Medal to Yau and Witten,[5] and to award the 2011 Shaw Prize in mathematics to Christodoulou [32].[6]

Briefly, the positive mass conjecture [30, 31] says that if a three-dimensional manifold has positive scalar curvature and is asymptotically flat, then the mass in the asymptotic expansion of the metric is positive (Wikipedia). The unique coupling signs are also implicitly used in the positive energy theorem of Schoen and Yau. A crucial assumption in the theorem is that the solution is asymptotically flat. Yau [30] requires the metric,

$$g_{ij} = \delta_{ij} + O(r^{-1}). \qquad (20)$$

The motivation of (20) seems to be the linearized equation (3). Assumption (20) can be considered as common since it is satisfied in stable solutions such as the Schwarzschild solution, the harmonic solution, the Kerr solution, etc. [7] Thus, this theorem was universally accepted for a long time as a standard argument or the truth in general relativity.

However, if one understands the physics in general relativity as well as Gullstrand [13] does, the above is clearly incorrect. Note that the asymptotically flat does not necessarily imply the inclusion of a dynamic solution. Schoen and Yau failed to see that the linearized equation and the Einstein equation are not always compatible.

Since it has been proven that the Einstein equation has no dynamic solution, which is bounded [10-12]; then the assumption of asymptotically flat implies the exclusion of the dynamic solutions. However, Schoen and Yau failed to see this because it is difficult to see whether there is a dynamic solution in their approach. Thus, they chose to rely on the current conclusion of most physicists. Then, some physicists have turned around to use their theorem to claim absurdly that their proof of the positive energy theorem in general relativity demonstrated—sixty years after its discovery—that Einstein's theory is consistent and stable (Wikipedia). In other words, the conclusions drawn from the positive theorem are grossly misleading. However, the Chinese Physics does not seem to be aware of this.

Thus, Yau and Schoen used an invalid implicit assumption, the existence of bounded dynamic solutions, but were not stated in their theorem. Atiyah, being a pure mathematician, was not aware of the problem of non-existence of bounded dynamic solutions. Moreover, this made Witten and associated string theorists fail to understand general relativity, and thus would not be able to do meaningful work on unification.

Theorists such as Yau [30], Witten [31], Christodoulou [26], Wald [23], and Penrose & Hawking [23] make essentially the same error of defining a set of solutions that actually includes no dynamic solutions [10-12]. This is why many theorists agree with each other due to making the same errors. The fatal error is that they neglected to find explicit examples to support their claims. Had they tried, they should have discovered their errors. Moreover, after Christodoulou was awarded

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the 2011 Shaw Prize, Christodoulou was elected to the Member of U.S. National Academy of Sciences (2012). It would be interesting to see how this special case would end up since the contributions of Christodoulou to general relativity are just errors.

6. Discussions and Conclusions.

Einstein started his faith on general relativity with the remarkable calculation of the remaining perihelion of Mercury. However, Gullstrand, the Chairman (1922-1929) of Nobel Committee for Physics suspected that his calculation was questionable since he failed to show such a calculation is derivable from a many-body problem approach. Thus, Einstein was awarded a Nobel Prize for his photo-electric effects, but not for general relativity.

Although the 1993 Nobel Committee was convinced that Einstein was right [33], in 1995, it was proven that for the dynamic case, i.e., when the gravitational waves are involved, there is no bounded dynamic solution for the Einstein equation. In other words, Einstein has been proven wrong, but Gullstand is right. However, except a few such as Prof. P. Morrison of MIT, many theorists just do not want to go over the proof. Besides, well-known theorists such as Misner et al and Wald insisted, as Einstein claimed, the existence of the dynamic solutions.

In this paper, we show through the theories of Misner et al. [19] and Wald [23] that they are mistaken. It is hope that theorists would go through their errors, and start to read the general proof for the non-existence of bounded dynamic solutions. A problem of the Chinese Physics is that they are not able to stand alone for the truth.

From the explicit calculations, clearly for the dynamic case, the linearized equation is independent of the non-linear Einstein equation. The calculation for the gravitational wave [10-12, 17] illustrates the following:

1) The linearized equation and the non-linear Einstein equation have no compatible solutions.
2) The non-linear Einstein equation for waves has no bounded solution.
3) For the dynamic case, the Einstein equation and its linearized equation are independent equations, and the linearization procedure is not valid for this case.
4) The space-time singularity theorems of Penrose and Hawking are irrelevant to physics since its energy conditions are not satisfied by equation (2).[8)]

The linearized equation is actually a valid linearization of the Lorentz-Levi-Einstein equation [10-12] as follows:

$$G_{\mu\nu} \equiv R_{\mu\nu} - \frac{1}{2} g_{\mu\nu}R = - K [T(m)_{\mu\nu} - t(g)_{\mu\nu}], \qquad (2)$$

where $t(g)_{\mu\nu}$ is the energy-stress tensors for gravity. *Since this equation was approved by Chandraseklar as an editor in 1995, he no longer believed his own view point of 1983 [3].*

Equation (2) explains why the nonlinear Einstein equation always resulting in violating the principle of causality because $t(g)_{\mu\nu}$ is neglected. From Eq. (2), the equation in vacuum is

$$G_{\mu\nu} \equiv R_{\mu\nu} - \frac{1}{2} g_{\mu\nu}R = K\, t(g)_{\mu\nu} . \qquad (2')$$

Note that $t(g)_{\mu\nu}$ is equivalent to $G^{(2)}_{\mu\nu}$ (and Einstein's gravitational pseudotensor) in terms of his radiation formula [3]. The fact that $t(g)_{\mu\nu}$ and $G^{(2)}_{\mu\nu}$ are related under some circumstances does not mean $G^{(2)}_{\mu\nu}$ to be an energy-stress nor $t(g)_{\mu\nu}$ a geometric part, just as $G_{\mu\nu}$ and $T_{\mu\nu}$ must be considered as distinct in (1).

When gravitational wave is present, the gravitational energy-stress tensor $t(g)_{\mu\nu}$ is non-zero. Thus, a radiation does carry energy-momentum as physics requires. This explains also that the absence of an anti-gravity coupling is the physical reason that the 1915 Einstein equation (1) is incompatible with radiation. Now, it is clear that the Einstein equation has no bounded dynamic solution. The most important conclusion is that general relativity has not yet completely replaced Newtonian theory since there is no dynamic solution for a two-body problem.[9)]

Although we have formally obtained a modified Einstein equation (2), this rectification is still incomplete because the exact form of the gravitational energy-stress tensor $t(g)_{\mu\nu}$ is still not known. Moreover, in a dynamic situation, the geodesic as the equation of motion is also inadequate because there is no radiation reaction force in general relativity. Although an accelerated massive particle would create radiation, the metric elements in the geodesic equation are created by particles other than the test particle. Thus, Einstein's general relativity is intrinsically incomplete even for the case of massive sources.

The existence of a dynamic solution requires an additional gravitational energy-momentum tensor with an antigravity coupling. Thus, the space-time singularity theorems, which require the same sign for couplings, are irrelevant to physics and general relativity is valid not only in the large scale. The positive energy theorem of Schoen and Yau is misleading in physics. Moreover, the formula $E = mc^2$ is only conditionally valid [25]. However, such recognition is crucial to identify the charge-mass interaction. Its experimental verification and confirmation means that Einstein's unification between electromagnetism and gravitation is proven valid [34].[10)]

In short, Einstein turns out to be the biggest winner from the rectification of his errors.

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Endnotes:

1) This equation was proposed by Lorentz [36] and later Levi-Civita [37] as a possibility in the following form,

$$\kappa t(g)_{ab} = G_{ab} + \kappa T_{ab}$$

where $t(g)_{ab}$ is the gravitational energy-stress tensor, G_{ab} is the Einstein tensor, and T_{ab} is the sum of other massive energy-stress tensors. Thus, the anti-gravity coupling was first proposed by Lorentz [36] and Levi-Civita [37]. However, Einstein [38] objected to this form on the grounds that his field equation implies $t(g)_{ab} = 0$. Now, Einstein is clearly wrong since his equation is proven invalid for the dynamic case [10-12].

2) To be exact, $\partial^{\mu}\bar{\gamma}_{\mu\nu} = 0$ actually means $\partial^{\mu}\bar{\gamma}_{\mu\nu} =$ a second order term.

3) This is a problem for some established theorists. They have to insist on their errors to maintain their status.

4) The Ph. D. degree advisor of D. Christodoulou is J. A. Wheeler, whose mathematics is also unreliable. The honors awarded to Christodoulou reflected the blind faith toward Einstein and accumulated errors in general relativity [16]. Being incompetent in mathematics, the Wheeler School has made errors in general relativity [39].

5) S. T. Yau and E. Witten respectively won a Fields Medal in 1982 and in 1990. Their works on the positive mass (or energy) were cited as an achievement because the mathematicians do not understand the related physics [40].

6) Some journals just decline to consider a critical article since Atiyah is a well-known mathematician. Thus, they could avoid the burden of being against a well-known mathematician.

7) These solutions do not involve the gravitational waves.

8) Hawking in his visit (June 2006) to China, still misleadingly told his audience that his theory was based on general relativity only. The root of his problem would be that he still does not understand the formula $E = mc^2$.

9) Journals such as the Physical Review, Proceedings of the Royal Society A, the Annals of Physics, and the Chinese Physics were also not aware of this. A problem of the Chinese Physics is that they are not able to stand alone for the truth as Zhou [41] did. Moreover, the editors of the Chinese Physics in gravitation like Eric J. Weinberg, editor of the Physical Review D, are incompetent in both pure mathematics and physics.

10) The existence of repulsive gravitation has been unequivocally verified [42]. Note also that this paper has been sent to International Journal of Modern Physics D for their consideration. After more than half a year, I asked the journal on what has happened to my article. Their reply is that they have not got a response from the referee. Then, one year later, I received another article [35] from this journal, that has committed essentially the same error as before, i.e. it used a perturbation approach to obtain an approximate solution without a proof that it has a bounded solution. Now, it is clear that this journal does not seem to have the ability to care about the truth. Of course, I inform them their new errors, but decide to publish this paper elsewhere.

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Note that a common error is that many believed general relativity has superseded Newtonian theory. This is simply not true and thus should be corrected at this hundred year memory. -- C. Y. Lo

評 Hod 的"廣義相對論中的一個簡化的二体問題"与廣義相對論的修正

Hod 說他有一個解決二体問題的方法。他与前人的基本彷錯誤是沒有看出在廣義相對論中，根本沒有"有界的二体問題解"。共同的错誤是以為線性化方程永遠提供一個近似解。但是，線性化的証明只是在靜态或穩定态，当引力波沒參与的情況下才成立。在動态而引力波參与的情況下，由於 1955 年己証明沒有有界的動力解，線性化是在数學上是不成立的。實際上對動态解而言，爱因斯坦方程及其線性化方程基本上是独立的，而且微扰的方法並不成立。注意，線性化程是線性化具有界動力解的 Lorentz-Levi-Einstein 方程而不是沒有有界動力解的爱因斯坦方程。由於對非線性方程不了解，人们犯错而不自知。