General Relativity – A Theory in Crisis

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The black hole, gravitational waves, and the Big Bang cosmology have no valid basis in science. It is demonstrated herein that Einstein's field equations violate the usual conservation of energy and momentum and are therefore in conflict with experiment on a deep level, so that General Relativity is invalid. This fact alone proves the invalidity of the black hole, gravitational waves, the Big Bang cosmology and Einstein's conception of the gravitational field.

1. Introduction

The black hole, gravitational waves and the Big Bang cosmology have been spawned by Einstein's General Theory of Relativity. However, it is rather easily proven that Einstein's field equations violate the usual conservation of energy and momentum and are therefore in conflict with experiment on a deep level and are therefore invalid. This means that the black hole, gravitational waves and Big Bang cosmology are also invalid. General Relativity fails as a theory of gravitation and cannot describe the Universe.

2. Einstein's Field Equations

According to Einstein, matter is the cause of the gravitational field and the causative matter is described in his theory by a mathematical object called the energy-momentum tensor, which is coupled to geometry (i.e. spacetime) by his field equations, so that matter causes spacetime curvature (his gravitational field) and spacetime constrains motion of matter when gravity alone acts. According to the astrophysics community, Einstein's field equations,

"*... couple the gravitational field (contained in the curvature of spacetime) with its sources.*" (Foster & Nightingale 1995)

"*Since gravitation is determined by the matter present, the same must then be postulated for geometry, too. The geometry of space is not given a priori, but is only determined by matter.*" (Pauli 1981)

"*Again, just as the electric field, for its part, depends upon the charges and is instrumental in producing mechanical interaction between the charges, so we must assume here that the metrical field (or, in mathematical language, the tensor with components* g_{ik} *) is related to the material filling the world.*" (Weyl 1952)

"*... we have, in following the ideas set out just above, to discover the invariant law of gravitation, according to which matter determines the components* $\Gamma^{\alpha}_{\beta\iota}$ *of the gravitational field, and which replaces the Newtonian law of attraction in Einstein's Theory.*" (Weyl 1952)

"*Thus the equations of the gravitational field also contain the equations for the matter (material particles and electromagnetic fields) which produces this field.*" (Landau & Lifshitz 1951)

"*Clearly, the mass density, or equivalently, energy density* $\rho(\vec{x},t)$ *must play the role as a source. However, it is the 00 component of a tensor* $T_{\mu\nu}(x)$ *, the mass-energy-momentum distribution of matter. So, this tensor must act as the source of the gravitational field.* ('t Hooft 2009)

"*In general relativity, the stress-energy or energy-momentum tensor* T^{ab} *acts as the source of the gravitational field. It is related to the Einstein tensor and hence to the curvature of spacetime via the Einstein equation*." (McMahon 2006)

"*Mass acts on spacetime, telling it how to curve. Spacetime in turn acts on mass, telling it how to move.*" (Carroll and Ostlie 1996)

Qualitatively Einstein's field equations are:

Spacetime geometry = -κ × *causative matter*

where *causative matter* is described by the energy-momentum tensor and κ is a constant. The *spacetime geometry* is described by a mathematical object called Einstein's tensor, $G_{\mu\nu}$, (μ, ν = 0, 1, 2, 3). Einstein's field equations are therefore[1]:

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = -\kappa T_{\mu\nu} \qquad (2.1)$$

$R_{\mu\nu}$ is called the Ricci tensor and R the Ricci curvature. If $T_{\mu\nu} = 0$ then one finds that R = 0 and this expression according to Einstein allegedly reduces to

$$R_{\mu\nu} = 0 \qquad (2.2)$$

and is said to describe a universe that contains no matter (the so-called static empty universe).

In the transition from Minkowski spacetime of Special Relativity to Schwarzschild spacetime for the black hole, matter is not involved. The speed of light c that appears in the Minkowski spacetime line-element is a speed, not a photon. For this speed to be assigned to a photon, the photon must be present *a priori*. Similarly, for the relations of Special Relativity to hold, multiple arbitrarily large finite masses and photons must also be present *a priori*. Minkowski spacetime is not Special Relativity because the latter requires the presence of matter, whereas the former does not. Similarly, the presence of the constant c in the line-element for Schwarzschild spacetime does not mean that a photon is present. The transition from empty Minkowski spacetime to empty Schwarzschild spacetime is thus not a generalisation of Special Relativity at all, merely a generalisation of the geometry of Minkowski spacetime. In the usual derivation of Schwarzschild spacetime, mass is included by means of a circular argument, viz. $R_{\mu\nu} = 0$ describes the gravitational field "outside a body". When

[1] The so-called "cosmological constant" is not included.

one inquires of the astrophysics community as to what is the source of this alleged gravitational field "outside a body", one is told that it is the body outside of which the gravitational field exists, in which case the body must be described by a non-zero energy-momentum tensor since Einstein's field equations "*… couple the gravitational field … with its sources*" (Foster & Nightingale 1995). Dirac (1996) tells us that

"*…the constant of integration m that has appeared … is just the mass of the central body that is producing the gravitational field.*"

We are told by Einstein (1967) that in the "Schwarzschild solution"

"*… M denotes the sun's mass centrally symmetrically placed about the origin of coordinates.*"

According to Weyl, (1952)

"*… the quantity* m_o *introduced by the equation* $m=km_o$ *occurs as the field-producing mass in it; we call m the gravitational radius of the matter causing the disturbances of the field.*"

Foster and Nightingale (1995) assert that

"*…the corresponding Newtonian potential is* $V = -GM/r$*, where M is the mass of the body producing the field, and G is the gravitational constant … we conclude that* $k = -2GM/c^2$ *and Schwarzschild's solution for the empty space outside a spherical body of mass M is …*"

After the so-called "Schwarzschild solution" (which is not in fact Schwarzschild's solution at all – see Schwarzschild 1916, Abrams 1989, Antoci 2001) is obtained, there is no matter present. This is because the energy-momentum tensor is set to zero and Minkowski spacetime is not Special Relativity. The astrophysics community merely inserts (Weyl 1952 says "*introduced*") mass and photons by erroneously appealing to Newton's theory and assigning to the constant of integration in the resulting metric the square of Newton's expression for escape velocity, through which they also get any number of masses and any amount of radiation by applying the Principle of Superposition (and also the 'escape velocity' of a black hole). This is done despite the fact that the Principle of Superposition does not apply in General Relativity. However, Newton's relations involve *two bodies* and the Principle of Superposition. Even though only one mass term appears in Newton's expression for escape velocity it is implicitly a two-body relation: one body escapes from another body. One cannot deduce Newton's expression for escape velocity without appealing to Newton's expression for gravitational force, which is a two-body relation, or alternatively appealing to classical conservation of energy involving once again two-bodies. It is impossible for an implicit two-body relation to appear in what is alleged to be an expression for a universe that contains only one body. Conversely, $R_{\mu\nu} = 0$ contains *no bodies* and cannot accommodate the Principle of Superposition. The astrophysics community removes all matter on the one hand by writing $R_{\mu\nu} = 0$ on account of setting the energy-momentum tensor to zero, and then puts matter back in at the end with the other hand by means of Newton's theory in order to satisfy the initial words "outside a body" by which the alleged presence of a body is maintained despite setting the energy-momentum tensor to zero at the outset. The whole procedure constitutes a violation of elementary logic and a play on the words "outside a body".

Einstein asserted that his Principle of Equivalence and his laws of Special Relativity must hold in sufficiently small regions of his gravitational field, and that these regions can be located anywhere in his gravitational field. Here is what Einstein (1967) said in 1954, the year before his death:

"*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 later, 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 co-ordinate systems which are in non-uniform motion relatively to each other. In fact, through this conception we arrive at the unity of the nature of inertia and gravitation. For, according to our way of looking at it, the same masses may appear to be either under the action of inertia alone (with respect to K) or under the combined action of inertia and gravitation (with respect to K′).*

"*Stated more exactly, there are finite regions, where, with respect to a suitably chosen space of reference, material particles move freely without acceleration, and in which the laws of special relativity, which have been developed above, hold with remarkable accuracy.*"

In their textbook, Foster and Nightingale (1995) succinctly state the Principle of Equivalence thus:

"*We may incorporate these ideas into the principle of equivalence, which is this: In a freely falling (nonrotating) laboratory occupying a small region of spacetime, the laws of physics are the laws of special relativity.*"

According to Pauli (1981),

"*We can think of the physical realization of the local coordinate system* K_0 *in terms of a freely floating, sufficiently small, box which is not subjected to any external forces apart from gravity, and which is falling under the influence of the latter. ... It is evidently natural to assume that the special theory of relativity should remain valid in* K_0.

Taylor and Wheeler (2000) state in their book,

"*General Relativity requires more than one free-float frame.*"

Carroll and Ostlie (1996) write,

"***The Principle of Equivalence****: All local, freely falling, nonrotating laboratories are fully equivalent for the performance of all physical experiments. … Note that special relativity is incorporated into the principle of equivalence. … Thus general relativity is in fact an extension of the theory of special relativity.*"

In the Dictionary of Geophysics, Astrophysics and Astronomy (Matzner 2001) it is stated that:

"*Near every event in spacetime, in a sufficiently small neighborhood, in every freely falling reference frame all phenomena (including gravitational ones) are exactly as they are in the absence of external gravitational sources.*"

Note that the Principle of Equivalence is defined in terms of the *a priori* presence of multiple arbitrarily large finite masses. Similarly, the laws of Special Relativity are defined by the *a priori* presence of arbitrarily large finite masses and photons, for otherwise relative motion between two bodies cannot manifest. The postulates of Special Relativity are themselves couched in terms of multiple inertial systems, which are in turn defined in terms of masses via Newton's First Law of motion. "Schwarzschild's solution" (and indeed all black hole "solutions"), pertains to a universe that contains only *one* mass. According to the astrophysics community, "Schwarzschild" spacetime consists of one mass in an otherwise *totally empty universe*, and so its alleged black hole is the only matter present - it has nothing to interact with, including "observers" (on the assumption that any observer is material).

In the space of Newton's theory of gravitation, one can pile up into space as many masses as desired. Although solving for the gravitational interaction of these masses rapidly becomes intractable, there is nothing to prevent us inserting masses conceptually. This is essentially the Principle of Superposition. However, one cannot do this in General Relativity, because Einstein's field equations are non-linear. In General Relativity, each and every configuration of matter must be described by a corresponding energy-momentum tensor and the field equations solved separately for each and every configuration, because matter and geometry are coupled, as eq. (2.1) describes. This is not the case in Newton's theory, where space is not coupled to matter. The Principle of Superposition does not apply in General Relativity:

"*In a gravitational field, the distribution and motion of the matter producing it cannot at all be assigned arbitrarily --- on the contrary it must be determined (by solving the field equations for given initial conditions) simultaneously with the field produced by the same matter.*" (Landau & Lifshitz 1951)

"*An important characteristic of gravity within the framework of general relativity is that the theory is nonlinear. Mathematically, this means that if g_{ab} and γ_{ab} are two solutions of the field equations, then $ag_{ab} + b\gamma_{ab}$ (where a, b are scalars) may not be a solution. This fact manifests itself physically in two ways. First, since a linear combination may not be a solution, we cannot take the overall gravitational field of the two bodies to be the summation of the individual gravitational fields of each body.*" (McMahon 2006)

The astrophysics community claims that the gravitational field "outside" a mass contains no matter, and thereby asserts that the energy-momentum tensor $T_{\mu\nu} = 0$. Despite this, it is routinely alleged that there is only one mass in the whole Universe with this particular problem statement. But setting the energy-momentum tensor to zero means that there is no matter present by which the gravitational field can be caused, by virtue of the fact that the field equations couple the gravitational field to its sources. As we have seen, when the energy-momentum tensor is set to zero, it is also claimed that the field equations then reduce to the much simpler form,

$$Ric = R_{\mu\nu} = 0 \ .$$

"*Black holes were first discovered as purely mathematical solutions of Einstein's field equations. This solution, the Schwarzschild black hole, is a nonlinear solution of the Einstein equations of General Relativity. It contains no matter, and exists forever in an asymptotically flat space-time.*" (Matzner 2001)

However, since this is a spacetime that *by construction* contains no matter, Einstein's Principle of Equivalence and his laws of Special Relativity cannot manifest, thus violating the physical requirements of his gravitational field. It has never been proven that Einstein's Principle of Equivalence and his laws of Special Relativity, both of which are defined in terms of the *a priori* presence of multiple arbitrary large finite masses and photons, can manifest in a spacetime that *by construction* contains no matter. Now the "Schwarzschild solution" relates to eq. (2.2). However, there is allegedly mass present, denoted by *m* in the "Schwarzschild solution". This mass is not described by an energy-momentum tensor. The reality that the *post hoc* mass *m* is responsible for the alleged gravitational field due to a black hole associated with the "Schwarzschild solution" is confirmed by the fact that if $m = 0$, the "Schwarzschild solution" reduces to Minkowski spacetime, and hence no gravitational field according to the astrophysics community. If not for the presence of the alleged mass *m* in the "Schwarzschild solution" there would be no cause of their gravitational field. But this contradicts Einstein's relation between geometry and matter, since *m* is introduced into the "Schwarzschild solution" *post hoc*, not via an energy-momentum tensor describing the matter causing the associated gravitational field.

In Schwarzschild spacetime, the components of the metric tensor are only functions of one another, and reduce to functions of just one component of the metric tensor. None of the components of the metric tensor contain matter, because the energy-momentum tensor is zero. There is no transformation of matter in Minkowski spacetime into Schwarzschild spacetime, and so the laws of Special Relativity are not transformed into a gravitational field by *Ric* = 0. The transformation is merely from a pseudo-Euclidean geometry containing no matter into a pseudo-Riemannian (non-Euclidean) geometry containing no matter. Matter is introduced into the spacetime of *Ric* = 0 by means of a vicious circle, as follows. It is stated at the outset that *Ric* = 0 describes spacetime "outside a body". The words "outside a body" immediately re-introduces matter, contrary to the energy-momentum tensor $T_{\mu\nu} = 0$, that describes the causative matter as being absent. There is no matter involved in the transformation of Minkowski spacetime into Schwarzschild spacetime via *Ric* = 0, since the energy-momentum tensor is zero, making the components of the resulting metric tensor functions solely of one another, and reducible to functions of just one component of the metric tensor. To satisfy the initial claim that *Ric* = 0 describes spacetime "outside a body", so that the resulting spacetime curvature is caused by the alleged mass present, the alleged causative mass is *inserted* into the resulting metric *ad hoc*. This is achieved by means of a contrived analogy with Newton's theory and his expression for escape velocity (a *two-body* relation in what is alleged to be a one-body problem), thus closing the vicious circle. Here is how Chandrasekhar (1972) unwittingly presents the vicious circle:

"That such a contingency can arise was surmised already by Laplace in 1798. Laplace argued as follows. For a particle to escape from the surface of a spherical body of mass M and radius R, it must be projected with a velocity v such that $v^2/2 > GM/R$ *; and it cannot escape if* $v^2 < 2GM/R$ *. On the basis of this last inequality, Laplace concluded that if* $R < 2GM/c^2 = R_s$ *(say) where c denotes the velocity of light, then light will not be able to escape from such a body and we will not be able to see it!*

"By a curious coincidence, the limit R_s *discovered by Laplace is exactly the same that general relativity gives for the occurrence of the trapped surface around a spherical mass."*

But it is not surprising that General Relativity (apparently) gives the same R_s "*discovered by Laplace*" because the Newtonian expression for escape velocity is deliberately inserted *post hoc* by the astrophysicists and astronomers, into the "Schwarzschild solution". Newton's escape velocity does not drop out of any of the calculations to Schwarzschild spacetime. Furthermore, although $R_{\mu\nu} = 0$ is said to describe spacetime "outside a body", the resulting "Schwarzschild metric" is nonetheless, in contradiction, used to describe the *interior* of a black hole as well ($0 \le r < 2m$) for the black hole begins at the alleged "event horizon", not at its infinitely dense point-mass singularity inside the "event horizon" (allegedly at $r = 0$ in the so-called "Schwarzschild solution"). Indeed, according to Misner, Thorne and Wheeler (1970), who use the spacetime signature (−,+,+, +),

"The most obvious pathology at r =2M is the reversal there of the roles of t and r as timelike and spacelike coordinates. In the region r > 2M, the t direction, $\partial/\partial t$ *is timelike (*$g_{tt} < 0$*) and the r direction,* $\partial/\partial r$ *, is spacelike (*$g_{rr} > 0$*); but in the region r < 2M,* $\partial/\partial t$ *, is spacelike (*$g_{tt} > 0$*) and* $\partial/\partial r$ *, is timelike (*$g_{rr} < 0$*).*

"What does it mean for r to 'change in character from a spacelike coordinate to a timelike one'? The explorer in his jet-powered spaceship prior to arrival at r =2M always has the option to turn on his jets and change his motion from decreasing r (infall) to increasing r (escape). Quite the contrary in the situation when he has once allowed himself to fall inside r =2M. Then the further decrease of r represents the passage of time. No command that the traveler can give to his jet engine will turn back time. That unseen power of the world which drags everyone forward willy-nilly from age twenty to forty and from forty to eighty also drags the rocket in from time coordinate r =2M to the later time coordinate r =0. No human act of will, no engine, no rocket, no force (see exercise 31.3) can make time stand still. As surely as cells die, as surely as the traveler's watch ticks away 'the unforgiving minutes', with equal certainty, and with never one halt along the way, r drops from 2M to 0.

"At r =2M, where r and t exchange roles as space and time coordinates, g_{tt} *vanishes while* g_{rr} *is infinite."*

Chandrasekhar (1972) has expounded the same claim as follows,

'There is no alternative to the matter collapsing to an infinite density at a singularity once a point of no-return is passed. The reason is that once the event horizon is passed, all time-like trajectories must necessarily get to the singularity: "all the King's horses and all the King's men" cannot prevent it.'

Carroll (1977) also says,

"This is worth stressing; not only can you not escape back to region I, you cannot even stop yourself from moving in the direction of decreasing r, since this is simply the timelike direction. (This could have been seen in our original coordinate system; for r < 2GM, t becomes spacelike and r becomes timelike.) Thus you can no more stop moving toward the singularity than you can stop getting older."

Vladmimirov, Mitskiévich, and Horský (1984) assert,

"For $r < 2GM/c^2$*, however, the component* g_{00} *becomes negative, and* g_{rr} *, positive, so that in this domain, the role of time-like coordinate is played by r, whereas that of space-like coordinate by t. Thus in this domain, the gravitational field depends significantly on time (r) and does not depend on the coordinate t."*

3. Consequences of Ric = 0

Since Ric = $R_{\mu\nu} = 0$ cannot describe Einstein's gravitational field, Einstein's field equations cannot reduce to $R_{\mu\nu} = 0$ when $T_{\mu\nu} = 0$. In other words, if $T_{\mu\nu} = 0$ (i.e. there is no matter present) then there is no gravitational field. Consequently Einstein's field equations *must* take the form (Lorentz 1916, Levi-Civita 1917),

$$\frac{G_{\mu\nu}}{\kappa} + T_{\mu\nu} = 0 \qquad (3.1)$$

The $G_{\mu\nu}/\kappa$ are the components of a gravitational energy tensor. Thus the total energy of Einstein's gravitational field *is always zero*; the $G_{\mu\nu}/\kappa$ and the $T_{\mu\nu}$ *must vanish identically* (so that when $T_{\mu\nu} = 0$ there is no gravitational field); there is *no possibility* for the localization of gravitational energy (i.e. *there are no Einstein gravitational waves*). This also means that Einstein's gravitational field violates the experimentally well-established usual conservation of energy and momentum. Indeed, according to Pauli (1981), Einstein:

"… raised the objection that, with this definition of the gravitational energy, the total energy of a closed system would always be zero, and the maintenance of this value of the energy does not require the continued existence of the system of one form or other. The usual kind of conclusions could not then be drawn from the conservation laws."

Einstein's objections however are groundless in view of the fact that Ric = 0 is inadmissible as proven above and so his field equations *must* take the form given in equation (3.1).

Since there is no experimental evidence that the usual conservation of energy and momentum is invalid, Einstein's General Theory of Relativity violates the experimental evidence, and so it is invalid.

In an attempt to circumvent the foregoing conservation problem, Einstein invented his gravitational pseudo-tensor, the components of which he says are '*the "energy components" of the gravitational field*' (Einstein 1952, Pauli 1981). His invention had a twofold purpose (a) to bring his theory into line with the usual conservation of energy and momentum, (b) to enable him to get gravitational waves that propagate with speed *c*. First, Einstein's gravitational pseudo-tensor is not a tensor, and is therefore not in keeping with his theory that all equations be tensorial. Second, he constructed his pseudo-tensor in such a way that it behaves like a tensor in one particular situation, that in which he could get gravitational waves with speed *c*. Now Einstein's pseudo-tensor is claimed to represent the energy and momentum of the gravitational field and it is routinely applied in relation to the localization of gravitational energy, the conservation of energy and the flow of energy and momentum.

Dirac (1996) pointed out that,

"It is not possible to obtain an expression for the energy of the gravitational field satisfying both the conditions: (i) when added to other forms of energy the total energy is conserved, and (ii) the energy within a definite (three dimensional) region at a certain time is independent of the coordinate system. Thus, in general, gravitational energy cannot be localized. The best we can do is to use the pseudotensor, which satisfies condition (i) but not condition (ii). It gives us approximate information about gravitational energy, which in some special cases can be accurate."

On gravitational waves Dirac (1996) says,

"Let us consider the energy of these waves. Owing to the pseudo-tensor not being a real tensor, we do not get, in general, a clear result independent of the coordinate system. But there is one special case in which we do get a clear result; namely, when the waves are all moving in the same direction."

About the propagation of gravitational waves A. S. Eddington (1960) remarked $\left(g_{\mu\nu} = \delta_{\mu\nu} + h_{\mu\nu}\right)$,

$$\frac{\partial^2 h_{\mu\nu}}{\partial t^2} - \frac{\partial^2 h_{\mu\nu}}{\partial x^2} - \frac{\partial^2 h_{\mu\nu}}{\partial y^2} - \frac{\partial^2 h_{\mu\nu}}{\partial z^2} = 0$$

"... showing that the deviations of the gravitational potentials are propagated as waves with unit velocity, i.e. the velocity of light. But it must be remembered that this representation of the propagation, though always permissible, is not unique. ... All the coordinate-systems differ from Galilean coordinates by small quantities of the first order. The potentials $g_{\mu\nu}$ pertain not only to the gravitational influence which is objective reality, but also to the coordinate-system which we select arbitrarily. We can 'propagate' coordinate-changes with the speed of thought, and these may be mixed up at will with the more dilatory propagation discussed above. There does not seem to be any way of distinguishing a physical and a conventional part in the changes of the $g_{\mu\nu}$.

"The statement that in the relativity theory gravitational waves are propagated with the speed of light has, I believe, been based entirely upon the foregoing investigation; but it will be seen that it is only true in a very conventional sense. If coordinates are chosen so as to satisfy a certain condition which has no very clear geometrical importance, the speed is that of light; if the coordinates are slightly different the speed is altogether different from that of light. The result stands or falls by the choice of coordinates and, so far as can be judged, the coordinates here used were purposely introduced in order to obtain the simplification which results from representing the propagation as occurring with the speed of light. The argument thus follows a vicious circle."

Now Einstein's pseudo-tensor, $\sqrt{-g}\, t^{\mu}_{\nu}$, is defined by (Levi-Civita 1917, Einstein 1952, Eddington 1960),

$$\sqrt{-g}\, t^{\mu}_{\nu} = \frac{1}{2}\left[\delta^{\mu}_{\nu} L - \left(\frac{\partial L}{\partial g^{\sigma\beta}_{,\mu}}\right) g^{\sigma\beta}_{,\nu}\right] \qquad (3.2)$$

where L is given by

$$L = -g^{\alpha\beta}\left(\Gamma^{\gamma}_{\alpha\kappa}\Gamma^{\kappa}_{\beta\gamma} - \Gamma^{\gamma}_{\alpha\beta}\Gamma^{\kappa}_{\gamma\kappa}\right) \qquad (3.3)$$

and where

$$\Gamma^{a}_{bc} = \frac{1}{2} g^{ad}\left(g_{dc,b} + g_{bd,c} - g_{bc,d}\right)$$

$$g_{dc,b} = \partial_b g_{dc}$$

According to Einstein (1952) his pseudo-tensor,

"expresses the law of conservation of momentum and of energy for the gravitational field."

T. Levi-Civita (1917) provided a clear and rigorous proof that Einstein's pseudo-tensor is meaningless, and therefore any argument relying upon it is fallacious. I repeat Levi-Civita's proof. Contracting eq. (3.2) produces a linear invariant, thus

$$\sqrt{-g}\, t^{\mu}_{\mu} = \frac{1}{2}\left[4L - \left(\frac{\partial L}{\partial g^{\sigma\beta}_{,\mu}}\right) g^{\sigma\beta}_{,\mu}\right] \qquad (3.4)$$

Since L is, according to eq. (3.3), quadratic and homogeneous with respect to the Riemann-Christoffel symbols, and therefore also with respect to the $g^{\sigma\beta}_{,\mu}$, one can apply Euler's theorem to obtain (also see Eddington 1960),

$$\left(\frac{\partial L}{\partial g^{\sigma\beta}_{,\mu}}\right) g^{\sigma\beta}_{,\mu} = 2L \qquad (3.5)$$

Substituting expression (3.5) into expression (3.4) yields the linear invariant as L. This is a first-order, intrinsic differential invariant, i.e. it depends solely on the components of the metric tensor and their first derivatives (see expression (3.3) for L). However, the mathematicians G. Ricci-Curbastro and T. Levi-Civita, inventors of the tensor calculus, proved (Ricci-Curbastro & Levi-Civita 1900), that such invariants *do not exist*! Thus by *reductio ad absurdum* Einstein's pseudo-tensor is invalid. This is sufficient to render Einstein's pseudo-tensor entirely meaningless, both mathematically and physically, and hence all arguments relying on it false. Consequently, Einstein's conception of the conservation of energy and momentum in his gravitational field is completely erroneous.

Linearization of Einstein's field equations and associated perturbations has been popular. However, "*The existence of exact solutions corresponding to a solution to the linearised equations must be investigated before perturbation analysis can be applied with any reliability.*" (Wald 1984).

Unfortunately, the astrophysical scientists have not properly investigated. Indeed, linearisation of the field equations is inadmissible, even though the astrophysical scientists write down linearised equations and proceed as though they are valid, because linearisation of the field equations implies the existence of a tensor which, except for the trivial case of being precisely zero, *does not otherwise exist*; proven by the German mathematician Hermann Weyl (1944).

Over a period of some 40 years and at great public monetary expense, the international search for Einstein's gravitational waves has detected nothing. This is not surprising – the search for these waves is destined to detect none.

It follows from $R_{\mu\nu} = 0$ that not only is the black hole invalid but so too is the Big Bang and the associated expansion of the Universe and gravitational waves. The invalidity of Einstein's pseudo-tensor and the consequent violation of the usual conservation of energy and momentum cannot be circumvented in order to save General Relativity.

4. Conclusion

General Relativity violates the usual conservation of energy and momentum and is therefore in conflict with experiment on a deep level, making it invalid. Einstein's attempt to save General Relativity from this catastrophe by means of his pseudo-tensor fails because his pseudo-tensor has no mathematical validity and therefore has no physical meaning. Consequently the black hole, gravitational waves, and the Big Bang cosmology have no theoretical basis whatsoever. The search for the black hole and gravitational waves has always been destined to detect nothing. The so-called Cosmic Microwave Background is not the afterglow of the birth of the Universe from a Big Bang.

Dedication

I dedicate this paper to my late beloved brother:

Paul Raymond Crothers
12th May 1968 – 25th December 2008

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