Reply to the Article 'Watching the World Cup' by Jason J. Sharples

Stephen J. Crothers

Queensland, Australia
steve@plasmaresources.com
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FOREWORD

In 2010 Jason J. Sharples, an Associate Professor at the University of New South Wales, wrote an article titled 'Watching the World Cup'. Despite the title, the article addresses a number of papers and articles refuting the theories of black holes and Big Bang cosmology written by Stephen J. Crothers. In his article, Sharples has committed several major errors, and resorted to language unbefitting a publicly funded professorship when addressing the person of Crothers. After some rolling preamble, Sharples disputes two matters addressed by Crothers: (a) Einstein's Principle of Equivalence, (b) Einstein's pseudotensor. In the first case Sharples incorrectly argues that multiple arbitrarily large finite masses are not involved in its definition. In the second case he failed to understand the problem and thereby expounded upon an entirely different matter that was never contested by Crothers in the first place - Sharples confounded the Einstein tensor for Einstein's pseudotensor and consequently did not even address the issue.

Jason J. Sharples is an Associate Professor of applied mathematics at the University of New South Wales, Australian Defence Force Academy, in Canberra, Australia. In 2010 he wrote an article titled 'Watching the World Cup' [1]. This article seems not to have been formally published but Sharples has made it freely available on the World Wide Web, and it is even cited by critics [2] of Crothers as 'proof' of errors committed by Crothers. The very title of the article by Sharples has attached to it a footnote which reads:

> "*This article was written late at night while watching the World Cup finals, hence the title. That the article could be written in the presence of such a distraction attests to the infantile nature of the issues it addresses, i.e. the issues raised in [CrBS].*"

This opening footnote sets the tone for the entire article which not only assigns to Crothers claims he has never made, but also presents arguments that are false in both physics and mathematics. That the Author opens his article with such malicious derision speaks for itself. Other perjorative epithets and jibes appear in the article. Indeed, the first two sentences of Sharples' article [1] are:

> "*The following is a response to the article [CrBS]. This article, like many of the articles by the same author, contains a significant number of misunderstandings and statements what would cause the mathematically qualified to shake their head in wonderment.*"

The second paragraph [1] begins with,

> "*The article [CrBS] begins with a characteristic rant before referring the reader to the paper [Cr07], in which the author attempts to argue that the usual interpretation of solutions of Einstein's gravitational field equations satisfying spherical symmetry contains anomalies that are not mathematically permissible.*"

Then, after some preamble about manifolds, Sharples [1] writes:

> "*The author of [CrBS] closes his extraordinary article by issuing a challenge. In particular he asks for the following:*
>
> 1. *Prove that the Principle of Equivalence and Special Relativity can manifest in a spacetime that by construction contains no matter.*
> 2. *Prove that Einstein's pseudo-tensor is not a meaningless concoction of mathematical symbols."*

Concerning point **1**, Sharples [1] objects to the presence of multiple arbitrarily large finite masses, and says:

> "*the author of [CrBS] insists that the principle of equivalence requires the existence of large finite masses. This is untrue; the principle of equivalence is actually a statement about the local properties of spacetime, which are quite analogous to the statement that a Riemannian manifold must be locally Euclidean.*"

Sharples has left out the word 'arbitrarily' from my statement. I made it plain that the multiple finite masses present are 'arbitrarily large'. Moreover, Albert Einstein [3] explained his Principle of Equivalence as follows:

> "*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.*"

Einstein obviously invokes multiple arbitrarily large finite masses for his Principle of Equivalence. Furthermore,

> "*space as opposed to 'what fills space', which is dependent on the coordinates, has no separate existence*" Einstein [4]

> "*I wish to show that space-time is not necessarily something to which one can ascribe a separate existence, independently of the actual objects of physical reality*" Einstein [5]

Consequently any model of the Universe that contains no matter by mathematical construction precludes Einstein's Principle of Equivalence and his Special Relativity. Einstein's field equations $R_{\mu\nu} = 0$* contain no matter. $R_{\mu\nu} = 0$ is therefore untenable. Sharples [1] objects to my arguments that $R_{\mu\nu} = 0$ contains no mass:

> "*The author of [CrBS] claims that the condition of the Ricci tensor being zero automatically implies that the entire spacetime contains no mass. This is not true.*"

That the universe modelled by $R_{\mu\nu} = 0$ contains no material sources is easily proven. According to Einstein [6, §14], matter, which causes his gravitational field, is everything except his gravitational field:

> "*We make a distinction hereafter between 'gravitational field' and 'matter' in this way, that we denote everything but the gravitational field as 'matter'. Our use of the word therefore includes not only matter in the ordinary sense, but the electromagnetic field as well.*"

Einstein's field equations without cosmological constant are:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} = -\kappa T_{\mu\nu} \tag{1}$$

The energy-momentum tensor $T_{\mu\nu}$ describes all material sources. Einstein's field equations,

> "*couple the gravitational field (contained in the curvature of spacetime) with its sources.*"
> Foster and Nightingale [7]

Einstein [3, 6] and his followers assert that when $T_{\mu\nu} = 0$, Eq.(1) reduces to,

$$R_{\mu\nu} = 0 \tag{2}$$

Einstein claims that although $T_{\mu\nu} = 0$, there is nevertheless a material source present in the universe modelled by Eq.(2) in order to produce a gravitational field. But in Eq.(2) his gravitational field is not coupled to a material source. Einstein merely inserted a material source by asserting that Eq.(2) applies outside a body such as a star - he removed all material sources mathematically by setting $T_{\mu\nu} = 0$, then immediately reinstated a material source, linguistically, by alluding to a body such as a star, outside of which Eq.(2) allegedly applies. The argument is a contradiction and therefore invalid. That the universe modelled by Eq.(2) contains no material sources is easily reaffirmed by considering Einstein's field equations with cosmological constant λ:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \lambda g_{\mu\nu} = -\kappa T_{\mu\nu} \tag{3}$$

*The Field Equations of Gravitation in the Absence of Matter [6, §14]

According to Einstein and his followers, when $T_{\mu\nu} = 0$ Eq.(3) reduces to,

$$R_{\mu\nu} = \lambda g_{\mu\nu} \tag{4}$$

The solution to Eq.(4) is de Sitter's empty universe, which is empty precisely because $T_{\mu\nu} = 0$:

> "*This is not a model of relativistic cosmology because it is devoid of matter.*" d'Inverno [8]

> "*the de Sitter line element corresponds to a model which must strictly be taken as completely empty.*" Tolman [9]

> "*the solution for an entirely empty world.*" Eddington [10]

> "*there is no matter at all!*" Weinberg [11]

Thus, according to Einstein and his followers, by Eq.(2) and Eq.(4), material sources are both present in and absent from their respective universes by the very same mathematical constraint on material sources, which is impossible. The universe modelled by Eq.(2) contains no material sources for the very same reason that de Sitter's empty universe is empty: $T_{\mu\nu} = 0$. Thus, Eq.(2) has no physical meaning, just as Eq.(4) has no physical meaning. But it is from Eq.(2) that the black hole was first constructed by Einstein's followers. Since Eq.(2) contains no matter, neither does its solution. Consequently the black hole is invalid.

Sharples objects to my point that Minkowski spacetime alone is not Special Relativity. He says [1],

> "*The author of [CrBS] also insists that special relativity is not simply Minkowski space since it requires the existence of photons and observers. This again is untrue - all that is required is the existence of inertial frames and a finite speed limit (it is not necessary that we attribute this speed limit to a particular entity).*"

However, the very title of Einstein's 1905 paper on Special Relativity is 'On the Electrodynamics of Moving Bodies'*. His paper is replete with light rays, rigid bodies, and observers. Einstein does not even mention Minkowski's spacetime or its metric. Minkowski introduced his spacetime metric in 1908†. Moreover, according to Einstein [5, §I:Special Relativity],

> "*In accordance with the theory of relativity the kinetic energy of a material point of mass m is no longer given by the well-known expression*
>
> $$m\frac{v^2}{2}$$
>
> *but by the expression*
>
> $$\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$$
>
> *This expression approaches infinity as the velocity v approaches the velocity of light.*"

Clearly, Special Relativity requires light rays (photons), observers, clocks, and masses. Consequently, Sharples is incorrect: Minkowski spacetime alone is not Special Relativity.

Pursuing point **1** further, Sharples [1] says:

> "*If we suppose that the spherically distributed mass lies wholly within a sphere of radius a, then the region defined by $r > a$ is empty and the stress-energy tensor over this region must be zero. ... As long as the gravitational field over the region $r > a$ is spherically symmetric we can apply the analysis of Schwarzschild ...*"

There are two equally fatal mistakes in these assertions.

(a) The Schwarzschild solution is the solution to Eq.(2). But Eq.(2) is physically meaningless because it contains no matter. The Schwarzschild solution therefore contains no matter and is consequently physically meaningless. Including a material source *ad hoc* in the Schwarzschild solution is improper, compounded by the fact this it is achieved by insinuating the Newtonian expression for escape speed: which is an implicit two-body relation into the solution for an alleged one-body problem.

(b) It is clear from his remarks that Sharples is not referring to Schwarzschild's solution but to Hilbert's solution which is not equivalent to the former. The quantity r in Hilbert's solution is neither the radius nor even a distance therein [12–14].

Sharples [1] next objects to my point that there are no known solutions to Einstein's field equations for two or more masses. He says that my point,

> "*is false. While there are no known closed-form analytical solutions to the Einstein equations for multi-body interactions, there are indeed solutions. However, they must be found numerically, just like the overwhelming majority of solutions to almost all of the partial differential equations found in mathematical physics. Anyone who legitimately considers themselves a mathematical physicist, as the author of [CrBS] does, should be aware of this.*"

*Einstein, A., On the Electrodynamics of Moving Bodies, *Annalen der Physik*, 17, 1905.

†Minkowski, H., Space and Time, 80th Assembly of German National Scientists and Physicians, at Cologne, 21 September, 1908.

It is however a fact that there are no known energy-momentum tensors for two or more masses and so there are no known Einstein nonlinear field equations for configurations of masses beyond one. Therefore there are no known solutions for two or more masses. Given any partial differential equation it might be solved analytically in closed form, or resolved numerically in the absence of an analytical solution. But one must first have the differential equation. The multiple masses Sharples invokes with his numerical means involve approximations based upon the linearised form of Einstein's nonlinear field equations, post-Newtonian higher order iterative approximations on Newton's equation of motion by applying it to a geodesic equation of motion, parameterised-post-Newtonian approximations containing ten parameters, perturbations on the likes of the solution to Eq.(2), and superpositions. However, one cannot perturb or otherwise numerically analyse a universe that by mathematical construction contains no material sources to generate two gravitationally coupled masses, or use the linearised form of Einstein's field equations to produce two or more masses, such as two black holes, each one of which is extracted from distinct sets of Einstein's nonlinear field equations. Neither can one simply superpose because the Principle of Superposition does not hold in General Relativity. To apply numerical or perturbation methods one must first have a valid set of equations. Such methods, when applied to invalid equations, produce invalidities [13, 14]. With its multiple black holes, and such, cosmology has gravely erred.

Concerning point **2**, Sharples confounds the gravitational tensor (i.e. the Einstein tensor) for Einstein's pseudotensor and so does not even address the latter. The gravitational or Einstein tensor $G_{\mu\nu}$ is simply the left side of Eq.(1):

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} \tag{5}$$

Of Eq.(5) Sharples [1] remarks,

> "*this is not the form of the tensor that Einstein had initially proposed. While this may be historically interesting, it is completely irrelevant. . . . a proper recognition of its place in the history of the development of general relativity, item 2 becomes a non-issue.*"

Contrary to the charge made by Sharples, I have never contested the form of the Einstein (i.e.gravitational) tensor. The issue I raised is Einstein's pseudotensor, t^{α}_{σ}, defined by [6, §15],

$$t^{\alpha}_{\sigma} = \frac{1}{\kappa}\left(\frac{1}{2}\delta^{\alpha}_{\sigma}g^{\mu\nu}\Gamma^{\lambda}_{\mu\beta}\Gamma^{\beta}_{\nu\lambda} - g^{\mu\nu}\Gamma^{\alpha}_{\mu\beta}\Gamma^{\beta}_{\mu\sigma}\right) \tag{6}$$

An invariant t is obtained by setting $\sigma = \alpha$,

$$t^{\alpha}_{\alpha} = t = \frac{1}{\kappa}\left(\frac{1}{2}\delta^{\alpha}_{\alpha}g^{\mu\nu}\Gamma^{\lambda}_{\mu\beta}\Gamma^{\beta}_{\nu\lambda} - g^{\mu\nu}\Gamma^{\alpha}_{\mu\beta}\Gamma^{\beta}_{\mu\alpha}\right) \tag{7}$$

Since the $\Gamma^{\alpha}_{\beta\sigma}$ are functions solely of the components of the metric tensor and their first derivatives, so too is the invariant t. This makes t a first-order intrinsic differential invariant. However, the pure mathematicians [15] proved, in 1900, that first-order intrinsic differential invariants do not exist. Thus, by *reductio ad absurdum*, Einstein's pseudotensor is a meaningless concoction of mathematical symbols and therefore, contrary to Einstein and his followers, it cannot be used to represent any physical quantity, to model any phenomena, or to make any calculations. Yet Einstein and his followers do all three. This is the meaning of my point **2**.

Sharples [1] closes his article with the following:

> "*Postscript: An amusing Corollary*
>
> *According to the author of [CrBS], the preceding discussion delivers an immediate corollary, namely that the author of [CrBS] is a mug. As such, the plethora of articles by the author of [CrBS], which are largely identical, do not warrant serious contemplation by qualified scientists and mathematicians.*"

Yet it is the "*qualified scientists and mathematicians*", including Sharples, who have repeatedly violated the rules of logic and the rules of pure mathematics.

At the bottom of the last page of Sharples' article is the following footnote:

> "*The author of [CrBS] could learn much about the appropriate tone for scientific discourse from the example set by Einstein and Levi-Civita.*"

Apparently Sharples does not feel obliged to conduct himself in accordance with the examples he cites. In any event he has failed to prove any of his charges against me.

References

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