How a 2011 Shaw Prize Is Awarded for Mathematical Errors of Christodoulou

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The work of Christodoulou on general relativity is based on obscure errors in mathematics, and gives misleading consequences. The problem of Einstein's equation was discovered by honorable Nobel Laureate Gullstrand, a member of the 1921 Nobel Committee. In 1955, Gullstrand is proven correct. Initially the error of Christodoulou is due to a failure in distinguishing the difference between mathematics and physics. Here the nature of his errors in mathematics and related literature are pointed out so that scientists can make better objective judgments. Also, examples that illustrate errors with mathematics at the undergraduate level, are useful since a similar mistake has already been made by the 1993 Committee for the Nobel Prize in Physics. It is found that many made judgments based on popular opinions, instead of the scientific evidence as Galileo advocated. In fact, blind acceptance of invalid claims has reached the level of Fields Medalists and Nobel Laureates. The Shaw Prize Committee is clearly outdated on certain area of scientific developments.

Key Words: Shaw Prize; Nobel Prize; general relativity; Einstein equation, Riemannian Space; the non-existence of dynamic solution; Galileo. 04.20.-q, 04.20.Cv

1. Introduction

The Shaw Prize, named after Hong Kong film and television magnate Run Run Shaw since 2002, each year recognizes innovation in three fields—astronomy, medicine and mathematics—with three awards of US$1 million each.

This year, 2011, a half prize in mathematics is awarded to Richard S. Hamilton, a distinguish mathematician for his work on the Ricci flow that lays down the foundation for Perelman's sub-conjectures to prove the Poincare conjecture. However, another half of the Prize was awarded to D. Christodoulou for works based on obscure errors against the honorable Nobel Laureate Gullstrand [1, 2], a member of the 1921 Nobel Committee. [1)] Although the work of Christodoulou had misled many including the 1993 Nobel Committee [3], his errors are now well established since they can be illustrated with mathematics at the undergraduate level [4, 5]. Thus, it is necessary to neutralize this disservice to science owing to such a misleading mistake.

The official announcement for awarding them is, "for their highly innovative works on nonlinear partial differential equations in Lorentzian and Riemannian geometry and their applications to general relativity and topology." (Apparently, the word "topology" is referred to the excellent work of Hamilton, who shares the prize.)

Christodoulou claimed in his Autobiography that his work is essentially based on two sources: 1) The claims of Christodoulou and Klainerman on general relativity as shown in their book, **The Global Nonlinear Stability of the Minkowski Space** [6]; 2) Roger Penrose had introduced, in 1965, the concept of a trapped surface and had proved that a space-time containing such a surface cannot be complete [7]. However, this work of Penrose, which uses an implicit assumption of unique sign for all coupling constants, actually depends on the errors of Christodoulou and Klainerman [6]. Nevertheless, such a relation was not clear until 1995 when this implicit assumption was proved incorrect [8].

Due to inadequate mathematical background in comparison with Gullstrand, physicists including Einstein [9], Pauli [10], Misner, Thorne & Wheeler [11] and etc. claimed that an approximation of a bounded dynamic solution could be obtained by linearization of the non-linear equation, and that the nonlinear Einstein equation must have a bounded dynamic solution. Some went so far as even to claim that Gullstrand had the advantage because he is Sweden. In fact, Einstein's equation cannot have a bounded dynamic solution as claimed [6]. To have a bounded dynamic solution, an energy-stress tensor for the gravitational wave must be added to the source term with a different coupling sign [8]. Thus, the singularity theorems of Penrose and Hawking [7] are actually irrelevant to physics because they use an unphysical implicit assumption. Since Christodoulou and Klainerman did not see the non-existence of a bounded dynamic solution [6], they are not able to see the assumption of Penrose being invalid in physics.

Historically, in 1921 Gullstrand [1, 2] conjectured and sustained that Einstein's equation may not have a dynamic solution. However, in 1993 Christodoulou and Klanerman [6] claimed that bounded dynamic solutions were constructed. Then, in 1995 Gullstrand's conjecture is proven to be correct, and there are no dynamic solutions or wave solutions for Einstein's equation [8]. Subsequently, their book [6] was severely criticized [12-14] while it is still classified as No. 41 in the Princeton Mathematical Series. Because of an absence of the energy–stress tensor for the gravitational wave in the source, the principle of causality is violated. [2)]

Nevertheless, Nobel Laureate 't Hooft attempted to challenge Gullstrand with a bounded time-dependent solution in 2004, but was defeated because his solution also violates the principle of causality [4, 15]. [3)] Meanwhile Professor P. Morrison of MIT met Nobel Laureate Professor J. Taylor of Princeton University several times to discuss problems on the dynamic solution, but Taylor failed to defend their calculation of the binary pulsars [18, 17]. [4)]

To facilitate theorists, who have biased views because of earlier mathematical errors, in understanding the absence of dynamic solutions and wave solutions of the Einstein equation, a review paper on this subject with counter examples being understandable at the undergraduate level [4, 5] was published in 2011. Thus, the errors of Christodoulou on general relativity are no longer in doubt.[5] It is amazing that some theorists could become so careless after having been established in some areas. *A basic rule in mathematics learned in my undergraduate years is that one must be able to support his mathematical statements with examples. It seems that many theorists including members of the Selection Committee of the Shaw Prize have forgotten this simple rule.*

Both Christodoulou and Hamilton have cited the influence of Fields Medalist (1982) S. T. Yau. I discussed with Yau on "General Relativity" in 1993 at the Hong Kong Chinese University when I participated in a conference in Hong Kong. Apparently, Yau may still not understand that general relativity was not yet self-consistent [18] since he has not made any modification on the positive mass theorem of Schoen and Yau [19, 20] that also used the invalid implicit assumption of unique sign for all coupling constants, as Penrose and Hawking did [7]. Since blind acceptance of invalid claims and misinterpretations has reached the level of Fields Medalists [21],[6] the mistake of the awarding a prize to a mathematician for his errors should no longer be a great surprise!

To help the scientific community from being further misled by mistakes of the institutes, which includes the 1993 Nobel Committee, Caltech, Harvard University, Princeton University, and etc., it would be necessary to point out the related literature.

The basic problem in terms of physics is that just as in Maxwell's classical electromagnetism [22], there is also no radiation reaction force in general relativity. Although an accelerated massive particle would create gravitational radiation [23], the metric elements in the geodesic equation are created by particles other than the test particle [9].[7]

This problem is further manifested theoretically by the fact that there is no dynamic solution for the Einstein equation [8, 12, 17, 24], which does not include the gravitational energy-stress tensor of its gravitational waves in the sources.[8] Thus, to fit the data,[9] it is necessary to modify the Einstein equation [8] to

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

where $t(g)_{\mu\nu}$ is the energy-stress tensor for gravity. For radiation, the tensor $t(g)_{\mu\nu}$ is equivalent to Einstein's notion of gravitational energy-stress. Because a wave carries energy and momentum in vacuum, it is necessary to have such an additional tensor term. However, Einstein's notion is a pseudo-tensor and can become zero by choosing a suitable coordinate system, but the energy-momentum of a radiation cannot be zero, and thus must be a tensor [8].

In conclusion, the Einstein equation cannot have a dynamic solution because the principle of causality is violated. Thus, Christodoulou is clearly incorrect in terms of both mathematics and physics. Moreover, his errors are obstacles to theoretical progress that have been experimentally confirmed [18]!

The Shaw Prize is governed by a "Board of Adjudicaters", under which there are three selection committees of astronomy, medicine and mathematics. Each committee selects the winners for each prize.

Members of the Board of Adjudicators and the Selection Committee in Mathematical Sciences are as follows:

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The selection of mathematicians for the prize lies in this selection committee. However, if you check the background of her members, it seems none of them has an adequate research background in general relativity. Thus, one may wonder who initiated the nomination of Christodoulou. Some members are clearly not involved for obvious reasons. Thus, it is a puzzle as to who actually brought the Shaw Prize into such a difficult situation.

C. N. Yang himself has worked little on general relativity, although he is known for also regarding the view of Zhou Pei-Yuan [25, 26] on Einstein's covariance principle being invalid as incorrect.[10] It turns out that, according to the work of S. Weinberg on gauge theories [27] and direct research in general relativity [18], Prof. Yang has been proven wrong. However, the work of Christodoulou is in another area. Also, the Chinese physicists have not inherited the excellence of Zhou; and thus failed to provide the Shaw Prize Committee the necessary assistance. Also, it

is clear that the so-called Yang-Mills-Shaw theory is based on an invalid notion of unconditional gauge invariance in physics. The Shaw Prize is simply not up-to-date on the current developments of science [18, 21].

It seems that, due to inherited from Christodoulou, Penrose, 't Hooft and etc. a failure in distinguishing mathematics and physics [8), 9)] the Selection Committee in Mathematical Sciences carelessly leads to giving an award for mathematical errors. Their misjudgment should have been expected since they are unaware of the errors of Hawking and Penrose in physics. Nevertheless, one should not be too surprised since at least a dozen of Nobel Laureates had made errors in general relativity [18].

The 1933 press release of the Nobel Committee for Physics and the 2011 Shaw Prize have made clear that essentially the whole scientific community was still wrong on the question of dynamic solutions of the Einstein equation, and subsequent invalid theories would continue. Thus, for the progress of sciences, it is urgent to rectify such a problem.

Although the Shaw Prize is directly responsible for this error, there are theorists, starting from Einstein and Hilbert in 1915 [28], helping its unusual long gestation of more than 95 years because of inadequate knowledge in the non-linear equation [18]. It took a genius such as Gullstrand to discover this error, but was still believed among many theorists because of their inadequacy in mathematics and physics.

Meanwhile, this error was made obscure by other errors such as the failure in distinguishing the difference between mathematics and physics [18]. Such a failure is responsible for rejecting invalidity of Einstein's covariance principle, a discovery of Zhou Pei-Yuan [25, 26]. This confusion also leads to an inadequate understanding on the principle of causality, [2)] and this problem leads to further errors in general relativity [18]. A lesson to be learned is that a theory should be supported with explicit specific examples. We should learn from these lessons to prevent such happenings in the future.

In short, the honor of Gullstrand should be recovered. Because of accumulated mistakes over a long time by scientific institutes, [11)] awarding Christodoulou seems to be inevitable. Nevertheless, after giving such an award, the Shaw Prize Committee has the responsibility for exposing these errors although she is not solely responsible for their creation.

It seems that frontier physicists should pay more attention to physical principles and have a better education in pure mathematics. Moreover, in view of the errors once prevailing in general relativity, [12)] the communication between mathematicians and physicists should be further strengthened.

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Endnotes

1) A. Gullstrand was Chairman of the Nobel Physics Committee of the Swedish Academy of Sciences (1922-1929).
2) In disagreement with Einstein & Rosen, the Physical Review accepted "wave" solutions with unbounded amplitude as valid in physics [29]. Thus, the editors rejected Einstein's requirement on weak gravity because of being unaware of the violation of the principle of causality [29].
3) Although the time-dependent solution of 't Hooft is bounded, it also violates the principle of causality because his "solution" has no valid sources [4]. 't Hooft does not understand the principle of causality adequately because he failed in distinguishing a difference between mathematics and physics [4, 30]. He also failed to see that, for a dynamic case, the linearization to obtain an approximate solution is invalid. Moreover, he failed to understand special relativity and Newton's second law adequately as shown in his Nobel Lecture [31].
4) Their calculation of the gravitational waves of binary pulsars failed because Einstein's equation does not have a bounded dynamic solution [8], which is necessary for their calculations of the gravitational radiation. Thus, Einstein's equation has been proven inadequate directly, independent of the principle of causality.
5) Many errors are actually created by the so-called "experts" [18]. For instance, the notion of local Lorentz invariance comes from the misinterpretation of Einstein's equivalence principle by the Wheeler School [21]. Such a notion is theoretically invalid [12, 17, 21, 23] and recently has been shown as not supported by experiments [32]. Their errors come from two sources: 1) They probably do not aware that Einstein's equivalence principle has a mathematical foundation from mathematical theorems in Riemannian space [33]. Therefore, it cannot be modified arbitrarily as Pauli [10] and Misner et al. [11] did. 2) They did not understand enough mathematical analysis to know that the assumption of local Lorentz invariance cannot be valid except for the case of special relativity. Moreover, some editors and theorists, in disagreement with Einstein [15], accepted unbounded solutions as valid in physics because of a failure in understanding the principle of causality adequately [4, 26, 34, 35].
6) A difficulty is that mathematicians do not always understand the physical requirements, and physicists do not always understand the related mathematics. For instance, Christodoulou failed in both mathematics and physics [8, 12, 17]. Fields Medalists S. T. Yau (1982) and E. Witten (1990) also follow the invalid assumption of Penrose and Hawking [21]. In fact, Yau even overlooked Hawking's logical error at the high school level although it is clearly stated in Hawking's book, "A Brief History of Time". Being essentially a mathematician, Penrose was unaware of the principle of causality in the calculation of physics [15].
7) The geodesic equation as an equation of motion in general relativity is only approximately valid. However, since the radiation reaction force is very small, the geodesic equation would be an accurate approximation.
8) Mathematically, it is necessary to prove that Einstein's equation had a bounded dynamic solution. However, unlike a linear equation, the non-linear Einstein equation unexpectedly has no bounded dynamic solution [8].
9) Physically, according to the principle of causality, a bounded dynamic solution must exist [24].

10) Some Chinese have a special kind of discrimination, i.e. against the out-standing achievements of other Chinese [21]. This problem is also recognized by Mao, Yau, and etc. Another well-known example is the completion of the proof for the Poincare conjecture by Cao and Chu [36], but most Chinese mathematicians failed to support them.
11) In spite of 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.
12) For instance, Eric J. Weinberg, editor of the Physical Review D, also incorrectly believes that there are dynamic solutions for the Einstein equation [37]. Friedrich W. Hehl, Co-Editor of Annalen der Physik, believes an approximate solution can always be obtained by perturbation [21]. The Physical Review has made the mistake of accepting unbounded solution as valid. However, because the derivation of Mercury's perihelion is based on a perturbation method, it is necessary to have bounded dynamic solutions.

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