Short Note

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Einstein's Dream: Realization and Failure

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Abstract: Several mathematicians and physicists are working all over the globe to get a unified theory. However, most of them are discarding Einstein's view at the very first step of their theories. This article provides a brief description about this. Also, on the basis of Koga's theory we point out two reasons which might have caused Einstein's failure to get a unified theory.

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"I think it is quite likely, or at any rate quite possible, that in the long run Einstein will turn out to be correct." **P. A. M. Dirac [1]**

1. Introduction

Einstein is generally considered to be one of the foremost physicists of recent times and one of history's greatest scientists. The main contributions of Einstein to the modern science are the discovery of the photoelectric effect, the special theory of relativity and the general theory of relativity. All these three discoveries are of fundamental importance in physics.

The work of Einstein is not limited to the above three discoveries, as he was much curious to understand the structure of the matter. He was a major early contributor to quantum theory through his work on the photoelectric effect published in 1905 and a major dissenter of the orthodox quantum mechanics.

The aim of this article is to provide a general introduction on the fundamental distinction between the Einstein's dream and some attempts of present time made to get a unified theory. Whether Einstein was completely wrong or there were some mistakes made by Einstein in his attempts to get a unified theory. Both are two things.

This article suggests that still there is a little ray of hope for the latter view. However, almost universal view is that he was wrong because he did not make any progress to fulfill his long standing interest.

In order to get a unified theory, various theories have been developed without any recognition and some are in their early stage for the same purpose. But almost none of these theories are realizing Einstein's goal because the pioneers of these theories are ignoring Einstein at the very first step of their theories. This article sheds some light on this.

Moreover in this note we mainly consider two theories developed by M. Sachs and T. Koga as both have claimed that Einstein might have approved their theories.

2. Some attempts to realize Einstein's dream

Einstein had become a great well-recognized scientist when the axiomatic theory of quantum mechanics came into being in the 1920's. It was founded on uncertainty and indeterminism. Einstein was quite unhappy with the theory so he became a dissenter.

Some other founders of quantum theory were also unhappy with quantum mechanics: Planck, Schrodinger and de Broglie. Each had his own point of view but all of them rejected concepts like wave-particle duality, the uncertainty principle and quantum jumps. Einstein believed that there was an underlying deterministic theory waiting to be found.

Most of the dissenters eventually lapsed into silence but Einstein continued searching for a unified field theory for several decades until his death in 1955. Such a theory was to include general relativity and quantum mechanics as special or limiting cases. Meanwhile, quantum mechanics developed into quantum field theory, a theory which very successfully explains all known physical interactions expect gravity.

Attempts to create unified field theories continue. These can be classified into two groups: those that are founded on quantum mechanics (and/or quantum field theory) and attempt to quantize general relativity, and other theories that are founded on general relativity and try to make quantum theory consistent with general relativity. The former include string theory [2], various versions of quantum gravity [3] and noncommutative geometry [4]. Some of the world's best known physicists and mathematicians are interested in the first group of theories. However Einstein was a supporter of the second group of theories. Though, he could not succeed even after a lifelong attempt.

Most probably, Einstein's failure gave a message among mathematicians and physicists that he was completely on a wrong track. May be due to this reason most of them abandoned Einstein's path. However, they could not get rid of the very intuitive and innovative idea to get a unified theory.

Almost all theories of present time like string theory, quantum gravity and noncommutative geometry etc. are founded on the belief that there is no need to modify the orthodox quantum mechanics as it is suitably formulated and correct and Einstein's field equations may be modified at high energy. Even though, pioneers of these theories believe that they are realizing Einstein's dream that is not justified. Of course they are working to get a unified theory but at the same time they are ignoring Einstein's deterministic approach to understand the matter.

There are two theories one of which is due to M. Sachs [5–7] and other is due to T. Koga [8–11]. These two fall under the second group of theories mentioned above. Sachs has claimed that he has derived quantum mechanics from general relativity and thus he has completed Einstein's program. Sachs died recently and has spent more than half a century to complete his goal. Sachs's general relativistic matter field equations given in [5, chapter 4] do not reduce to the usual Dirac equation in the flat space limit. This is because the quaternion field variables do not reduce to the Pauli matrices and the identity matrix in the flat space limit which is very crucial for his theory. As the algebras formed by quaternions and the Pauli matrices along with the identity matrix are not isomorphic to each other and so from a mathematical point of view an irreparable error persists in his theory. This can be seen as follows.

M. Sachs's general relativistic matter field (Dirac) equations are given by [5–7]

$$(q^{\mu}\partial_{\mu}+Q)\eta=-\lambda\chi \tag{1}$$

$$(q^{*\mu}\partial_{\mu}+Q^{*})\chi=-\lambda\eta$$

Here

$$\lambda=\frac{1}{2}\left[\left|\det\Lambda_{+}\right|+\left|\det\Lambda_{-}\right|\right]^{\frac{1}{2}} \tag{2}$$

Where

$$\Lambda_{\pm}=q^{\mu}\Omega_{\mu}\pm\text{h.c.} \tag{3}$$

Here second term on the right hand side is the Hermitian conjugate of the first term on the right hand side and Ω_{μ} is spinor connection:

$$\Omega_{\mu}=\frac{1}{4}(\partial_{\mu}q^{\rho}+\Gamma^{\rho}_{\tau\mu}q^{\tau})q*_{\rho} \tag{4}$$

Here q^*_ρ is conjugate quaternion (for further details please refer [5,6]). As per Sachs the interaction term Q, in the generally covariant matter field equations (1) play the role of the required dynamical coupling. If one considers the ith constituent field of a closed physical system the interaction term is given by [5]

$$Q_i = Q\left(\eta^{(1)}, \eta^{(2)}, \ldots\ldots, \eta^{(i-1)}, \eta^{(i+1)}, \ldots\ldots, \eta^{(n)}\right) \quad (5)$$

Where $\eta^{(1)}(x), \eta^{(2)}(x), \eta^{(3)}(x)$ etc. are matter field variables representing the matter distributed into space-time.

This much detail suffices for our purpose. Now we shall consider the flat space limit of Sachs's general relativistic matter field equations.

Sachs has claimed that in the flat space limit his general relativistic matter field equations given by (1) takes the following form

$$\begin{aligned}\left(\sigma^\mu \partial_\mu + I\right)\eta &= -m\chi,\\ \left(\sigma^{*\mu}\partial_\mu + I^*\right)\chi &= -m\eta\end{aligned} \quad (6)$$

This is the Dirac equation in two-component spinor form. This is also known as Majorana form of the Dirac equation. Here σ^0 is the identity matrix of the second order and σ^1, σ^2 and σ^3 are the well-known Pauli matrices. χ and η are spinor variables, m is the mass of the electron, I is the interaction term and $\sigma^{*\mu}$ and I^* are conjugate to σ^μ and I respectively. For further details please refer [5–7].

As per M. Sachs the Dirac equation given by (6) is obtained from (1) under the following approximations:

$$Q_i = Q\left(\eta^{(1)}, \eta^{(2)}, \ldots\ldots, \eta^{(i-1)}, \eta^{(i+1)}, \ldots\ldots, \eta^{(n)}\right) \to Q\left(x^1, x^2, \ldots\ldots\right) \quad (7)$$

$$\begin{aligned} q^\mu &\to \sigma_\mu \\ \Omega_\mu &\to 0 \\ \lambda &\to \lambda_s \end{aligned}$$

$$\lambda_s = \frac{mc}{\hbar} \equiv \frac{1}{2}\left[\left|\det\Lambda_+\right| + \left|\det\Lambda_-\right|\right]^{\frac{1}{2}} = \lambda$$

It may be noted that in (6) Sachs has taken $c = \hbar = 1$. Now we shall discuss the correspondence between the quaternion metric coefficients and the Pauli spin matrices.

In order to obtain (6) from (1) Sachs has considered the following limits on the field $q^\mu(x)$:

$$q^0(x) \to \sigma^0 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$q^1(x) \to \sigma^1 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$q^2(x) \to \sigma^2 = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

$$q^3(x) \to \sigma^3 = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

The assumption that the quaternion metric coefficients approach the Pauli spin matrices in the flat space limit is crucial for the derivation of the flat space Dirac equation in two component spinor form from the Sachs's general relativistic Dirac equation. However it is notable that the Pauli spin matrices are not quaternions. Therefore the above correspondence is not justified. One reason for this is that the quaternion algebra is 4 dimensional whereas the Pauli algebra is 8 dimensional.

It may be noted that the above correspondence may be mathematically corrected if we consider the following limits:

$$q^0(x) \to \sigma^0 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$q^1(x) \to \sigma^1 = \begin{pmatrix} 0 & -i \\ -i & 0 \end{pmatrix}$$

$$q^2(x) \to \sigma^2 = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$$

$$q^3(x) \to \sigma^3 = \begin{pmatrix} -i & 0 \\ 0 & i \end{pmatrix}$$

Thus we conclude that Sachs has considered that the quaternion metric coefficients approach the Pauli spin matrices in the flat space limit which is mathematically not justified. Hence it is mathematically wrong to assume that in the flat space limit Sachs's general relativistic Dirac equation reduces to the usual Dirac equation in two-component spinor form.

As far as Koga's theory is concerned, it gives deeper insights into the structure of matter and it addresses almost all the objections of Einstein regarding the conventional or orthodox quantum mechanics. But unfortunately this theory needs some more mathematical exploration. Koga has also died recently. Mathematical justification for some parts of this theory can be found in [12–15].

It is worth to mention the following quotation due to Einstein:

"You know, it would be sufficient to really understand the electron" [16].

Koga's theory has also made an attempt to consider this idea of Einstein. On the basis of Einstein's attempt to understand the structure of the matter and Koga's theory it seems very crucial to understand first the electron properly. As per Koga's theory the electron field is anisotropic in nature. It has an axis of symmetry and the electron spins about this axis. We have addressed this issue in [12–14] and have given mathematical justification using geometric algebra.

Among several speculations/objections of Koga we would like to point out that the well known phenomenon like tunneling and stability of matter occur in the nature and we do not understand these properly. As per Koga [9] it is the gravity of the electron (electron's own gravity) that plays an important role for the tunneling and stability of matter. This should also be understood properly with suitable mathematical justification for the same.

It may be noted that apart from the mathematical ambiguity mentioned above Sachs's theory does not discuss the structure of the electron and its spin explicitly.

3. Two reasons which might have caused Einstein's failure

As per Koga, Einstein failed to realize his dream due to one serious error. The error was the assumption that the Schrodinger equation has only ensemble solutions. Due to this Einstein discarded quantum mechanics at the outset of his search and apparently intended to express the existence of matter immediately in terms of the metric tensor.

In addition to this it may be noted that though in reality there is no singularity however as Koga has said that all the equations of physics are approximations and therefore singularities may arise due to the approximate mathematical description of reality and hence regular solutions of the equations describing the laws of nature may not necessarily exist.

It seems that Einstein could not perceive this idea otherwise he would not have put great stress to find regular solutions of the laws of nature.

4. Concluding remarks

There are at least two theories one is due to M. Sachs and other is due to T. Koga both of which claim that these are based on the Einstein's path. However none of these has drawn much attention. Also Sachs's theory is not mathematically compatible as mentioned above. Koga's theory begins by taking into account almost all the objections of Einstein on the orthodox quantum mechanics and hence it seems along the lines that Einstein might have been pursued.

It seems that as per Dirac's belief (quoted above) Einstein may win the game in the end and Koga's theory along with further researches on this or any other theory similar to this may succeed to fulfill the Einstein's quest

References

1. P.A.M. Dirac, The Early Years of Relativity, in G. Holton and Y. Elkana, editors, *Albert Einstein: Historical and Cultural Perspective*, Princeton, 1982.
2. C. Rovelli, *Quantum Gravity*, Cambridge University Press, 2007.
3. A. Connes, *Noncommutative Geometry*, Academic Press, 1994.
4. P. Woit, *Not Even Wrong: The Failure of String Theory and the continuing Challenge to Unify the Laws of Physics*, Vintage Books, London, 2006.
5. M. Sachs, *General Relativity and Matter*, D. Reidel Publishing Company, Holland, 1982.
6. M. Sachs, *Quantum Mechanics from General Relativity: An Approximation for a Theory of Inertia*, D. Reidel Publishing Company, Holland, 1986.
7. M. Sachs, *Quantum Mechanics and Gravity*, Springer-Verlag, Berlin and Heidelberg, 2004.
8. T. Koga, A Rational Interpretation of the Dirac Equation for the Electron, *Int. J. of Theo. Phys.*, 13(1975), 271-278.
9. T. Koga, A Relativistic Field Theory of the Electron, *Int. J. of Theo. Phys.*, 15 (1976), 99-119.
10. T. Koga, *Foundations of Quantum Physics*, Wood & Jones, Pasadena, California, 1980.
11. T. Koga, Inquiries into Foundations of Quantum Physics, Wood and Jones, Pasadena, California, 1982.
12. S. K. Pandey and R. S. Chakravarti, The Dirac equation: An Approach Through Geometric Algebra, *Ann. Fond. L. de Broglie*, 34(2009), 223-228.
13. S. K. Pandey and R. S. Chakravarti, The Dirac equation Through Geometric Algebra: Some Implications, *Ann. Fond. L. de Broglie*, 36(2011), 73-77.
14. S. K. Pandey, Electronic Spin: Abstract Mathematical or Real Physical Phenomenon, *arXiv:1208.5764v4* [quant-ph].
15. S. K. Pandey, Canonical Representation of the Koga's Solution to the Dirac Equation in A Kumar et. al.(editor), Advanced Applications of Computational Mathematics, Taylor and Francis, 2022 (Imprint River Publishers).
16. V. Bargmann, *Some Strangeness in Proportion*, In H. Woolf (editor), A Centennial symposium to celebrate the achievements of Albert Einstein, Addison-Wesley, Reading, Massachusetts, 1980.