Do we need two theories of relativity?

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This article discusses the ambiguity created by dividing the theory of relativity into special and general branches. A systematic study of covariant electrodynamics reveals the relation between matter and Minkowskian space-time, and the governing non-Euclidean geometry. This in turn results in the completion of Poincare's theory of relativity by showing that motion of a particle is a four-dimensional rotation of its body frame and the interaction field is a four-dimensional vorticity field. Therefore, one can see that there is only one theory of relativity, which is fully covariant.

Maxwell's theory of electrodynamics is one of the greatest advances in physics. This theory has played a key role in the development of the theory of relativity, which unifies the concepts of space and time based on the work of Lorentz on space-time transformations. The Lorentz transformation was originally the result of attempts by Lorentz and others to explain how the speed of light was observed to be independent of the reference frame, and to understand the symmetries of the laws of electrodynamics. Based on the Lorentz ether theory, Poincaré in 1905 proposed the relativity principle as a general law of nature, including electrodynamics and gravitation. Although the Lorentz transformation among inertial systems is fundamental in this development, Poincaré's theory of relativity does not clearly explain its physical meaning. Despite the fact that Poincaré's theory shows a relationship between pure Lorentz transformation and hyperbolic rotation, it does not specify what is rotating. Thus, Poincaré's theory does not completely resolve fundamental aspects of space-time, including its geometry, and does not give a new insight to the Maxwellian covariant electrodynamics. This is the origin of most troubles in the theory of relativity and electrodynamics, including the speculation about the existence of magnetic monopoles and the explanation of the mechanisms behind the electromagnetic force. In particular, this interaction, called the Lorentz force, is not a direct consequence of Maxwell's equations; rather this force has to be postulated in an independent manner. Although it has been noted that the electromagnetic field strength tensor and Lorentz force are both a natural consequence of the geometric structure of Minkowskian space-time, this fundamental geometry was not developed.

Early investigators of relativity, such as Robb, Varičak, Lewis, Wilson and Borel [1-5], have noticed and extensively investigated the non-Euclidean geometric character of uniform relative motion, where hyperbolic geometry governs the velocity addition law. Interestingly, Borel [5] has shown that non-Euclidean geometry is the origin of the famous Thomas-Wigner rotation. The importance of this non-Euclidean geometry and its affinity with the Minkowskian space-time in a complete theory of relativity has not been appreciated. Instead the geometrical theory of Einstein has been accepted as the correct theory of gravity to complete relativity. Since this theory of gravity has no systematic connection with Poincare's theory of relativity, it has been taken as the second theory of relativity. Therefore, Poincare's relativity is now called the special theory of relativity and that of Einstein for gravity is considered the general theory of relativity. Unfortunately, this may have prevented systematic progress in modern physics during the last century.

The theory of relativity of Lorentz and Poincare has to be completed in such a way that it explains:

1. The fundamental meaning of Lorentz transformation and geometrical structure of Minkowskian space-time;
2. The non-Euclidean geometry governing relative motion and electrodynamics;
3. The mechanism behind the electromagnetic interaction and some insight on the nature of other fundamental interactions, such as gravity.

Recently, in [6,7], the completion of theory of relativity has been achieved by discovering the relation between matter and the Minkowskian space-time. This more complete theory of relativity shows that every massive particle specifies a Minkowskian space-time body frame in a universal entity, which may be referred to as ether. The relative motion of particles is actually the result of relative four-dimensional rotation of their corresponding space-time body frames. This fundamental character of space-time shows that the pure Lorentz transformations represent the relative four-dimensional orientation among the space-time body frames of uniformly translating particles. Inertial observers in these frames relate components of four-vectors and four-tensors by Lorentz transformation. This is the origin of known non-Euclidean geometry governing the three vector and three tensor components. The hyperbolic geometry of the velocity addition law for uniform motion is the manifest of this fact [2-5]. However, we realize that orthogonal transformations similar to Lorentz transformations are not restricted to relative uniform motion. The relative motion of accelerating particles is also represented by varying orthogonal transformations. This not only establishes the general theory of motion for accelerating particles, but also furnishes the theory of fundamental interaction. The acceleration of a particle is the result of the instantaneous rotation of its space-time body frame in the ether. This instantaneous rotation is specified by a four-dimensional angular velocity tensor in the inertial reference frame. The hyperbolic part of this rotation is actually what is known as accelerating motion. However, there is also a circular spatial rotation, which is observed in some phenomena, such as the spin precession of a stationary charged particle in a magnetic field. The theory detailed in [6,7] also shows that every fundamental interaction is represented by an anti-symmetric four-tensor field with characteristics of a vorticity field. Therefore, particles interact with each other through four-vorticity and four-stress that they induce in the ether. The four-vorticity tensor field is a combination of three-vector circular and three-vector hyperbolic vorticities. It is seen that a Lorentz-like Minkowski force is an essential feature of every fundamental interaction. Interestingly, this vortex theory not only shows the geometrical character of four-vector Lorentz force, but also reveals its mechanical character as a lift-like force normal to the four-vector velocity analogous to the well known lift force on wings in fluid mechanics.

The vortex theory of interaction shows that covariant electrodynamics is a model for every classical fundamental interaction. Therefore, a Maxwellian theory of gravity, which generalizes Newtonian gravity to moving bodies in analogy to electrodynamics, is the consistent theory of gravity. This theory was proposed by Heaviside [8] for the first time, and thus should be called the Newton-Heaviside vortex theory of gravity or gravitomagnetism. Jefimenko [9] provides a collection of solved problems regarding moving and stationary bodies of different shapes, sizes and configurations. It should be emphasized that linearization of Einstein's field equations gives a pseudo-Maxwellian theory of gravitomagnetism, which is not covariant [10]. This is because a perfect isomorphism between the linearized Einstein equations and electromagnetism does not exist, which in hindsight shows the inconsistency of the general theory of relativity.

The historical records show that the idea of using vortex theory to explain gravity and electromagnetics is not new at all. Descartes [11] devised a theory of vortices, which postulated that space was entirely filled with a subtle matter, some kind of effluvium, not much different from the ether of later authors. He postulated that the sun by its rotation causes this effluvium to be concentrated in space vortices that carry the planets around the sun on their orbits. However, Newton rejected a vortex theory of gravity [12], because he did not find any relation between his theory of gravitation and a circular vortex theory. Now we know that his theory is actually a hyperbolic vortex theory with hyperbolic rotation instead of familiar circular rotation. He could not have imagined that his theory could be completed by adding circular vorticity as a co- or gyro- gravitational part. It is this. theory of circular vorticity, which Maxwell, Kirchhoff, Thomson, Lorentz, Larmor and other investigators used to explain the electromagnetic phenomenon without complete success. Now we understand that their vortex theory only explains the magnetic part of the electromagnetic phenomenon. However, the electric part has a hyperbolic character, which was not clear to them

The complete theory of relativity including geometry of space-time, classical theory of motion and vortex theory of interaction, systematically links all efforts of great minds from Descartes to Maxwell and Larmor in a span of three centuries. Surprisingly, this has been achieved by discovering the fundamental meaning of Lorentz transformation. Now we know there is only one theory of relativity.

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