Einstein's Special Theory of Relativity and Gravitational Time Dilation from the Law of Conservation of Spin

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Abstract: Here we showed that we can derive the Special-Theory-of-Relativity (SR) energy-momentum relation and the formulae for relativistic mass and time dilation on the basis of the law of conservation of spin on assumption that the SR length contraction is invalid. The SR length contraction follows from the Lorentz Transformation so the Lorentz Transformation violates the law of conservation of spin - the SR needs a reformulation. Notice as well that the reciprocation of the SR time dilation (each observer claims that the moving clocks are time dilated) suggests that the SR is an incomplete theory. Generally, theories starting from the Lorentz Transformation lead to correct formulae because we incorrectly assume that the relativistic mass is always not real. The Scale-Symmetric Theory (SST) shows that the consistent SR and General Theory of Relativity (GR), instead starting from the invariant speed of light, must start from the law of conservation of spin (it concerns the spin-0 particles as well). The origin of the SR reciprocation is considered. We showed that grainy spacetime, commonness of spinning vortices of matter inside particles and conservation of spin lead directly to the SR and to the GR formula for the gravitational time dilation.

1. Introduction

The Scale-Symmetric Theory (SST) [1], [2], shows that spinning vortices of matter inside leptons, hadrons and virtual pairs are common. To conserve spin of the vortices, especially of relativistic ones, planes defined by them must be perpendicular to their velocities.

SST shows that the gravitating Einstein spacetime (ES) is grainy – it consists of the ES components moving with the speed of light in "vacuum" c [1]. The ES components can be entangled so there can appear different structures composed of the ES components. In the Quantum Mechanics (QM) very important are loops created in ES. Consider a spinning loop in the rest in ES created from the ES components. Spin of such a loop, S_{Loop}, is defined as follows

$$S_{Loop} = m_o c R = const. = C_1, \quad (1)$$

where m_o is the rest mass of the loop and R is its radius.

Assume that such spinning loop accelerates. To protect its stability, the loop must adopt the orientation for which the spin is parallel or antiparallel to the motion velocity, v, which appears in the Lorentz Transformation. The loop consists of the ES components, which are moving with the resultant velocity equal to c, so there is valid following formula

$$c^2 = v^2 + v_{Spin}^2, \tag{2}$$

where v_{Spin} is the spin speed of the loop. Assume that mean radius of accelerated loop is invariant i.e. $R = const.$. The Special Theory of Relativity (SR) says nothing about internal structure of particles and ES spacetime so we can use the classical definition of spin to test the SR. Spin of the moving loop is defined by following formula and must be invariant

$$S_{Loop} = m_{Rel}\, v_{Spin}\, R = const. = C_1, \tag{3}$$

where m_{Rel} is the relativistic mass of the loop.

2. Relativistic mass

From formulae (1), (2) and (3), we obtain the well known SR formula for relativistic mass

$$m_{Rel} = m_o / (1 - v^2 / c^2)^{1/2}. \tag{4}$$

3. Energy-momentum relation

Since resultant energy is defined by $E = m_{Rel}\, c^2$ whereas momentum by $p = m_{Rel}\, v$ so we can transform formula (4) into the well known SR energy-momentum relation

$$E^2 = p^2 c^2 + m_o^2 c^4. \tag{5}$$

4. SR time dilation

We can define unit of time as the period of spinning of the accelerated loop. For a resting loop is $\Delta t = 2\pi R / c$ whereas for moving one is $\Delta \tau = 2\pi R / v_{Spin}$. Applying formula (2) we obtain

$$\Delta t = \Delta \tau\, (1 - v^2 / c^2)^{1/2}. \tag{6}$$

We can see that for $v > 0$ is $\Delta t < \Delta \tau$ i.e. unit of time in moving loop is longer i.e. time is going slower. Notice that contrary to the SR derived here from the law of conservation of spin, the SR derived on basis of the Lorentz Transformation is logically inconsistent [3], [4].

5. General-Theory-of-Relativity (GR) time dilation

Consider a free fall of a spinning loop in gravitational field of a point mass M (Fig.1).

For $r \to \infty$ is $v_{radial} \to 0$ so the sum of kinetic and potential energy (respectively $E_{kin} \equiv E_{FF} = m_{rel}\, v_{radial}^2 / 2$ and $E_{pot} \equiv E_G = -G\, M\, m_{rel} / r$) must be zero for freely falling loop. From the law of conservation of energy we have

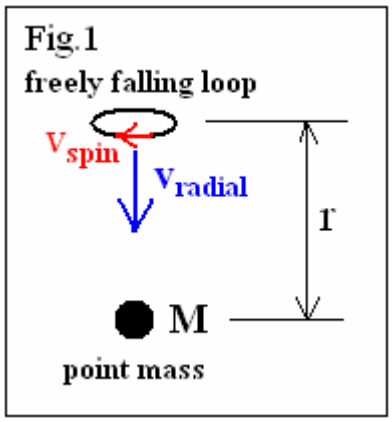
$$E_{FF} + E_G = 0. \tag{7}$$

We can define the free-fall potential: $V_{FF} = E_{FF} / m_{rel} = v_{radial}^{\,2} / 2$, and the gravitational potential: $V_G = E_G / m_{rel} = - G M / r$. From (7) we have

$$- V_G = V_{FF}, \tag{8}$$

i.e. the absolute value of gravitational potential is equivalent to the free-fall potential. From (8) we obtain

$$v_{radial}^{\,2} = 2 G M / r. \tag{9}$$



To conserve spin, plane of the freely falling loop must be perpendicular to the radial velocity so from formula (2) we have

$$c^{\,2} = v_{radial}^{\,2} + v_{spin}^{\,2}. \tag{10}$$

Applying formulae (10), (9) and the definitions of units of time from Paragraph 4, we obtain

$$\Delta t = \Delta \tau \, (1 - r_S / r)^{\,1/2}, \tag{11}$$

where $r \geq r_S$ and $r_S = 2 G M / c^{\,2}$ is the Schwarzschild radius of the point mass M. We can see that in fields with higher absolute value of gravitational potential (smaller r), clocks are going slower i.e. unit of time is longer (Δt is the unit of time for very distant observer i.e. $r \rightarrow \infty$ so $\Delta t = 2\pi R / c$, where R is the radius of loop).

6. Summary

The SR says nothing about internal structure of spacetime, dark energy and observed objects so we can use the classical definition of spin to test it.

Notice that the derivation of the SR formulae on basis of the law of conservation of spin (instead the Lorentz Transformation) is much, mach simpler and shows incompleteness, weak points and logical inconsistency of the SR based on the Lorentz Transformation.

The reciprocation of the SR time dilation (each observer claims that the moving clocks are time dilated) suggests that the SR is an incomplete theory. Is the time dilation or relativistic mass real? The Scale-Symmetric Theory shows that the reciprocation follows from the fact that the Lorentz Transformations neglects internal structure of spacetime, dark energy and relative motions of observed objects in relation to dark energy.

Moving loop must know what its state is in relation to an observer. It leads to conclusion that the moving loop must be entangled with the frame of reference associated with the observer. Due to the quantum entanglement, the loop knows whether it is accelerated and what is v_{Spin} in the frame of reference. According to SST, maximum value of v_{Spin} is c [1]. Emphasize as well that the gravitating ES components are not the SR masses – their mass is invariant [1]. Most important is the fact that resultant speed of the free or bound ES components, in each entangled system (it can be an observer plus a loop), is always equal to c.

Consider a galaxy cluster. The local recessional velocities of the cluster and dark energy are the same i.e. the cluster knows the state of the local dark energy. It means that spin speed in a loop in the rest in relation to the cluster is c. Now we can accelerate a loop in relation to the resting frame of reference i.e. such loop is entangled with the cluster – the increasing speed of the loop means that spin speed decreases (it is real), that relativistic mass increases (it is real) while time is going slower and slower (it is real).

Why ES must be grainy and gravitating? Just only then the accelerating loop can increase its relativistic mass by absorbing more and more new ES components to conserve the spin of the loop. It leads to conclusion that the thickness of the accelerating loop must increase, not decrease as it is in SR! For $v = c$, the thickness should be infinite.

We know that in SR, the length contraction follows from the Lorentz Transformation. Here we showed that we can derive the SR formulae on the basis of the law of conservation of spin on the assumption that the SR length contraction is invalid. Since SR starts from the Lorentz Transformation so we proved logical inconsistency of the Lorentz Transformation. It is showed as well in S. Crothers papers [3], [4]. SR needs a reformulation. Notice that there are not direct experimental confirmations of length contraction.

In reality, the SST shows stat Nature is even more complicated because there are in existence stable tori/charges with internal helicity which distinguishes fermions from antifermions [1]. When we accelerate the torus/charge of a nucleon then its thickness increases but the two characteristic mean radii of the torus, due to the very strong short-distance quantum entanglement between the ES components, are invariant – it leads to conclusion that the finite volume of the torus/charge of nucleon sets the upper limit for the relativistic mass of it. In SST, the half-integral spin of the tori/charges is the invariant as well.

SST shows also why the GR gravitational time dilation is not reciprocal.

Here we showed that grainy spacetime, commonness of spinning vortices of matter inside particles and conservation of spin lead directly to the SR and to the GR formula for gravitational time dilation.

On the basis of the SST and the partially incoherent SR, we can see that mathematical part of a theory should not be isolated from physical properties of Nature.

We showed that the origin of SR and GR is not associated with invariance of speed of light in “vacuum” c (due to the quantum entanglement, the c is invariant only for detectors) but with the law of conservation of spin. Even spin-0 particles consist of fermions and/or non-zero-spin loops. For example, SST shows that the spin-0 neutral pion is the binary system of spin-1 loops composed of entangled ES components.

So why, generally, we obtain correct formulae (besides the formula for the length contraction) starting from the Lorentz Transformation? It follows from the definition of the invariant spin $S_{Loop} = m_{Rel}\, v_{Spin}\, R = const.$. Since $R = const.$ so $m_{Rel}\, v_{Spin} = m_o\, c = const.$. Since in SR and GR we incorrectly assume that always the relativistic mass is not real

so $m_o = const.$ in all frames of reference – it leads to the incorrect assumption $c = const.$. SST shows that such assumption is not correct for systems composed of entangled parts.

References

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