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Gravity as An Explanation of Spin Measurement in Quantum Entanglement Possible Timeless State of the Universe

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We investigate the matching point between non-inertial frames and local inertial frames. This localization of gravity lead to an emergence of a timeless state of the universe in a mathematically consistent way. We find a geometric interpretation of the speed of light and mass. I find also a relation between every mass measured and the black hole entropy which introduces an information-matter equation from gravity. The experimental evidence of the timeless state of the universe is the quantum entanglement. Since the spin measurement is the manifestation of quantum entanglement measurement. Therefore, the internal spin of quantum particles can be understood as a relative gravitational red-shift at two different points. Therefore the spin measurements introduce the quantum gravity measurements in local inertial frames. We found that uncertainty is reduced as the measurements happens closely to the gravitational source. Least computations of gravitational measurement is achieved when the relative gravitational red-shift is equal to the difference in gravitational red-shift.

I. LOCALIZATION OF GRAVITY

Consider an existence of Schwarzschild black hole with event horizon. We consider the gravitational red-shift which is a property of general covariance. To localize gravity, we consider two points in the gravitational field of black hole as shown in the following Fig. (1) Notice here this triangle follow the geodesics geometry of the considered black hole to connect the three points with each other. If R and A are far enough from K, the triangle become approximately Euclidean triangle.

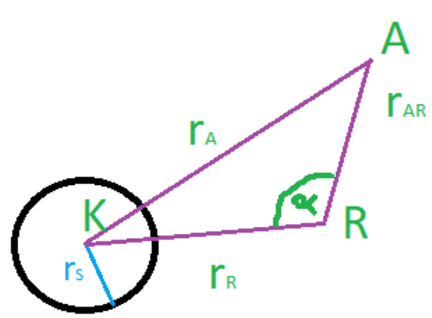

Figure 1. Black hole

Between these two points A and R, there are two local measurements:

1. Relative gravitational red-shift which is represented by the ratio at two different points

$$\frac{z_A}{z_R} = \frac{(1-\frac{r_s}{r_A})^{-1/2}-1}{(1-\frac{r_s}{r_R})^{-1/2}-1} \tag{1}$$

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2. The difference in gravitational red-shift at two different two different points.

$$\Delta z = z_A - z_R = (1 - \frac{r_s}{r_A})^{-1/2} - (1 - \frac{r_s}{r_R})^{-1/2} \tag{2}$$

II. MATCHING LOCAL GRAVITY MEASUREMENT WITH LOCAL INERTIAL FRAMES

A. Relative gravitational red-shift

In this section we match the local gravitational measurements with the local inertial frames. Therefore, we consider the weak gravitational approximations. We set $r_s << r_K$ and $r_s << r_R$. The gravitational red-shift for both A and R can be approximated as follows

$$z_A = (1 - \frac{r_s}{r_A})^{-1/2} - 1 \approx \frac{r_s}{2r_A} \tag{3}$$

$$z_R = (1 - \frac{r_s}{r_R})^{-1/2} - 1 \approx \frac{r_s}{2r_R}. \tag{4}$$

We compute the relative gravitational red-shift using Eq(1). We express it in terms of all lengths measured at R including the distance between A and R (r_{AR}).

$$\frac{z_R}{z_A} = \frac{1}{\sqrt{1 - \frac{r_{AR}^2}{r_A^2} + 2\frac{r_R r_{AR}}{r_A^2}\cos\alpha}} = \delta \tag{5}$$

Notice the value of α can be $0 \leq \alpha \leq \pi/2$. This equation represents the relative gravitational-red-shift between two points A and R in a weak gravitational field. For the case $\alpha = \pi/2$. The relative gravitational red-shift will be given by

$$\frac{z_R}{z_A} = \frac{1}{\sqrt{1 - (\frac{r_{AR}}{r_A})^2}} = \delta \tag{6}$$

At the matching point between non-inertial frames and local inertial frames, the relative gravitational red-shift or relative gravitational time dilation would equal to definition of time dilation in special relativity ($1/\sqrt{1 - v^2/c^2}$) if the ratio $r_{AR}^2/{r_A}^2$ can be replaced by ratio v^2/c^2 where v is the relative velocity and c is the speed of light. The match is legitimate and mathematically consistent since the relative gravitational red-shift introduces a local measurement which is the case for special relativity that holds only in local inertial frames. This means when $\alpha = \pi/2$, the gamma factor of special relativity emerges as a ratio between the gravitational red-shift at A and red-shift at R. Local gravity measurements depends only on **"one variable"**; the distance from the gravitational source, which is the reason for velocity ratios turned to be lengths ratios in this delta factor in Eq. (6). The ratio $r_{AR}^2/{r_A}^2$ can be considered as a geometric interpretation of the ratio v^2/c^2. This comparison can be written as

$$\frac{r_{AR}}{r_A} = \frac{r_{AR}/t}{r_A/t} = \frac{v}{c} \tag{7}$$

This would support the approach of time varying speed of light as a solution of cosmological puzzles that was suggested in [4].

Notice that time can be inserted easily in the previous equation as a "redundant variable" which can be interpreted that the state of matching local gravity measurements with local inertial frames would

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correspond to a possible timeless state of the universe which is consistent mathematically through the matching process that we performed.

To realize the effect of other values of angle α in weak gravitational field, we consider an approximation which is $r_{AR} << r_A$, $r_{AR} << r_R$. In that case, the delta factor in Eq. (5) is approximated as following

$$\delta \approx 1 - \frac{r_R r_{AR}}{r_A^2} \cos\alpha \tag{8}$$

It is found that this equation matches with the derivative of Kepler equation.

$$\frac{dM}{dE} = 1 - e\cos E \tag{9}$$

where M is the mean anomaly, E is the eccentric anomaly, and e is the eccentricity. In our approximation, the eccentricity e is approximately equal to $r_R r_{AR}/r_A^2$, and E refers to the angle α. This once again give a geometric interpretation of Kepler equation from the relative gravitational red-shift.

B. Difference in Gravitational red-shift

In this section, we compute local measurement as difference in gravitational red-shift. For weak gravitational approximation, we get

$$\Delta z = z_R - z_A = \frac{r_s}{2r_R} - \frac{r_s}{2r_A} \tag{10}$$

Let us make an approximation as following $r_A = r_R + x$, where $x << r_A$ and $x << r_R$. In that case, Eq. (10) will be rewritten as follows. We use the value of Schwarzschild radius $r_s = 2GM/c^2$

$$\Delta z\ M\ c^2 = GM^2 \frac{x}{r_R^2} \tag{11}$$

where G, is the gravitational constant, M, is the black hole mass and c is the speed of light. From Eq.(7), c can be set to equal to r_A if we take t to be unity since we agree that t is a redundant factor through matching local gravity measurement with local inertial frames. We find that Eq. (11) can be arranged to take the following form

$$\Delta z\ M = \Delta M = GM^2 \frac{x}{r_A^2 r_R^2} \tag{12}$$

where $\Delta M = \Delta z\ M$. ΔM represents relative relation of mass between any two different points in the gravitational field. This would give a geometric representation for relativistic relation mc^2 in terms of the difference between different points to the black hole. We want to understand the physical meaning of the factor GM^2 in r.h.s of Eq. (12). When we look at Bekenstein-Hawking entropy equation

$$S_{BH} = \frac{c^3 A}{4G\hbar} = \frac{4\pi}{c\hbar} GM^2 \tag{13}$$

where $A = 16\pi(GM/c^2)^2$ stands for surface area of a black hole. We found that the factor GM^2 in r.h.s of Eq. (12) between any two different points can be expressed in terms of black hole entropy as follows

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$$\Delta z\ M = \Delta M = \frac{\hbar}{4\pi}\frac{x}{r_R^2 r_A} S_{BH} \tag{14}$$

We assumed that time is a unity. let us consider this unit as the Planck time. This means that the Planck constant in previous equation can be replaced through the following process

$$t_p = \sqrt{\frac{\hbar G}{c^5}} = 1 \tag{15}$$

Since the Planck time is our unity, then c can set to be r_A. Therefore, the Planck constant in this geometric picture will be given by

$$\hbar G = r_A^5 \tag{16}$$

This equation gives a geometric or gravitational interpretation of Planck constant when matching local gravity measurement with local inertial frames.

The relative mass between any two different points is therefore given by

$$\Delta z M = \Delta M = \frac{1}{4\pi G}\frac{x\ r_A^4}{r_R^2} S_{BH} = \frac{1}{16\pi G}\frac{x\ \ r_A^2}{r_R^2}\quad A \tag{17}$$

We notice that the difference in gravitational red-shift gives an emergence of relative mass. The previous equation gives purely a geometric expression for the relative mass in terms of the gravitational source area of its full entropy.

It is experimentally proved that the difference in gravitational potential has an effect on the apparent weight of the 14.4-keV ray of Iron (Fe) [2, 3]. This may be an experimental support for the derived relation that connect the difference in gravitational red-shift and emergence of mass in this section.

III. GRAVITY AND UNCERTAINTY

In previous sections, we have shown that the concept of velocity is replaced with the relative distance between any any two different points in the space time when we match local gravitational measurements with the local inertial frames. This would generate a timeless state of the universe that is mathematically consistent in connecting non-inertial frames with local inertial frames or in other words matching non-locality with locality. In that state, the gravitational measurements happens in terms of only one variable which is the distance from the gravitational source. Time variable at the matching process appear to be a redundant variable. Since time, and therefore velocity dissolve when the matching process happens, therefore there is no meaning to define uncertainty in this timeless state of the universe. We conclude that the distance from the gravitational source form the hidden variable of quantum mechanics, which would complete the connection between quantum mechanics and gravity in one unified theory, which is the timeless state of the universe. This may complete the picture that was introduced in EPR [1]. This implies that the uncertainty amount would decrease as the measurement happens closer to the gravitational source. The uncertainty emerges, once we start varying the distance from the black hole. The uncertainty emerges due to the difference in information between point A and point R without knowing the distance to the source. This difference is encoded in Eq. 17. For the case when r_A is approximately equal to r_R, the difference in information (uncertainty) would be given by

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$$\frac{\Delta M r_R^2 r_A}{x} = \hbar \ \ S_{BH} \tag{18}$$

Notice that the difference in information between Point A and point R depends on the distances r_A and r_R. If we do not know these values, this difference will be hidden in our local measurements, and therefore, we get the uncertainty. Notice that the variables on the left hand side are greater than or equal to the Planck constant. This relation represent the hidden variables which is reason for emergence of uncertainty principle inequality in local measurements.

IV. STRONG GRAVITY CASE

In strong gravity case, we can use Eqs. 1 and 2 without any approximation. These relations can be computed for any two points, and it gives a wide spectrum of measurements of relative gravitational red-shifts and masses in strong gravity field. In strong gravity field, the triangle will not be perfectly Euclidean but can be computed for every kind of measurement by knowing the length of this triangle.

V. LEAST COMPUTATIONS AS A GUIDANCE PRINCIPLE

The computations of gravitational measurements will use less computations if the relative gravitational red-shift equal to the difference in gravitational red-shift. In that case, what can represent the ratio will certainly represent the difference, with one variable. To achieve the least computations, the local gravitational measurements should satisfy the following condition

$$z_A - z_R = \frac{z_A}{z_R} \tag{19}$$

Which can be solved in which $z_A = \phi^2$ and $z_R = \phi$ for any arbitrary variable ϕ.

For weak gravitational approximation; this condition can be written as

$$-\frac{r_s}{2} = \frac{r_R^2}{r_A - r_R} \tag{20}$$

Or it can be expressed in terms of black hole mass as

$$GM = -\frac{r_A^2 r_R^2}{r_A - r_R} \tag{21}$$

This equation seems to be a universal code of matter-gravity which is noted to be universal inverse proportionality between Matter and Gravity.

VI. EXPERIMENTAL QUANTUM ENTANGLEMENT EVIDENCE OF TIMELESS STATE

The only measurement that happens in the timeless state is the quantum entanglement between internal symmetries of elementary particles at two different points in the space [5]. Therefore, it is mathematically consistent to consider internal degree of freedom of elementary particles as a relative gravitational red-shift between two different points in the space. In that sense, gravity explain the origin of spin for elementary particles in two different cases as follows:

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- the measurement between two different points at equal distance from the black hole would introduce the spin 1 excitation since $z_R/z_A = 1$ in that case. In that case, $r_{AR} = r_A = r_R$ which corresponds to equilateral triangle.

- The measurement between two different points in distances from the gravitational source would result the spin-1/2 excitation, which mean in local inertial frames, $z_A/z_R = 1/2$. Since there is a difference between z_A and z_R, it can be guided by least computations, therefore, $z_A = \phi$ and $z_R = 1/2\ \phi$ for an arbitrary parameter ϕ.

- The measurement on the same point, would result spin 0 state. This state is represented by a straight line that has a length arbitrary length.

We interpret that as spin is a non-local completeness of local quantum theory which is related to gravitational source. The spin in that sense is the gravity effect or gravitational degree of freedom on every quantum particle. This would open a door for "gravity technology" through understanding the spin as a a relative gravitational red-shift.

VII. SU(2) BLACK HOLE INTERNAL SYMMETRY

In previous section, We have shown that the emergence of two SO(3) symmetries at two different points in the space around the black hole. Where each gravitational red-shift at every point has a spherical symmetry around the black hole. Through isomorphism, $SU(2)/\mathcal{Z}_2 \sim SO(3)$. This mathematical geometry relation would imply that the black hole would have a perfect SU(2) symmetry that can be detected through the spin measurements in local inertial frames. The isomorphism between $SU(2)$ and two different spheres SO(3) symmetry at two different points can be understood as a projection of SU(2) into two SO(3) sphere symmetries. The projection would yield spin 1/2 excitation if the two spheres have different radius and yield spin 0 excitation if the radius of the two spheres is the same.

VIII. STANDARD MODEL AS BLACK HOLE SYMMETRY

Our experimental measurements would follow the standard model that has a symmetry $SU(3) \times SU(2) \times U(1)$ where its measurements have been confirmed in local inertial frames. Therefore, we conjecture that our universe emerges from a black hole that has internal symmetry $SU(3) \times SU(2) \times U(1)$. This group has 12 $(8 + 3 + 1)$ free parameters. Through projection process of this symmetry into the space around the black hole, the internal symmetries such as color and spin form the different components of gravitational red-shift for each quantum particle. These internal symmetries can be measured in the timeless state through experiments such as quantum entanglement.

IX. ORIGIN OF CONSERVATION OF ENERGY

Based on gravitational red-shift computations and the timeless state of the universe, a principle can be added for the emergence of conservation of energy

- For every action and a reaction, there is always a gravitational source to which both events happens simultaneously in a timeless state, which explains the origin of conservation of energy.

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X. CONCLUSION

We match non-inertial frames with local inertial frames at their connecting point through equating the relative gravitational red-shift with the gamma factor in local inertial frames. We got a timeless state of the universe in which we found a geometric interpretations of speed of light, mass and spin. We found that the measured spin of quantum particles in quantum entanglement is an experimental evidence for the timeless state of the universe, in which relative gravitational red-shift is measured. The spin in that sense is the relative gravitational red-shift between any two different points of measurement. This would open the door for new gravitational technology.

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