Kaluza-Klein-Carmeli Metric from Quaternion-Clifford Space, Lorentz' Force, and Some Observables

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It was known for quite long time that a quaternion space can be generalized to a Clifford space, and vice versa; but how to find its neat link with more convenient metric form in the General Relativity theory, has not been explored extensively. We begin with a representation of group with non-zero quaternions to derive closed FLRW metric [1], and from there obtains Carmeli metric, which can be extended further to become 5D and 6D metric (which we propose to call Kaluza-Klein-Carmeli metric). Thereafter we discuss some plausible implications of this metric, beyond describing a galaxy's spiraling motion and redshift data as these have been done by Carmeli and Hartnett [4, 5, 6]. In subsequent section we explain Podkletnov's rotating disc experiment. We also note possible implications to quantum gravity. Further observations are of course recommended in order to refute or verify this proposition.

1 Introduction

It was known for quite long time that a quaternion space can be generalized to a Clifford space, and *vice versa*; but how to find its neat link to more convenient metric form in the General Relativity theory, has not been explored extensively [2].

First it is worth to remark here that it is possible to find a flat space representation of quaternion group, using its algebraic isomorphism with the ring division algebra [3, p.3]:

$$E_i E_j = -\delta_{ij} + f_{ijk} E_k \,. \tag{1}$$

Working for R^{dim}, we get the following metric [3]:

$$ds^2 = dx_\mu dx^\mu , \tag{2}$$

imposing the condition:

$$x_\mu x^\mu = R^2 . \tag{3}$$

This rather elementary definition is noted here because it was based on the choice to use the square of the radius to represent the distance (x_μ), meanwhile as Riemann argued long-time ago it can also been represented otherwise as the square of the square of the radius [3a].

Starting with the complex $n = 1$, then we get [3]:

$$q = x_0 + x_1 E_1 + x_2 E_2 + x_3 E_3 \,. \tag{4}$$

With this special choice of x_μ we can introduce the special metric [3]:

$$ds^2 = R^2 (\delta_{ij} \partial \Phi_i \partial \Phi_j). \tag{5}$$

This is apparently most direct link to describe a flat metric from the ring division algebra. In the meantime, it seems very interesting to note that Trifonov has shown that the geometry of the group of nonzero quaternions belongs to closed FLRW metric. [1] As we will show in the subsequent Section, this approach is more rigorous than (5) in order to describe neat link between quaternion space and FLRW metric.

We begin with a representation of group with non-zero quaternions to derive closed FLRW metric [1], and from there we argue that one can obtain Carmeli 5D metric [4] from this group with non-zero quaternions. The resulting metric can be extended further to become 5D and 6D metric (which we propose to call Kaluza-Klein-Carmeli metric).

Thereafter we discuss some plausible implications of this metric, beyond describing a galaxy's spiraling motion and redshift data as these have been done by Carmeli and Hartnett [4–7]. Possible implications to the Earth geochronometrics and possible link to coral growth data are discussed. In the subsequent Section we explain Podkletnov's rotating disc experiment. We also note a possible near link between Kaluza-Klein-Carmeli and Yefremov's Q-Relativity, and also possible implications to quantum gravity.

The reasons to consider this Carmeli metric instead of the conventional FLRW are as follows:

- One of the most remarkable discovery from WMAP is that it reveals that our Universe seems to obey Euclidean metric (see Carroll's article in *Nature*, 2003);
- In this regards, to explain this observed fact, most arguments (based on General Relativity) seem to agree that in the edge of Universe, the metric will follow Euclidean, because the matter density tends to approaching zero. But such a proposition is of course in contradiction with the basic "assumption" in GTR itself, i.e. that the Universe is *homogenous isotropic* everywhere, meaning that the matter density should be the same too in the edge of the universe. In other words, we need a new metric to describe the *inhomogeneous isotropic* spacetime.

$$g_{\alpha\beta} = \begin{pmatrix} \tau(\eta)(\frac{\dot{R}}{R})^2 & 0 & 0 & 0 \\ 0 & -\tau(\eta) & 0 & 0 \\ 0 & 0 & -\tau(\eta)\sin^2(\chi) & 0 \\ 0 & 0 & 0 & -\tau(\eta)\sin^2(\chi)\sin^2(\vartheta) \end{pmatrix}. \quad (6)$$

- Furthermore, from astrophysics one knows that spiral galaxies do not follow Newtonian potential exactly. Some people have invoked MOND or modified (Post-) Newton potential to describe that deviation from Newtonian potential [8, 9]. Carmeli metric is another possible choice [4], and it agrees with spiral galaxies, and also with the redshift data [5–7].
- Meanwhile it is known, that General Relativity is strictly related to Newtonian potential (Poisson's equation). All of this seems to indicate that General Relativity is only applicable for some limited conditions, but it may not be able to represent the *rotational aspects of gravitational phenomena*. Of course, there were already extensive research in this area of the generalized gravitation theory, for instance by introducing a torsion term, which vanishes in GTR [10].

Therefore, in order to explain spiral galaxies' rotation curve and corresponding "dark matter", one can come up with a different route instead of invoking a kind of strange matter. In this regards, one can consider dark matter as a property of the metric of the spacetime, just like the precession of the first planet is a property of the spacetime in General Relativity.

Of course, there are other methods to describe the *inhomogeneous* spacetime, see [15, 16], for instance in [16] a new differential operator was introduced: $\frac{\delta}{\delta\tau} = \frac{1}{H_o}\frac{1}{c}\frac{\delta}{\delta t}$, which seems at first glance as quite similar to Carmeli method. But to our present knowledge Carmeli metric is the most consistent metric corresponding to generalized FLRW (derived from a quaternion group).

Further observations are of course recommended in order to refute or verify this proposition.

2 FLRW metric associated to the group of non-zero quaternions

The quaternion algebra is one of the most important and well-studied objects in mathematics and physics; and it has natural Hermitian form which induces Euclidean metric [1]. Meanwhile, Hermitian symmetry has been considered as a method to generalize the gravitation theory (GTR), see Einstein paper in *Ann. Math.* (1945).

In this regards, Trifonov has obtained that a natural extension of the structure tensors using nonzero quaternion bases will yield formula (6). (See [1, p.4].)

Interestingly, by *assuming* that [1]:

$$\tau(\eta)\left(\frac{\dot{R}}{R}\right)^2 = 1\,, \quad (7)$$

then equation (6) reduces to closed FLRW metric [1, p.5]. Therefore one can say that closed FLRW metric is neatly associated to the group of nonzero quaternions.

Now consider equation (7), which can be rewritten as:

$$\tau(\eta)(\dot{R})^2 = R^2. \quad (8)$$

Since we choose (8), then the radial distance can be expressed as:

$$dR^2 = dz^2 + dy^2 + dx^2. \quad (9)$$

Therefore we can rewrite equation (8) in terms of (9):

$$\tau(\eta)(d\dot{R})^2 = (dR)^2 = dz^2 + dy^2 + dx^2, \quad (10)$$

and by defining

$$\tau(\eta) = \tau^2 = \frac{1}{H_0^2(\eta)} = \frac{1}{\alpha(H_0^2)^n}\,. \quad (11)$$

Then we can rewrite equation (10) in the form:

$$\tau(\eta)(d\dot{R})^2 = \tau^2(dv)^2 = dz^2 + dy^2 + dx^2, \quad (12)$$

or

$$-\tau^2(dv)^2 + dz^2 + dy^2 + dx^2 = 0\,, \quad (13)$$

which is nothing but an original Carmeli metric [4, p.3, equation (4)] and [6, p.1], where H_0 represents Hubble constant (by setting $\alpha = n = 1$, while in [12] it is supposed that $\alpha = 1.2$, $n = 1$). Further extension is obviously possible, where equation (13) can be generalized to include the $(i\,cdt)$ component in the conventional Minkowski metric, to become (Kaluza-Klein)-Carmeli 5D metric [5, p.1]:

$$-\tau^2(dv)^2 + dz^2 + dy^2 + dx^2 + (icdt)^2 = 0\,. \quad (14)$$

Or if we introduce equation (13) in the general relativistic setting [4, 6], then one obtains:

$$ds^2 = \tau^2(dv)^2 - e^{\xi}\cdot dr^2 - R^2\cdot(d\vartheta^2 + \sin^2\vartheta\cdot d\phi^2). \quad (15)$$

The solution for (15) is given by [6, p.3]:

$$\frac{dr}{dv} = \tau\cdot\exp\left(-\frac{\xi}{2}\right)\,, \quad (16)$$

which can be written as:

$$\frac{d\dot{r}}{dr} = \frac{dv}{dr} = \tau^{-1}\cdot\exp\left(\frac{\xi}{2}\right)\,. \quad (17)$$

This result implies that there shall be a metric deformation, which may be associated with astrophysics observation, such as the possible AU differences [11, 12].

Furthermore, this proposition seems to correspond neatly to the Expanding Earth hypothesis, because [13]:

"In order for expansion to occur, the moment of inertia constraints must be overcome. An expanding Earth would necessarily rotate more slowly than a smaller diameter planet so that angular momentum would be conserved." (Q.1)

We will discuss these effects in the subsequent Sections.

We note however, that in the original Carmeli metric, equation (14) can be generalized to include the potentials to be determined, to become [5, p.1]:

$$ds^2 = \left(1 + \frac{\Psi}{\tau^2}\right)\tau^2 (dv)^2 - dr^2 + \left(1 + \frac{\Phi}{c^2}\right) c^2 dt^2, \quad (18)$$

where

$$dr^2 = dz^2 + dy^2 + dx^2. \quad (19)$$

The line element represents a spherically symmetric *inhomogeneous* isotropic universe, and the expansion is a result of the spacevelocity component. In this regards, metric (18) describes *funfbein* ("five-legs") similar to the standard Kaluza-Klein metric, for this reason we propose the name Kaluza-Klein-Carmeli for all possible metrics which can be derived or extended from equations (8) and (10).

To observe the expansion at a definite time, the $(i\,cdt)$ term in equation (14) has been ignored; therefore the metric becomes "*phase-space*" Minkowskian. [5, p.1]. (A similar phase-space Minkowskian has been considered in various places, see for instance [16] and [19].) Therefore the metric in (18) reduces to (by taking into consideration the isotropic condition):

$$dr^2 + \left(1 + \frac{\Psi}{\tau^2}\right)\tau^2 (dv)^2 = 0\,. \quad (20)$$

Alternatively, one can suppose that in reality this assumption may be reasonable by setting $c \to 0$, such as by considering the metric for the phonon speed c_s instead of the light speed c; see Volovik, etc. Therefore (18) can be rewritten as:

$$ds^2_{phonon} = \left(1 + \frac{\Psi}{\tau^2}\right)\tau^2 (dv)^2 - dr^2 + \left(1 + \frac{\Phi}{c_s^2}\right) c_s^2\, dt^2. \quad (21)$$

To summarize, in this Section we find out that not only closed FLRW metric is associated to the group of nonzero quaternions [1], but also the same group yields Carmeli metric. In the following Section we discuss some plausible implications of this proposition.

3 Observable A: the Earth geochronometry

One straightforward implication derived from equation (8) is that the ratio between the velocity and the radius is directly proportional, regardless of the scale of the system in question:

$$\left(\frac{\dot{R}}{R}\right)^2 = \tau(\eta)^{-1}\,, \quad (22)$$

or

$$\left(\frac{R_1}{\dot{R}_1}\right) = \left(\frac{R_2}{\dot{R}_2}\right) = \sqrt{\tau(\eta)}\,. \quad (23)$$

Therefore, one can say that there is a direct proportionality between the *spacevelocity* expansion of, let say, Virgo galaxy and the Earth geochronometry. Table 1 displays the calculation of the Earth's radial expansion using the formula represented above [17]:

Therefore, the Earth's radius increases at the order of $\sim$0.166 cm/year, which may correspond to the decreasing angular velocity (Q.1). This number, albeit very minute, may also correspond to the Continental Drift hypothesis of A. Wegener [13, 17]. Nonetheless the reader may note that our calculation was based on Kaluza-Klein-Carmeli's phase-space *spacevelocity* metric.

Interestingly, there is a quite extensive literature suggesting that our Earth experiences a continuous deceleration rate. For instance, J. Wells [14] described a increasing day-length of the Earth [14]:

"It thus appears that the length of the day has been increasing throughout geological time and that the number of days in the year has been decreasing. At the beginning of the Cambrian the length of the day would have been 21^{h}." (Q.2)

Similar remarks have been made, for instance by G. Smoot [13]:

"In order for this to happen, the lunar tides would have to slow down, which would affect the length of the lunar month. ... an Earth year of 447 days at 1.9 Ga decreasing to an Earth year of 383 days at 290 Ma to 365 days at this time. However, the Devonian coral rings show that the *day is increasing by 24 seconds every million years,* which would allow for an expansion rate of about 0.5% for the past 4.5 Ga, all other factors being equal." (Q.3)

Therefore, one may compare this result (Table 1) with the increasing day-length reported by J. Wells [13].

4 Observable B: the Receding Moon from the Earth

It is known that the Moon is receding from the Earth at a constant rate of $\sim$4cm/year [17, 18].

Using known values: $G = 6.6724\times10^{-8}$ cm^2/(g $\cdot$ sec^2) and $\rho = 5.5\times10^6$ g/m^3, and the Moon's velocity $\sim$7.9 km/sec, then one can calculate using known formulas:

$$\mathrm{Vol} = \frac{4}{3}\,\pi\cdot(R + \Delta R)^3, \quad (24)$$

$$M + \Delta M = \mathrm{Vol}\cdot\rho\,, \quad (25)$$

$$r + \Delta r = \frac{G\cdot(M + \Delta M)}{v^2}\,, \quad (26)$$

where r, v, M each represents the distance from the Moon to the Earth, the Moon's orbital velocity, and the Earth's mass,

Nebula	Radial velocity (mile/s)	Distance (10^3 kly)	Ratio (10^{-5} cm/yr)	the Earth dist. (R, km)	Predicted the Earth exp. (ΔR, cm/year)
Virgo	750	39	2.617	6371	0.16678
Ursa Mayor	9300	485	2.610	6371	0.166299
Hydra	38000	2000	2.586	6371	0.164779
Bootes 2	86000	4500	2.601	6371	0.165742
Average			2.604		0.1659

Table 1: Calculation of the radial expansion from the Galaxy velocity/distance ratio. Source: [17].

respectively. Using this formula we obtain a prediction of the Receding Moon at the rate of 0.00497 m/year. This value is around 10% compared to the observed value 4 cm/year.

Therefore one can say that this calculation shall take into consideration other aspects. While perhaps we can use other reasoning to explain this discrepancy between calculation and prediction, for instance using the "*conformal brane*" method by Pervushin [20], to our best knowledge this effect has neat link with the known paradox in astrophysics, i.e. the observed matter only contributes around ∼1–10% of all matter that is supposed to be "there" in the Universe.

An alternative way to explain this discrepancy is that there is another type of force different from the known Newtonian potential, i.e. by taking into consideration the expansion of the "surrounding medium" too. Such a hypothesis was proposed recently in [21]. But we will use here a simple argument long-time ago discussed in [22], i.e. if there is a force other than the gravitational force acting on a body with mass, then it can be determined by this equation [22, p.1054]:

$$\frac{d(mv_0)}{dt} = F + F_{gr}\,, \tag{27}$$

where v_0 is the velocity of the particle relative to the absolute space [22a]. The gravitational force can be defined as before:

$$F_{gr} = -\,m\,\nabla V\,, \tag{28}$$

where the function V is solution of Poisson's equation:

$$\nabla^2\,V = 4\pi K\mu\,, \tag{29}$$

and K represents Newtonian gravitational constant. For system which does not obey Poisson's equation, see [15].

It can be shown, that the apparent gravitational force that is produced by an aether flow is [22]:

$$F_{gr} = m\,\frac{\partial v}{\partial t} + m\,\nabla\left(\frac{v^2}{2}\right) - mv_0\times\nabla\times v + v\,\frac{dm}{dt}\,, \tag{30}$$

which is an extended form of Newton law:

$$\vec{F} = \frac{d}{dt}\,(\vec{m}\vec{v}) = m\left(\frac{d\vec{v}}{dt}\right) + v\left(\frac{d\vec{m}}{dt}\right). \tag{31}$$

If the surrounding medium be equivalent to Newton's theory, this expression shall reduce to that given in (27). Supposing the aether be irrotational relative to the particular system of the coordinates, and $m = \text{const}$, then (29) reduces [22]:

$$F_{gr} = -m\left(-\frac{\partial v}{\partial t} - \nabla\left(\frac{v^2}{2}\right)\right), \tag{32}$$

which will be equivalent to equation (27) only if:

$$\nabla V = \frac{\partial v}{\partial t} + \nabla\left(\frac{v^2}{2}\right). \tag{33}$$

Further analysis of this effect to describe the Receding Moon from the Earth will be discussed elsewhere. In this Section, we discuss how the calculated expanding radius can describe (at least partially) the Receding Moon from the Earth. Another possible effect, in particular the deformation of the surrounding medium, shall also be considered.

5 Observable C: Podkletnov's rotation disc experiment

It has been discussed how gravitational force shall take into consideration the full description of Newton's law. In this Section, we put forth the known equivalence between Newton's law (31) and Lorentz' force [23], which can be written (supposing m to be constant) as follows:

$$\vec{F} = \frac{d}{dt}\,(\gamma\vec{m}\vec{v}) = \gamma m\left(\frac{d\vec{v}}{dt}\right) = q\left(\vec{E} + \frac{1}{c}\,\vec{v}\times\vec{B}\right), \tag{34}$$

where the relativistic factor is defined as:

$$\gamma = \pm\sqrt{\frac{1}{1-\beta^2}}\,. \tag{35}$$

while we can expand this equation in the cylindrical coordinates [23], we retain the simplest form in this analysis. In accordance with Spohn, we define [24]:

$$E = -\nabla A\,. \tag{36}$$

$$B = \nabla\times A\,. \tag{37}$$

For Podkletnov's experiment [26–28], it is known that there in a superconductor $E = 0$ [25], and by using the mass m in lieu of the charge ratio $\frac{e}{c}$ in the right hand term of (34) called the "gravitational Lorentz force", we get:

$$m\left(\frac{d\vec{v}}{dt}\right) = \frac{m}{\gamma}\left(\vec{v}\times\vec{B}\right) = \frac{1}{\gamma}\left(\vec{p}\times\vec{B}\right). \tag{38}$$

Let us suppose we conduct an experiment with the weight $w = 700$ g, the radius $r = 0.2$ m, and it rotates at $f = 2$ cps (cycle per second), then we get the velocity at the edge of the disc as:

$$v = 2\pi \cdot fr = 2.51 \text{ m/sec}, \tag{39}$$

and with known values for $G = 6.67\times10^{-11}$, $c \simeq 3\times10^{8}$ m/sec, $M_{earth} = 5.98\times10^{24}$ kg, $r_{earth} = 3\times10^{6}$ m, then we get:

$$F_{gr} = \frac{G}{c^2 r} Mv \approx 3.71\times10^{-9} \text{ newton/kgm sec}. \tag{40}$$

Because $B = F/\text{meter}$, then from (39), the force on the disc is given by:

$$F_{disc} = \vec{B}_{earth} \cdot \vec{p}_{disc} \approx B_{earth} \cdot \left(m \frac{c}{\gamma} \right). \tag{41}$$

High-precision muon experiment suggests that its speed can reach around $\sim 0.99\,c$. Let us suppose in our disc, the particles inside have the speed $0.982\,c$, then $\gamma^{-1} = 0.1889$. Now inserting this value into (40), yields:

$$\begin{aligned} F_{disc} &= (3.71\times10^{-9}) \cdot (0.7) \cdot (3\times10^{8}) \cdot 0.189 = \\ &= 0.147 \text{ newton} = 14.7 \text{ gr}. \end{aligned} \tag{42}$$

Therefore, from the viewpoint of a static observer, the disc will get a mass reduction as large as $\frac{14.7}{700} = 2.13\%$, which seems quite near with Podkletnov's result, i.e. the disc can obtain a mass reduction up to 2% of the static mass.

We remark here that we use a simplified analysis using Lorentz' force, considering the fact that superconductivity may be considered as a relativistic form of the ordinary electromagnetic field [25].

Interestingly, some authors have used different methods to explain this apparently bizarre result. For instance, using Tajmar and deMatos' [29] equation: $\gamma_0 = \frac{a\Omega}{2} = \frac{0.2\cdot 2}{2} = 0.2$. In other words, it predicts a mass reduction around $\sim\frac{0.2}{9.8} = 2\%$, which is quite similar to Podkletnov's result.

Another way to describe those rotating disc experiments is by using simple Newton law [33]. From equation (31) one has (by setting $F = 0$ and because $g = \frac{dv}{dt}$):

$$\frac{dm}{dt} = -\frac{m}{v}\, g = -\frac{m}{\omega R}\, g\,, \tag{43}$$

Therefore one can expect a mass reduction given by an angular velocity (but we're not very how Podkletnov's experiment can be explained using this equation).

We end this section by noting that we describe the rotating disc experiment by using Lorentz' force in a rotating system. Further extension of this method in particular in the context of the (extended) Q-relativity theory, will be discussed in the subsequent Section.

6 Possible link with Q-Relativity. Extended 9D metric

In the preceding Section, we have discussed how closed FLRW metric is associated to the group with nonzero quaternions, and that Carmeli metric belongs to the group. The only problem with this description is that it neglects the directions of the velocity other than against the x line.

Therefore, one can generalize further the metric to become [1, p.5]:

$$-\tau^2 (dv_R)^2 + dz^2 + dy^2 + dx^2 = 0\,, \tag{44}$$

or by considering each component of the velocity vector [23]:

$$\begin{aligned} (i\tau\, dv_X)^2 + (i\tau\, dv_Y)^2 + (i\tau\, dv_Z)^2 &+ \\ + dz^2 + dy^2 + dx^2 &= 0\,. \end{aligned} \tag{45}$$

From this viewpoint one may consider it as a generalization of Minkowski's metric into biquaternion form, using the modified Q-relativity space [30, 31, 32], to become:

$$ds = (dx_k + i\tau\, dv_k)\, q_k. \tag{46}$$

Please note here that we keep using definition of Yefremov's quaternion relativity (Q-relativity) physics [30], albeit we introduce dv instead of dt in the right term. We propose to call this metric *quaternionic Kaluza-Klein-Carmeli metric*.

One possible further step for the generalization this equation, is by keep using the standard Q-relativistic dt term, to become:

$$ds = (dx_k + i\,c\,dt_k + i\tau\, dv_k)\, q_k\,, \tag{47}$$

which yields 9-Dimensional extension to the above quaternionic Kaluza-Klein-Carmeli metric. In other words, this generalized 9D KK-Carmeli metric is seemingly capable to bring the most salient features in both the standard Carmeli metric and also Q-relativity metric. Its prediction includes plausible time-evolution of some known celestial motion in the solar system, including but not limited to the Earth-based satellites (albeit very minute). It can be compared for instance using Arbab's calculation, that the Earth accelerates at rate 3.05 arcsec/cy^2, and Mars at 1.6 arcsec/cy^2 [12]. Detailed calculation will be discussed elsewhere.

We note here that there is quaternionic multiplication rule which acquires the compact form [30–32]:

$$1q_k = q_k 1 = q_k\,, \quad q_j q_k = -\delta_{jk} + \varepsilon_{jkn} q_n\,, \tag{48}$$

where δ_{kn} and ε_{jkn} represent 3-dimensional symbols of Kronecker and Levi-Civita, respectively [30]. It may also be worth noting here that in 3D space Q-connectivity has clear geometrical and physical treatment as movable Q-basis with behavior of Cartan 3-frame [30].

In accordance with the standard Q-relativity [30, 31], it is also possible to write the dynamics equations of Classical Mechanics for an inertial observer in the constant Q-basis, as follows:

$$m\,\frac{d^2}{dt^2}\,(x_k q_k) = F_k q_k\,. \tag{49}$$

Because of the antisymmetry of the connection (the generalized angular velocity), the dynamics equations can be written in vector components, by the conventional vector notation [30, 32]:

$$m\left(\vec{a} + 2\vec{\Omega}\times\vec{v} + \vec{\Omega}\times\vec{r} + \vec{\Omega}\times(\vec{\Omega}\times\vec{r})\right) = \vec{F}\,, \qquad (50)$$

which represents known types of classical acceleration, i.e. the linear, the Coriolis, the angular, and the centripetal acceleation, respectively.

Interestingly, as before we can use the equivalence between the inertial force and Lorentz' force (34), therefore equation (50) becomes:

$$m\left(\frac{d\vec{v}}{dt} + 2\vec{\Omega}\times\vec{v} + \vec{\Omega}\times\vec{r} + \vec{\Omega}\times(\vec{\Omega}\times\vec{r})\right) = \\ = q_{\otimes}\left(\vec{E} + \frac{1}{c}\,\vec{v}\times\vec{B}\right), \qquad (51)$$

or

$$\left(\frac{d\vec{v}}{dt}\right) = \frac{q_{\otimes}}{m}\left(\vec{E} + \frac{1}{c}\,\vec{v}\times\vec{B}\right) - \\ - \frac{2\vec{\Omega}\times\vec{v} + \vec{\Omega}\times\vec{r} + \vec{\Omega}\times(\vec{\Omega}\times\vec{r})}{m}\,. \qquad (52)$$

Please note that the variable q here denotes electric charge, not quaternion number.

Therefore, it is likely that one can expect a new effects other than Podkletnov's rotating disc experiment as discussed in the preceding Section.

Further interesting things may be expected, by using (34):

$$\vec{F} = m\left(\frac{d\vec{v}}{dt}\right) = q\left(\vec{E} + \frac{1}{c}\,\vec{v}\times\vec{B}\right) \Rightarrow \\ \Rightarrow m\,(d\vec{v}) = q\left(\vec{E} + \frac{1}{c}\,\vec{v}\times\vec{B}\right) dt\,. \qquad (53)$$

Therefore, by introducing this Lorentz' force instead of the velocity into (44), one gets directly a plausible extension of Q-relativity:

$$ds = \left[dx_k + i\,\tau\,\frac{q}{m}\left(\vec{E}_k + \frac{1}{c}\,\vec{v}_k\times\vec{B}_k\right) dt_k\right] q_k\,. \qquad (54)$$

This equation seems to indicate how a magnetic wormhole can be induced in 6D Q-relativity setting [16, 19]. The reason to introduce this proposition is because there is known link between magnetic field and rotation [34]. Nonetheless further experiments are recommended in order to refute or verify this proposition.

7 Possible link with quantum gravity

In this Section, we remark that the above procedure to derive the closed FLRW-Carmeli metric from the group with nonzero quaternions has an obvious advantage, i.e. one can find Quantum Mechanics directly from the quaternion framework [35]. In other words, one can expect to put the gravitational metrical (FLRW) setting and the Quantum Mechanics setting in equal footing. After all, this may be just a goal sought in "quantum gravity" theories. See [4a] for discussion on the plausible quantization of a gravitational field, which may have observable effects for instance in the search of extrasolar planets [35a].

Furthermore, considering the "phonon metric" described in (20), provided that it corresponds to the observed facts, in particular with regards to the "surrounding medium" vortices described by (26–29), one can say that the "surrounding medium" is comprised of the phonon medium. This proposition may also be related to the superfluid-interior of the Sun, which may affect the Earth climatic changes [35b]. Therefore one can hypothesize that the signatures of quantum gravity, in the sense of the quantization in gravitational large-scale phenomena, are possible because the presence of the phonon medium. Nonetheless, further theoretical works and observations are recommended to explore this new proposition.

8 Concluding remarks

In the present paper we begun with a representation of a group with non-zero quaternions to derive closed FLRW metric [1], and we obtained Carmeli 5D metric [4] from this group. The resulting metric can be extended further to become 5D and 6D metric (called by us *Kaluza-Klein-Carmeli metric*).

Thereafter we discussed some plausible implications of this metric. Possible implications to the Earth geochronometrics and possible link to the coral growth data were discussed. In subsequent Section we explained Podkletnov's rotating disc experiment. We also noted possible neat link between Kaluza-Klein-Carmeli metric and Yefremov's Q-Relativity, in particular we proposed a further extension of Q-relativity to become 9D metric. Possible implications to quantum gravity, i.e. possible observation of the quantization effects in gravitation phenomena was also noted.

Nonetheless we do not pretend to have the last word on some issues, including quantum gravity, the structure of the aether (phonon) medium, and other calculations which remain open. There are also different methods to describe the Receding Moon or Podkletnov's experiments. What this paper attempts to do is to derive some known gravitational phenomena, including Hubble's constant, in a simplest way as possible, without invoking a strange form of matter. Furthermore, the Earth geochronometry data may enable us to verify the cosmological theories with unprecedented precision.

Therefore, it is recommended to conduct further observations in order to verify and also to explore the implications of our propositions as described herein.

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