Calculating and Converting QGD's Constants and Units (updated)

By

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This paper assumes that the reader is familiar with quantum-geometry dynamics and is already acquainted with its equations explaining and describing the dynamics of physical phenomenon at all scales. Minimally, one should have read An Axiomatic Approach to Physics.

We have seen that some of the qualitative predictions which distinguish QGD from other theories are supported by experimental evidence but its quantitative predictions, expressed in natural discrete units derived from its axiom set have not until now been converted to conventional measurement units and without such conversions, it is not possible to test QGD's predictions against experimental and observational data.

The aim of the present paper is to fill that gap, thus making quantum-geometry dynamics a fully descriptive and predictive theory.

The Constants, Units and Quantities of QGD

QGD uses very few constants and units:

$preon^{(+)}$: The fundamental particle of matter and the fundamental unit of mass.

$\vec{c}$: The momentum vector of the $preon^{(+)}$ whose magnitude is fundamental and given by $c=\|\vec{c}\|$

$preon^{(-)}$: The fundamental particle of space

d_{φ} : The preonic leap which is the fundamental unit of displacement

$g^{(-)}$: The fundamental unit of n-gravity which corresponds to the magnitude of the repulsive force between any two $preons^{(-)}$ or $g^{(-)}=\|g^{(-)}\|$.

$g^{(+)}$: The fundamental unit of p-gravity which corresponds to the attractive force between $preons^{(+)}$ or $g^{(+)}=\|\vec{g}^{(+)}\|$

k : The proportionality constant between $g^{(+)}$ and $g^{(-)}$; $\|g^{(+)}\|=k\|g^{(-)}\|$.

$\vec{P}_a$: momentum vector of a particle or structure

$\|\vec{P}_a\|$: momentum of a particle or structure where $\|\vec{P}_a\| = \left\| \sum_{i=1}^{m_a} \vec{c}_i \right\|$:

E_a : energy of a particle or structure $E_a = \sum_{i=1}^{m_a} \|\vec{c}_i\|$

v_a : speed of a particle or structure where $v_a = \frac{\|\vec{P}_a\|}{m_a} = \frac{\left\| \sum_{i=1}^{m_a} \vec{c}_i \right\|}{m_a}$

We need two things if QGD is to be a fully descriptive and predictive theory. The first is that we assign numerical values to the constants and find a way to convert the natural units of QGD into conventional measurement units.

Assigning Value to d_φ

Quantum-geometry dynamics is an axiomatic theory but there is no way to axiomatically derive d_φ or the corresponding value in conventional units. Also, by definition, it is not physically possible to measure it. This leaves us with only one alternative, which is the use of placeholder value. In a previous version of this paper, I suggested using the Planck length as a place hold value which we would later correct or (most probably) replace to solve discrepancies between QGD's predictions using the placeholder value and observational and experimental data. But when equating d_φ with the Planck length and solving QGD's gravity equation to derive the masses of gravitationally interacting bodies we find that d_φ is orders of magnitude smaller.

Assigning Value to k

The simplified QGD equation for gravitational interactions $G(a;b) = m_a m_b \left(k - \frac{d^2 + d}{2} \right)$ where m_a and m_b are the masses of objects a and b in $preons^{(+)}$. The gravitational interaction equation predicts that for the distance d_Λ such that $k = \frac{d_\Lambda^2 + d_\Lambda}{2}$ the gravitational interaction between two objects must be equal to zero, that is $G(a;b) = 0$ (for $d > d_\Lambda$ gravity becomes negative and is, as we explained in other papers, is responsible for the effect we call dark energy).

So in order to find d_Λ and if QGD is correct, there should be systems with zero gravitational interactions between. Recent observations suggest that that $d_\Lambda \approx 10Mpc$ [i].

Since $10Mpc \approx 3*10^{23}$ meters and $G(a;b)=0$ the $d_\Lambda = \frac{3*10^{23}}{d_\varphi}$ then resolving

$k=\frac{d_\Lambda^2+d_\Lambda}{2}$ we find that k.

Assigning Conventional Value to the Mass of a Preon$^{(+)}$

Now that we have a value for k and d_φ, we can describe quantitatively the gravitational interactions between bodies of known masses a and b and between a and b' and make use of the equivalence principle to calculate m_a in $preons^{(+)}$.

Once we know the mass of a body in $preons^{(+)}$, we can use it as a reference to calculate the masses of other objects which.

Unlike QGD geometrical properties which can be converted into conventional units, there are several differing definitions and conventions of mass used by current physical theories. There are the gravitational mass, the rest mass, the inertial mass, the relativistic mass, the active and passive gravitational mass, etc. As we see, all of these notions of mass can be derived from QGD's natural definition of mass.

The Inertial Mass

$\Delta v_a = \frac{\Delta \vec{P}'_a}{m_a} = \frac{\vec{P}_F}{m_a}$ so $m_a \Delta v_a = \vec{P}_F$ and the inertial mass is given by $m_a = \frac{\Delta \vec{P}'_a}{\Delta v_a}$ which is the same as the QGD mass.

Gravitational Mass

$G(a;b) = m_a m_b \left(k - \frac{d^2+d}{2}\right)$. The gravitational mass is not intrinsic to an object since gravity is the result of the interactions between at least two objects.

What we call the gravitational mass, is then simply the derivation of the absolute mass from a measurement of the magnitude of the gravitational interaction between the object and a second object of known mass.

For instance, if m_a is determined, than we can resolve the gravitational interaction equation for m_b . Here again, the mass derived from gravitational interaction is the QGD mass.

Rest Mass and Relativistic Mass

Unless an object absorbs particle (which it does only when non-gravitational forces are applied to a body) the mass of an object does not change with speed.

The mass remains equal to the number of $preons^{(+)}$ it contains. What changes under the influence of gravity is the net orientation of the components $preons^{(+)}$, what we call its momentum given by the equation $\left\|\vec{P}_a\right\| = \left\|\sum_{i=1}^{m_a} \vec{c}_i\right\|$. The magnitude of $\vec{P}_a$ increases in towards b when $G(a;b) > 0$ and increases away from b when $G(a;b) < 0$ but as we explained it mass m_a or its energy $\sum_{i=1}^{m_a} \left\|\vec{c}_i\right\|$ remain constant.

For a body at rest, which is, a body that which experiences no displacement as a whole in quantum-geometrical space, we would have $\left\|\sum_{i=1}^{m_a} \vec{c}_i\right\| = 0$.

The relation between mass and energy expressed by $E_a = \sum_{i=1}^{m_a} \left\|\vec{c}_i\right\| = m_a c$ is a proportionality relation. Here again, the relativistic and QGD mass are one and the same.

It follows that the definitions of mass used in physics are conventional and are not based on fundamental physics. Which is why the conversion of the intrinsic and absolute mass used in QGD should not be converted to conventional units. All calculations must be made using the absolute mass.

Assigning Value to the c

According to QGD, the speed of an object is an intrinsic property that is independent of the frame of reference. The intrinsic (or absolute) speed of an object a is given by

$v_a = \dfrac{\|\vec{P}_a\|}{m_a}$ where m_a is its mass of in $preons^{(+)}$ and $\|\vec{P}_a\|$ is its momentum given by $\|\vec{P}_a\| = \left\| \sum_{i=1}^{m_a} \vec{c}_i \right\|$.

The momentum of a $preon^{(+)}$ is fundamental and equal given by $\left\|\vec{P}_{p^{(+)}}\right\| = \|\vec{c}\| = c$ so using the equation for speed we find that the speed of a $preon^{(+)}$ is $\dfrac{\left\|\vec{P}_{p^{(+)}}\right\|}{m_{p^{(+)}}} = \dfrac{c}{1} = c$.

Note: Though speed and momentum of a $preon^{(+)}$ *are numerically equal they are two distinct physical properties so we always must keep in mind the context in which* c *is used when discussing* $preons^{(+)}$ *so that we can make the distinction. For any other particle (the photons and neutrino, for example), since all their component the momentum is equal to their energy, that is* $\left\| \sum_{i=1}^{m_a} \vec{c}_i \right\| = \sum_{i=1}^{m_a} \|\vec{c}_i\| = m_a c$ *and speed equal to* $\dfrac{m_a c}{m_a} = c$ *so that there is no possible confusion as to the meaning of* c *.*

Since $\dfrac{G(\gamma;a)}{\|\vec{P}_\gamma\|} = \sin(\theta)$ so that $\dfrac{m_\gamma m_a \left(k - \dfrac{d^2+d}{2}\right)}{m_\gamma c} = \sin(\theta)$ then

$$\frac{m_a \left(k - \dfrac{d^2+d}{2}\right)}{\sin(\theta)} = c \, .$$

Note: an alternative approach based on the mechanism QGD proposes for the formation of particles from $preons^{(+)}$ *suggests that* $c \approx k$ *.*

Once d_φ is known, using QGD's equation for gravity, we can also derive the mass of the Sun in $preons^{(+)}$ and by inserting this value and the angle of deflection of starlight by the sun into the equation describing the gravitational interaction the Sun and light, we can derive the value of c .

Of course, all three methods described above must arrive at the same value of c. That could be a test of the correctness of d_φ or, depending on the point of view, be taken as a set of equations which unique solution is the actual value of c .

Correspondence between Intrinsic Speed and Conventional Speed

If $v'_a = \frac{d_a}{t}$ and $v'_\gamma = \frac{d_\gamma}{t}$ All that we need to know is that $\frac{v'_a}{v'_\gamma} c = \frac{d_a / t}{d_\gamma / t} c = \frac{d_a}{d_\gamma} = v_a$ so that having a value for c we can go back and forth between the relative speed v'_a and v_a .

Then, by comparing the predictions of QGD to observations, we can correct or replace the placeholder value so that predictions using the new value will be consistent with observations and allow for a new set of predictions. The process should be repeated until the predictions of QGD are consistent even with one observation, at which point all QGD's descriptions using the corrected value will allow predictions that are consistent with all observations regardless of scale.

Once we have a good approximation of the constants and units of QGD, it will be possible to apply the equations to dynamic systems at all scales.

Below is suggested application of QGD to a dynamic system consisting of n gravitationally interacting bodies.

Application to States of Gravitationally Interacting Bodies

The two bodies systems described by the simplified gravitational interaction equation is the basis of the state matrix used to describe the behaviour of a system composed of n gravitationally interacting bodies.

The change in momentum due to gravitational interaction is given by

$$\Delta \vec{P}_a = \Delta G_{1\to 2}(a;b) = \frac{\left\|\vec{G}_2(a;b)\right\| - \left\|\vec{G}_1(a;b)\right\|\cos(\theta)}{\left\|\vec{G}_2(a;b)\right\|}\vec{G}_2(a;b) \qquad (1)$$

where θ is the angle between $\vec{G}_1(a;b)$ and $\vec{G}_2(a;b)$ which are respectively the gravitational vectors between a and b in states 1 and 2 and $\Delta G_{1\to 2}(a;b)$ is understood to be the difference in the magnitude of the gravitational interaction between a and b from state 1 to state 2 (or $1 \to 2$)

For a system consisting of n gravitationally interacting bodies,

$$\Delta\vec{P}_{a_{i_{s+1}}} = \underset{j=1}{\overset{n}{\Delta\vec{G}}}\left(a_{i_s};a_{j_{s+1}}\right) = \sum_{j=1}^{n}\frac{\left\|\vec{G}_{s+1}\left(a_{i_s};a_{j_{s+1}}\right)\right\| - \left\|\vec{G}_s\left(a_{i_s};a_{j_{s+1}}\right)\right\|\cos\left(\theta\right)}{\left\|\vec{G}_{s+1}\left(a_{i_s};a_{j_{s+1}}\right)\right\|}\vec{G}_{s+1}\left(a_{i_s};a_{j_{s+1}}\right) \qquad (2)$$

where a_i and a_j are gravitationally interacting astrophysical bodies of the system, $j \neq i$ and s and $s+1$ are successive states of the system (a state being understood as the momentum vectors of the bodies of a system at given co-existing positions of the bodies) and $a_{i|s+x}$ is the body a_i and its position when at the state $s+x$. The position itself is denoted $\varepsilon_{a_i|s+x}$.

In order to plot the evolution in space of such a system, we must choose one of the bodies as a reference so that the motions of the others will be calculated relative to it. A reference distance travelled by our reference body is chosen, d_{ref} , which can be as small as the fundamental unit of distance (the leap between two $preons^{(-)}$ or *preonic leap*) but minimally small enough as to accurately follow the changes in the momentum vectors resulting from changes in position and gravitational interactions between the bodies.

So given an initial state s , the state $s+1$ corresponds to the state described by the positions and momentum vectors of the bodies of the system after the reference body travels a distance of d_{ref} . For simplicity, we will assign a_1 to the reference body.

$$s+1=\left\{\begin{matrix} \vec{P}_{a_{1|s+1}} = \vec{P}_{a_{1|s}} \vec{+} \Delta \underset{j=1}{\overset{n}{\vec{G}}}\left(a_{1|s};a_{j|s+1}\right) & | & \varepsilon_{a_1|s+1} \\ \ldots & | & \ldots \\ \vec{P}_{a_{n|s+1}} = \vec{P}_{a_{n|s}} \vec{+} \Delta \underset{j=1}{\overset{n}{\vec{G}}}\left(a_{n|s};a_{j|s+1}\right) & | & \varepsilon_{a_n|s+1} \end{matrix}\right\}$$

Using the above state matrix, the evolution of a system from one state to the next is obtained by simultaneously calculating the change in the momentum vectors from the variation in the gravitational interaction between bodies resulting from their change in position. Changes in the momentum vectors have are as explained earlier. Changes in position are given by $\varepsilon_{a_i|s+1} = \varepsilon_{a_i|s} + \frac{v_{a_i}}{v_{a_1}}\frac{d_{ref}}{\left\|\vec{P}_{a_i}\right\|}\vec{P}_{a_i}$. The distance travelled by a_i from s to

$s+1$ is $\frac{v_{a_i}}{v_{a_1}}d_{ref}$ (for $j=1$, the distance becomes simply d_{ref}) and distance between two bodies of the system at state $s+x$ is $d_{a_i;a_j|s+x}=\varepsilon_{a_i|s+x}-\varepsilon_{a_j|s+x}$.

Of course, we find that for $i=j$, then $d_{a_i;a_j|s+x}=0$, so that

$$\begin{aligned}\left\|\Delta\vec{G}_{s+1}\left(a_{i|s+1};a_{j|s+1}\right)\right\| &= \left\|\vec{G}\left(a_{i|s+1};a_{i|s+1}\right)\right\|-\left\|\vec{G}\left(a_{i|s};a_{i|s}\right)\right\| \\ &= m_a m_a\left(k-\frac{d^2_{a_i;a_i|s+1}-d_{a_i;a_j|s+1}}{2}\right)-m_a m_a\left(k-\frac{d^2_{a_i;a_i|s}-d_{a_i;a_i|s}}{2}\right), \\ &= m_a m_a k - m_a m_a k \\ &= 0\end{aligned}$$

the variation in the gravitational interaction between a body with itself is equal to zero, which implies that its momentum vector will remain unchanged unless $n>1$ and $\Delta\overset{n}{\underset{j=1}{\vec{G}}}\left(a_{n|s};a_{j|s+1}\right)\neq 0$. This is the QGD explanation of the first law of motion.

Note also that for an object a_j freefalling towards an object a_i, $\theta=0$ so equation (2) becomes $\Delta\vec{P}_{a_{i_{s+1}}}=\overset{n}{\underset{j=1}{\Delta\vec{G}}}\left(a_{i_s};a_{j_{s+1}}\right)=\frac{\left\|\vec{G}_{s+1}\left(a_{i_s};a_{j_{s+1}}\right)\right\|-\left\|\vec{G}_s\left(a_{i_s};a_{j_{s+1}}\right)\right\|}{\left\|\vec{G}_{s+1}\left(a_{i_s};a_{j_{s+1}}\right)\right\|}\vec{G}_{s+1}\left(a_{i_s};a_{j_{s+1}}\right)$ and

$$\left\|\overset{n}{\underset{j=1}{\Delta\vec{G}}}\left(a_{i_s};a_{j_{s+1}}\right)\right\|=\left\|\frac{\left\|\vec{G}_{s+1}\left(a_{i_{s+1}};a_{j_{s+1}}\right)\right\|-\left\|\vec{G}_s\left(a_{i_s};a_{j_{s+1}}\right)\right\|}{\left\|\vec{G}_{s+1}\left(a_{i_{s+1}};a_{j_{s+1}}\right)\right\|}\vec{G}_{s+1}\left(a_{i_{s+1}};a_{j_{s+1}}\right)\right\|=\left\|\vec{G}_{s+1}\left(a_{i_{s+1}};a_{j_{s+1}}\right)\right\|-\left\|\vec{G}_s\left(a_{i_s};a_{j_{s+1}}\right)\right\|$$

[i] Dark energy and key physical parameters of clusters of galaxies http://arxiv.org/abs/1206.1433