Quantum Electric Gravity: Unravelling Big *G* and Potential Consequences for *G*-Dependent Theories

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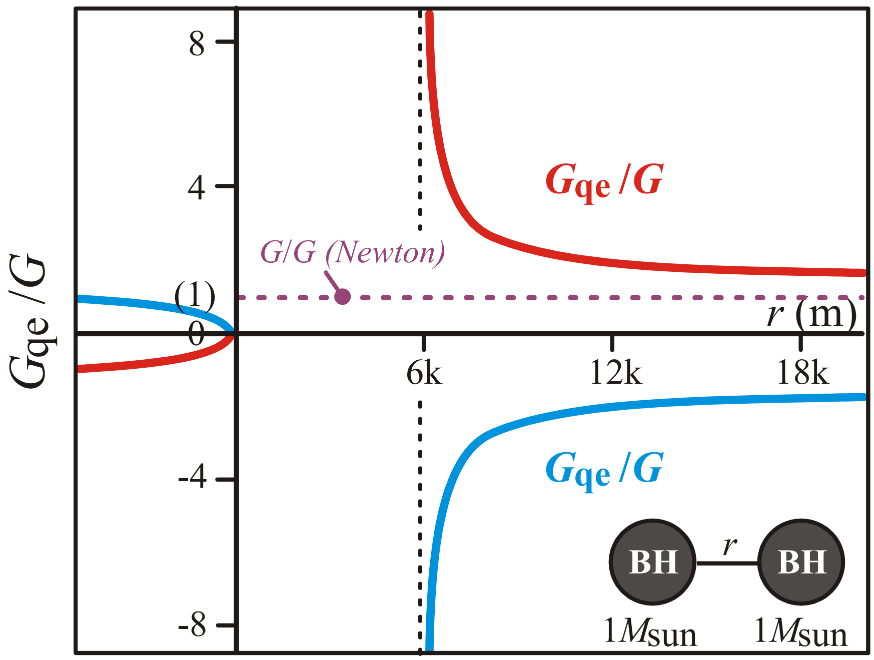

Figure 1. Normalised G_{qe}/G for two $1M_{Sun}$ BHs

Abstract

Quantum Electric Gravity (QEG) is a new theory of quantum gravity predicated on EM and QM. Unlike the classical Newton and Einstein's General Relativity theories, QEG can derive gravity from the fundamental pillars of EM, QED and QCD, and can potentially reveal the origin and root cause of gravity. The experimentally verifiable QEG equation comprises QCD binding energy, quantum probability, and EM entities. Prior to QEG, the origin of the gravitational parameter Big *G* remained highly elusive for centuries since its inception by Sir Isaac Newton. It had no apparent QM connections and there were no clues as to its origin, properties or dependencies. QEG is completely independent of *G*, however, it is uniquely positioned to derive *G* a priori in terms of fundamental Quantum Electric (QE) parameters and entities, and reveal its true QE character and origin. QEG demonstrates the inconstancy and variability of Big *G* and its dependency on object compositions, strong gravity, and other energy couplings. While

heretofore considered a constant of nature in classical gravity, G appears to be inconstant especially outside the cosy confines of the weak gravity of the solar system. This strongly suggests that G may not be worthy of its status as a fundamental constant of nature ranked along e, c, h, and α.

Keywords: QM Big G, New Theory of Gravity, Quantum Gravity.

1. The QEG Equation

The general QEG equation was derived in detail in [1, S6], [2, S2], [3], and [4], leading up to

$$\boxed{U_{\mathrm{QEG}} = D_{\mathrm{qe}} \frac{n_1 n_2}{U_0\, r} ECF_{\mathrm{qe}}}$$

$$ECF_{\mathrm{qe}} = \left(\frac{1}{U_{01}/U_0\ \ U_{\mathrm{N1}}} + \frac{1}{U_{02}/U_0\ \ U_{\mathrm{N2}}} \right) \qquad (1)$$

$$U_{\mathrm{N}} \quad = 1 + U_{\mathrm{s}} + U_{\mathrm{g}} + U_{\mathrm{a}} + U_{\mathrm{t}} + \cdots \equiv \text{normalised energy parameter}$$

$$U_{\mathrm{s}} \equiv \text{self-gravity},\quad U_{\mathrm{g}} \equiv \text{gravity},\quad U_{\mathrm{a}} \equiv \text{acceleration},\quad U_{\mathrm{t}} \equiv \text{temperature}$$

Parameter ECF_{qe} is the dimensionless Quantum Electric (QE) Energy Coupling Factor, and D_{qe} is the QE parameter defined as follows [1, S5]

$$D_{\mathrm{qe}} = 2\left(\frac{A_{\mathrm{vib}}\, e^2 P_{\mathrm{qp}}}{4\pi\varepsilon_0} \right)^2 \ 1/n_{\mathrm{qk}} - 1 \quad \left(\frac{\mathrm{J^2 m}}{\mathrm{nuc^2}} \right) \text{ or } \left(\frac{\mathrm{N^2 m^3}}{\mathrm{nuc^2}} \right) \qquad (2)$$

$$D_{\mathrm{qe}} = 2\ \ A_{\mathrm{vib}}\, \alpha\, \hbar\, c\, P_{\mathrm{qp}}\ {}^{2}\ \ 1/n_{\mathrm{qk}} - 1 \qquad \text{alternative}$$

2. QE Newtonian Gravitational Parameter – G_{qe} (G)

It must be noted that QEG does not need nor depend on Newton's Big G. However, it is uniquely positioned to derive it or its equivalent, referred to herein as G_{qe}, a priori in terms of fundamental QE parameters and entities, and reveal its QE origin. Prior to QEG, the origin of the gravitational parameter Big G remained highly elusive for over 300 years since its inception by Sir Isaac Newton. It had no apparent QM connections and there were no clues as to its origin, properties or dependencies. Sir Henry Cavendish measured the force of gravitational attraction between two bodies in 1798, using the torsion balance apparatus of John Michell, and subsequently calculated the value of G, thus making it easy to calculate the force of gravity from Newton, $\boldsymbol{F}_{\mathrm{New}} = GMm/r^2$. Newton's Law of Gravitation has been used ever since as a benchmark for any new theory of gravity before it can be taken seriously. Despite that, however, Newton's G has the reputation of being one of the least accurately determined parameter of nature, presumed to be "constant" with an Earth-bound uncertainty of ≈ 0.0128%. This may largely be due to the classical notion that gravity is proportional to object mass regardless of composition and the QCD binding energy, which is an inaccurate simplistic notion that had plagued Newton, GR and all theories of gravity prior to QEG. Another reason is the absence of the effect of strong gravity and the energy coupling factor (ECF_{qe}). Being a nucleon-centric theory and in addition to proposing a new concept for mass (m_{qe}) [2, S8], QEG is capable of pinning down the various intricate parameters and processes at work that can provide it with the means to distinguish between the individual gravitational interaction of protons and neutrons in the objects [1, SS5.2], among other things.

We shall derive G for the example of two equal mass Black Holes (BH) detailed in [1, SS6.1], each with mass $m = M_{\mathrm{Sun}}$. The force $\boldsymbol{F}_{\mathrm{QEG}}$ can be determined by implicit differentiation of energy U_{QEG} (1), as follows (U=U_{QEG})

$$F_{\mathrm{QEG}} = \frac{4D_{\mathrm{qe}}\, n^3 \;\; 2nU_0 + 2nU_s U_0 + U}{r \;\; 4rn^2U_0^2 + 8rn^2U_0^2U_s + 4rnUU_0 + 4rn^2U_s^2U_0^2 + 4rnUU_sU_0 + rU^2 + 4D_{\mathrm{qe}}n^3} \quad (3)$$

The basic approach is to equate the force (3) to Newton's as $\boldsymbol{F}_{\mathrm{QEG}} = G_{\mathrm{qe}}\, m^2/\, r^2$, then solve for G_{qe}. The latter approach is based on the assumption of the classical Newton/GR theories, advocating that mass is independent of gravity, i.e., invariant. Replacing object mass m with m=$n\, m_{\mathrm{nuc}}$, wherein m_{nuc} is the average nucleon mass in the object, leads to the following

$$F_{\mathrm{QEG}} = G_{\mathrm{qe}} \frac{m^2}{r^2} = G_{\mathrm{qe}} \frac{m_{\mathrm{nuc}}^2 n^2}{r^2}$$
$$\boxed{G_{\mathrm{qe}} = \frac{r^2}{m_{\mathrm{nuc}}^2 n^2} F_{\mathrm{QEG}}} \quad (4)$$

A plot of G_{qe} normalised to classical G (G_{qe}/G) in strong gravity is shown in Figure 1. Also plotted is the normalised classical Newtonian G/G for comparison. Figure 1 clearly demonstrates that parameter G_{qe} is a variable dependent on the ECF_{qe} among other things. In addition to the negative solution, the figure also shows a positive solution to G_{qe}, which may perhaps allude to repulsive gravity. Furthermore, Figure 1 also shows some interesting theoretical or imaginary solutions with negative distance.

G_{qe} in Weak Gravity

Note that in weak gravity with comparable object compositions, $U_{\mathrm{a}} \approx U_{\mathrm{t}} \approx 0$, $U_{\mathrm{N1}} \approx U_{\mathrm{N2}} \approx 1$, and $ECF_{\mathrm{qe}} \approx 2$, parameter G_{qe} approximately approaches that of classical G, as follows [1, SS5.2, eq. (19)]

$$\boldsymbol{F}_{\mathrm{QEG}} = 2D_{\mathrm{qe}} \frac{n^2}{U_0 r^2} = \left(\frac{2D_{\mathrm{qe}}}{U_0\, m_{\mathrm{nuc}}^2} \right) \frac{m^2}{r^2} = G_{\mathrm{qe}} \frac{m^2}{r^2}$$
$$G_{\mathrm{qe}} = \left(\frac{2D_{\mathrm{qe}}}{U_0\, m_{\mathrm{nuc}}^2} \right) \approx G \qquad \mathrm{Nm^2/kg^2} \quad (5)$$

Equation (5) may alternatively be written in terms of fundamental constants of nature, as follows

$$G_{qe} = \frac{4\left(A_{vib}\,\alpha\hbar c\,P_{qp}\right)^{2}}{U_0\,m_{nuc}^{2}}\left(1/n_{qk}-1\right) \approx G \qquad \mathrm{Nm^2/kg^2} \tag{6}$$

Furthermore, if one were to substitute $P_{qp} \approx P^2 \approx \alpha^4$, G_{qe} may also be written as:

$$G_{qe} = \frac{4\left(A_{vib}\,\alpha^{5}\hbar c\right)^{2}}{U_0\,m_{nuc}^{2}}\left(1/n_{qk}-1\right) \approx G \qquad \mathrm{Nm^2/kg^2} \tag{7}$$

It is worth noting that the analysis above assumes invariant masses in line with Newton. However, the analysis of the nucleon QE mass (m_{qe}) [2, S8] suggests that mass too depends on strong gravity via energy parameter U_N. This implies that one may have to take the variable mass concept (m_{qe}) into account in the analysis above, such as by perhaps considering the effect of the combined term (Gm_1m_2) rather than G alone in the above derivation. It remains to be seen whether the outcome of the latter may perhaps somewhat reduce the dependency of classical gravity on G alone in strong gravity. Nonetheless, incorporating a variable mass is expected to further complicate matters for the rather clumsy mass-centric classical theories of gravity.

3. Remarks

1) The QEG-derived G_{qe} above demonstrates how $|G_{qe}|$ increases substantially with strong gravity until it hits a gravitational energy limit (U_{lmt}) at $r_{lmt} \approx 3000$ m for each BH (6000 m C-C), which coincides with the Event Horizons (EH) [1, SS6.1]. Potentially, the concept of U_{lmt} may spell trouble for Dark Energy (DE) in classical gravity.
2) While not having a direct role to play in QEG, G_{qe} (G) is likely to change everything for classical gravity with significant impacts. In particular, G_{qe} is likely to have serious adverse impacts on GR, which naively considers G as a sacrosanct constant of nature throughout the universe.
3) The dependency of G_{qe} on strong gravity may imply significant slowing down impact on the expansion of the universe in classical gravity, which may likely support a closed and cyclic universe – see also [2, S4, S7].
4) A variable G_{qe} (G) is likely to question its role as a defining constant in physics, such as in natural units, Planck units, and others.
5) A variable G_{qe} (G) is also expected to impact orbital and celestial mechanics as well as astrophysical and cosmological analysis and calculations. For example, the true mass of the SMBH Sgt A* at the centre of the Milky Way galaxy may have to be revised accordingly.
6) The distance r_{lmt} (EH) at the gravitational energy limits U_{lmt} depends on the particular system under consideration. For example, for a system comprising two equal mass BHs with $m = 2M_{Sun}$, the distance is expected to be $r_{lmt} \approx$ EH ≈ 6148 m [1, S6.1].
7) The presumption by Newton and GR theories that G must be a constant throughout the universe has blighted cosmology for centuries. In contrast, QEG predicts a variable G for a number of reasons. One reason is due to the failure of classical gravity to account for the relative number of protons and neutrons and their proportions (composition) in the

objects [1, SS5.2], as well as their failure to account for the different QCD binding energies of proton (U_{0p}) and neutron (U_{0n}) in the objects [1, SS5.2]. Other reasons include the absence of the effect of strong gravity and energy couplings (ECF_{qe}), and the absolute dependency of classical gravity on mass, which is a variable [2, S8].

Conclusion

Though mysterious, Newton's Big *G* is central to classical gravity as well as physics in general. All theories of gravity including Newton, GR, String, LQG and others rely on *G* and erroneously presume its constancy throughout the universe. In particular, GR considers *G* a sacrosanct constant of nature throughout the universe, on which GR was built in its entirety, without providing any viable justification. The deep-rooted QM foundation of QEG enables it to derive G_{qe} a priori via the QE paradigm, and helps unravel its strange and surprising character and nature. This is likely to undermine classical *G* in a significant way, and is expected to have profound implications for classical gravity and physics in general.

References

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