

Experimental Test of Quantum Gravity: General Relativity vs. Gauge Theory Gravity

Peter Cameron and Michaele Suisse*
*PO Box 1030
 Mattituck, NY USA 11952*

(Dated: May 12, 2017)

With recent detection of gravitational waves[1], the possibility exists that orientation-dependent detector responses might permit distinguishing between General Relativity (GR) and Gauge Theory Gravity (GTG)[2]. The classical equivalence of these two models was established over twenty years ago.[3–6]. The question is whether this equivalence persists in their respective quantum theories. While no such theory yet exists for the curved spacetime of GR, the task is not so difficult in the flat Minkowski spacetime of GTG.

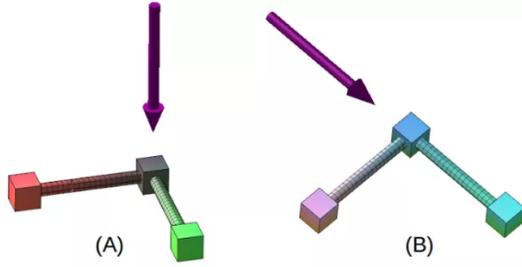


FIG. 1. Classical GR says interferometer response is optimal for orientation (A) and less so for (B)[19], whereas quantized GTG is optimal for (B) and less so for (A).

GR models the phase shifts of a gravitational wave detected by the interferometers as quadrupole distortion of the two transverse dimensions, as curvature of spacetime. Quantized GTG models them as quantum phase oscillations in one transverse and one longitudinal dimension of flat Minkowski spacetime[14, 15]. As shown in figure 1, optimal interferometer responses are orthogonal for these two models.

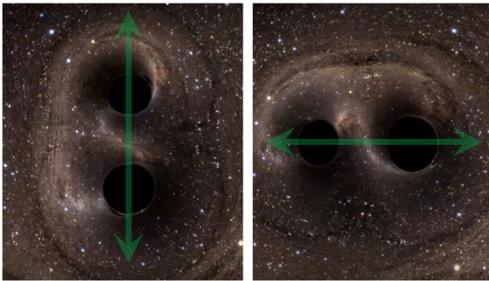


FIG. 2. Classical GR says the wave propagates normal to the plane of the paper as defined by the orbiting pair[17] (image A of figure 1), whereas quantized GTG has it propagating in the plane (image B of figure 1). Time symmetry requires reciprocity of source and detector.

waves seen by the detectors of figure 1. As seen by detector B, the left panel of figure 2 generates the 1D transverse phase shifts of quantized GTG and the right longitudinal phase shifts for a wave propagating left to right.

Triangulating source location by time of flight[19] and detector orientation dependence permits construction of analysis templates[16, 20, 21] for both models, an experimental test of GR grounded in a quantum theory of both gravity and the elementary particle spectrum[22].

The language of GTG is geometric Clifford algebra, the background-independent[7] language of interactions of fundamental geometric objects of physical space - the point, line, plane, and volume elements of Euclid. They are the geometric objects of the Pauli algebra of three-dimensional space. In quantized GTG they are taken to comprise the vacuum wavefunction. Their interactions generate the Dirac algebra of four-dimensional Minkowski spacetime[8]. They permit one to define a geometric wavefunction at the Planck length, and when endowed with quantized electric and magnetic fields reveal an exact relation between electromagnetism and gravity, yielding a naturally finite, confined, and gauge invariant quantum theory that has no free parameters and contains gravity[9–14, 22].

In an electromagnetic theory of quantum gravity[14], the mechanical impedance matching practiced by the gravitational wave community[16] becomes matching corresponding electromagnetic interaction impedances of the geometric wavefunctions. Event horizon of the Planck particle is unstable, wants to instantaneously Hawking radiate the Planck energy photon. Impedance mismatch of event horizon (huge inductance, nil capacitance) limits escaping energy to photon wavelength of a thousand billion light years. The universe is in the longitudinal near field of the radiating Planck particle. It is essentially a DC field, a bias field, the gravitational field. The gravitational wave is a tiny modulation of that field strength.

Figure 2 shows images taken from simulation of an inspiraling black hole pair[18], a possible source for

* michaele.suisse@gmail.com

-
- [1] B. Abbott et.al, “Observation of Gravitational Waves from a Binary Black Hole Merger”, PRL 116, 061102 (2016)
- [2] https://en.wikipedia.org/wiki/Gauge_theory_gravity
- [3] A. Lasenby, C. Doran, and S. Gull, “Astrophysical and Cosmological Consequences of a Gauge Theory of Gravity”, in N. Sanchez and A. Zichichi (ed.), Current Topics in Astrofundamental Physics, World Scientific (1995)
- [4] D. Hestenes, “Spacetime Calculus for Gravitation Theory” (1996)
<http://libra.msra.cn/Publication/4860262/spacetime-calculus-for-gravitation-theory>
- [5] A. Lasenby et.al, “Gravity, gauge theories and geometric algebra”, Phil. Trans. R. Lond. A **356** 487582 (1997)
<http://arxiv.org/abs/gr-qc/0405033>
- [6] D. Hestenes, “Oersted Medal Lecture 2002: Reforming the mathematical language of physics”, Am. J. Phys. 71, 104 (2003) <http://geocalc.clas.asu.edu/pdf/OerstedMedalLecture.pdf>
- [7] L. Smolin, “The Case for Background Independence” (2005) <http://arxiv.org/abs/hep-th/0507235>
- [8] D. Hestenes, Space-Time Algebra, Gordon and Breach, New York (1966)
- [9] P. Cameron “The Two Body Problem and Mach’s Principle”, submitted to Am. J. Phys. (1975), in revision. The original was published as an appendix to [10].
- [10] P. Cameron, “Electron Impedances”, Apeiron **18** 2 222-253 (2011) <http://redshift.vif.com/JournalFiles/V18N02PDF/V18N2CAM.pdf>
- [11] P. Cameron, “Background Independent Relations between Gravity and Electromagnetism” (2012)
<http://vixra.org/abs/1211.0052>
- [12] P. Cameron, “A Possible Resolution of the Black Hole Information Paradox”, Rochester Conference on Quantum Optics, Information, and Measurement (2013) <http://www.opticsinfobase.org/abstract.cfm?URI=QIM-2013-W6.01>
- [13] P. Cameron, “Identifying the Gauge Fields of Gauge Theory Gravity”, Gravity Research Foundation Essay Competition (2015) <http://vixra.org/abs/1503.0262>
- [14] P. Cameron, “Quantizing Gauge Theory Gravity”, Barcelona conference on applications of geometric Clifford algebra, p.89-98 (2015) <http://www-ma2.upc.edu/agacse2015/3641572286-EP/>
- [15] P. Cameron and M. Suisse, “Strings and Loops in the Language of Geometric Clifford Algebra”, Gravity Research Foundation Essay Competition (2017) <http://vixra.org/abs/1703.0307>
- [16] D. Blair et.al, “Advanced Gravitational Wave Detectors”, p.50-53 and thereafter, Cambridge (2012).
- [17] A helpful animation of binary black hole gravitational wave generation can be found at the CalTech site:
<http://www.tapir.caltech.edu/~teviet/Waves/gwave.html>
- [18] <https://www.black-holes.org/gw150914>
- [19] J. Miller, “The Direction of LIGO’s Gravitational Waves”, The Physics Mill (2016) <http://www.thephysicsmill.com/2016/03/06/direction-ligos-gravitational-waves/>
- [20] J. Whelan, “Visualization of Antenna Pattern Factors via Projected Detector Tensors”, LIGO-T1100431-v2 (2012)
<https://dcc.ligo.org/public/0068/T1100431/002/projectedTensor.pdf>
- [21] J. Veitch et.al, “Parameter estimation for compact binaries with ground-based gravitational-wave observations using LALInference” (2015) <https://arxiv.org/pdf/1409.7215.pdf>
- [22] P. Cameron and M. Suisse, “Geometry and Fields: Illuminating the Standard Model from Within”, submitted to Can. J. Phys. (Feb 2017) <http://vixra.org/abs/1701.0567>