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

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With recent detection of gravitational waves[1, 2], the possibility exists that orientation-dependent detector responses might permit distinguishing between General Relativity (GR) and Gauge Theory Gravity (GTG)[3]. The classical equivalence of these two models was established over twenty years ago.[4–7]. The question is whether this equivalence persists in their respective quantum theories. While such a theory is not yet known to exist for the curved spacetime of GR, the task is not so difficult in the flat Minkowski spacetime of GTG.

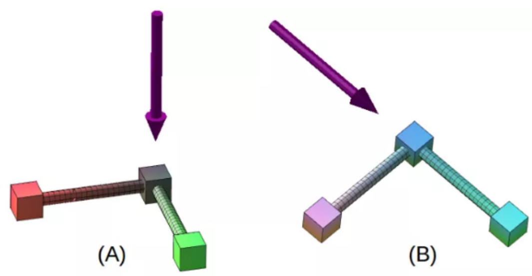

FIG. 1. Classical GR says interferometer response is optimal for orientation (A) and less so for (B)[20], whereas quantized GTG is optimal for (B) and less so for (A).

The language of GTG is geometric Clifford algebra, the background-independent[8] interaction language of fundamental geometric objects of space - Euclid's point, line, plane, and volume elements, the geometric objects of 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[9]. They permit one to define a geometric wavefunction at the Planck length, and when endowed with experimentally observed 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[10–16].

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[15]. As shown in figure 1, optimal interferometer responses are orthogonal for these two models.

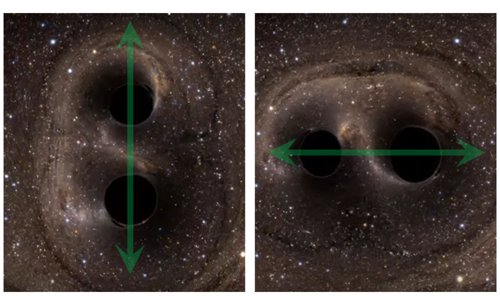

FIG. 2. Classical GR says the wave propagates normal to the plane of the paper as defined by the orbiting pair[18] (image A of figure 1), whereas quantized GTG has it propagating in the plane (image B of figure 1). Time symmetry requires reciprocity of source and detector.

In an electromagnetic theory of quantum gravity the mechanical impedance matching practiced by the gravitational wave community[17] becomes matching corresponding electromagnetic interaction impedances of the geometric wavefunctions. Event horizon at the Planck length is unstable, wants to 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 event horizon at the core of every massive 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[19], a possible source for 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[20] and detector orientation dependence permits construction of analysis templates[17, 21, 22] for both models, an experimental test of GR grounded in a quantum theory of both gravity and the elementary particle spectrum[16].

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