QUANTUM HALL MIXMASTER GRAVITATIONAL WAVE ECHOES BOUNDED BY GEOMETRIC CLIFFORD WAVEFUNCTION INTERACTION IMPEDANCES

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This note proposes a topic to the upcoming 7th Conference on Applied Geometric Algebras[1]. It conjectures that exact impedance quantization of the fractional quantum Hall effect[2, 3], claims of gravitational wave echoes recovered from LIGO/VIRGO data[4], and mixmaster tidal oscillations of Professor Thorne's wife[5] share causal origins in quantized impedance networks of **Geometric Wavefunction Interactions** of the particle physicist's Clifford algebra.

Figure 1 shows the 'theoretical minimum' of the GWI model. Euclid's fundamental geometric objects are taken to comprise a minimally complete Pauli algebra of 3D space, the vacuum wavefunction. Topologically appropriate electromagnetic field quanta are assigned via the five fundamental constants of the model. Wavefunction interactions are modeled by the geometric product of Clifford algebra, generating a 4D Dirac algebra of flat Minkowski spacetime, an impedance representation of the particle physicist's S-matrix of *single-measurement* observables.

Wavefunction interaction **impedance matching** governs amplitude and phase of energy transmission. Given that fields of quantum field theory are quantized, it is unavoidable that impedances of wavefunction interactions are likewise quantized. Absence of the concept from mainstream particle physics is a consequence of several unrelated historical accidents[6].

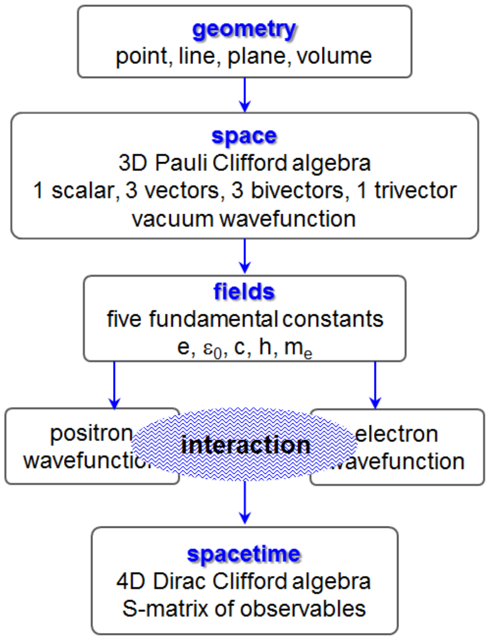

FIGURE 1. The GWI model

Attributing quantized electromagnetic fields to geometric wavefunctions defined at the electron Compton wavelength and the Planck length permits one to calculate the quantized impedance network of figure 2.

In SI units, the **vacuum impedance** excited by the photon is $Z_0 = \sqrt{\mu_0/\varepsilon_0} = 377$ ohms, where μ_0 is magnetic permeability and ε_0 electric permittivity of the perturbed vacuum wavefunction. With similar electric/magnetic ratios, **quantum Hall impedance** excited by electric charge is $Z_H = g/e = \Phi_0/e = \hbar/e^2 = Z_0/2\alpha = 25812$ ohms, where e is electric charge quantum, Φ_0 magnetic flux quantum, $\hbar$ Planck's quantum of angular momentum, α the fine structure constant, and by the Dirac relation $eg = \hbar$, g is the magnetic charge quantum. That vector magnetic flux quantum and pseudoscalar magnetic charge are numerically equal in SI units, $\Phi_0 = g$, is a consequence of topological symmetry breaking by the pseudoscalar[7].

The **fractional quantum Hall impedance** arises from continued fractions of integer quantum Hall. $Z_{frac} = mg/ne = m\Phi_0/ne$ where m and n are integers with no common factors, and n is odd excepting filling factors 5/2 and 7/2. Whereas integer QHE has $m = n$, one flux quantum/magnetic charge paired with one electric charge, fractional QHE has m flux quanta/magnetic charges paired with n electric charges. The possibility of finding a relationship between fQHE and **mixmaster cosmology** arises from similar continued fractions[8].

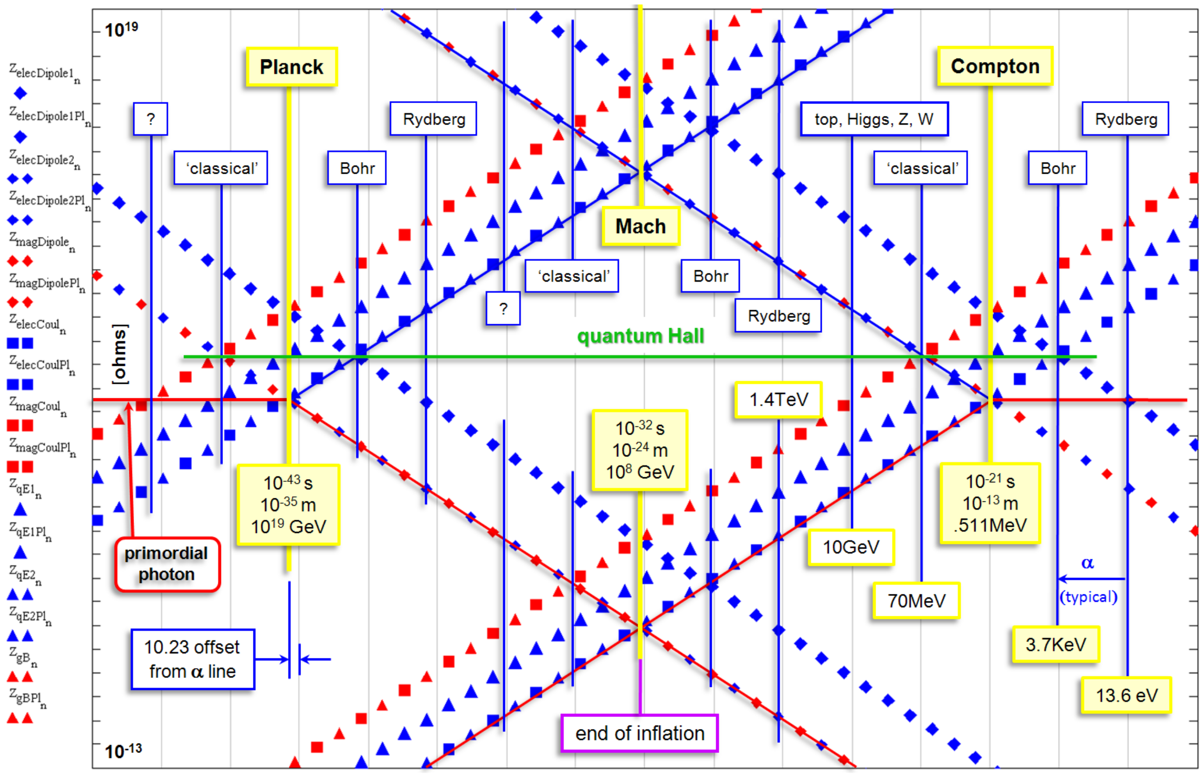

FIGURE 2. Mismatch of Compton and Planck wavefunction interaction impedances, revealing an exact identity between gravitation and electromagnetism[9]

The point here, the *first conjecture*, is that **mixmaster tidal oscillations**[10] at the quantum level are an equivalent representation of the various quantum impedance matches Kip and his wife encounter on their path to the singularity, implying a requirement for quantum phase coherence at the macroscale of experimentally observed black holes. The *second conjecture* suggests that **gravitational wave echoes**[4] might similarly be regarded as reflections from impedance mismatches at both the event horizon and the 'angular momentum boundary'.

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