Cosmological quantum gravity

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Abstract

The mirror neutrino hypothesis for quantum gravity has been used to resolve known cosmological problems using quantised inertia [1]. In this note we clarify the theoretical principles, describe the true electroweak vacuum, and explain where conventional holographic scenarios go wrong.

Holographic approaches to quantum gravity using entanglement in tensor networks have made much progress in recent years. Since the modern, motivic formulation of the Standard Model also hinges on categorical diagram techniques, it is expected that the full theory of quantum gravity employs such methods. We will now explain why the bulk boundary correspondence should reduce to a *boundary boundary* theory, where the CFTs themselves describe gravitational degrees of freedom in the bulk.

The dualities of M theory have a long history in string theory, but we take the bare bones of T duality, comparing the smallest and the largest possible scales, meaning literally the Planck scale and the Hubble volume. Here quantum causality cuts off the singularities of Penrose's thermodynamic cosmology, leaving the CMB as the true boundary to the observable universe [1].

The equivalence principle of general relativity is broken by quantum inertia [2][3], but the difference $m_g - m_i$ is only appreciable at very low accelerations. It is characterised by the wavelength associated to Wien's displacement law

$$E = \frac{hc}{\lambda} = \beta kT, \tag{1}$$

where $\beta = 4.965$. When λ is twice the Hubble diameter [4][5], the limit of observation, the inertial mass m_i vanishes at a minimal cosmological acceleration, so that

$$m_i = m_g(1 - \frac{\lambda}{4R_h}) \tag{2}$$

for R_h the Hubble radius. Mass is generated non locally, pairing a local Rindler horizon at T with a Hubble scale horizon. Dually, the temperature T is a Hawking temperature for the cosmological horizon. This is motivated by the recovery of MOND [6] from a Newtonian law [2] for the mass of a galaxy $M \sim R$, as in a black hole mass. Local masses use the Unruh temperature and wavelength.

In quantum cosmology, the observable boundary to our universe is the CMB. When T in (1) is the present day CMB temperature, the energy E corresponds to the mass of a mirror neutrino [1][2]. Mirror neutrinos were originally viewed as non local SM states, designed to obtain the MOND solution [6] to the dark matter problem, but now we see that they are really *antineutrinos* (as discovered in 2010 [7][8]), because the cosmological horizon that hides the mirror world represents the electroweak vacuum. That is, the classical boundary must be replaced by a chaotic, spacetime filling boundary that *is* the vacuum, and pair production of $e^- e^+$ separates matter and antimatter.

Charged lepton diagrams in the ribbon scheme [9][10] are fundamental [2], because the Cayley permutation representation of S_3 is a three stranded ribbon diagram with charge twists. Yet charged leptons form proper Dirac spinors, with equal masses for e^- and e^+, while this is not true for oscillating neutrinos. All neutrino masses are given by the Brannen-Koide 3×3 algebra [11], in which the quantum Fourier transform diagonalises the circulant $\sqrt{m}$ operator. Although this IR phenomenology is often criticised for ignoring mass running in QFT, it really is a non perturbative result, linking the IR, the UV and pole masses.

Given a unification scale M_G, associated to cosmological perturbations when R_h is small, the Higgs mass appears to satisfy $m_H = \sqrt{m_\nu M_G}$, where m_ν is the averaged neutrino mass, the minimal mass scale of the Standard Model. At unification, we talk about an emergent pure color gravity, where lepton and quark ribbon diagrams are easily interchanged using generalised boson diagrams [2]. Supersymmetry is a twisted quantum Fourier transform between these states. Now the Koide lepton mass scale ratio $\sqrt{m_l}/\sqrt{m_\nu}$ (which includes the proton mass m_p) may naturally arise from a cosmological rescaling parameter, such as z^2 for the CMB redshift z (twice around the universe for a unit of charge). This would solve the hierarchy problem.

A non local mechanism for mass generation is expected in twistor geometry [12], where solutions to the Dirac equation are replaced by first cohomology classes on twistor space, and a pair of such spinors breaks the conformal symmetry with a two dimensional class [13]. We have implemented this idea with mirror neutrino mass, breaking the natural $m_\nu = 0$ condition of the Standard Model, which corresponds to the semiclassical $m \to 0$ condition in the $R_h = ct$ picture [14][15].

Conventional holographic scenarios [16] focus on the recovery of GR metrics from boundary information, but our bulk data *is* boundary data. A lower dimensional spacetime, in which pure gravity is topological, is easily embedded in $3 + 1$D as a dense foam (or chaotic curves). The information paradox disappears because pair production at an event horizon *is* vacuum pair production, and there is no such thing as an unobservable interior to a black hole (although of course black holes remain genuine astrophysical objects).

Quantum causality has implemented cosmic censorship. There is no dark matter and no dark energy (removed with $R_h = ct$). The horizon problem is solved when the energy of CMB photons corresponds to mirror mass [1]. The black body spectrum for bosons represents exactly the quantum uncertainty Δm of short lived mirror fermion states in the vacuum.

The Chern-Simons $2+1$D theory of pure gravity [17] is then presumably physically relevant. In 2007 [18], Witten used it to associate rational functions of the modular j invariant to the Bekenstein-Hawking entropy of a black hole. Future work should include a study of such moonshine functions starting from modular tensor categories of ribbon diagrams, and of other number theoretic functions whose zeroes correspond to a canonical energy spectrum, like the Riemann zeta function (for which the hypothesis is satisfied when the q-number description of terms in the sum ζ^2 permits only values of q on the unit circle, appropriate to modular tensor categories).

The author is homeless and badly abused, and this was written on an ipad in her tent. Maybe the squirrel really wants to climb the window.

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