Three Roads to Quantum Gravity

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Three Complementary Derivations of Gravity: An Archimedean Framework

1 Introduction: Archimedes' Method and the Value of Multiple Proofs

In *The Method*, Archimedes explains that he first used mechanical balancing arguments—treating areas and volumes as if they were weights on a lever—to *discover* results, and only afterwards supplied rigorous geometric proofs. The logic of discovery and the logic of proof were different, but they led to the same quantitative laws.

A simple modern example is his law of buoyancy for a cube-shaped balloon in air. There are two logically distinct derivations:

1. **Volume displacement (Archimedes' law):**

$$F_{\mathrm{up}} = \rho_{\mathrm{air}} g V - W_{\mathrm{balloon}}.$$

2. **Pressure-gradient proof:** Side pressures cancel. The pressure at the bottom face is

$$p_{\mathrm{bottom}} = p_0 + \rho_{\mathrm{air}} g h,$$

and at the top face

$$p_{\mathrm{top}} = p_0.$$

Thus the net upward force is

$$F_{\mathrm{up}} = (p_{\mathrm{bottom}} - p_{\mathrm{top}})A = \rho_{\mathrm{air}} g h A = \rho_{\mathrm{air}} g V.$$

Two completely different logics—volume displacement vs. pressure gradient—yield the same law. The quantum-gravity framework developed in this monograph is deliberately constructed in the same Archimedean spirit. We now present three independent routes to the same gravitational physics.

2 Method 1: Dirac-Sea Aether and the Prediction of GG

In the 2011 analysis, the universe is treated as a "Dirac sea aether of QFT" in Euclidean space. Matter flies outward from us in the big bang; the vacuum field flows inward to fill the wake, just as water flows around a moving submarine rather than leaving an empty cavity.

Using Hubble's law $v = HR$ and the resulting acceleration

$$a = \frac{dv}{dt} = H^2 R,$$

the outward inertial force on a mass M is

$$F_{\text{out}} = MH^2 R.$$

The same Hubble flow defines an effective mass of the moving spacetime fabric (density ρ) inside radius R:

$$m_{\text{eff}} = \frac{4\pi\rho R^3}{3},$$

producing an inward gravitational response

$$F_{\text{in}} = m_{\text{eff}}\, g = \frac{4\pi\rho R^3}{3}\, g.$$

Equating $F_{\text{out}} = F_{\text{in}}$ and using $g = GM/R^2$ gives

$$MH^2 R = \frac{4\pi\rho R^3}{3}\,\frac{GM}{R^2} \quad \Rightarrow \quad G = \frac{3H^2}{4\pi\rho}.$$

This is the sole role of Method 1: it predicts G (and the associated cosmological acceleration scale $a \sim 7 \times 10^{-10}\,\mathrm{m\,s^{-2}}$) from the dynamics of the QFT aether in an expanding universe. No cross-section appears here; it is a global equilibrium statement.

3 Method 2: Flux–Shadow Geometry and the Weak-Scale Cross-Section

Method 2 is local and geometric. Begin with an isotropic inward graviton (vacuum) flux that produces an inward acceleration a_{inward} per unit mass. In the absence of matter, forces from all directions cancel.

A mass M with graviton cross-section $\sigma_{\text{grav}}(M)$ at separation R shadows a fraction

$$\frac{\sigma_{\text{grav}}(M)}{4\pi R^2}$$

of that inward flux. The net force on a test mass m toward M is then

$$F_{\rm net} = m\, a_{\rm inward}\, \frac{\sigma_{\rm grav}(M)}{4\pi R^2}.$$

To reproduce Newton's law,

$$F_{\rm net} = \frac{GMm}{R^2},$$

we require

$$m\, a_{\rm inward}\, \frac{\sigma_{\rm grav}(M)}{4\pi R^2} = \frac{GMm}{R^2} \quad \Rightarrow \quad \sigma_{\rm grav}(M) = \frac{4\pi GM}{a_{\rm inward}}.$$

Method 1 fixes both G and the relevant acceleration scale $a_{\rm inward}$. Thus Method 1 + Method 2 together predict a definite graviton cross-section.

Independently, from Feynman's rules and the Raby–Slansky–West scaling,

$$\sigma_{\rm grav}^{(\rm Feynman)}(M) = \sigma_{\rm weak}(E \sim M_Z) \left(\frac{G}{G_F}\right)^2,$$

where the relevant weak cross-section is the neutral-current cross-section at the Z-boson mass scale $M_Z \approx 91\,\mathrm{GeV}$. This is the same scale that sets the mass mechanism in this framework.

4 Method 3: Horizon Emission, Random-Walk Statistics, and the Density Correction

Method 3 is fully microscopic. Each fundamental fermion core behaves as a tiny horizon, emitting gauge bosons with a Hawking-type spectrum and power $P_{\rm core}(m)$. At distance r, this gives an energy flux

$$\Phi_E(r) \sim \frac{P_{\rm core}}{4\pi r^2},$$

and a momentum flux (pressure)

$$p_{\rm core}(r) \sim \frac{\Phi_E(r)}{c}.$$

Summing over N randomly distributed fermions with charges of both signs, the net momentum scales as a random walk:

$$p_{\rm net} \sim \sqrt{N}\, p_{\rm core}.$$

However, gravitons observed today were not emitted at today's density. They were emitted when the universe was denser and have been redshifted on their way to us. A graviton emitted at redshift z sees:

$$\rho(z) = \rho_0(1+z)^3, \qquad E(z) \propto \frac{1}{1+z}, \qquad arrivalrate \propto \frac{1}{1+z}.$$

Thus the contribution to today's vacuum pressure includes a density correction factor of the form

$$\frac{\rho(z)}{(1+z)^2} \propto (1+z).$$

In the notation of Section 10.2 of *The Final Theory*, this appears as an e^3-type correction: gravitons emitted at higher density but observed at lower energy.

When this density-corrected microscopic acceleration a_{micro} is evaluated, it matches the same acceleration scale a that Method 1 uses to fix G. Feeding this a_{micro} into the flux–shadow relation gives a third, fully microscopic route to the same graviton cross-section.

Density correction from emission and redshift

Consider a thin comoving shell at redshift z, between comoving radii r and $r + dr$, in a spatially flat FRW universe. The matter density at emission is

$$\rho(z) = \rho_0(1+z)^3. \tag{1}$$

Assume the graviton emission power per unit proper volume is proportional to the local matter density,

$$\mathcal{P}(z) \propto \rho(z). \tag{2}$$

The proper volume of the shell at emission is

$$dV(z) = 4\pi r^2 a^3(z)\, dr = 4\pi r^2 \frac{dr}{(1+z)^3}, \tag{3}$$

since $a(z) = 1/(1+z)$. The total emitted power from that shell is then

$$dP_{\text{emit}}(z) \propto \mathcal{P}(z)\, dV(z) \propto \rho_0(1+z)^3 \cdot 4\pi r^2 \frac{dr}{(1+z)^3} = 4\pi\rho_0\, r^2\, dr. \tag{4}$$

Thus the $(1+z)^3$ from the density is exactly cancelled by the $(1+z)^{-3}$ from the volume factor: the total emitted power per comoving shell is independent of z.

Next, propagate this power to the observer today. Two redshift effects enter:

- **Energy redshift:** each graviton loses a factor $1/(1+z)$ in energy.
- **Arrival-rate dilation:** an emission interval dt_{emit} corresponds to an observer interval $dt_0 = (1+z)\, dt_{\text{emit}}$, so the arrival rate is reduced by another factor $1/(1+z)$.

The observed power from the shell is therefore

$$dP_0(z) = dP_{\rm emit}(z)\,\frac{1}{(1+z)}\,\frac{1}{(1+z)} = \frac{dP_{\rm emit}(z)}{(1+z)^2}. \qquad (5)$$

The observed flux (power per unit area) at the origin is

$$dF_0(z) = \frac{dP_0(z)}{4\pi D_L^2(z)}, \qquad (6)$$

where the luminosity distance in a flat FRW universe is $D_L(z) = (1+z)\,r$. Hence

$$dF_0(z) \propto \frac{4\pi\rho_0\, r^2\, dr}{(1+z)^2} \cdot \frac{1}{4\pi(1+z)^2 r^2} = \rho_0\,\frac{dr}{(1+z)^4}. \qquad (7)$$

If, instead of carrying the explicit r-dependence, we focus on the *local* scaling of the contribution from redshift z, we can write the effective weight of that shell as

$$w(z) \propto \frac{\rho(z)}{(1+z)^2}, \qquad (8)$$

i.e. emission power density $\propto \rho(z)$, reduced by two factors of $(1+z)$ from energy and arrival-rate redshift. Substituting $\rho(z) = \rho_0(1+z)^3$ gives

$$w(z) \propto \frac{\rho_0(1+z)^3}{(1+z)^2} = \rho_0(1+z). \qquad (9)$$

Thus, relative to simply using today's density ρ_0, each redshift slice is effectively weighted by an extra factor $(1+z)$: gravitons emitted at higher density but observed with redshifted energy and rate contribute with a net density correction factor

$$\frac{\rho(z)}{(1+z)^2} \propto (1+z). \qquad (10)$$

This is the "density correction" described in Section 10.2 of *The Final Theory*: gravitons observed today were emitted when the universe was denser and have been redshifted on their way to us, so the present-day vacuum pressure is enhanced by an effective factor $(1+z)$ compared to a naive use of ρ_0 alone.[1]

5 Numerical Example at the Z-Boson Mass

Take:

$$G = 6.67\times10^{-11}\,\mathrm{m^3\,kg^{-1}\,s^{-2}}, \qquad a = 7\times10^{-10}\,\mathrm{m\,s^{-2}}, \qquad M_Z = 1.62\times10^{-25}\,\mathrm{kg}.$$

Flux–shadow prediction

$$\sigma_{\rm grav}^{(\rm flux)}(M_Z) = \frac{4\pi G M_Z}{a} \approx 1.9\times10^{-25}\,\mathrm{m^2}.$$

[1] In the shorthand of the original text, this is referred to as an e^3-type correction, encoding the combined effect of higher emission density and redshift.

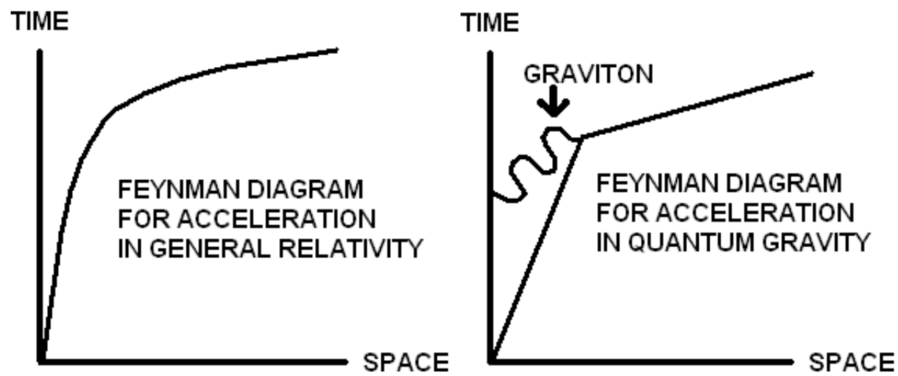

Figure 1: Quantum gravity Feynman diagram

Feynman/black-hole scaling

$$r_s = \frac{2GM_Z}{c^2} \approx 2.4 \times 10^{-52}\,\mathrm{m}, \qquad \sigma_{\mathrm{grav}}^{(\mathrm{Feynman})}(M_Z) = \pi r_s^2 \approx 1.8 \times 10^{-103}\,\mathrm{m}^2.$$

The ratio is

$$\frac{\sigma_{\mathrm{grav}}^{(\mathrm{flux})}(M_Z)}{\sigma_{\mathrm{grav}}^{(\mathrm{Feynman})}(M_Z)} \sim 10^{78}.$$

This enormous hierarchy is precisely what the horizon-emission, random-walk, and density-correction mechanism of Method 3 is designed to explain.

6 Synthesis

- **Method 1** (Dirac-sea aether) predicts G and the acceleration scale a from H and ρ.
- **Method 2** (flux–shadow + weak-scale cross-section) uses the same G and a to infer a graviton cross-section $\sigma_{\mathrm{grav}}(M)$.
- **Method 3** (horizon emission + random-walk + density correction) independently reproduces the same acceleration scale a and therefore the same $\sigma_{\mathrm{grav}}(M)$.

Three different logics—global Dirac-sea equilibrium, local flux–shadow geometry, and microscopic horizon emission with density correction—all converging on the same G, the same acceleration scale, and the same weak-scale-anchored graviton cross-section. This is the Archimedean structure underlying the quantum gravity developed in this monograph.

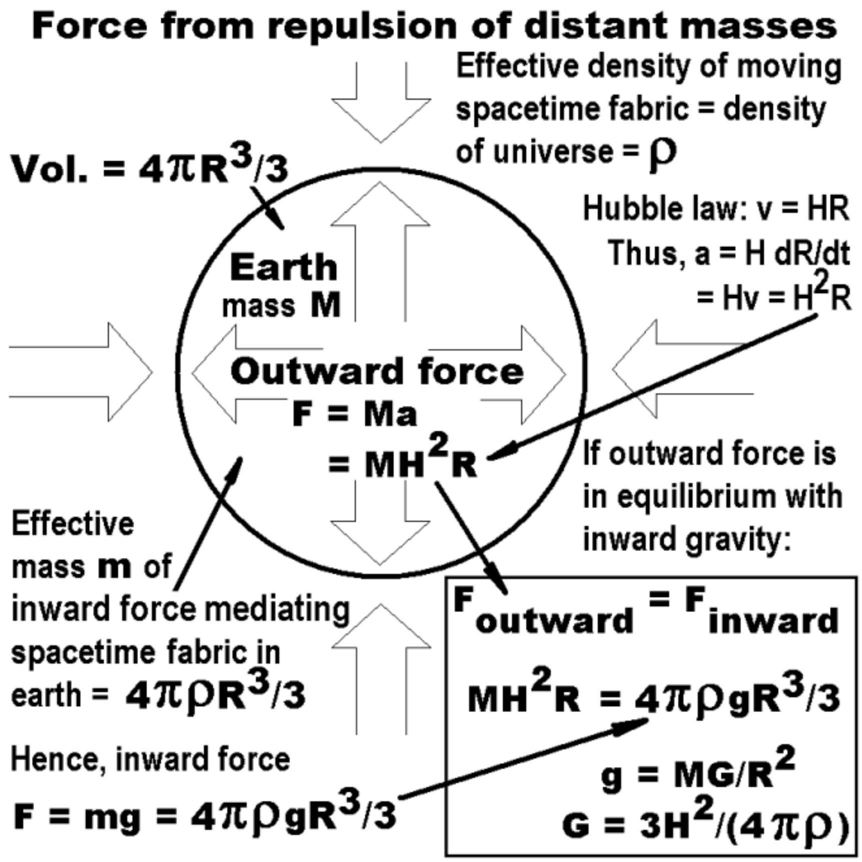

Figure 2: Dirac sea "aether" using Archimedes' Method scaffolding from vixra paper 1111.0111v1, page 49. A line of moving submarines underwater don't leave a cylindrical vacuum behind it as it moves. When you look it the problem like an accountant, you end up with a dynamic system in which the net result is than an equal volume of water or aether in Dirac's sea notation, flows the opposite direction to matter!

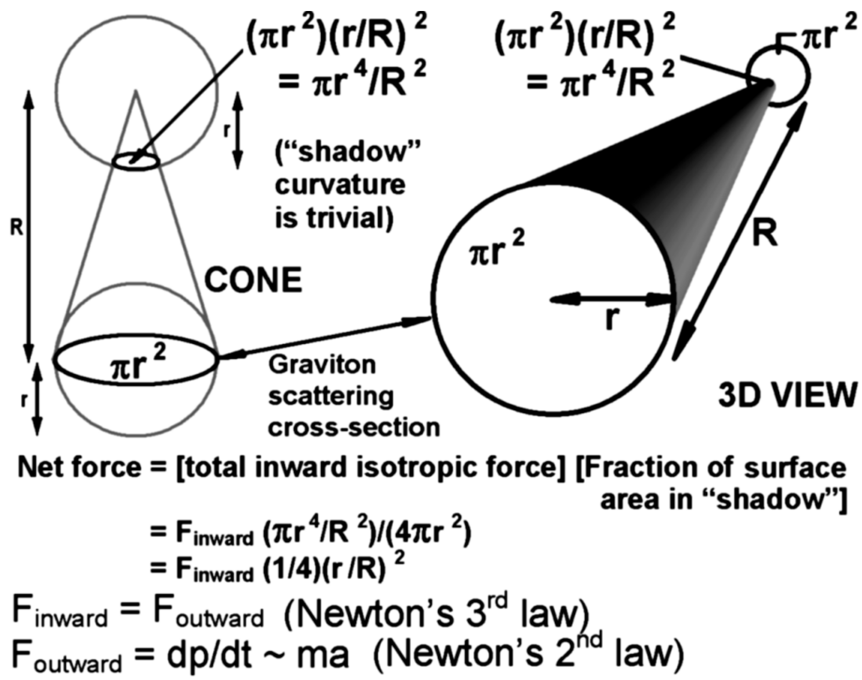

Figure 3: Quantum gravity geometry scaffolding from vixra paper 1111.0111v1 at page 6

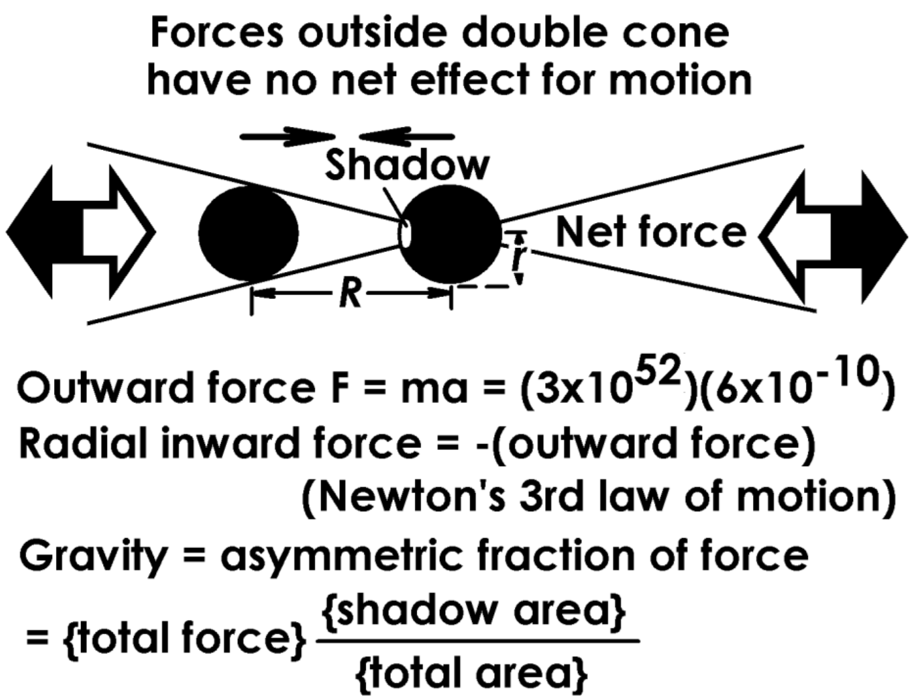

Figure 4: 1111.0111v1 page 6 extracted diagram

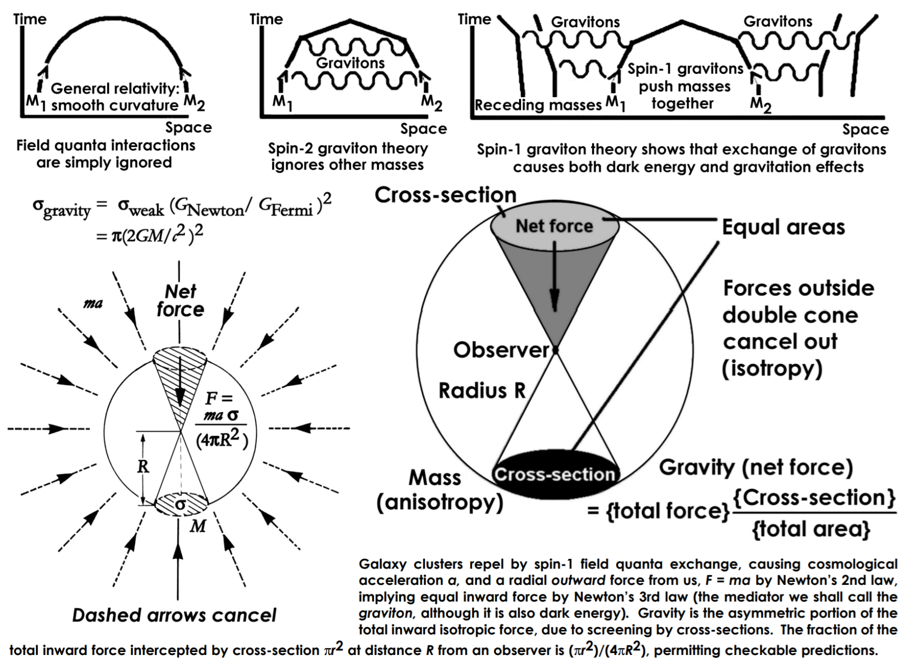

Figure 5: 1305.0012v2.pdf diagram extracted