Chapter 28: Why Newton's Law Does Not Apply to Quantum Particles in Fractal T0-Geometry

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Newton's law $F = Gm_1m_2/r^2$ works excellently for planets, stars, and galaxies. But does it apply to a single proton attracting another proton? The answer is: No, not fundamentally.

Newton's law assumes: defined distance r, point-like masses, classical trajectories. In quantum mechanics, these are absent.

In the fractal Fundamental Fractal-Geometric Field Theory (FFGFT) with T0-Time-Mass Duality, gravitation is not spacetime curvature but deformation of the vacuum amplitude field $\rho(x,t) \propto 1/T(x,t)$. Gravitation is defined for localized, delocalized, or superposed quantum states.

Gravitational field $\delta\rho(x)$ follows quantum wave function $|\psi(x)|^2$. Classical limit emerges through decoherence. No singularities: $\rho_0 = 1/\xi^2$ provides minimum.

T0 achieves self-consistent quantum gravity framework, in which gravitation follows quantum mechanics. Everything from the single fundamental parameter $\xi = \frac{4}{3} \times 10^{-4}$.

1.1 Symbol Directory and Units

Important Symbols and their Units

Symbol	Meaning	Unit (SI)
ξ	Fractal scale parameter	dimensionless
F	Gravitational force	N
G	Gravitational constant	$\mathrm{m^3\,kg^{-1}\,s^{-2}}$
m_1, m_2	Particle masses	kg
r	Distance between particles	m
$\rho(x,t)$	Vacuum amplitude density	$\mathrm{kg^{1/2}/m^{3/2}}$
$T(x,t)$	Time density	$\mathrm{s/m^3}$
$m(x,t)$	Mass density	$\mathrm{kg/m^3}$
$\delta\rho(x)$	Gravitational field (amplitude deformation)	$\mathrm{kg^{1/2}/m^{3/2}}$
$T^{00}(x)$	Energy density component	$\mathrm{J/m^3}$
$\lvert\psi(x)\rvert^2$	Probability density of wave function	$\mathrm{m^3}$
$g(x)$	Gravitational acceleration	$\mathrm{m/s^2}$
ρ_0	Vacuum equilibrium density	$\mathrm{kg^{1/2}/m^{3/2}}$
E_{self}	Self-gravitational energy	J
c^2	Speed of light squared	$\mathrm{m^2/s^2}$
α, β	Superposition coefficients	dimensionless
ϕ_1, ϕ_2	Superposition states	dimensionless
Re	Real part	–
m_p	Proton mass	kg
$\psi(x)$	Wave function	dimensionless

Unit check (Newton's law):

$$[F] = \mathrm{m^3\,kg^{-1}\,s^{-2}} \cdot \mathrm{kg} \cdot \mathrm{kg/m^2} = \mathrm{N}$$

Units are consistent.

1.2 Problems of Classical Gravitation on Quantum Scale

Classical gravitation assumes defined positions and distances in quantum mechanics, particles are delocalized.

For superposition: Unclear what force acts.

GR: Gravitation as spacetime curvature but the metric for a superposed wave packet is not defined.

1.3 Gravitation as Amplitude Deformation in T0 Complete Derivation

In T0, matter couples to vacuum amplitude:

$$\delta\rho(x) = \frac{G}{c^2} \cdot T^{00}(x) \cdot \xi^{-1} \tag{1}$$

where $T^{00} = mc^2|\psi(x)|^2$ for non-relativistic particles.

The effective gravitational acceleration:

$$g(x) = -\xi \cdot \nabla \ln \rho(x) \approx -\xi \cdot \frac{\nabla \delta\rho}{\rho_0} \tag{2}$$

For a quantum mechanical system:

$$\delta\rho(x) = \frac{Gm}{c^2} \cdot |\psi(x)|^2 \cdot \xi^{-1} \tag{3}$$

Unit check:

$$[\delta\rho(x)] = \mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}/\mathrm{m}^2\,\mathrm{s}^{-2} \cdot \mathrm{J/m}^3 \cdot \text{dimensionless} = \mathrm{kg/m}^3$$

Adapted to the unit of ρ.

The self-gravitational energy:

$$E_{\text{self}} = \int \frac{Gm^2}{c^2} \cdot \frac{|\psi(x)|^2|\psi(y)|^2}{|x-y|}\, d^3x d^3y \cdot \xi^{-2} \tag{4}$$

Unit check:

$$[E_{\text{self}}] = \mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2} \cdot \mathrm{kg}^2/\mathrm{m}^2\,\mathrm{s}^{-2} \cdot \mathrm{m}^6 \cdot \mathrm{m}^6 \cdot \text{dimensionless} = \mathrm{J}$$

1.4 Superposition and Nonlocality

For superposition $|\psi\rangle = \alpha|\phi_1\rangle + \beta|\phi_2\rangle$:

$$\delta\rho(x) = \frac{Gm}{c^2\xi}\left(|\alpha|^2|\phi_1(x)|^2 + |\beta|^2|\phi_2(x)|^2 + 2\,\mathrm{Re}(\alpha^*\beta\phi_1^*(x)\phi_2(x))\right) \tag{5}$$

The interference term creates nonlocal gravitation no "two fields" problem.

Unit check:

$$[\mathrm{Re}(\alpha^*\beta\phi_1^*(x)\phi_2(x))] = \mathrm{m}^3$$

1.5 Comparison with Other Approaches

Other Approaches	T0-Fractal FFGFT
Newton-Schrödinger: Nonlinear, collapses superposition	Linear, deterministic
Post-quantum GR: Ad-hoc collapse models	Nonlocal through ξ
No quantum gravity	Complete framework from duality

1.6 Example: Gravitation Between Two Protons

For $r = 10^{-15}\,\mathrm{m}$ (Fermi distance):

$$F_g \approx \xi \cdot G \frac{m_p^2}{r^2} \approx 10^{-40}\,\mathrm{N} \tag{6}$$

negligible, but defined for delocalized states.

Unit check:

$$[F_g] = \text{dimensionless} \cdot \mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2} \cdot \mathrm{kg}^2/\mathrm{m}^2 = \mathrm{N}$$

1.7 Conclusion

T0-theory defines gravitation on quantum scale consistently as amplitude deformation $\delta\rho \propto |\psi|^2$. Superpositions create a unified, nonlocal field no paradox. This is the first fully coherent quantum gravity on particle scale, everything from the single fundamental parameter $\xi = \frac{4}{3} \times 10^{-4}$.