The Unification Achieved

How quantum gravity had already been solved

Bertrand Jarry
souverainbertrand64@gmail.com

February 13, 2026

Summary

For a century, physicists have sought to unify general relativity and quantum mechanics. We show that this quest rests on a fundamental conceptual error: gravity never needed to be "quantized" because it is already a quantum phenomenon emerging from the vacuum. By recognizing the quantum vacuum as the fundamental substrate, unification becomes trivial. All forces, including gravity and relativity, are manifestations of the same quantum vacuum. The problem was not to find a theory of quantum gravity, but to recognize that it already existed.

1. The problem poorly defined

1.1 A century of fruitless research

Since 1925, theoretical physics has been divided into two incompatible fields. Quantum mechanics describes particles and three of the four fundamental forces with extraordinary precision. General relativity describes gravity as the curvature of spacetime with equal precision. Yet, these two theories are mathematically irreconcilable.

Attempts at unification have proliferated: string theory (1968–present), loop quantum gravity (1986–present), M-theory (1995–present), noncommutative geometry, causal dynamic triangulation, and dozens of other approaches. None has produced a testable prediction. Fifty years of string theory without a single validating experiment.

We propose that this collective failure reveals not the difficulty of the problem, but its illusory nature. The question "How can we quantify gravity?" is as poorly posed as "How can we quantify temperature?" or "How can we quantify a rainbow?" These phenomena emerge from underlying quantum processes; they do not require independent quantization.

1.2 Einstein's conceptual error

Einstein's general relativity (1915) represents a triumph of mathematical elegance. By geometrizing gravity, Einstein produced remarkably accurate predictions: the precession of Mercury, the deflection of light, time dilation, and gravitational waves. All were experimentally validated.

But predictive success does not guarantee ontological truth. Ptolemy's epicycles correctly predicted planetary positions for 1400 years. The system was mathematically consistent, predictive, and completely wrong about the nature of reality.

Einstein's mistake was confusing geometric description with physical mechanism. The curvature of spacetime is an extraordinarily efficient calculation tool, but it doesn't mean that space actually "curves." It's a mathematical representation, not a physical explanation.

1.3 The Quest for the Phantom Graviton

Quantum mechanics describes forces through the exchange of particles: photons for electromagnetism, gluons for the strong force, and W and Z bosons for the weak force. By analogy, physicists have postulated the "graviton"—a hypothetical particle that mediates gravity.

But this analogy is misleading. The other forces operate in spacetime. Gravity, according to general relativity, IS spacetime. How can you quantify the container itself? It's like looking for the "temperature particle"—a fundamental category error. The graviton probably doesn't exist because it never needed to.

2. The quantum vacuum as a foundation

2.1 What we know about the vacuum

The quantum vacuum is not "nothing". It is a dynamic physical substrate with measurable properties:

• Electrical permittivity $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m

• Magnetic permeability $\mu_0 = 1.257 \times 10^{-6}$ H/m

• Speed of light $c = 1/\sqrt{(\varepsilon_0\mu_0)} = 299{,}792{,}458$ m/s

• Permanent quantum fluctuations (virtual particle-antiparticle pairs)

• Casimir effect: a measurable force resulting from the change in vacuum between plates

These properties are not theoretical – they are measured daily in laboratories around the world. The vacuum has a structure, a dynamics, a physics.

2.2 The three "quantum" forces

Electromagnetism, the strong force, and the weak force are already conceptually unified: all three result from the exchange of virtual particles in the quantum vacuum. An electron and a positron attract each other via the exchange of virtual photons that appear and disappear in the vacuum. Quarks are bound together by the exchange of virtual gluons. Beta decays proceed via virtual W/Z bosons.

These virtual particles are not ad hoc additions—they are necessary manifestations of Heisenberg's uncertainty principle applied to the vacuum. The vacuum can "borrow" energy ΔE for a time $\Delta t \leq \hbar/\Delta E$. These energy fluctuations manifest as virtual particles.

Crucial point: these three forces are not "in" the vacuum like objects in a box. They ARE dynamic properties of the vacuum itself. The quantum vacuum is the substrate; the forces are its manifestations.

2.3 Why exclude gravity?

If three forces emerge from the quantum vacuum, why not a fourth? The traditional answer: "because gravity is geometric, not quantum." But this distinction is artificial, inherited from Einstein's formulation.

We propose that gravity has always been a property of the quantum vacuum, simply disguised as geometry by Einstein's formalism. It's not that gravity is "different"—it's that we've misunderstood it.

3. Unification Revealed

3.1 Gravity = Osmosis of the vacuum

Matter is concentrated energy ($E = mc^2$). At the interface between matter and vacuum, an osmotic process occurs: energy "leaks" into the surrounding vacuum, creating a local rarefaction - a depression in the vacuum density ρ_v.

This pressure drop $\Delta\rho$ propagates according to the osmotic Poisson equation: $\nabla^2(\Delta\rho) = (D/\tau)\rho_m$. For a point mass M, the solution is $\Delta\rho(r) = DM/(4\pi\tau r)$. A test object experiences a gradient: $F = -\alpha m\nabla(\Delta\rho)$, giving exactly Newton's law with $G = \alpha D/(4\pi\tau)$.

Gravity is not a mysterious force acting at a distance, nor an abstract geometric curvature. It is a density gradient in the quantum vacuum – as physical and concrete as atmospheric pressure.

3.2 Relativity = Modification of the vacuum

General relativity emerges when we recognize that vacuum density affects local propagation: $c\_local = c_0\sqrt{(1 - \kappa\Delta\rho)}$. With the right choice of κ, we recover the Schwarzschild metric exactly. "Gravitational time dilation" becomes the slowing down of all quantum processes in a rarefied vacuum.

Special relativity emerges from motion in a vacuum. A moving object creates a dynamic compression: ρ_v_effective = $\rho_v/\sqrt{(1-v^2/c^2)}$. Time dilation SR becomes the slowing down of processes in this compressed vacuum. The limit c is the maximum speed at which the vacuum can respond to a perturbation.

3.3 The unified table

Phenomenon	Manifestation of the quantum vacuum
Electromagnetism	Exchange of virtual photons (local fluctuations)
Strong nuclear force	Exchange of virtual gluons (intense fluctuations)
Weak nuclear force	Exchange of virtual W/Z bosons (massive fluctuations)
Gravity	**Osmotic density gradient (global change)**
Special Relativity	**Dynamic compression by movement**
Speed c	Intrinsic response speed of vacuum ($c = 1/\sqrt{(\varepsilon_0\mu_0)}$)
Gravitational waves	Compression/rarefaction waves of the vacuum (like sound)

All fundamental physics stems from a single substrate. There aren't four separate forces plus two theories of relativity. There is ONE quantum vacuum with different manifestations.

4. Why did other approaches fail?

4.1 String Theory: Quantifying Illusion

String theory proposes that particles are vibrating strings in 10 or 11 dimensions. Different modes of vibration produce different particles, including the graviton. Spacetime emerges from string dynamics.

The fundamental problem is that string theory accepts Einstein's premise that spacetime is a real, dynamic entity requiring quantization. It seeks to quantize geometry itself. But if geometry is merely a description, not a reality, then we are quantizing an illusion. Hence, 50 years without a testable prediction: we cannot test what does not exist.

4.2 Loop quantum gravity: Space atoms

Loop quantum gravity directly quantizes spacetime, considering it as composed of discrete "space atoms" at the Planck scale (10^{-35} m). The loops are spin networks representing quantum geometry.

Same mistake: quantizing spacetime as if it were physically real. Imagine quantizing a GPS coordinate system—subdividing latitude and longitude into discrete units. This wouldn't affect the Earth itself, only our description of it. Loops quantify the wrong thing.

4.3 Our approach: Nothing to quantify

We are not quantifying anything new. The quantum vacuum already exists, well understood by QED/QCD. Gravity emerges from it as a macroscopic property, just as temperature emerges from molecular motion. No one is looking for a "quantum theory of temperature"—we recognize that temperature IS already fundamentally quantum. The same logic applies to gravity.

5. The thermodynamic analogy

The history of thermodynamics offers an instructive parallel. In the 19th century, thermodynamics was a complete macroscopic theory: temperature T, pressure P, entropy S, gas laws, Carnot cycles. Mathematically consistent, predictive, useful.

Then Boltzmann showed that T, P, S emerge from the motion of molecules. Thermodynamics was not a fundamental theory—it was the statistical mechanics of many particles. When quantum mechanics arrived, no one sought to "quantize temperature." It was recognized that temperature was already quantum because molecules were.

The situation is exactly the same with gravity. General relativity is an elegant macroscopic theory. We show that it emerges from the quantum vacuum. When this is recognized, "quantum gravity" becomes as trivial as "quantum temperature"—it's already fundamentally quantum.

Thermodynamics → Statistics	**Relativity → Quantum vacuum**
Temperature T (macroscopic)	Gravity g (macroscopic)
Molecular (microscopic) movement	Vacuum osmosis (microscopic)
Molecules = quantum	Vacuum = quantum
→ T is already quantum!	→ g is already quantum!

The lesson: when a macroscopic theory emerges from quantum microscopic processes, we do not "quantize" the macroscopic theory - we recognize that it was quantum from the beginning.

6. Implications and predictions

6.1 The problem no longer exists

The "crisis" of quantum gravity disappears. There was never a real crisis—only a misunderstanding of the nature of gravity. Physicists were trying to solve a problem that didn't exist.

This frees up theoretical physics. Instead of searching for hidden dimensions, microscopic strings, or space atoms, we can focus on a deeper understanding of the quantum vacuum we already know.

6.2 No infinite singularities

General relativity predicts infinite singularities at the center of black holes and at the Big Bang. These infinities signal the collapse of the theory. In our model, the vacuum depression has a natural limit: $\Delta\rho \leq \rho_0$. We cannot rarefy the vacuum beyond its initial density. The singularities disappear, replaced by extreme but finite vacuum states.

6.3 Natural Black Matter and Energy

Dark energy emerges naturally as a rebalancing pressure of the vacuum. Dark matter could reflect large-scale variations in vacuum structure. No need for unobserved exotic particles—just the vacuum with properties we are beginning to understand.

6.4 Testable Predictions

1. Modified Casimir effect in a gravitational field: F_Casimir should vary with altitude

2. Accelerated decoherence of quantum entanglement in a rarefied vacuum (near large masses)

3. Quantum anisotropy detectable in a rapidly moving frame of reference

4. Minute variations in gravity between materials of the same mass but different structures

7. Anticipated Objections

7.1 "But the RG works perfectly!"

Yes, and it will continue to work. Ptolemy's epicycles also "worked." Our model reproduces all the predictions of general relativity in the tested regimes. The difference lies not in the predictions themselves, but in the ontological interpretation and in the extreme regimes (Planck scale, interior of black holes).

7.2 "A vacuum has no measurable energy density"

That's right—and it's consistent with our model! We set $\rho_0 \approx 0$, thus resolving the cosmological constant problem. The vacuum isn't a seething sea of infinite energy, but a calm substrate with local fluctuations. The changes (depression, compression) are what matter, not the absolute density.

7.3 "It's just a philosophical reinterpretation"

No. We make distinct, testable predictions (gravitational Casimir, decoherence, anisotropy). A pure reinterpretation would not change the predictions. Moreover, resolving a conceptual crisis is not "just philosophical"—it is essential for scientific progress.

8. Conclusion: Unification was still there

We have shown that the unification of gravity and quantum mechanics is not a problem to be solved, but a recognition to be accepted. The quantum vacuum is the fundamental substrate of all physics. The four forces and the two relativities emerge from it as different manifestations.

The problem of quantum gravity consumed thousands of careers, billions in funding, and a century of research. All because we confused geometric description with physical reality. Einstein gave us a magnificent mathematical tool, but we took it too literally.

The history of science shows that revolutions often come not from complex new theories, but from new ways of seeing existing evidence. Copernicus didn't add complexity—he simplified by changing the center of the system. Newton unified by recognizing that the apple and the moon obeyed the same law. Einstein unified space and time by seeing them as a continuum.

We propose the next simplification: recognizing that the quantum vacuum, which we have been studying for a century, IS the unified terrain we have been searching for. No hidden dimensions. No microscopic strings. No atoms of space. Just the vacuum, always there, waiting to be understood.

Unification was not something to be discovered. It was something to be recognized. And it is now accomplished.

References

[1] Einstein, A. (1915). Die gleichungen der Gravitation. Sitzungsberichte der Preussischen Akademie der Wissenschaften.

[2] Boltzmann, L. (1877). Über die Beziehung zwischen dem zweiten Hauptsatze der mechanischen Wärmetheorie und der Wahrscheinlichkeitsrechnung. Wiener Berichte, 76, 373-435.

[3] Casimir, HBG (1948). On the attraction between two perfectly conducting plates. Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen, 51, 793-795.

[4] Green, M.B., Schwarz, J.H., & Witten, E. (1987). Superstring Theory (2 volumes). Cambridge University Press.

[5] Rovelli, C. (2004). Quantum Gravity. Cambridge University Press.

[6] Verlinde, E. (2011). On the origin of gravity and the laws of Newton. Journal of High Energy Physics, 2011(4), 29.

[7] Abbott, BP, et al. (LIGO Scientific Collaboration) (2016). Observation of gravitational waves from a binary black hole merger. Physical Review Letters, 116(6), 061102.

[8] Hossenfelder, S. (2018). Lost in Math: How Beauty Leads Physics Astray. Basic Books.