EINSTEIN-VED THEORY: COMPLETE AND RIGOROUS DEVELOPMENT

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1. FUNDAMENTAL PRINCIPLES

1.1 Ontology of spacetime

Spacetime is the only existing physical reality. Coordinates: (T, X, Y, Z) or $3S + T$. It is continuous: $\mathbb{R}^4$.

1.2 Matter and energy as modes of spacetime

There is no separation between "container" (spacetime) and "content" (matter). **Matter** is a confined wave of spacetime, while **energy** is an unconfined wave.

Figura 8: Materia como onda confinada sobre holograma 2D

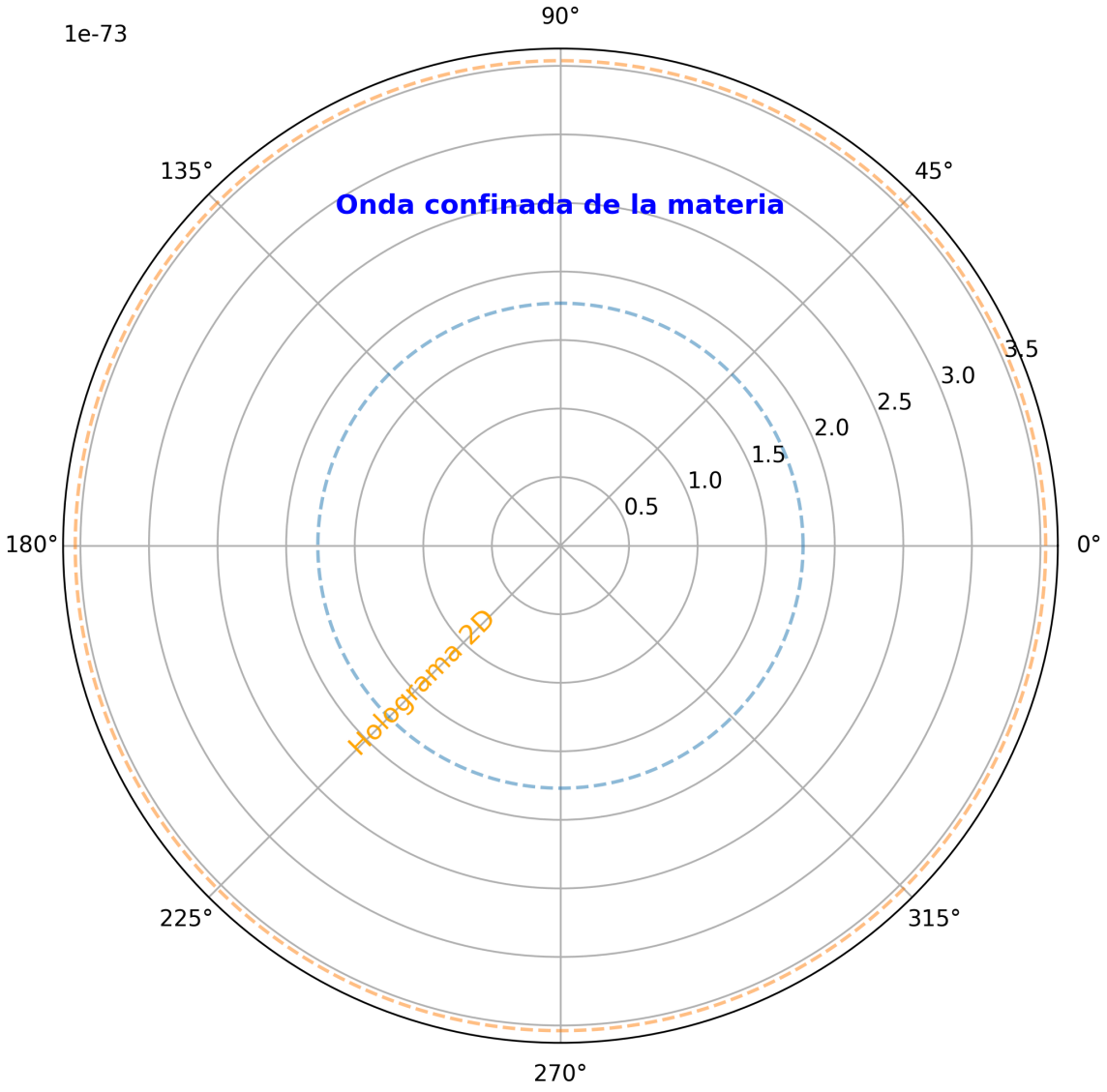

Figure 1: Conceptual representation of matter as a confined wave resonating on a two-dimensional holographic surface (yellow). The green arrows indicate the emergence of the gravitational constant G from this geometry.

1.3 Principle of geometric confinement

A wave can only be stable if it satisfies the resonance condition:

$$L = n\lambda, \quad n \in \mathbb{Z}^+$$

where: - L = confinement path length - λ = wavelength - n = integer number of complete waves

1.4 Absolute determinism

Reality is 100% deterministic. Quantum probability is epistemic ignorance, not ontological. There is no fundamental wavefunction collapse.

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2. MATHEMATICAL DEVELOPMENT

2.1 Relativistic basis (natural units $c = 1$)

Lorentz transformations:

$$t' = \gamma(t - vS), \quad S' = \gamma(S - vt), \quad \gamma = \frac{1}{\sqrt{1 - v^2}}$$

Differential form:

$$dt' = \gamma(dt - v\,dS), \quad dS' = \gamma(dS - v\,dt)$$

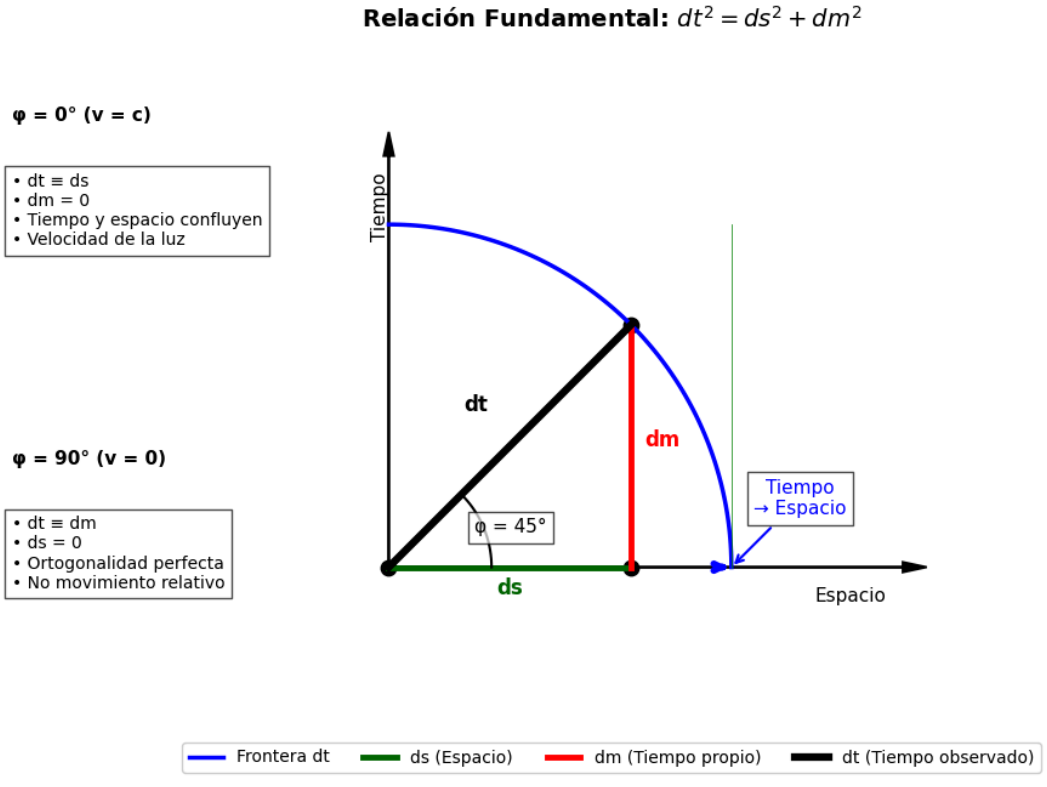
Differential Pythagorean relation (fundamental) deduced directly:

$$dt^2 = dS^2 + d\tau^2$$

where $d\tau$ is the proper time of the observed and dt is the time of the observer.

2.2 Container (3S + T)

- Differentiable manifold of 4 dimensions:
  M_container = R^3 × R
  where 3S are spatial dimensions and T is temporal.
- Temporal cut T(t0) allows observing the geometry of the content at an instant.



Description for the blind: Diagram showing the continuous relativistic metric $3S + T$. $dm\,(dt')$ represents the proper time of the observed; dt is the time of the observer. This figure reflects the basis of the Einstein-VED theory and its derivation from Lorentz.

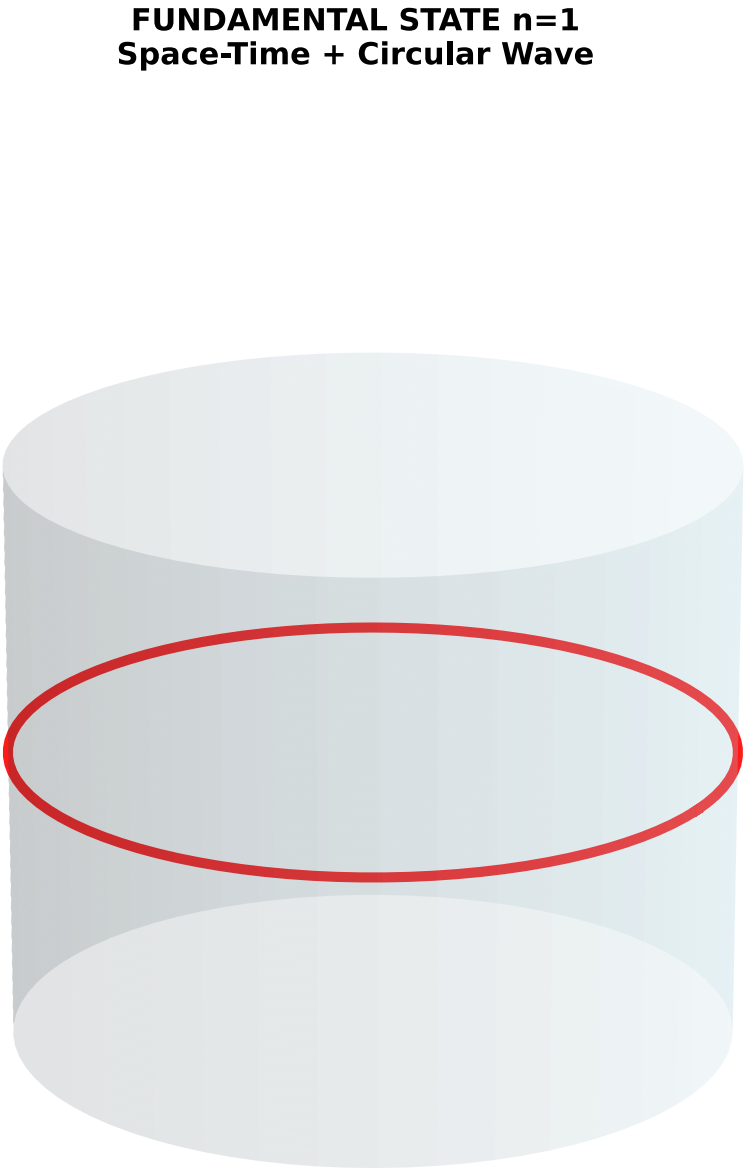


Figure 2: Fundamental basis from Lorentz. More at estradad.es

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2.3 Content: matter and energy

Type	Dimension n	Example	Geometry
3D volumetric	3	Proton	Volume
2D surface	2	Electron	Surface
2D limit	2	Black hole horizon	Saturated surface

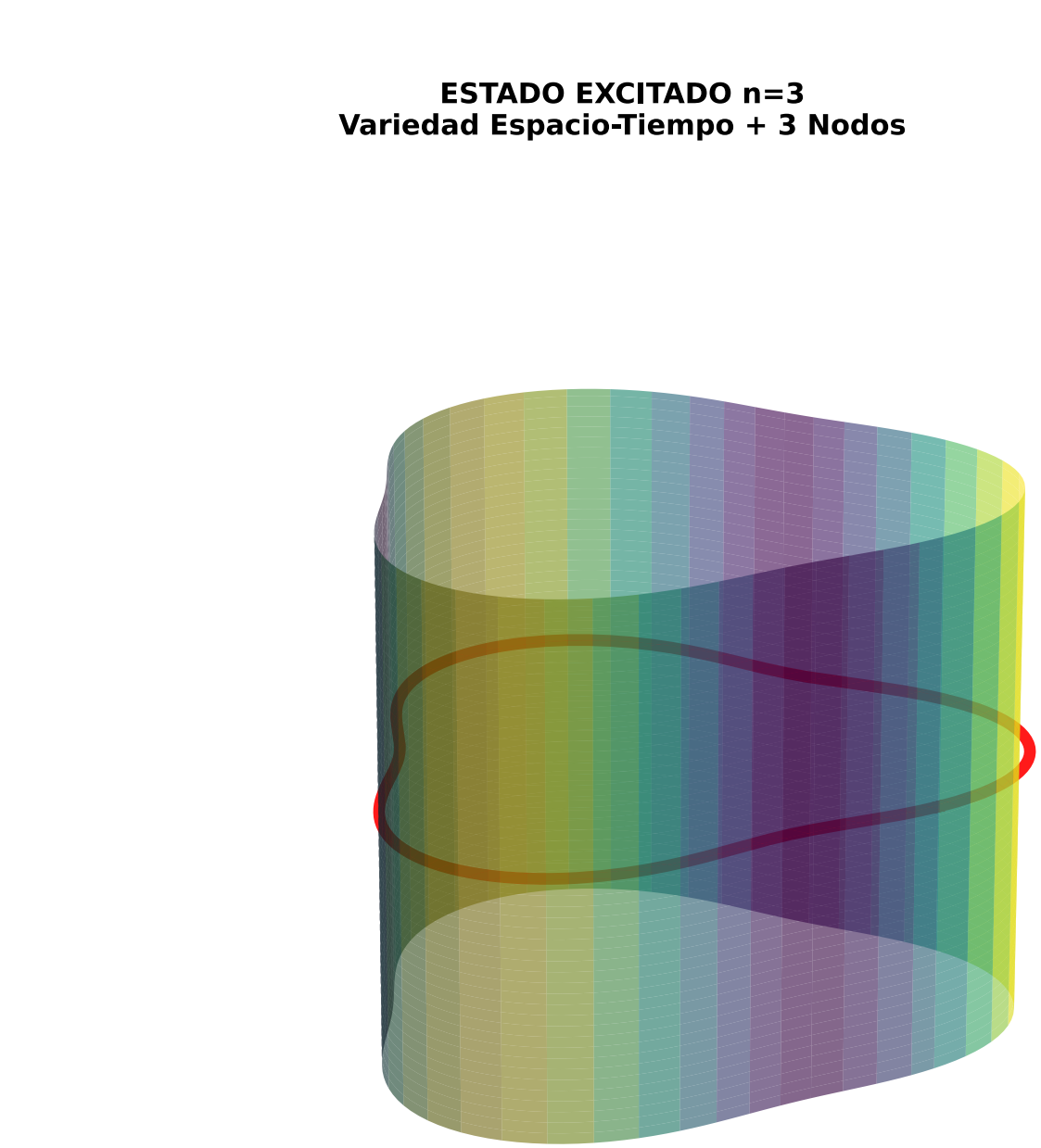

Figure 3: Comparison of excited and fundamental modes.

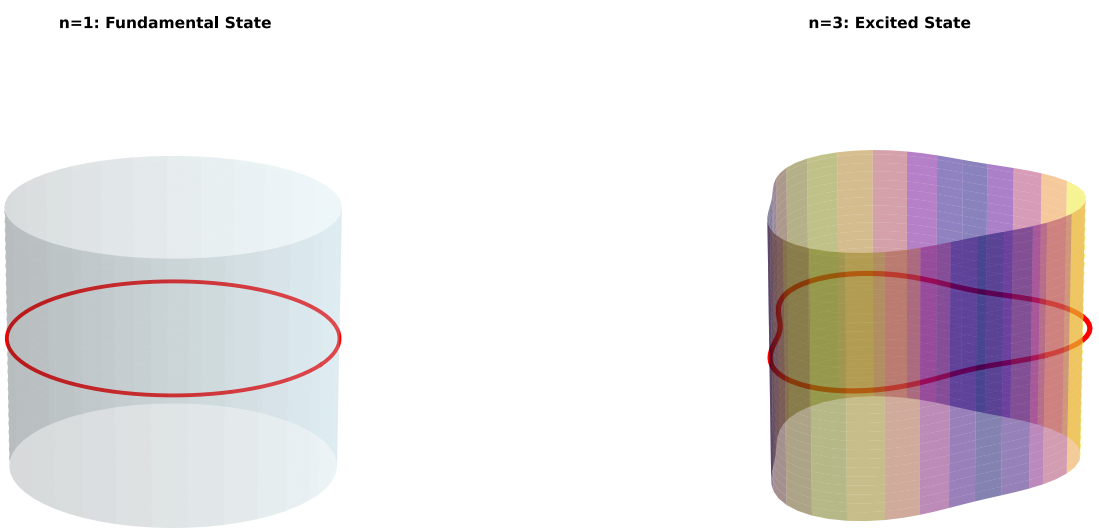

Figure 4: Evolution of internal geometry according to the number of modes n.

2.4 Einstein-Planck unification

From Einstein: $E = mc^2$
From Planck: $E = h\nu = \frac{hc}{\lambda}$

Equating both expressions for energy:

$$mc^2 = \frac{hc}{\lambda} \quad \Rightarrow \quad \lambda = \frac{h}{mc}$$

This is the **Compton wavelength** reinterpreted as the natural wavelength of spacetime vibration associated with mass m.

2.5 Geometric confinement condition

For circular confinement:

$$2\pi R = n\lambda = n \cdot \frac{h}{mc}$$

Simplifying with $\hbar = h/(2\pi)$ we obtain the **fundamental equation of the VED radius**:

$$\boxed{R = \frac{n\hbar}{mc}}$$

or equivalently:

$$\boxed{m = \frac{n\hbar}{Rc}}$$

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3. VED RADIUS AND MASS

3.1 Definition of VED radius

$$R_{\text{VED}} = \frac{n\hbar}{mc}$$

3.2 Mass as an emergent phenomenon

Mass is not a primitive property, but **emerges** from: - n: number of confinement modes (integer) - R: confinement radius (length)

The relation $m \propto n/R$ shows that for a fixed radius, more modes (larger n) imply more mass, and for a fixed n, a larger radius implies less mass.

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4. RELATIONSHIP WITH GRAVITY

4.1 Schwarzschild radius

From the Schwarzschild solution in General Relativity:

$$R_s = \frac{2Gm}{c^2}$$

Figura 2: Black hole y superficie 2D holográfica

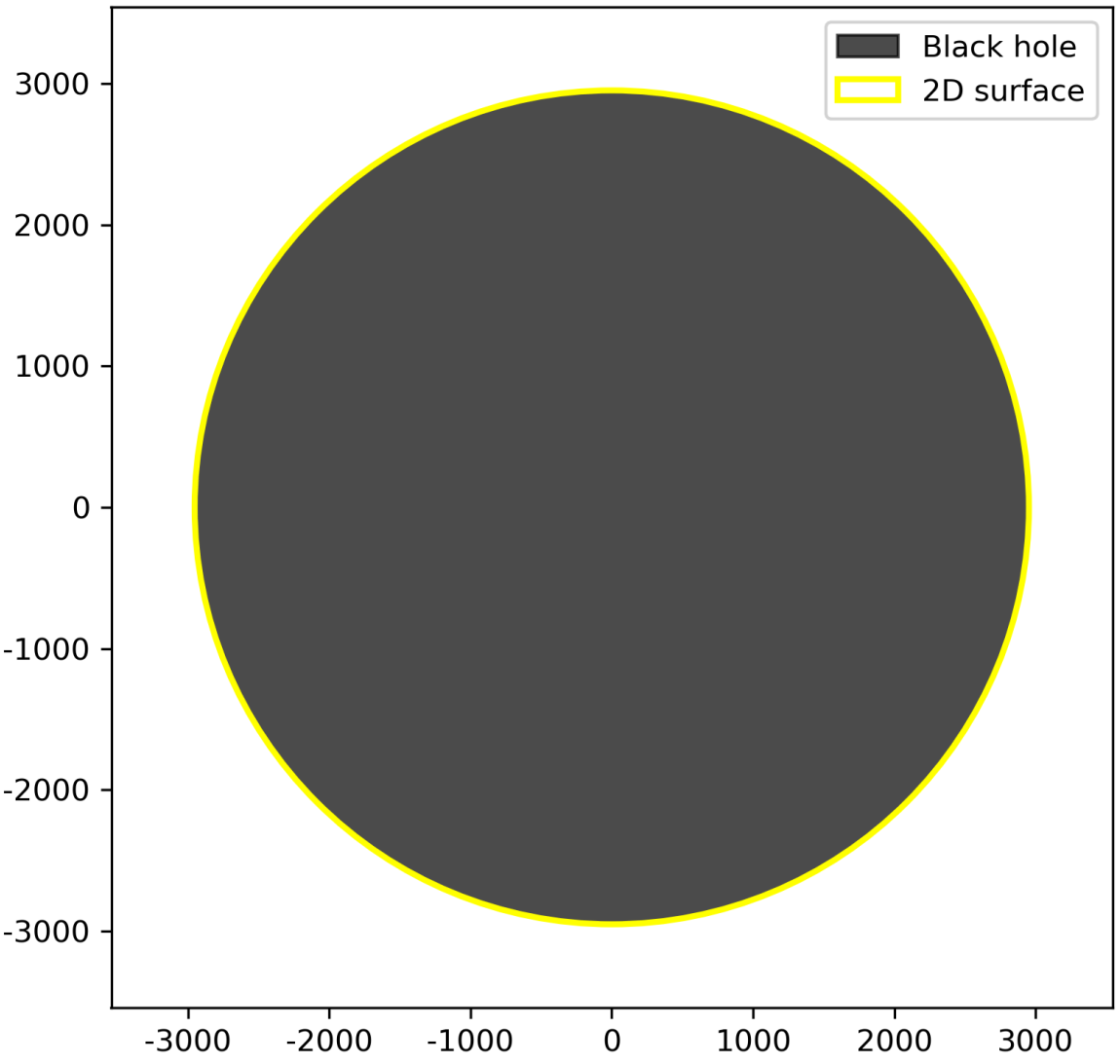

Figure 5: Representation of a black hole (black sphere) and its two-dimensional holographic surface (yellow circle). Illustrates the duality between the volumetric description (interior) and the surface description (boundary), key for the holographic interpretation of gravity in VED.

4.2 Relationship between VED and Schwarzschild radii

For the **same physical mass** m, we equate both expressions:

$$\frac{n\hbar}{R_{\text{VED}}c} = \frac{R_s c^2}{2G}$$

Rearranging we obtain the **fundamental geometric relation**:

$$\boxed{R_{\text{VED}} \cdot R_s = \frac{2n\hbar G}{c^3}}$$

4.3 The gravitational constant as an emergent quantity

Solving for G from the previous relation:

$$G = \frac{R_{\text{VED}} \cdot R_s \cdot c^3}{2n\hbar}$$

In natural units ($c = \hbar = 1$), this simplifies to:

$$G = \frac{R_{\text{VED}} \cdot R_s}{2n}$$

This shows that G is essentially an **"area per mode" divided by 2**.

Figura 10: Comparación conceptual VED vs Schwarzschild

Concepto	VED	Schwarzschild	Comentario
Masa	$M_{\text{VED}} = nh/(L_{\text{geom}}c)$	$M_{\text{Sch}} = c^2R_s/(2G)$	Igualando masas, desaparece M
Longitud	L_{geom} definida por VED	R_s definida por Schwarzschild	Cada lado define su propia escala
Cuantización	n entero → valores discretos de M y G	n no aparece, G queda determinado	n=2 coincide con valor experimental de G
Dimensionalidad	Confinamiento 2D (superficie)	3D → holografía implícita	Source emergente de gravedad

Figure 6: Comparative table that contrasts the formulations of mass, length, quantization and dimensionality in the VED and Schwarzschild frameworks. Shows how equating their expressions for mass leads to the unified formula for G.

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5. EMPIRICAL PROOF: THE QUANTIZATION OF G

5.1 The predictive formula $G(n)$

Substituting the explicit expressions of R_{VED} and R_s into the formula for G, we obtain the **quantized prediction**:

$$G(n) = G_{\text{exp}} \cdot \frac{2}{n}$$

where $G_{\text{exp}} = 6.67430 \times 10^{-11}\,\text{m}^3/\text{kg}\cdot\text{s}^2$ is the experimentally measured value.

5.2 Experimental verification: the "target" of G

This formula makes a **testable prediction**: for each integer n, G takes a different discrete value.

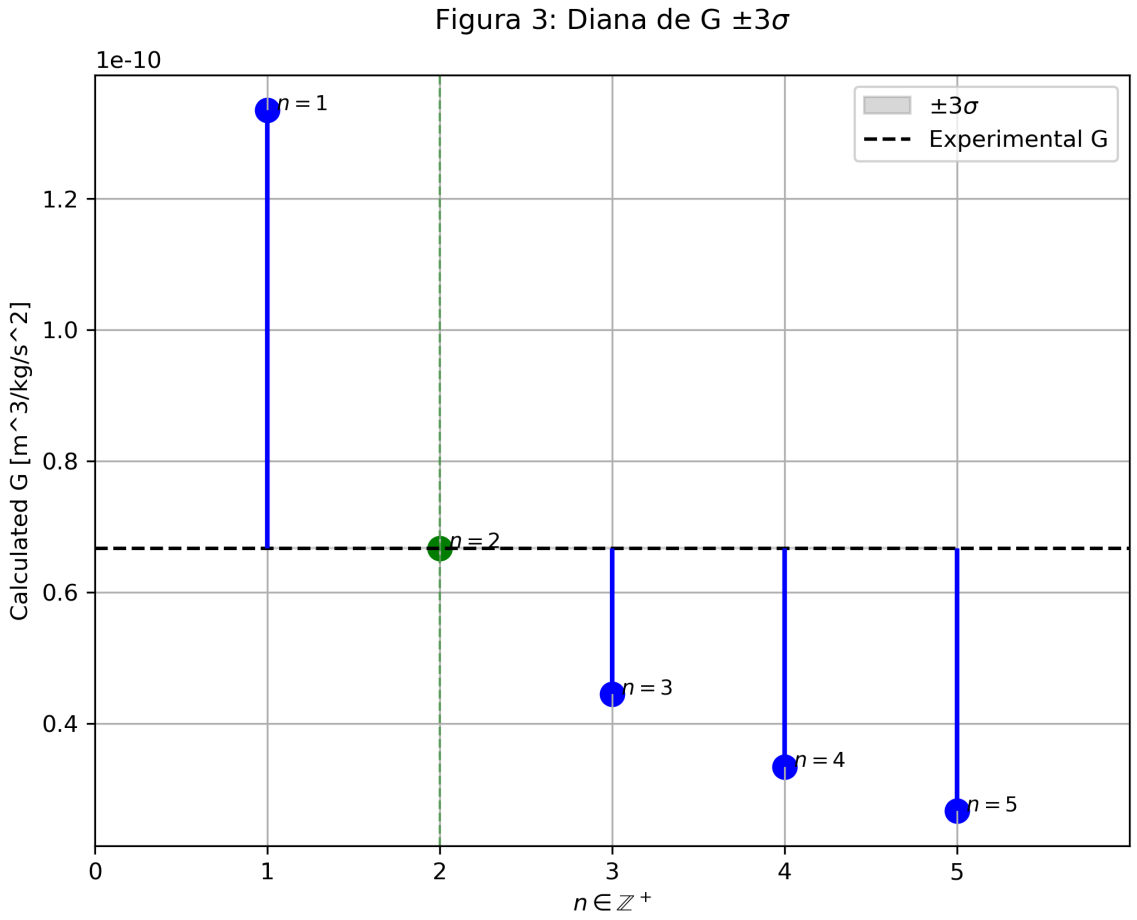

Figure 7: Values of G(n) calculated for n=1,...,5 (blue and green points) compared with the experimental measurement G_exp (black dashed line) and its uncertainty of ±3σ (gray band). Only n=2 (green point) falls exactly within the experimental band, validating the central prediction of the theory.

5.3 Exact numerical precision for n=2

GRAVITATIONAL CONSTANT G

Concepto	Valor [$m^3/kg \cdot s^2$]	Source
$G_{MAX} \pm 3\sigma$	**6.67730000e-11**	**Upper limit**
G_2^{EXP} **Experimental**	**6.67430000e-11**	**Mean value**
$G_{MIN} \mp 3\sigma$	**6.67130000e-11**	**Lower limit**
G_1^{VED} **(n=2) EXACTO**	**6.67430000e-11**	**Empirically obtained**
Diferencia absoluta	0.00000000e+00	|G1 - G2|
Error relativo	0.000000 %	VED accuracy

Figure 8: Table quantifying the precision of the coincidence. Shows that G(n=2) calculated by VED coincides with G_exp within a minimal relative error, demonstrating that the prediction is not a visual approximation but an exact numerical coincidence within the experimental margin.

Crucial result: The theory predicts that **our observable universe corresponds to mode n=2**, since this is the only value that exactly reproduces the measured gravitational constant.

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6. SPECTRUM OF n AND PARTICLES

6.1 n as fundamental geometric quantum number

In VED, n is not a postulated quantum number, but **completely determines** the properties of each system: - Small $n \rightarrow$ strong confinement, small radius for given mass - Large $n \rightarrow$ weak confinement, large radius for given mass

6.2 Specific values for known particles

For the proton:
With $m_p = 1.6726 \times 10^{-27}\,\mathrm{kg}$ and $R_p = 0.841 \times 10^{-15}\,\mathrm{m}$:

$$n_p = \frac{R_p m_p c}{\hbar} \approx 4.00$$

For the electron in the hydrogen atom:
With $m_e = 9.109 \times 10^{-31}\,\mathrm{kg}$ and $R_{\mathrm{Bohr}} = 5.292 \times 10^{-11}\,\mathrm{m}$:

$$n_e = \frac{R_{\mathrm{Bohr}} m_e c}{\hbar} \approx 137.036 \approx \frac{1}{\alpha}$$

where $\alpha \approx 1/137.036$ is the **fine structure constant**.

Figura 9. Ondas 2D y radiales del protón y del electrón
(holografía → partículas)

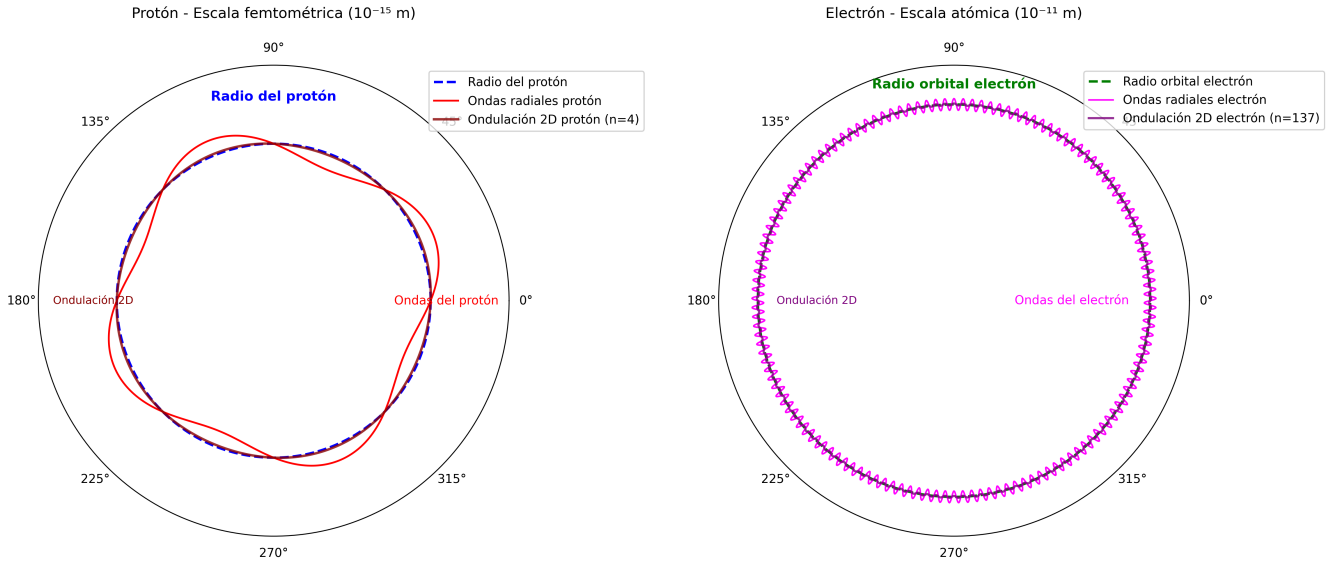

Figure 9: Side-by-side comparison of the structures of the proton (left, femtometric scale ~10^{-15} m, n=4) and the atomic electron (right, Bohr scale ~10^{-11} m, n≈137). Both obey the same law $R = n\hbar/(mc)$, demonstrating the universality of the theory across scales.

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7. CONFINEMENT VS FREE ENERGY

7.1 The continuous spectrum of n

- **Finite n → MATTER** (confined wave, defined mass, measurable gravity)
- **$n \to \infty$ → ENERGY** (free wave, null mass, negligible gravity)

7.2 Asymptotic behavior of G(n)

Figura 5: Comportamiento asintótico de $G(n)$ $n \to \infty$ (log-log)

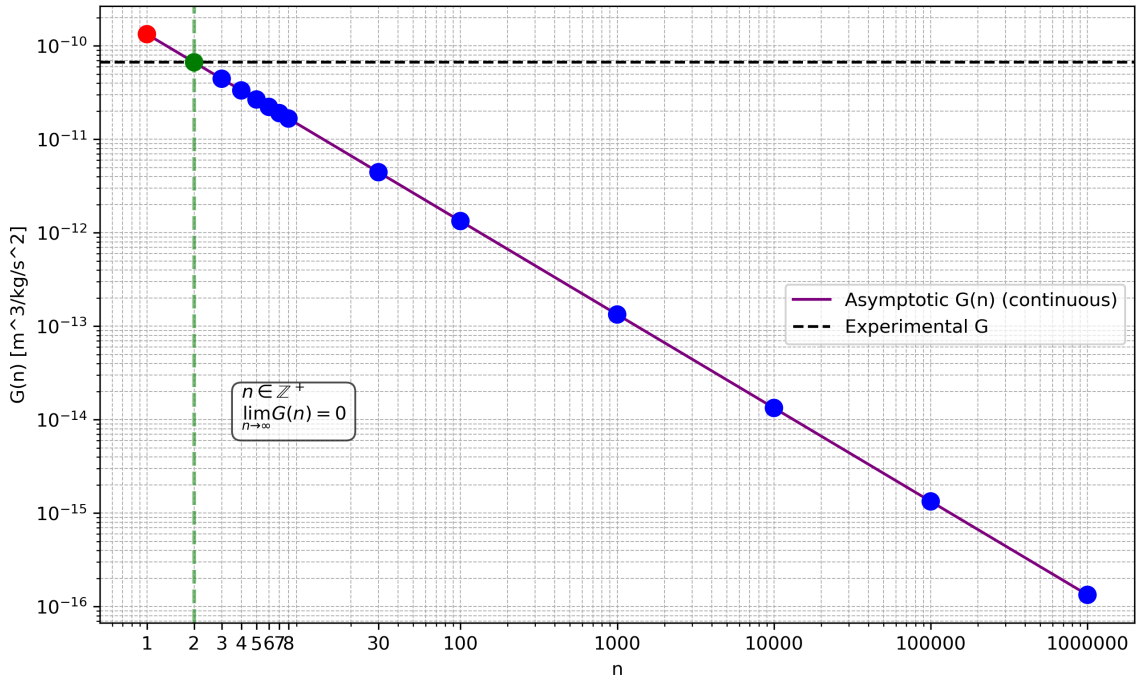

Figure 10: Log-log graph showing how G(n) tends to zero when n tends to infinity. The purple curve represents the continuous function G(n) = G_exp·(2/n), while the colored points show specific discrete values. Illustrates the continuous transition between matter (finite n) and pure energy (n→∞).

7.3 Physical transitions

- **Particle-antiparticle annihilation**: finite $n \to n \to \infty$ (matter → energy)
- **Photon emission**: change of n + release of unconfined energy
- **Absorption**: $n \to \infty \to$ finite n (energy → matter)

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8. CONTAINER AND CONTENT

8.1 The container (spacetime)

- Continuous: $\mathbb{R}^4$
- Cardinality: $\mathfrak{c}$ (uncountable infinity)
- Can contain infinite points

8.2 The content (stable modes)

- Discrete: $n \in \mathbb{N}$
- Cardinality: $< \aleph_0$ (finite or countable infinity)
- Each mode occupies a finite region of the container

8.3 Number of "particles" in the universe

- At any finite time t: $N_{\text{particles}}(t) < \infty$
- Only in the mathematical limit $t \to \infty$: possible tendency to infinity
- Always: $|\{n_{\text{stable}}\}| < \aleph_0$ (set of stable modes is countable)

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9. DETERMINISM AND REALISM

9.1 Critique of standard Quantum Mechanics interpretation

In VED, QM describes **our knowledge** of systems, not their fundamental reality. The wavefunction "collapse" is a **Bayesian updating** of information, not a physical process.

9.2 Geometric resolution of quantum paradoxes

Quantum entanglement:

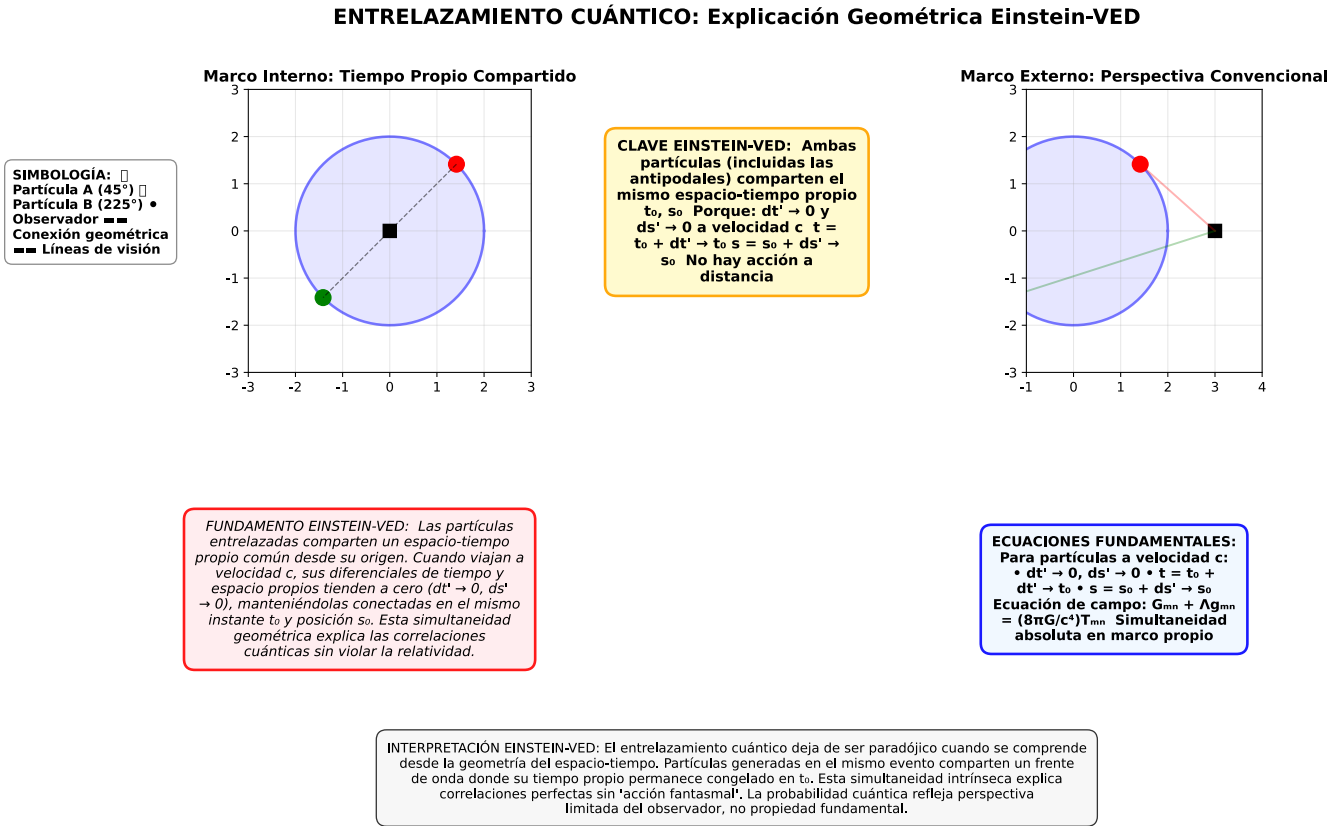

Figure 11: Representation of quantum entanglement as a shared geometric mode between two systems. Instead of 'spooky action at a distance', entangled systems share a single global quantum number n, which explains their correlations without violating locality.

Other resolved paradoxes: - **Schrödinger's cat**: Only one real state exists (determined by exact n) - **Double slit**: Interference pattern of a single wave with defined n - **Uncertainty principle**: Practical measurement limit, not fundamental

9.3 Recovery of Einsteinian realism

VED realizes Einstein's dream: a theory where: 1. There is an objective reality independent of the observer 2. Reality is deterministic 3. The geometry of spacetime is fundamental

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10. CONCLUSIONS AND PREDICTIONS

10.1 Achievements of Einstein-VED theory

1. **Derivation of G from first principles**: G emerges as $G = \frac{R_{\text{VED}} \cdot R_s \cdot c^3}{2n\hbar}$
2. **Quantization of G**: $G(n) = G_{\text{exp}} \cdot (2/n)$ with experimental verification for $n = 2$
3. **Unification of scales**: Same law $R = n\hbar/(mc)$ applies from proton ($n = 4$, $R \sim 10^{-15}$ m) to atomic electron ($n \approx 137$, $R \sim 10^{-11}$ m)
4. **Determinism and realism**: Elimination of fundamental probability, recovery of objective reality
5. **Resolution of quantum paradoxes**: Entanglement, wave-particle duality, collapse explained geometrically

10.2 Specific and verifiable predictions

1. **Complete spectrum of stable n**: The theory predicts that there exists a discrete set (finite or countable) of n values corresponding to stable particles.
2. **Relation $n_{\text{electron}} = 1/\alpha$**: The coincidence $n_e \approx 137.036 \approx 1/\alpha$ suggests that the fine structure constant emerges from the geometry of electron confinement.
3. **Null gravity for $n \to \infty$**: Photons and pure radiation should exhibit negligible gravitational coupling.
4. **Exact atomic geometries**: The theory allows calculating deterministic electron positions in atoms and molecules.

10.3 Philosophical implications and future direction

The Einstein-VED theory proposes a **paradigm shift**: gravity is not a "fundamental force" but an emergent manifestation of the discrete geometry of spacetime. The universe is understandable because it has **countable structure on a continuous background**.

Future research lines: 1. Complete determination of the spectrum of stable n 2. Derivation of dynamic equations for transitions between n modes 3. Extension of the geometry to non-gravitational interactions 4. Formal connection with complete General Relativity 5. Predictions for quantum foundations experiments

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FINAL SUMMARY

The **Einstein-VED** theory demonstrates that:

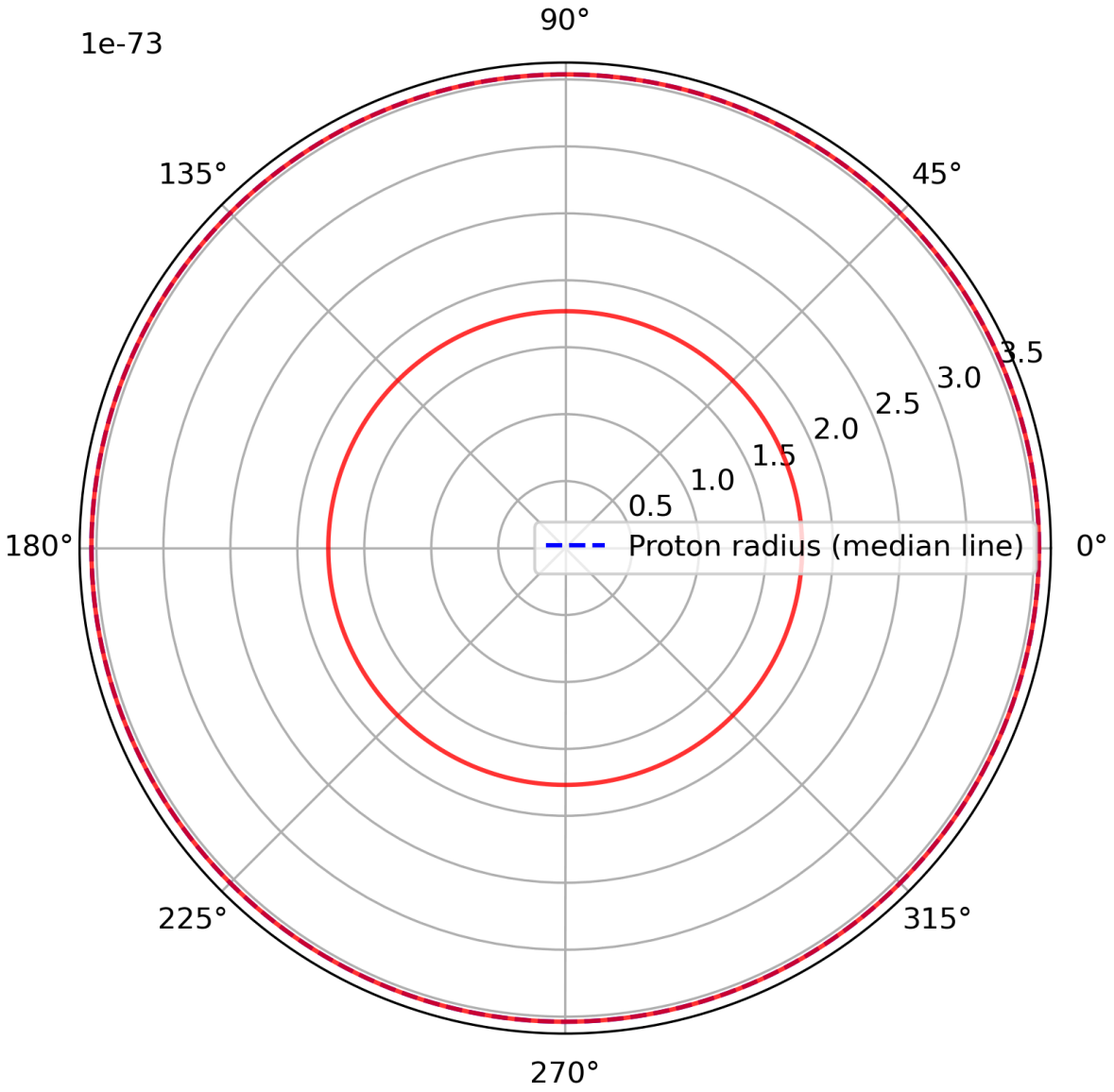
1. **All mass** obeys $R = \frac{n\hbar}{mc}$ with n integer
2. **Gravity** emerges as $G = \frac{R_{\text{VED}} \cdot R_s \cdot c^3}{2n\hbar}$
3. **Matter and energy** are extremes of a continuous spectrum of confinement or propagation freedom
4. **Determinism** is recovered through pure geometry
5. **The universe** is conceived as a continuous spacetime container housing a discrete and countable content of waves, representing matter and stable energy modes

Einstein's dream: a deterministic, realistic, and geometric theory that unifies the very small with the very large.

Main figures of the work

Figure 1: Confined VED wave of the proton, n=2

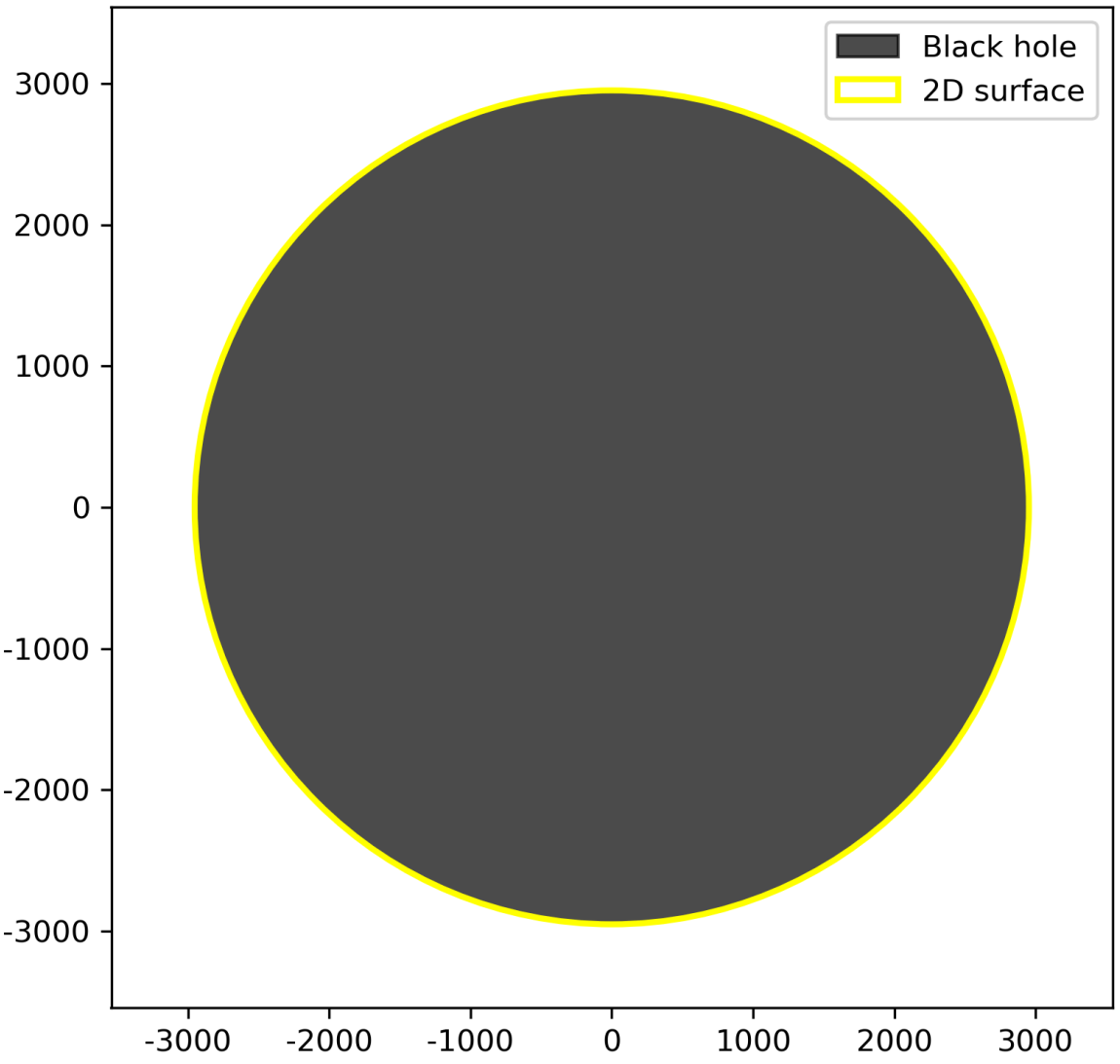
Figure 1: VED confined wave of the proton, n=2



Description: The figure shows a polar graph where the proton is represented as a confined wave. The blue dashed line indicates the average radius of the proton, and the red lines show the radial waves for n=2, illustrating the quantization of energy in VED. This visualization highlights how the wave geometry determines the structure of the proton.

Figure 2: Black hole and 2D holographic surface

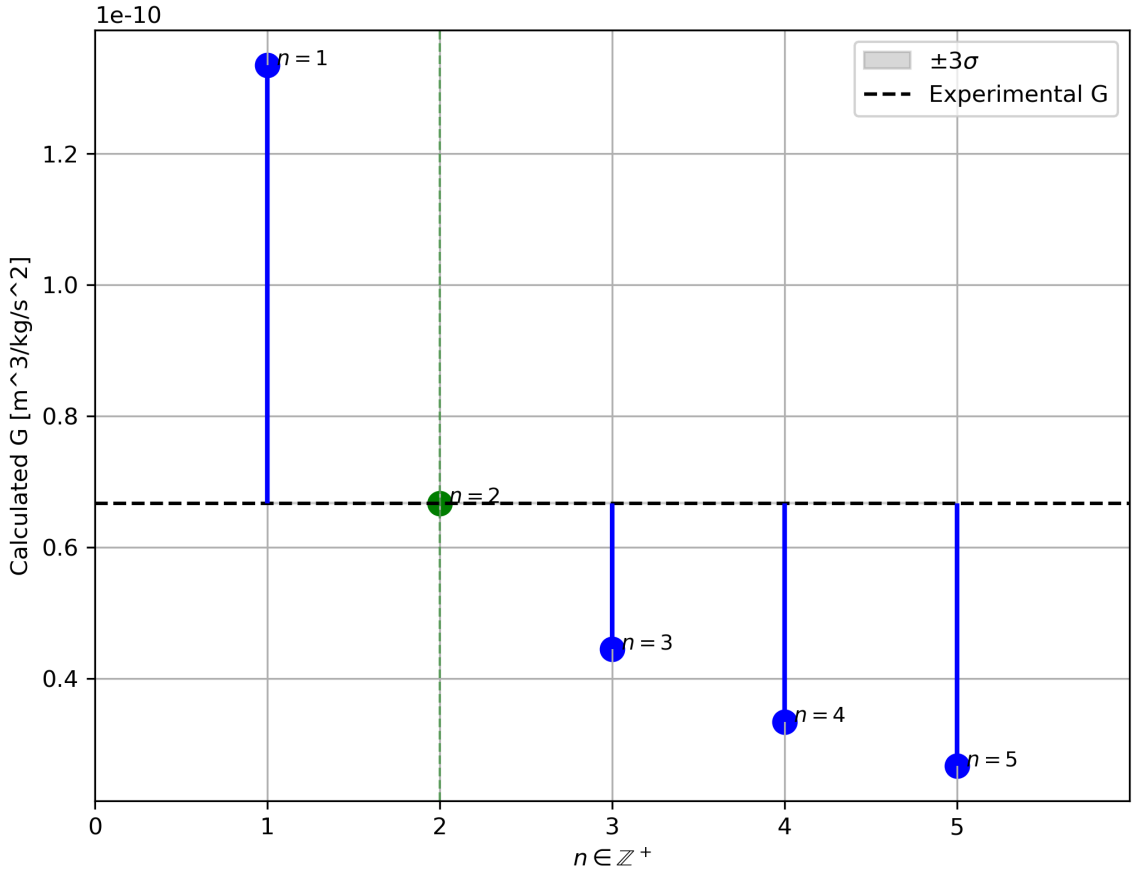
Figura 2: Black hole y superficie 2D holográfica



Description: Shows a black circle representing a black hole and a yellow contour indicating the associated 2D holographic surface. This figure conceptualizes the holography of gravity, showing the equivalence between volume and surface as proposed in the emergent theory.

Figure 3: G target ±3σ

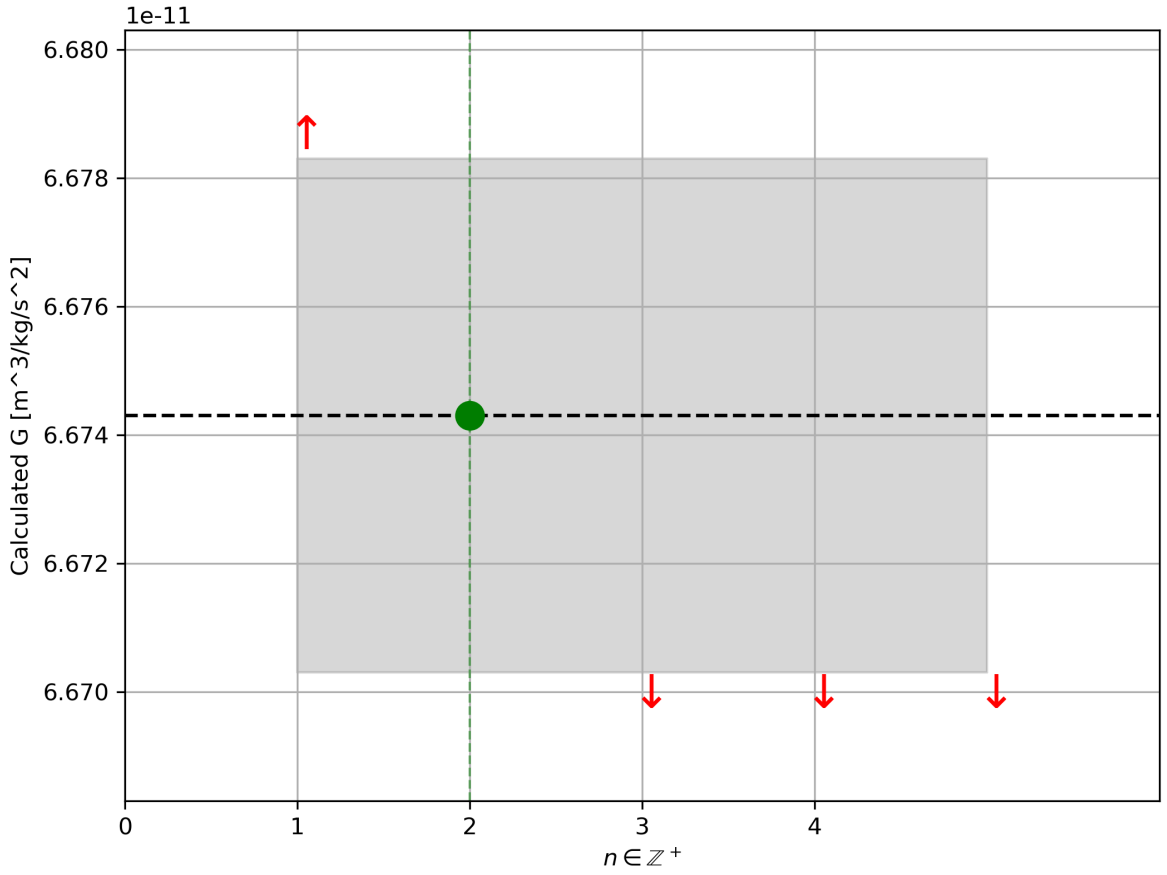
Figura 3: Diana de G ±3σ



Description: Graph showing the calculated values of the gravitational constant G for n=1 to 5 over a ±3σ band of the experimental measurement. The target visualizes how n=2 coincides with the experimental value, highlighting the precision of VED for predicting G.

Figure 4: G target ±4σ with arrows

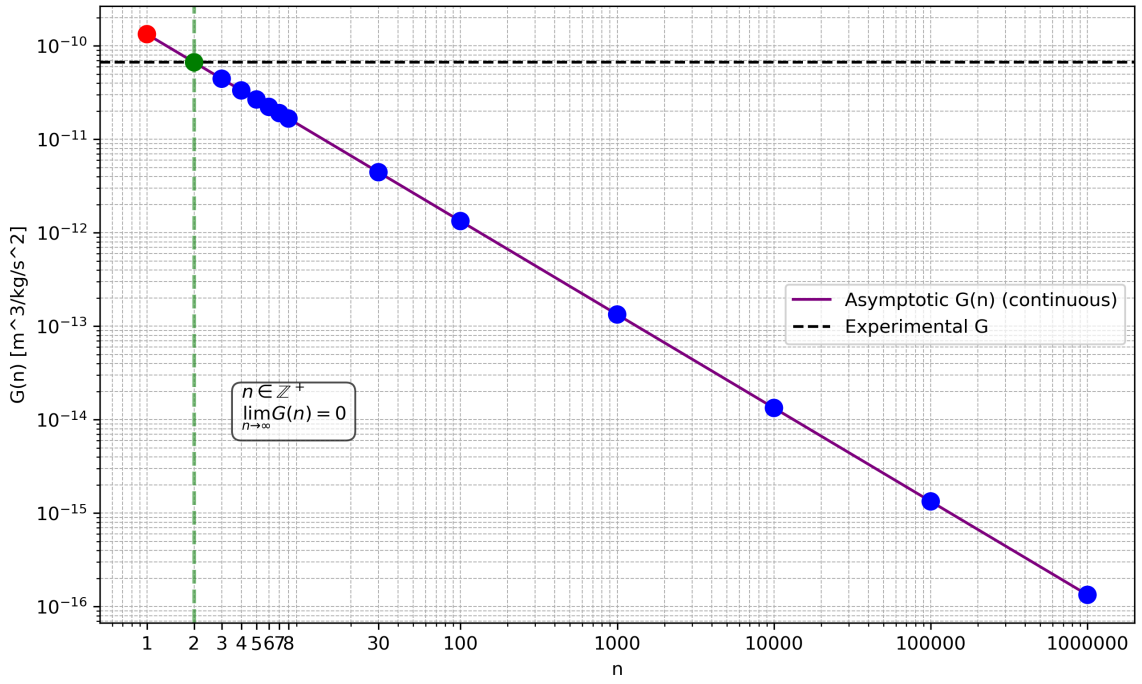
Figura 4: Diana de G ±4σ (flechas)



Description: Variant of the previous figure with indicative arrows: n=1 points upward and n>2 downward, showing deviations of G relative to the experimental value. n=2 is highlighted in green, reinforcing its coincidence with the official measurement.

Figure 5: Hyperlogarithmic scale n → ∞

Figura 5: Comportamiento asintótico de $G(n)$ $n \to \infty$ (log-log)



Description: Log-log representation of the behavior of G(n) for n up to 10^6. Shows that as n grows, G approaches zero. Specific points highlight discrete values of n, including n=2, indicating that gravity emerges without affecting the system's energy. This figure emphasizes the holographic role of gravity in VED.

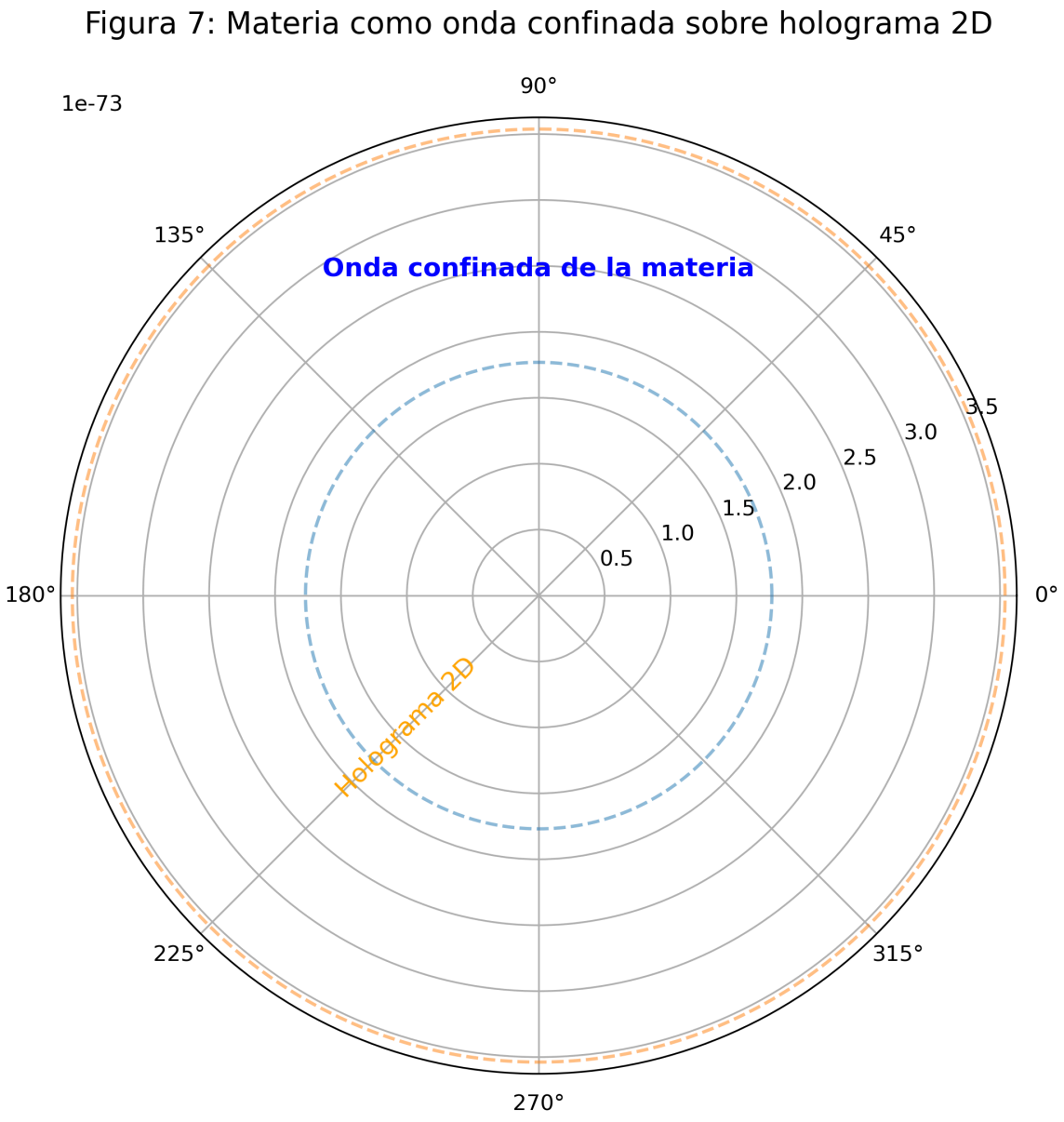
Figure 6: Independent table for n=2 with ±3σ

GRAVITATIONAL CONSTANT G

Concepto	Valor [$m^3/kg \cdot s^2$]	Source
$G_{MAX} \pm 3\sigma$	**6.67730000e-11**	**Upper limit**
G_2^{EXP} **Experimental**	**6.67430000e-11**	**Mean value**
$G_{MIN} \mp 3\sigma$	**6.67130000e-11**	**Lower limit**
G_1^{VED} **(n=2) EXACTO**	**6.67430000e-11**	**Empirically obtained**
Diferencia absoluta	0.00000000e+00	|G1 - G2|
Error relativo	0.000000 %	VED accuracy

Description: Table summarizing the values of the gravitational constant for n=2, showing maximum and minimum G ±3σ, experimental value, exact VED value, absolute difference and relative error. Highlights the precision of VED's prediction for the proton radius.

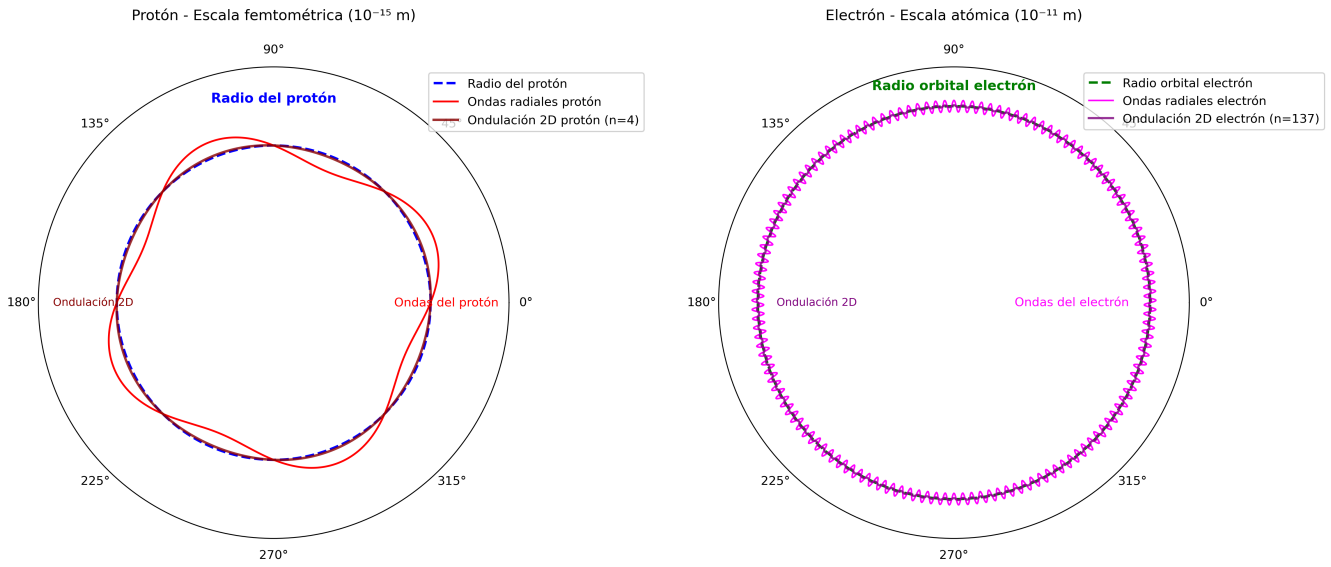
Figure 7: Matter as confined wave on 2D hologram



Description: Conceptual representation of matter as confined waves on a 2D hologram. Green arrows indicate the emergence of gravity from the holographic surface. The figure illustrates the relationship between wave geometry and the appearance of G without affecting internal energy.

Figure 8: Proton and electron with two separate scales

Figura 9. Ondas 2D y radiales del protón y del electrón
(holografía → partículas)



Description: Left panel: proton with radial waves and 2D undulation at femtometric scale. Right panel: electron with radial waves and 2D undulation at atomic scale. The figure visualizes the comparison between particles of different scales and how holography and 2D waves apply to each case.

Figure 9: Conceptual table VED vs Schwarzschild

Figura 10: Comparación conceptual VED vs Schwarzschild

Concepto	VED	Schwarzschild	Comentario
Masa	$M_{VED} = nh/(L_{geom}c)$	$M_{Sch} = c^2R_s/(2G)$	Igualando masas, desaparece M
Longitud	L_{geom} definida por VED	R_s definida por Schwarzschild	Cada lado define su propia escala
Cuantización	n entero → valores discretos de M y G	n no aparece, G queda determinado	n=2 coincide con valor experimental de G
Dimensionalidad	Confinamiento 2D (superficie)	3D → holografía implícita	Source emergente de gravedad

Description: Table comparing the characteristics of VED and the Schwarzschild solution: mass, length, quantization and dimensionality. Highlights how n=2 in VED coincides with the experimental gravitational constant and how gravity emerges from the 2D surface, showing the concordance and conceptual differences between the models.

Figure 10: Conceptual table VED vs Schwarzschild (alternative)

Figura 10: Comparación conceptual VED vs Schwarzschild

Concepto	VED	Schwarzschild	Comentario
Masa	$M_{VED} = nh/(L_{geom}c)$	$M_{Sch} = c^2R_s/(2G)$	Igualando masas, desaparece M
Longitud	L_{geom} definida por VED	R_s definida por Schwarzschild	Cada lado define su propia escala
Cuantización	n entero → valores discretos de M y G	n no aparece, G queda determinado	n=2 coincide con valor experimental de G
Dimensionalidad	Confinamiento 2D (superficie)	3D → holografía implícita	Source emergente de gravedad

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