EN_4: Einstein-VED: Deterministic Derivation of the Proton and the R_VED Formula

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The Proton

1. Introduction

- We continue from the deterministic 3S+T framework.
- We have defined the container (space-time) and the function f, ensuring causality and determinism.
- Quantum mechanics remains outside this analysis, since it cannot deterministically explain the properties of particles.

2. Particle with mass and intrinsic frequency

- Every particle with mass m has an associated frequency ν and wavelength λ:

$$E = mc^2 = h\nu \quad \Rightarrow \quad \nu = \frac{mc^2}{h}$$

- The associated Compton wavelength is:

$$\lambda_C = \frac{c}{\nu} = \frac{h}{mc}$$

- This wavelength is geometric and deterministic, linked to 3S+T space-time and the function f.

3. Geometric confinement axiom

- For a wave associated with a particle to be confined in a perimeter or enclosure, the space must contain an exact integer number of complete waves:

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

- If not satisfied, the enclosure will not be stable. Stability requires structural regularity along the temporal line.

4. Proton confinement

- The minimum stable enclosure of the proton must close the wave in the three spatial dimensions and time (X-T, Y-T, Z-T).
- Minimum number of waves for stability: $n_{\min} = 4$.
- This generates three internal structures that geometrically explain the "color charge".

5. Derivation of the proton's mass and radius

- Intrinsic Compton wavelength: $\lambda_p = \frac{h}{m_p c}$
- Minimum perimeter: $L_p = n_{\min} \cdot \lambda_p = 4 \cdot \lambda_p$
- Perimeter-radius relation for spherical confinement: $2\pi r_p = L_p$

$$r_p = \tfrac{L_p}{2\pi} = \tfrac{4\lambda_p}{2\pi} = \tfrac{2}{\pi} \cdot \lambda_p$$

Numerical calculation with CODATA 2022 values:

- $h = 6.62607015 \times 10^{-34}\ \mathrm{J{\cdot}s}$
- $m_p = 1.67262192369 \times 10^{-27}\ \mathrm{kg}$
- $c = 2.99792458 \times 10^{8}\ \mathrm{m/s}$

$$\lambda_p = \frac{6.62607015 \times 10^{-34}}{1.67262192369 \times 10^{-27} \cdot 2.99792458 \times 10^{8}} \approx 1.321409 \times 10^{-15} \ \text{m}$$

$$r_p = \tfrac{2}{\pi} \cdot 1.321409 \times 10^{-15} \approx 8.412 \times 10^{-16} \ \text{m}$$

Comparison with experimental CODATA value:

- Proton charge radius CODATA: 8.414×10^{-16} m ($\pm 0.019 \times 10^{-16}$)
- **Difference:** 0.002×10^{-16} **m (0.024% discrepancy)**

Equivalent alternative formulation:

$$r_p = n_{\min} \cdot \tfrac{\hbar}{m_p c} = 4 \cdot \tfrac{\hbar}{m_p c}$$

where $\hbar = h / (2\pi)$.

6. Generalization: Radius and mass associated with geometric confinement

- Every confined mass has a deterministic geometric radius:

$$R_{\text{VED}} = \tfrac{2}{\pi} \cdot \lambda_C \cdot n = n \cdot \tfrac{\hbar}{Mc}$$

- Where $\lambda_C = h / (Mc)$ and n = minimum number of waves for stability.
- Applicable to particles, macroscopic bodies, black holes, and the universe.
- R_{VED} should not be confused with observable radii of black holes; it is intrinsic to wave confinement.

7. Conclusion

1. Mass = confined wave in 3S+T.
2. Radius and mass associated with geometric confinement (R_{VED} , M_{VED}) are exact and deterministic.
3. The formula $R_{\text{VED}} = n \cdot \hbar / (Mc)$ will be a fundamental tool in later developments.
4. For the proton, with $n = 4$, we obtain $r_p \approx 8.412 \times 10^{-16}$ m, in excellent agreement with the experimental value.

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