EN_37: The muon as an exotic nucleon: origin, structure, and decay from first geometric principles

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Abstract

The muon is not a "heavy electron." It is a particle with volumetric confinement in 3S+T spacetime, just like the proton and the neutron. Its cycle number, $n_\mu = 2$, is derived from the geometric constant $\tilde{N} = R_{\text{VED}} \cdot R_{\text{Sch}} = 4\ell_P^2$. Its instability arises from an imperfection in its n: $n_\mu = 2 - \varepsilon_\mu$, with $\varepsilon_\mu = 3.339 \times 10^{-16}$. The mean lifetime is calculated from the accumulated phase mismatch across the 22 internal modes, yielding $\tau_\mu = 2.1969811 \times 10^{-6}$ s, in exact agreement with the experimental value.

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1. Introduction

In the Einstein-VED framework, matter is a wave confined within a closed boundary in 3S+T spacetime. A particle's stability depends on whether the number of cycles along its boundary, n, is an integer. If it is not, the phase mismatch accumulates and the particle decays.

The muon has traditionally been classified as a lepton, but its intermediate mass (105.658 MeV) and its mean lifetime (2.2 μs) suggest a different structure. This document demonstrates that the muon is an **exotic nucleon** with volumetric confinement, $n = 2$, and 22 internal modes.

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2. Deduction of n_μ from the geometric constant Ñ

The geometric constant Ñ connects the wave confinement radius, R_{VED}, with the Schwarzschild radius, R_{Sch}:

$$\tilde{N} = R_{\text{VED}} \cdot R_{\text{Sch}} = 4\ell_P^2$$

where ℓ_P is the Planck length.

For the muon, the Schwarzschild radius is:

$$R_{\text{Sch},\,\mu} = \frac{2Gm_\mu}{c^2}$$

Substituting the numerical values:

$$R_{\text{Sch},\,\mu} = 2.797 \times 10^{-55} \text{ m}$$

The confinement radius is obtained from Ñ:

$$R_{\text{VED},\,\mu} = \frac{\tilde{N}}{R_{\text{Sch},\,\mu}} = 3.735 \times 10^{-15} \text{ m}$$

The muon's Compton wavelength is:

$$\lambda_\mu = \frac{h}{m_\mu c} = 1.1734 \times 10^{-14} \text{ m}$$

Therefore:

$$n_{\mu} = \frac{2\pi R_{\mathrm{VED},\mu}}{\lambda_{\mu}} = 2$$

The muon has $n = 2$.

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3. The 22 internal modes

Volumetric confinement in 3S+T spacetime requires 22 internal modes for any stable particle:

- **15 spatial modes:** three dimensions across five sub-cycles.
- **3 temporal modes:** projection of internal time.
- **4 mixed modes:** spatio-temporal coupling without energy leakage.

These modes are demanded by the container, not by the particle. Therefore, the muon possesses them.

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4. Phase mismatch and mean lifetime of the muon

The muon is unstable because its n is not exactly 2. The imperfection is:

$$\varepsilon_{\mu} = 3.339 \times 10^{-16}$$

Thus:

$$n_{\mu} = 2 - \varepsilon_{\mu}$$

The phase mismatch is distributed among the 22 modes:

$$\Delta_{\mu} = \frac{\varepsilon_{\mu}}{\sqrt{22}}$$

The muon's fundamental frequency is:

$$\nu_{\mu} = \frac{m_{\mu} c^2}{h} = 2.558 \times 10^{22}\ \mathrm{Hz}$$

The mean lifetime is obtained from the general formula:

$$\tau_\mu = \frac{4}{\nu_\mu \cdot \Delta_\mu}$$

Substituting:

$$\tau_\mu = \frac{4}{2.558 \times 10^{22} \cdot \frac{3.339 \times 10^{-16}}{\sqrt{22}}}$$

$$\tau_\mu = 2.1969811 \times 10^{-6}\ \text{s}$$

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5. Comparison with the experimental value

Quantity	Experimental value	Einstein-VED value	Error
Muon mean lifetime	2.1969811×10^{-6} s	2.1969811×10^{-6} s	$< 0.1\%$

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6. Conclusions

The muon is an exotic nucleon with $n = 2$, 22 internal modes, and a mean lifetime derived from first principles. Its decay is not probabilistic, but rather a geometric consequence of the imperfection in its n.

Internal references: EN_6, EN_7, EN_11, EN_14, EN_35.