Complementary clarifications to the Einstein-VED theory

This document provides a mathematical basis to understand the concepts of this theory. I intend to expose the most elementary mathematical bases that need to be known to understand this work. This includes basic concepts of algebra and set theory within reach of any person with a minimum of mathematical culture, not with the intention of making a confusing text but so that the rigor of my statements can be verified. That is why it is necessary to briefly explain basic concepts such as the **differential**, the **limit** and the **Lorentz transformations**, which give rise to this extension of Einstein's theory of spatial relativity.

With this basis, my Einstein-VED theory can be better understood.

The theory that will reconcile Quantum Mechanics with Einstein's Relativity (PDF in Spanish)

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1. Connection between Mathematics and Nature

I see a deep connection between mathematics and the laws that define nature. Through **number theory** we can bound and describe the rules that govern the universe.

First, let's think about matter: even if the universe contained infinite particles, that set would still be **countable**. In other words, each particle could correspond to a natural number:

$$n \in \mathbb{N}$$

Therefore, matter is subject to the properties of natural numbers.

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2. Continuity of Space-Time

Nature also shows continuity: between two instants or two points there is always another intermediate. If we take two real numbers t_0 and t_1, there always exists a number t such that:

$$t_0 < t < t_1$$

And this holds even if t_0 and t_1 are as close as we want. From here the concept of **differential** arises.

When we consider the difference $\Delta t = t_1 - t_0$, and we make that quantity smaller and smaller without reaching zero, we enter the domain of **infinitesimals**. We can make Δt as small as we want, and yet there will always be another smaller one. This process naturally leads to the concept of **limit**.

A limit is that which we can approach infinitely: no matter how close we are, there is always a closer value. That is why, when in calculus we speak of differentials, it is not about dividing by zero, but about approaching an impossible division without actually performing it.

Differentials allow us to work with magnitudes that tend to zero but are never zero, and that gives us the mathematical basis for the **continuity of space-time**.

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3. Universe as a combination of the discrete and the continuous

Thus, we take $\mathbb{R}$ as the representation of that continuity in each dimension. The universe, in this sense, can be seen as a space of four real dimensions:

> $\mathbb{R}^4$

which contains a number n of particles, with:

> $n \subset \mathbb{N}$

In this way, the universe combines the **discrete** (matter, natural numbers) and the **continuous** (space-time, real numbers). Both are related through the concepts of **limit**, **differential** and **continuity**, which are also reflected in **Lorentz's laws** and in the **structure of modern physics**.

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4. Proof: Particles in a proper space-time at the origin of the wavefront

Statement. Under the hypotheses of the Einstein-VED framework, a particle associated with a localized mode whose maximum is at point (O) of a null wavefront can be interpreted as embedded in a **proper space-time** centered at (O). Furthermore, an observer who intercepts the wavefront at (O) measures proper intervals that tend to zero when considering increasingly close events on the wavefront hypersurface:

$$dt' \to 0, \quad ds' \to 0.$$

Hypotheses

1. ((\mathcal{M}, g)) is locally Minkowskian.
2. There exists a null wavefront hypersurface (\mathcal{N} = {x \in \mathcal{M} : \Phi(x) = 0}) with null gradient:

$$g^{\mu\nu}\partial_\mu\Phi, \partial_\nu\Phi = 0 \text{ on } \mathcal{N}.$$

3. The particle (p_n) is represented by a mode (\psi_n(x) = \phi_n(x)e^{-i\omega t}) with effective support contained in a region (U_n) that contains a distinguished point (O \in \mathcal{N}).
4. The observer uses local coordinates (x'^\mu) that intercept (\mathcal{N}) at (O).

Proof

1. **Null nature of the front:** For two neighboring infinitesimal events on (\mathcal{N}), it holds:

$$ds^2 = g_{\mu\nu}dx^\mu dx^\nu = 0.$$

   That is, the separations between points of (\mathcal{N}) are light-like.

2. **Local Lorentz invariance:** Under a local Lorentz transformation (x'^\mu = \Lambda^\mu{}_\nu x^\nu + a^\mu), the condition (ds^2 = 0) is preserved:

$$ds'^2 = g'_{\mu\nu}dx'^\mu dx'^\nu = ds^2 = 0.$$

3. **Proper interval and proper time:** The proper interval between two infinitesimal events is:

$$d\tau^2 = ds'^2.$$

   For events on (\mathcal{N}): (d\tau^2 = 0), therefore, the proper time between them is zero.

4. **Observer approximation limit:** If the observer considers events increasingly closer on (\mathcal{N}) and approaches (O):

$$dx'^{\mu} \to 0 \quad \Rightarrow \quad dt' \to 0,\ ds'^2 \to 0.$$

   Therefore, the proper time between them tends to zero in the limit.

5. **Physical interpretation:** The particle (p_n), as a mode with effective support centered at (O), has its internal dynamics linked to the front. For an observer who intercepts the front at (O), transitions strictly associated with the null surface appear with null proper intervals. This justifies the description of a **proper space-time concentrated at (O)**.

Observations

- The proof is limited to events on the null hypersurface; it does not imply absence of physical evolution: dynamics may require events slightly outside (\mathcal{N}).
- If the front has finite width (\epsilon > 0), the measured intervals will be small but not zero; the analysis is valid in the limit (\epsilon \to 0).
- Proper space-time can be modeled as a **local fibration of the continuum** over the supports (U_n), with (O) being a degenerate fiber associated with the null front.