

# A Tale of the Deep Symmetry of the World: Why Do the Electron and the Positron Have Opposite Signs?

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*“Science is the belief in the ignorance of experts.” — R. P. Feynman*



## Abstract

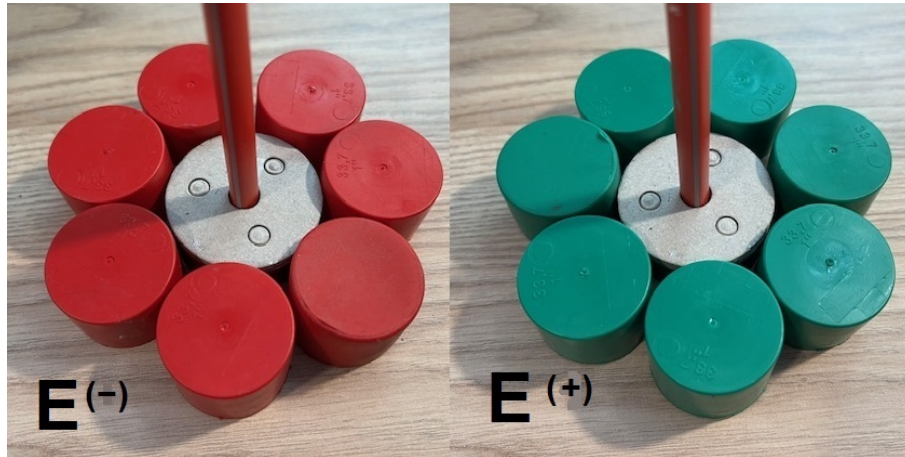
I present a geometric model of the electron and positron in the context of two symmetric worlds, World I and World II. The model is based on the concept of

internal dynamics determined by the direction of rotation (dC: o+ or o-) and the spin variant (Sp1 or Sp2). I demonstrate the mirror correlations between particles in both worlds and the consequences of these symmetries for annihilation and quasi-annihilation processes. The work is a continuation of *A Tale of Symmetry in the Universe*[1], in which the geometric nature of the proton was described.

## Prologue: Two Sides of the Same Coin

Deep within every atom, on an unimaginably small scale, a silent revolution takes place. The electron — this inconspicuous dancer orbiting the nucleus — hides one of the greatest mysteries of physics. Its partner, the positron, is almost identical, yet fundamentally different. For a hundred years physicists have described them with equations. But what if one could... **touch** them?

## 1 The Electron Model — “Vortex–Coupling–Boundary”



### 1.1 Elements of the model

- **V (Vortex)** — the quantization axis, the direction along which spin is projected.
- **dC (Core)** — the electron core, the platform of the 2:1 relation.
- **C (Coupling)** — the Möbius coupling, the topological engine.
- **E (Edge)** — boundary states, the particle’s edge.
- **ST (Arrow)** — the quantum-state marker.

The detailed description is given in [2].

## 2 The Fundamental Relation Between the Symbolic Model and the Mathematical Formalism

The introduced model uses the symbols (Sp1, Sp2, dC, E) as analogues of mathematical structures known from group theory, spinors, and the SU(2) representation. Below is a hybrid notation that unambiguously connects these two descriptive layers.

### 2.1 Symbolic counterparts in mathematical language

$$\text{Sp1} \longleftrightarrow |\psi_1\rangle \in \mathbb{C}^2 \quad (\text{first spinor component}) \quad (1)$$

$$\text{Sp2} \longleftrightarrow |\psi_2\rangle \in \mathbb{C}^2 \quad (\text{second spinor component}) \quad (2)$$

$$\text{dC} \longleftrightarrow \sigma_z \quad (\text{phase/“charge” shift operator}) \quad (3)$$

$$\text{E} \longleftrightarrow R(\theta) = e^{-i\theta \vec{n} \cdot \vec{\sigma}/2} \quad (\text{full SU(2) rotation operator}) \quad (4)$$

where  $\vec{\sigma}$  denotes the vector of Pauli matrices, and  $|\psi\rangle$  is the spinor state vector.

### 2.2 Fundamental relation

The model assumes that *two dC rotations correspond to one full rotation*. In the mathematical formalism this corresponds to the classic property of spinors: only a  $4\pi$  rotation restores the state.

$$2 \times \text{dC rotation} = 1 \times \text{full rotation} \quad (5)$$

$$R(4\pi) |\psi\rangle = + |\psi\rangle \quad (6)$$

A  $2\pi$  rotation yields a negative phase:

$$R(2\pi) |\psi\rangle = - |\psi\rangle \quad (7)$$

### 2.3 Interpretation

- $\psi$  in these equations denotes the **spinor**, the mathematical object representing a spin-1/2 particle.
- The dC rotation acts as a *half-step phase shift*.
- The full rotation acts as the full SU(2) generator.
- The relation

$$2 \times \text{dC} = \text{full rotation}$$

is the direct counterpart of:

$$\text{two spinor rotations } (2\pi + 2\pi) = 4\pi \text{ full return.}$$

## 2.4 Meaning for the mirror model

Since the “mirror charge” arises from the inversion of dC polarity, its mathematical equivalent is multiplication of the spinor by  $\sigma_z$ :

$$|\psi\rangle \longrightarrow \sigma_z |\psi\rangle \quad (8)$$

which flips the sign of one spinor component, analogous to:

$$\text{dC: } + \leftrightarrow -.$$

“Mirrorness” corresponds to the parity operator in spinor space.

## 3 Charge Generation in World I or World II: Two Possible Mechanisms

### 3.1 Mechanism I: Different Shapes

Electron ( $e^-$ ) : Shape “0”  $\Rightarrow$  E and dC rotate in the same direction

Positron ( $e^+$ ) : Shape “8”  $\Rightarrow$  E and dC rotate in opposite directions

### 3.2 Mechanism II: Different Gluing Methods

Method 1 (Sp1) : Right end passed BEHIND the strip

Method 2 (Sp2) : Right end passed IN FRONT of the strip

Table 1: Comparison of electron and positron properties in World I (ours)

Property	<b>Electron (<math>E^-</math>)</b>	<b>Positron (<math>E^+</math>)</b>
<b>Geometry (G)</b>	G0 (shape “0”)	G0 (shape “0”)
<b>Gluing method</b>	Sp1 (end BEHIND the strip)	Sp2 (end IN FRONT of the strip)
<b>Direction <math>E \leftrightarrow \text{dC}</math></b>	Always aligned (G0)	Always aligned (G0)
<b>dC polarity</b>	dC( $o^+$ )	dC( $o^+$ )
<b>Electric charge</b>	$-1$	$+1$
<b>Rest energy</b>	$0.511 \text{ MeV}/c^2$	$0.511 \text{ MeV}/c^2$
<b>Spinor relation</b>	2:1 (dC rotation : full rotation)	2:1 (dC rotation : full rotation)
<b>Post-annihilation state</b>	ECV (unfolded, twist-free)	
<b>Stability</b>	Stable configuration	Stable configuration

Table 2: Comparison of mirror electron and mirror positron in World II

Property	<b>Mirror electron (<math>E^+</math>)</b>	<b>Mirror positron (<math>E^-</math>)</b>
Geometry (G)	G0 (shape “0”)	G0 (shape “0”)
Gluings method	Sp1' (geometry identical to Sp1)	Sp2' (geometry identical to Sp2)
Direction $E \leftrightarrow dC$	Always aligned (G0)	Always aligned (G0)
dC polarity	$dC(o^-)$	$dC(o^-)$
Electric charge	+1	-1
Rest energy	0.511 MeV/c <sup>2</sup>	0.511 MeV/c <sup>2</sup>
Spinor relation	2:1 (dC : full rotation)	2:1 (dC : full rotation)
Post-annihilation state	ECV (unfolded, twist-free)	
Stability	Stable configuration	Stable configuration

## 4 Energetic Consequences

### 4.1 Mechanism I

$$m_{e^+} > m_{e^-} \quad (\text{due to the more complex topology}) \quad (9)$$

### 4.2 Mechanism II

$$m_{e^+} = m_{e^-} \quad (\text{for Sp.2 twist}) \quad (10)$$

## 5 Measurement Precision as a Test of the Geometric Model

### Precision of contemporary measurements

Modern experimental physics has achieved remarkable precision in determining fundamental constants:

- **Electron rest mass/energy:**

$$m_e c^2 = 0.51099895000(15) \text{ MeV}$$

$$\text{Relative uncertainty: } \sim 3 \times 10^{-11}$$

- **CPT symmetry tests for the positron:**

$$\frac{|m_{e^+} - m_{e^-}|}{m_e} < 8 \times 10^{-9}$$

The mass difference is essentially indistinguishable from zero.

## Implications for the geometric model

This extraordinary measurement precision naturally serves as a test for the proposed geometric model:

- **Mechanism I (different shapes):**
  - The “figure-eight” versus “zero” configuration
  - Expected energy difference  $\gtrsim 10^{-6}$
  - **Potentially detectable** in the newest experiments
- **Mechanism II (only different twistings):**
  - Same “zero” geometry, different Sp.1/Sp.2 twisting
  - Expected energy difference  $\lesssim 10^{-10}$
  - **Consistent with current measurements**

## Predictions and falsifiability

The geometric model yields explicit, falsifiable predictions:

$$\frac{m_{e^+} - m_{e^-}}{m_e} = \begin{cases} > 10^{-8} & \text{Mechanism I (figure-eight vs zero)} \\ < 10^{-10} & \text{Mechanism II (only different twistings)} \end{cases} \quad (11)$$

**Current knowledge** ( $< 8 \times 10^{-9}$ ) **favours Mechanism II**, in which the electron and positron differ only by the twisting method of the Möbius band, while maintaining identical base geometry.

## 6 Geometric Annihilation

### 6.1 Annihilation outcome

Mechanism I: CCV with Möbius twist

Mechanism II: ECV (unfolded, twist-free)

## 7 Electron and Positron in Worlds I and II

### 7.1 World I (ours)

- Electron  $E(-)$ : (Sp1, dC: o+, G=0)
- Positron  $E(+)$ : (Sp2, dC: o+, G=0)

### 7.2 World II (mirror)

- Mirror electron  $E(+)$ : (Sp1, dC: o-, G=0)
- Mirror positron  $E(-)$ : (Sp2, dC: o-, G=0)

### 7.3 Mirror electron–positron relations

- The electron  $E(-)$  in World I is mirror-equivalent to the positron  $E(-)$  in World II.
- The mirror electron  $E(+)$  in World II is mirror-equivalent to the positron  $E(+)$  in World I.

### 7.4 Remarks on classification

- Topology G8 is omitted because it is energetically unfavorable and does not appear in stable configurations.
- The key distinction for charge is the spin variant (Sp1 vs Sp2); the dC orientation and topology G=0 remain unchanged within each world.
- The masses of electrons and positrons remain identical in both worlds.

## 8 Annihilation in World I

### 8.1 Annihilation mechanism

After annihilation of the  $E(-)-E(+)$  pair in World I, photon energy is produced with no remaining Möbius-band twist, because the Sp1 and Sp2 configurations neutralize each other.

### 8.2 Energetics in World I

The rest energies of electrons and positrons are identical, ensuring stability of the system and symmetry in annihilation processes.

## 9 Annihilation and Topology Reduction

In the discrete model, the state of an elementary particle is defined by three independent invariants:

$$(\text{Sp}, dC, G),$$

where:

- $\text{Sp} \in \{\text{Sp1}, \text{Sp2}\}$  is the discrete spin variant (the carrier of charge sign),
- $dC \in \{o^+, o^-\}$  is the local orientation of the dynamic cycle,
- $G \in \{0, 8\}$  is the global topological class; in stable physical configurations we assume  $G = 0$ .

## 9.1 Charge rule and annihilation condition

Electric charge is defined as a function of the spin variant:

$$Q(\text{Sp1}) = -1, \quad Q(\text{Sp2}) = +1.$$

The dC direction and topological class  $G$  do not carry charge and do not change during annihilation.

Thus, the annihilation condition is the combination of two states of opposite charge:

$$(\text{Sp1}, dC, G = 0) + (\text{Sp2}, dC, G = 0).$$

## 9.2 Mechanism of charge disappearance

Since spin variants are discrete, the sum

$$\text{Sp1} + \text{Sp2}$$

does not define a new variant; instead, the pair forms a topologically neutral system. Formally:

$$(\text{Sp1}, dC, 0) \oplus (\text{Sp2}, dC, 0) \longrightarrow (\text{No defect}, dC, 0).$$

As a result, the degree of freedom responsible for charge (the antagonistic spin-variant pair) disappears, and the remaining configuration becomes topologically trivial.

## 9.3 Reduction of internal geometry

The topology  $G = 0$  is additively stable:

$$0 \oplus 0 = 0,$$

meaning that combining two states does not generate any new global twist or defect. Since the  $dC$  orientation is also the same for both particles, the local dynamic structure undergoes geometric compensation, leaving no residual curvature.

## 9.4 Final state after annihilation

Combining two oppositely charged states:

$$E(-) = (\text{Sp1}, o^+, 0), \quad E(+) = (\text{Sp2}, o^+, 0),$$

yields:

$$E(-) + E(+) \longrightarrow \text{topologically trivial configuration.}$$

In physical language, this corresponds to the emission of quanta of the field (electromagnetic or gravitational), while in the model it signifies the complete disappearance of the defect carrying charge.

Thus, annihilation is not destruction of objects but the neutralization of the discrete degrees of freedom  $\text{Sp1}$  and  $\text{Sp2}$  while preserving the global topology  $G = 0$ .

## 10 Quasi-annihilation of Worlds I and II Using Primed Variants

In the model, we assume the existence of two parallel geometric orders:

$$\text{World I (ours),} \quad \text{World II (mirror).}$$

World II arises through the mirror reflection of the dynamic cycle  $dC$ :

$$o_I^+ \longleftrightarrow o_{II}^-,$$

while the geometry of the spin variants remains identical. However, the interpretation of charge in World II is reversed, which is why we introduce primed labels:  $\text{Sp1}'$  and  $\text{Sp2}'$ .

### 10.1 Mirror counterparts of electrons

In World I, the convention is:

$$E(-)_I = (\text{Sp1}, o^+, G = 0), \quad E(+)_I = (\text{Sp2}, o^+, G = 0).$$

After mirror reflection we obtain the states in World II:

$$E(+)_II = (\text{Sp1}', o^-, G = 0), \quad E(-)_{II} = (\text{Sp2}', o^-, G = 0),$$

where the apostrophe signals the reversal in charge interpretation, not a change in geometry.

### 10.2 Quasi-annihilation condition

We consider the composition:

$$E(-)_I = (\text{Sp1}, o^+, 0) \oplus E(+)_II = (\text{Sp1}', o^-, 0).$$

These states are not topological inverses (as the  $\text{Sp1}$ – $\text{Sp2}$  pair in ordinary annihilation in World I). They share identical geometry but have opposite  $dC$  orientation, while the charge sign differs only interpretationally.

### 10.3 Mechanism of dynamic-structure smoothing

The key role is played by the neutralization of orientation:

$$o_I^+ \oplus o_{II}^- \longrightarrow o^0,$$

where  $o^0$  denotes the absence of cyclicity. The process:

$$(\text{Sp1}, o^+, 0) \oplus (\text{Sp1}', o^-, 0)$$

does not produce radiation (no  $\text{Sp1}$ – $\text{Sp2}$  pair), but leads to geometric relaxation and the disappearance of local  $dC$  curvature.

## 10.4 Phenomenological interpretation

We call this process **quasi-annihilation** because:

- no energy is emitted (no geometric “anti-state” is present),
- the difference in dynamic-cycle orientation disappears,
- the geometry transitions into a smoother state:  $o^+ \oplus o^- \rightarrow o^0$ ,
- the global topology  $G = 0$  remains unchanged,
- the charge change between worlds arises purely from convention ( $\text{Sp1} \leftrightarrow \text{Sp1}'$ ), not from different geometry.

## 10.5 Conclusion

Quasi-annihilation of Worlds I and II is a *purely geometric-semantic* process:

$$\boxed{(\text{Sp1}, o^+) \oplus (\text{Sp1}', o^-) \longrightarrow (\text{configuration without } dC \text{ cyclicity, } G = 0)}$$

It is the geometric analogue of phase alignment between two inverted systems, not classical particle–antiparticle annihilation.

# 11 Mapping the Former Markers from the *Tale of the Symmetry of the Universe* onto the New Formalism $(Sp, dC)$

This section supplements and clarifies the earlier work *The Tale of the Symmetry of the Universe*, in which the structure of the proton and the process of its unpacking and repacking in Worlds I and II were described in detail. In that narrative, the following markers were used:

$$K_{\text{Red}}, \quad K_{\text{Gren}}, \quad \text{ECV}(+), \quad \text{ECV}(-),$$

serving as encodings of charge and local topological polarization. That model was complete for the proton, but it lacked a corresponding construction for the electron, which made it impossible to describe a full, stable “atomic” object (e.g., hydrogen).

In the present work, a consistent model of the electron and positron has been introduced, together with a simplified and more unambiguous topological parametrization in the form of the pair:

$$(Sp, dC), \quad Sp \in \{\text{Sp1}, \text{Sp2}\}, \quad dC \in \{o^+, o^-\}.$$

## New mapping of the former markers

**1. Polarization:** The former local twist markers

$$\text{ECV}(+) \quad \text{and} \quad \text{ECV}(-)$$

map directly onto the polarization of the local twist:

$$\text{ECV}(+) \longleftrightarrow dC(o^+), \quad \text{ECV}(-) \longleftrightarrow dC(o^-).$$

**2. Charge marker (color):** In the *Tale*, charge markers were expressed by the labels:

$$K_{\text{Red}}, \quad K_{\text{Gren}}.$$

In the new formalism their role is taken by the spin variants:

$$K_{\text{Gren}} \longleftrightarrow Sp1, \quad K_{\text{Red}} \longleftrightarrow Sp2.$$

**3. Charge rule:** The change of charge sign now occurs exclusively through:

$$Sp1 \leftrightarrow Sp2,$$

and not through the change of polarization  $dC$ . This means that electric charge has been tied to the *global* spin variant rather than to the local twist structure.

## Interpretation and the connection to the hydrogen construction

In the original *Tale*, the full cycle of proton transformation (pack–smooth–unpack) in both worlds was described, but the electron lacked an appropriate, parallel topological construction. Introducing the parameters  $(Sp, dC)$  allows one to:

- define the electron and positron analogously to the proton and antiproton,
- encode charge unambiguously through  $Sp$ ,
- preserve the polarization through  $dC$ ,
- connect both objects into a stable proton–electron configuration, enabling a topological model of the hydrogen atom.

Thus, mapping the old markers onto the pair  $(Sp, dC)$  makes the earlier proton model and the new electron model parts of a single coherent structure, in which both objects are described by the same set of invariants.

## 12 Charge Transformation Between Worlds I and II

In the model, two parallel geometric orders exist:

$$\text{World I (ours)}, \quad \text{World II (mirror)}.$$

The transformation between them consists of two elements:

1. **Reflection of the rotational direction** of the dynamic cycle:

$$o_I^+ \longleftrightarrow o_{II}^-,$$

2. **Reversal of the interpretation of the spin variants** through the introduction of primed labels:

$$Sp1' \equiv \text{“interpretational counterpart of } Sp1 \text{ in World II”}, \quad Sp2' \equiv \text{“interpretational counterpart of } Sp2 \text{ in World II”}.$$

The geometry of the spin variants remains identical in both worlds— only the *interpretation of the charge sign* changes. Therefore, in World II:

$$Q(Sp1') = +1, \quad Q(Sp2') = -1.$$

## 12.1 Mirror counterparts of electrons

In World I the convention is:

$$E(-)_I = (\text{Sp}1, o^+, G = 0), \quad E(+)_I = (\text{Sp}2, o^+, G = 0).$$

After the mirror transformation we obtain:

$$E(+)_II = (\text{Sp}1', o^-, G = 0), \quad E(-)_II = (\text{Sp}2', o^-, G = 0).$$

The charge sign changes solely because the interpretational convention in World II is reversed — the geometry remains the same.

## 12.2 Charge-change mechanism

The transformation between worlds can be written symbolically as:

$$(\text{Sp}, o^+)_I \xrightarrow{\text{mirror}} (\text{Sp}', o^-)_{II},$$

where the apostrophe denotes:

“the same geometry, but a reversed charge interpretation”.

In particular:

$$\text{Sp}1 \rightarrow \text{Sp}1', \quad \text{Sp}2 \rightarrow \text{Sp}2'.$$

## 12.3 Geometric–spinor interpretation

The transformation  $o^+ \leftrightarrow o^-$  is a reflection of the rotational direction and corresponds to mirror inversion. In spinor language, this is represented by the action of:

$$\sigma_z |\psi\rangle,$$

which flips the sign of one spinor component.

Meanwhile, the transformation

$$\text{Sp}1 \leftrightarrow \text{Sp}1', \quad \text{Sp}2 \leftrightarrow \text{Sp}2'$$

is interpretational and corresponds to what, in QFT, is called “charge-conjugation semantics”:

*“append apostrophe, flip interpretation, keep the geometry”.*

## 12.4 Conclusion

The full charge change between Worlds I and II results from the combination:

$$o^+ \rightarrow o^- \quad (\text{geometric reflection}),$$

$$\text{Sp} \rightarrow \text{Sp}' \quad (\text{interpretational reversal}).$$

The particle’s geometry remains the same; only the world-dependent interpretation of the charge changes.

**NOTE.** This work is rather intricate and the author cannot guarantee that every detail is perfectly consistent and logically flawless. Most likely it is, and every effort has been made to ensure coherence. Even if minor inconsistencies appear, the underlying **framework** remains solid. The work is a continuation of the discussion involving blocks, puzzles, and a pencil case — what that means is explained in detail in [2].

## References

- [1] A. Okupski. *A Tale of Deep Symmetry in the World Version 2.0*. Zenodo, 2025. **DOI:** <https://doi.org/10.5281/zenodo.17566899>.
- [2] A. Okupski. *How Toys Predicted the End of the Accelerating Universe*. Zenodo, 2025. **DOI:** <https://doi.org/10.5281/zenodo.17665571>.
- [3] A. Okupski. *Gravitomagnetism as an Emergent Geometric Phenomenon*. Zenodo, 2025. **DOI:** <https://doi.org/10.5281/zenodo.17508247>