PARTICLE ACCELERATOR AS FORCED RECONFIGURATION OPERATOR: AN ODTOE INTERPRETATION

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ABSTRACT

Within the framework of the observer-dependent theory of everything (ODTOE), an interpretation of particle accelerators is proposed as technological devices that extend the dimensionality of the operator to the level $d \leq -2$ (subquark) and implement forced reconfiguration $C \to C'$ in regions inaccessible to the biological operator $\widehat{O}_{\text{human}}$. It is shown that collision energy $\sqrt{s}$ is identified with the potential gradient $|\nabla U(C)|$ in the dynamics equation, and the threshold for new particle production with the height of the barrier in the configurational landscape. Resonances (Higgs boson, Z, $W^{\pm}$) are interpreted as metastable fixed points of the mapping with finite lifetime, in contrast to the proton ($T \to \infty$). The detector is formalized as a collective reverse operator projecting the result of reconfiguration from subquark dimensionality back into the configurational region accessible to the human observer. The fundamental question is discussed: does the accelerator generate new configurations or actualize potentially pre-existing states? Testable predictions for future FCC experiments are formulated.

Keywords: particle accelerator, collider, reconfiguration, operator dimensionality, inertia, fixed point, Higgs boson, resonance, detector, ODTOE, constitution.

I. INTRODUCTION

1.1. The Standard Interpretation and Its Paradoxes

In modern particle physics, the accelerator is regarded as a high-resolution microscope: an instrument for discovering pre-existing objects. Under this paradigm, the Higgs boson existed in nature long before its discovery at the Large Hadron Collider (LHC) in 2012 [12, 13]; the machine was simply powerful enough to detect it.

ODTOE proposes a radically different interpretation. According to the central axiom (A) [1]: the observer constitutes the observed. The configuration $R = \widehat{O}(\Psi)$ does not logically pre-exist before the act of observation — it is actualized by the operator in the region of configuration space $\mathcal{C}$ accessible to that operator. In this sense, the accelerator is not a microscope peering at a ready-made reality, but a forced reconfiguration operator generating new states of matter in previously inaccessible regions.

1.2. Objectives of This Work

(a) Formalize the accelerator as an extension of operator dimensionality: $d_{\text{acc}} \ll d_{\text{human}}$.

(b) Reinterpret the key concepts of collider physics (collision energy, production threshold, resonance, cross section, detection) within the ODTOE formal framework.

(c) Explain the particle mass hierarchy through the hierarchy of potential barriers in the landscape $U(C)$.

(d) Formulate differences between the standard interpretation and ODTOE that admit experimental verification.

(e) Discuss the fundamental paradox: does the accelerator actualize potentially existing states or generate new configurations?

II. THE ACCELERATOR AS AN EXTENSION OF OPERATOR DIMENSIONALITY

2.1. The Access Problem

According to the D-Prot principle [1]: an observation operator with dimensionality $d(\widehat{O})$ cannot actualize configurations with dim$(C) > d(\widehat{O})$. For quark and subquark states, the required dimensionality is approximately $d_{\text{required}} \approx -2$. The biological operator of a human functions at the organismic level: $d_{\text{human}} \approx +3$. The gap amounts to $\Delta d \approx -5$. Without technological augmentation, subatomic configurations remain fundamentally inaccessible.

2.2. The Accelerator as a Technological Prosthesis

By analogy with the telescope (which extends the observation window Δn in time), the accelerator extends operator access along dimensionality (d). Both devices are technological extensions of the operator $\widehat{O}_{\text{human}}$, overcoming its biological limitations.

Formally, the accelerator implements a composite operator:

$$\widehat{O}_{\text{acc}} = \widehat{O}_{\text{human}} \circ \widehat{O}_{\text{magnetic}} \circ \widehat{O}_{\text{EM-cavity}} \tag{II.1}$$

where $\widehat{O}_{\text{magnetic}}$ provides beam focusing and acceleration, and $\widehat{O}_{\text{EM-cavity}}$ transfers kinetic energy [4]. The composition of these operators [6] extends the effective operator dimensionality:

$$d(\widehat{O}_{\text{acc}}) = d_{\text{human}} + \Delta d(\sqrt{s}) \tag{II.2}$$

where Δd grows with collision energy $\sqrt{s}$. Higher energy means deeper dimensionality access — more "internal" configurations become actualizable.

2.3. Energy–Dimensionality Correspondence

$\sqrt{s}$ (GeV)	$d_{\text{effective}}$	**Accessible configurations**	**Equipment**
$\sim 10^{-3}$	~ 0	Atomic transitions	Spectrometer
~ 1	~ -1	Nucleon–nucleon	Cyclotron
$\sim 10^{2}$	~ -2	Quarks, W/Z	LEP, Tevatron
$\sim 10^{4}$	~ -3	Higgs, top quark	LHC
$\sim 10^{5}$	~ -4	Supersymmetry?	FCC (proposed)
$\sim 10^{19}$	$\sim -\infty$	Planck scale	Theoretical limit

III. COLLISION ENERGY AS THE POTENTIAL GRADIENT

3.1. Fundamental Equation of Dynamics

According to equation (4.4) from [1]:

$$\frac{dC}{dt} = -\frac{\alpha}{I(C) + \varepsilon}\nabla U(C) + \eta(t) \tag{III.1}$$

The rate of system reconfiguration is determined by two independent factors: the configuration inertia $I(C)$ (resistance to change) and the potential gradient $\nabla U(C)$ (the driving force of reconfiguration). The noise term $\eta(t)$ represents fluctuations.

3.2. The Function of the Accelerator

The accelerator does not alter the intrinsic inertia of the target $I(C)$; the proton remains a proton with its mass and structure until the moment of collision. However, the accelerator creates an extremely steep potential gradient in the interaction region:

$$|\nabla U|_{\text{acc}} \approx \frac{\sqrt{s}}{l_{\text{int}}} \tag{III.2}$$

where $l_{\text{int}} \sim 10^{-15}$ m (femtometer) is the characteristic length of the strong interaction. At $\sqrt{s} = 13$ TeV (LHC energy [11]): $|\nabla U| \sim 10^{13}$ GeV/fm — a tremendous gradient forcing the system to transition from the initial configuration to a new one on the timescale $\Delta t \sim 10^{-24}$ s.

3.3. Production Threshold as Barrier Height

In configuration space, different elementary particles correspond to local energy minima in the landscape $U(C)$:

Particle	Type of minimum	Lifetime
Proton	Deep absolute minimum	$T > 10^{34}$ years
Higgs boson	Local minimum (shallow)	$T \sim 10^{-22}$ s
$W^{\pm}$ boson	Local minimum (shallow)	$T \sim 3 \times 10^{-25}$ s
Z boson	Local minimum (shallow)	$T \sim 2.6 \times 10^{-25}$ s

Between these minima lie potential barriers of height ΔU. The production threshold for a new particle is precisely this height:

$$\sqrt{s}_{\text{threshold}} = \Delta U(C_{\text{initial}} \to C_{\text{new}}) \tag{III.3}$$

When the collision energy is below the threshold ($\sqrt{s} < \Delta U$), reconfiguration is dynamically forbidden: the system remains in the initial minimum. When the threshold is reached ($\sqrt{s} \geq \Delta U$), the barrier is overcome and the new configuration becomes actualizable. Collision energy plays the role of a "lifting force" overcoming the configurational barrier.

IV. ELEMENTARY PARTICLES AS FIXED POINTS OF VARYING STABILITY

4.1. Classification by Stability

According to Assertion 4 from [1], the self-consistent configuration $\Psi^* = \Phi(\Psi^*)$ is a fixed point of the self-observation mapping. However, not all fixed points are equally resistant to perturbations.

Stable fixed point (attractor). Small perturbations cause the system to return to the point. Example: the proton, stable for a practically unlimited time.

Metastable fixed point. A local minimum with a finite surrounding barrier. The system resides at Ψ^*_{meta} for a finite time $T(C)$, then tunnels or transitions to a deeper minimum. Examples: free neutron ($T \approx 880$ s), muon ($T \approx 2.2 \times 10^{-6}$ s).

Resonance (fleeting configuration). An approximately saddle point or an extremely shallow minimum with $T \sim 10^{-22}$–10^{-25} s. Example: Z boson ($T \approx 2.6 \times 10^{-25}$ s), Higgs boson ($T \approx 1.6 \times 10^{-22}$ s).

4.2. Relation Between Lifetime and Coherence

According to the coherence relation P3 from [1]:

$$T(C) = \frac{T_0}{(1 - S)^n} \tag{IV.1}$$

where S is the coherence (self-consistency) coefficient of the structure, and n is the number of nesting levels. For elementary particles, S is determined by the internal organization of the quark triad [1, 5]:

Particle	T	S_{internal}	Classification
Proton	$> 10^{34}$ years	$\to 1$ (maximal)	Stable attractor
Neutron (in nucleus)	$\to \infty$	$\to 1$ (in protonic loop)	Stable within structure
Neutron (free)	880 s	$\ll 1$ (isolated)	Metastable
Muon	2.2×10^{-6} s	Low	Metastable
τ lepton	2.9×10^{-13} s	Very low	Metastable
$W^{\pm}$	3×10^{-25} s	≈ 0	Resonance
Z^0	2.6×10^{-25} s	≈ 0	Resonance
Higgs (H^0)	1.6×10^{-22} s	≈ 0	Resonance

The pattern: the deeper the required operator dimensionality ($|d|$ is larger), the less stable the fixed point. Subquark configurations ($d \leq -3$) are instantaneous "flashes" in configuration space, existing on the order of 10^{-25} s.

4.3. Structural Explanation of Heavy Particle Instability

In ODTOE the answer is structural: maintaining a high-energy configuration ($\sqrt{s} \gg m_p c^2$) requires coherence $S \to 1$ at the corresponding level of operator dimensionality. However, at deep levels $d \leq -3$ there are few internal nested loops (approximately 3–6 quarks/gluons). By formula (IV.1), with small n even a slight decrease in S sharply reduces the lifetime. Only the proton, with its threefold self-consistent architecture of quarks and the gluon field, achieves S sufficiently high for practical eternity.

V. THE DETECTOR AS A CASCADE OF REVERSE OPERATORS

5.1. The Dimensionality Projection Problem

The accelerator actualizes configurations at the level $d \leq -2$ (subquark). The human observer operates at $d \approx +3$ (organismic). How does one project the result of a collision that occurred in an inaccessible dimensionality into a space accessible to human perception?

5.2. The Detector as a Chain of Projecting Operators

The LHC detector systems (ATLAS, CMS) [11, 12, 13] solve this problem through cascaded projection — a sequence of operators that translate the configuration from deep subquark dimensionality to a level accessible to the human observer:

$$\widehat{O}_{\text{detector}} = \widehat{O}_{\text{display}} \circ \widehat{O}_{\text{reconstruction}} \circ \widehat{O}_{\text{electronics}} \circ \widehat{O}_{\text{calorimeter}} \circ \widehat{O}_{\text{tracker}} \tag{V.1}$$

Tracker. Silicon pixel detectors convert the trajectory of a charged particle (dimensionality ~ -1) into electrical pulses (dimensionality ~ 0).

Calorimeter. Scintillation layers absorb electrons and photons, converting their energy into streams of visible photons that are registered by photomultipliers, producing an electrical signal.

Electronics (trigger). A fast electronics system filters the event stream ($\sim 10^9$ per second) down to an acceptable level ($\sim 10^3$ per second), selecting events with a specific decay topology ($B_{\text{of interest}} > 0$).

Reconstruction. Software algorithms [7] reconstruct the four-momentum and invariant masses from the set of detector signals.

Display. Visualization on screen, in histograms and plots — projection of the result to the level $d \approx +3$, accessible to the human operator.

5.3. The Trigger as an Archetype Filter

The LHC trigger system [11] is one of the most expensive and complex "filters" in experimental physics. Out of approximately 10^9 proton collisions per second, it selects roughly 10^3 based on predetermined criteria (event shape, particle energies, track multiplicity). In ODTOE terms, the trigger is a hardware implementation of the physicist's attention focus archetype A. The trigger determines which configurations will be preserved for analysis and which will be discarded.

This is a direct demonstration of the central axiom (A): the result of an experiment depends on the properties of the observation operator. Changing the trigger conditions $\equiv$ changing the focus $A \equiv$ actualizing different configurations. For example, the Higgs boson would not have been discovered if the trigger had not been tuned to its characteristic decay channels ($H \to \gamma\gamma$, $H \to ZZ^* \to 4\ell$).

VI. THE COLLIDER PARADOX: DISCOVERY OR CONSTITUTION?

6.1. The Standard View

In the classical interpretation: the Higgs boson exists as an element of the Standard Model of nature; the accelerator discovers it at sufficient collision energy [3]. The theoretical prediction of its mass ($m_H \approx 125$ GeV) matched the experiment [12, 13] — therefore, it was there.

6.2. The ODTOE Interpretation

According to axiom (A) [1, 8]: the configuration $R = \widehat{O}(\Psi)$ is actualized by the observation operator. The Higgs boson in this sense is not a pre-existing physical object but a fixed point Ψ^*_H in the space of potential states $\mathcal{H}$, accessible to an operator with parameters $d \leq -3$ and $\sqrt{s} \geq 125$ GeV.

The theoretical "prediction" of its mass is the calculation of the position of this fixed point in the landscape $U(C)$ based on the Standard Model equations. The Standard Model describes the structure of the potential landscape [3, 4]. From this landscape it follows: under certain conditions (collision energy, trigger conditions, operator dimensionality) the operator is compelled to actualize a configuration with a mass of approximately 125 GeV. But "compelled to actualize" is not the same as "discover something pre-existing."

6.3. Analogy with a Mathematical Proof

A mathematician proves a theorem. Before the proof, the theorem existed in the space of potential logical structures $\mathcal{H}$, but had not been actualized in the consciousness of the mathematician and of humanity. Would it be correct to say that the Pythagorean theorem was "discovered"? No — it was *constituted* by the act of proof, after which it became a fixed point with $T \to \infty$ in cultural space [2, 9].

Analogously: the Higgs boson existed in $\mathcal{H}$ as a potential fixed point of the mathematical structure describing particles and their interactions. The LHC actualized it in real configuration space $\mathcal{C}$. The question "did the Higgs exist before the LHC?" is meaningless in ODTOE: before the act of observation the configuration is potential ($\in \mathcal{H}$), after the act it is actual ($\in \mathcal{C}$).

6.4. Distinguishability of Interpretations

The Standard Model and ODTOE yield identical numerical predictions (masses, cross sections, decay widths) because both describe the same mathematical landscape $U(C)$. The difference is interpretive, not numerical. However, at the boundaries of the formalism (Section VIII) the differences become observable.

VII. ∞-RECURSION AND THE SUBSTRUCTURE OF MATTER

7.1. The Principle of Unlimited Nesting

According to the principle of recursive self-similarity [1]: every proton contains an internal architecture of three quarks, each quark contains its own, and so on ad infinitum. There is no "elementary" particle without substructure; each dimensionality level reveals the next. The accelerator, by increasing $\sqrt{s}$, penetrates deeper into this ∞-recursion:

$$\sqrt{s}_1 \to \text{nucleons} \xrightarrow{\sqrt{s}_2} \text{quarks/gluons} \xrightarrow{\sqrt{s}_3} \;?\; \to \cdots \tag{VII.1}$$

At each level the same architecture is reproduced: observer, observed, operator [1, Section III].

7.2. The Resolution Limit

Does a "bottom" of the recursion exist? According to ODTOE — no. Infinite recursion has no final level; this is a structural consequence of self-reference [2]. Every new accelerator with higher $\sqrt{s}$ will open the next nesting level [10] — and at each level, threefold architecture will be found.

ODTOE prediction: an elementary (substructureless) particle will never be discovered. Any particle, at sufficient collision energy, will reveal internal architecture. This fundamentally diverges from the concept of point particles in the Standard Model.

7.3. The Planck Scale as the Limit of Operator Dimensionality

The limit $\sqrt{s} \to E_{\text{Planck}} \approx 1.2 \times 10^{19}$ GeV is the limit where the observation operator $\widehat{O}$ itself becomes indistinguishable from the observed R. At this scale, the distinction between observer and observed vanishes; the loop closes completely: $\Phi(\Psi^*) = \Psi^*$ [15]. This is not the "end of physics" but a transition from observing external configurations to pure self-affine reflection.

VIII. TESTABLE PREDICTIONS OF ODTOE

8.1. Cross Section Dependence on Experimental Group Coherence

ODTOE predicts: at fixed energy, collider luminosity, and trigger conditions, the production cross section may weakly depend on the coherence of the experimental group S_{group}. According to relation P4 [1]: $P(E|B) = B^k$. For a macroscopic collective (of the order of 10^3 physicists) the effect is small ($\Delta\sigma/\sigma \sim 10^{-6}$), but fundamentally nonzero.

Verification protocol: compare the reproducibility of measurements between independent experimental groups with controlled differences in methodology. The Standard Model predicts complete agreement; ODTOE allows microscopic differences.

8.2. New Resonances at the FCC

The Future Circular Collider ($\sqrt{s} \sim 100$ TeV) will extend the accessible dimensionality to $d \sim -4$. ODTOE predicts: new resonances will be discovered, forming threefold architecture at the subquark level. The Standard Model (in the absence of new physics mechanisms) predicts the absence of resonances beyond the known spectrum.

8.3. Resonance Width and Coherence

The decay width Γ is related to the lifetime $T(C)$ through the uncertainty relation: $\Gamma \cdot T \sim \hbar$. According to relation P3 (IV.1): $T = T_0/(1-S)^n$, whence:

$$\Gamma = \frac{\hbar(1-S)^n}{T_0} \tag{VIII.1}$$

ODTOE predicts: the widths of resonances at the next level of ∞-recursion ($d \sim -4$) will be noticeably larger than at the current level ($d \sim -3$), for equal invariant masses, since the internal coherence S at deeper levels is lower. This can be tested at the FCC.

8.4. Baryon Asymmetry as a Spiral Gap

According to the results of Section V from [1]: baryon asymmetry (the predominance of matter over antimatter) is explained by the helicity of operator dynamics related to the deviation of π from 3. The spiral gap $\delta_\Psi > 0$ creates a predominance of the "forward" direction of operator action (electron) over the "reverse" direction (positron):

$$\frac{n_B - n_{\bar{B}}}{n_B + n_{\bar{B}}} \sim \frac{\pi - 3}{\pi} \approx 0.045 \tag{VIII.2}$$

The experimental value is of order 6×10^{-10} [5]. The discrepancy of 8 orders of magnitude indicates that (VIII.2) gives an upper estimate; an additional suppression mechanism is required. However, the direction of the asymmetry (matter $>$ antimatter) is predicted correctly.

IX. CORRESPONDENCE BETWEEN THE STANDARD MODEL AND ODTOE

9.1. Translation Dictionary

Standard Model	ODTOE	Meaning of correspondence
Vacuum	$\mathcal{H}$ (space of potential states)	Not emptiness, but fullness of possibilities
Particle	Ψ^* (fixed point)	Stable or metastable
Mass	Depth of minimum in $U(C)$	Related to inertia $I(C)$
Charge	Sign of operator action $\widehat{O}$	$+$ = forward, $-$ = reverse [1]
Spin	Topology of operator cycle	Hypothesis [1]
Scattering cross section	$P(E\|B)\cdot$ geometric factor	Depends on focus archetype
Particle decay	$\Psi^*_{\text{meta}} \to \Psi^*_{\text{stab}}$	Metastable $\to$ stable
Quark confinement	D-Prot at $d \leq -2$	Structural inseparability
Higgs mechanism	Structure of landscape $U(C)$	Geometry of the potential

9.2. Confinement as Structural Inseparability

Why are quarks not observed in isolation? Standard Model: asymptotic freedom with confinement [14, 15] (growing coupling at large distances). ODTOE: the quark is a component of the threefold architecture of observation at the level $d = -2$. The minimal act of observation requires all three components: observer, observed, operator. An isolated quark = violation of this architecture = destruction of the act of observation itself. Confinement is not a dynamical effect but a structural necessity [1, Section III].

X. DISCUSSION AND METHODOLOGICAL REMARKS

10.1. Explanatory Power

ODTOE provides a unified interpretation for five key phenomena: collision energy (gradient of U), production threshold (barrier height), particle lifetime (coherence formula P3), detection (dimensionality cascade), confinement (D-Prot). All of these are manifestations of a single unified formalism of observer-dependence.

10.2. Limitations and Postulates

(a) ODTOE does not predict the numerical values of masses and cross sections; it interprets and explains the structure already described by the Standard Model.

(b) The relation $d(\widehat{O}) \leftrightarrow \sqrt{s}$ (formula II.2) is postulated, not derived from first principles.

(c) The hypothesis of spin as cycle topology (Section 9.1) is speculative.

(d) The substructure prediction (Section 8.2) is falsifiable but requires FCC-level experiments.

10.3. Paradigm Status

ODTOE is not a competing theory that displaces the Standard Model. It is a reinterpretive paradigm that translates the questions of physics into the language of observer-dependence [8, 10]. Both systems describe the same landscape; the difference lies in the understanding of the ontological status of configurations.

XI. CONCLUSION

The particle accelerator within the ODTOE framework is not a microscope peering at ready-made matter but a forced reconfiguration operator: a technological extension of the observer's dimensionality by $\Delta d(\sqrt{s})$, creating a potential gradient $|\nabla U|$ sufficient to overcome configurational barriers.

Elementary particles are not fundamental objects of nature but fixed points of the self-observation mapping, differing in stability: the proton (stable attractor, $T \to \infty$) vs. the Higgs boson (fleeting resonance, $T \sim 10^{-22}$ s). The mass hierarchy reflects the hierarchy of potential barriers in the configuration landscape.

The detector is a reverse cascade of operators projecting the result of actualization from subquark dimensionality ($d \leq -3$) into the region accessible to human perception ($d \approx +3$). The trigger is a hardware implementation of the physicist's attention focus archetype, determining which configurations will be preserved.

The ∞-recursion principle predicts: every new accelerator with higher energy will open a new dimensionality level and discover threefold observation architecture on it. There is no "bottom"; the strange loop [2] reproduces itself at all scales down to the Planck limit.

The fundamental paradox: does the accelerator generate new configurations or actualize potentially pre-existing ones? ODTOE resolves it: both statements are true in different senses. Configurations potentially exist in the space of mathematical structures $\mathcal{H}$ [9]; the accelerator actualizes them in real configuration space $\mathcal{C}$.

CONFLICT OF INTEREST

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