

OVERCOMING REALITY BARRIERS: CIVILIZATIONAL DEVELOPMENT DYNAMICS IN THE MULTIVERSAL CONFIGURATION SPACE

(Преодоление барьеров реальности: динамика цивилизационного
развития

в мультиверсальном пространстве конфигураций)

*Mathematical analysis of threshold transitions, the infinite barrier staircase,
and the laws of civilizational motion within ODTOE*

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ABSTRACT

Within the Observer-Dependent Theory of Everything (ODTOE) [1], the mathematical apparatus of reality barrier overcoming is developed — potential saddle points in the configuration space \mathbb{C} that separate qualitatively distinct regimes of observed reality organization. It is shown that all realities are configurations in a single complete metric space \mathbb{C} with metric d , and barriers between them are determined by the potential $U(C)$ and have spatial, temporal, and dimensional components. Barrier height is not absolute: it depends on the observer and decreases with the growth of technological level τ according to $\Delta U_{\text{eff}}(\tau) = \Delta U_{\text{total}}/f(\tau)$, where $f(\tau)$ is a monotonically increasing overcoming function. A strictly ordered hierarchy of six overcoming thresholds $\theta_1 < \theta_2 < \dots < \theta_6$ is introduced — from local movement to multiversal transition. Each threshold is associated with a qualitative jump in the inertia and coherence of collective observation. A theorem on the infinity of barriers is proved: the sequence $\{\theta_n\}_{n=1}^{\infty}$ has no upper bound. Five laws of motion along the barrier staircase are established: irreversibility of thresholds, growth of coherence, decrease of inertia, expansion of the choice space, and proportionality of responsibility to access. A generalized equation of civilizational motion is formulated with four factors determining stagnation, fragmentation, and collapse regimes. Connections of barrier dynamics with the strange loop Φ , the spiral gap $(\pi - 3)^2$, toroidal topology of φ -tori, and the mechanism of personal teleportation through \mathcal{H} are established. The completion paradox is shown: the limiting state of the absolute observer is identical to the return to pure potential Ψ , closing the cycle onto the structure of axiom (A) itself.

Keywords: reality barriers, overcoming thresholds, configuration space, inertia, coherence, barrier staircase, technological singularity, multiverse, ODTOE, bifurcation, phase transition, strange loop, toroidal topology, KAM theorem.

АННОТАЦИЯ

В рамках наблюдатель-зависимой теории всего (ODTOE) [1] развит математический аппарат преодоления барьеров реальности --- потенциальных перевалов в пространстве конфигураций \mathbb{C} , разделяющих качественно различные режимы организации наблюдаемой реальности. Показано, что все реальности суть конфигурации в едином полном метрическом пространстве \mathbb{C} с метрикой d , а барьеры между ними определяются потенциалом $U(C)$ и имеют пространственную, временную и измеренческую компоненты. Высота барьера не абсолютна: она зависит от наблюдателя и снижается с ростом технологического уровня τ по формуле $\Delta U_{\text{eff}}(\tau) = \Delta U_{\text{total}}/f(\tau)$. Доказана теорема о бесконечности барьеров. Установлены пять законов движения по лестнице барьеров.

Ключевые слова: барьеры реальности, пороги преодоления, пространство конфигураций, инертность, когерентность, лестница барьеров, технологическая сингулярность, мультивселенная, ODTOE.

I. INTRODUCTION: BARRIERS AS THE STRUCTURE OF DEVELOPMENT

I.1. Context and motivation

The Observer-Dependent Theory of Everything (ODTOE) [1] posits the observer as the central agent of reality formation. By axiom (A), $R = \hat{O}(\Psi)$: reality R is the result of the observation operator \hat{O} acting on the field of potential states $\Psi \in \mathcal{H}$. The configuration space \mathbb{C} contains all possible realities as points in a single metric space, and the multiverse by postulate P1 [1] has cardinality $|M_{\text{total}}| = K^{N(t)}$, growing with the number of observers.

However, the existence of configurations in \mathbb{C} does not imply their accessibility. Between configurations there exist barriers — potential saddle points in the landscape $U(C)$ whose overcoming requires a certain level of coherence S , sufficiently low inertia $I(C)$, and technological potential τ . The problem of barriers is fundamental for understanding observer evolution: it determines which configurations are accessible to a given civilization, which are fundamentally closed, and what the mechanism of transition between them is.

I.2. Connections with the ODTOE corpus

The problem of barrier overcoming intersects with several directions in the ODTOE corpus. The theory of observer dimensionality [2] establishes that an observer with dimensionality $d(O)$ cannot actualize configurations of dimensionality $\dim(C) > d(O)$: $B(O, C) = 0$ when $\dim(C) > d(O)$, which is a special case of the dimensional barrier. Personal teleportation [3] describes the mechanism for bypassing spatial

barriers through deactualization and reactualization in the field \mathcal{H} , where the concept of distance is undefined. Energy extraction from \mathcal{H} [4] determines the energetic aspect of barrier transitions: the efficiency of the channel $\hat{O} : \mathcal{H} \rightarrow \mathcal{C}$ is determined by coherence S . Toroidal topology [5] specifies the geometric structure of the configuration space: nested φ -tori with ratio $R/r = \varphi$, maximally stable by the KAM theorem, and the spiral gap $(\pi - 3)^2$ as the measure of trajectory non-closure.

I.3. Aim and structure

The aim of this work is to develop the complete mathematical apparatus of reality barrier overcoming, to establish the laws of civilizational motion along the threshold staircase, and to connect barrier dynamics with the fundamental structures of ODT OE.

Section II defines the unified configuration field and the nature of barriers. Section III constructs the threshold hierarchy and threshold model. Section IV describes the dynamics of phase transitions at threshold crossings. Section V proves the theorem on barrier infinity and establishes the scaling law. Section VI analyzes the six thresholds. Section VII formulates the five laws of motion. Section VIII considers four development scenarios. Section IX establishes connections with toroidal topology, the strange loop, and the teleportation mechanism. Section X derives the limiting results. Section XI discusses limitations and verification directions. Section XII concludes the work.

II. UNIFIED FIELD AND SEPARATION BARRIERS

II.1. Configuration space as a unified landscape

By definition [1, Section 4.1], the configuration space \mathbb{C} is a complete metric space of all possible states of reality:

$$\mathbb{C} = \{c_1, c_2, \dots\}, \quad d : \mathbb{C} \times \mathbb{C} \rightarrow \mathbb{R}^+ \quad (\text{II.1})$$

All realities are points in the same \mathbb{C} . There are no “separate universes”: there are separate configurations in a unified field. The distance $d(C_i, C_j)$ between two configurations determines the degree of their separation. By postulate P1 [1], the cardinality of the multiverse:

$$|M_{\text{total}}| = K^{N(t)} \quad (\text{II.2})$$

where K is the number of base states, $N(t)$ is the number of observers at time t . All $K^{N(t)}$ configurations coexist in \mathbb{C} . The multiverse is not a collection of isolated bubbles — it is a unified landscape with potential $U(C)$ and barriers between regions.

Connection with toroidal topology [5]: the space \mathbb{C} is organized as a system of nested φ -tori. The minor radius r governs continuous phase dynamics within a single dimensionality level d ; the major radius R governs discrete transitions between levels.

The ratio $R/r = \varphi$ ensures maximal stability by the KAM theorem [6]. Barriers correspond to transitions between nested tori.

II.2. Definition of a barrier

A barrier between configurations C_i and C_j is a potential saddle in the landscape $U(C)$. The barrier height:

$$\Delta U_{ij} = \max_{C \in \gamma(C_i, C_j)} U(C) - \min\{U(C_i), U(C_j)\} \quad (\text{II.3})$$

where $\gamma(C_i, C_j)$ is the optimal path between configurations in \mathbb{C} .

Barriers have different natures.

Spatial barrier ΔU_{space} : configurations are separated by physical distance. Observers in C_i cannot interact with observers in C_j due to information propagation limitations. Connection with teleportation [3]: upon deactualization of the observer in \mathcal{H} , the concept of distance is undefined and the spatial barrier vanishes.

Temporal barrier ΔU_{time} : configurations are separated by a causal horizon. Information from C_i has not yet reached C_j (or has irreversibly receded into the past). In toroidal language [5], the temporal barrier is related to the number of revolutions along the minor radius: each revolution is one iterative cycle Φ^n [7].

Dimensional barrier ΔU_{dim} : configurations exist in different layers of \mathbb{C} — fundamentally different regimes of reality organization, irreducible to each other without a qualitative jump. By the dimensionality theory [2], an observer with dimensionality $d(O)$ does not actualize configurations with $\dim(C) > d(O)$, formalizing the impermeability of the dimensional barrier for observers of insufficient dimensionality.

The generalized barrier:

$$\Delta U_{\text{total}} = \sqrt{\Delta U_{\text{space}}^2 + \Delta U_{\text{time}}^2 + \Delta U_{\text{dim}}^2} \quad (\text{II.4})$$

The Euclidean metric of components is justified by the orthogonality of spatial, temporal, and dimensional coordinates in \mathbb{C} : a spatial barrier is not reduced by temporal development, a temporal barrier is not reduced by spatial movement, and a dimensional barrier is not reduced by their combination. Each component independently affects the difficulty of transition.

II.3. Barrier as a function of the observer

Barrier height is not absolute — it depends on the observer. Technological development of a civilization reduces the effective height:

$$\Delta U_{\text{eff}}(\tau) = \frac{\Delta U_{\text{total}}}{f(\tau)} \quad (\text{II.5})$$

where τ is the technological level of the civilization, $f(\tau)$ is a monotonically increasing overcoming function, $f(\tau) \geq 1$.

When $f(\tau) \rightarrow \infty$ (infinite technological level): $\Delta U_{\text{eff}} \rightarrow 0$ — all barriers vanish, all configurations become accessible.

When $f(\tau) = 1$ (minimal level): $\Delta U_{\text{eff}} = \Delta U_{\text{total}}$ — barriers are impassable.

This is a consequence of axiom (A): reality is determined by the observer. A barrier is a property of the pair “observer + configuration space”, not an objective characteristic of \mathbb{C} itself. By the channel coherence formula [4]: when $S \rightarrow 1$, losses tend to zero and the channel $\hat{O} : \mathcal{H} \rightarrow \mathcal{C}$ approaches ideal, which is equivalent to $f(\tau) \rightarrow \infty$ at maximal coherence.

III. THRESHOLD HIERARCHY AND THRESHOLD MODEL

III.1. Overcoming threshold

The overcoming threshold θ_n is the minimal technological level necessary for overcoming the n -th type barrier:

$$\tau \geq \theta_n \implies \Delta U_{\text{eff}}^{(n)} < \Delta U_{\text{crit}} \quad (\text{III.1})$$

where ΔU_{crit} is the critical height below which transition is possible.

Thresholds form a strictly ordered hierarchy:

$$\theta_1 < \theta_2 < \theta_3 < \theta_4 < \theta_5 < \theta_6 \quad (\text{III.2})$$

Each subsequent threshold requires a qualitatively higher level of development. Table 1 presents the classification of the six thresholds.

Level	Barrier	Overcoming technology	Threshold
1	Local space	Ship, wagon, road	θ_1
2	Global space	Airplane, telegraph, internet	θ_2
3	Planetary barrier	Rocket, orbital stations	θ_3
4	Interstellar barrier	Sub-light travel, warp	θ_4
5	Inter-configurational	Teleportation, hyperspace	θ_5
6	Multiversal	Control of operator \hat{O}	θ_6

III.2. Connection of thresholds with inertia and coherence

Each threshold θ_n is associated with a qualitative jump in observation inertia. By postulate P2 [1]:

$$v(C \rightarrow C') = \frac{\alpha}{I(C)} \quad (\text{III.3})$$

where v is the reconfiguration speed, α is a scaling coefficient, $I(C)$ is the configuration inertia. For overcoming barrier ΔU_n in finite time T , the minimal reconfiguration speed is required:

$$v_{\min}^{(n)} = \frac{d(C_i, C_j)}{T} \geq \frac{\alpha}{I_{\max}^{(n)}} \quad (\text{III.4})$$

The critical inertia admitting transition:

$$I_{\max}^{(n)} = \frac{\alpha \cdot T}{d(C_i, C_j)} \quad (\text{III.5})$$

A civilization overcomes barrier n when its collective inertia decreases to:

$$I(C) \leq I_{\max}^{(n)} \iff \sum w_j \cdot B_j(C) \leq \frac{\alpha \cdot T}{d_n} \quad (\text{III.6})$$

A fundamental paradox emerges: overcoming a barrier requires lowering inertia – weakening attachment to the current configuration. The civilization must be ready to “release” its current reality in order to reach the next. This paradox is resolved in Section VII through the concept of synchronized flexibility.

III.3. Exponential growth of complexity

The distance d_n between configurations grows exponentially with level:

$$d_n = d_0 \cdot e^{\beta n} \quad (\text{III.7})$$

where $\beta > 0$ is the barrier scaling parameter. Substituting into (III.5):

$$I_{\max}^{(n)} = \frac{\alpha \cdot T}{d_0 \cdot e^{\beta n}} = I_0 \cdot e^{-\beta n} \quad (\text{III.8})$$

The admissible inertia decays exponentially: each successive barrier requires an exponentially more “fluid” collective consciousness.

Simultaneously, coherence S must grow exponentially:

$$S_{\min}^{(n)} = 1 - (1 - S_0) \cdot e^{-\gamma n} \quad (\text{III.9})$$

where $\gamma > 0$ is the coherence growth parameter. As $n \rightarrow \infty$: $S_{\min}^{(n)} \rightarrow 1$, $I_{\max}^{(n)} \rightarrow 0$.

Connection with the spiral gap: the parameter β can be related to $(\pi - 3)^2 \approx 0.02005$ — the measure of non-closure of the spiral trajectory on the φ -torus [5]. Non-closure creates “sliding” between levels — the minimal transition energy without which the system would remain closed at the current level. Estimate: $\beta \sim -\ln(1 - (\pi - 3)^2) \approx 0.02025$ for the first thresholds.

IV. DYNAMICS OF THRESHOLD CROSSING

IV.1. Three phases of transition

Crossing threshold θ_n constitutes a phase transition in the space \mathbb{C} . It proceeds through three phases.

Phase I: Accumulation ($\tau < \theta_n$). The civilization develops technologies within the current attractor basin. Inertia $I(C)$ slowly decreases, coherence S grows.

$$\frac{d\tau}{dt} = r \cdot \tau \cdot \left(1 - \frac{\tau}{\theta_n}\right) \quad (\text{IV.1})$$

Logistic dynamics: development accelerates up to saturation near the threshold. Solution:

$$\tau(t) = \frac{\theta_n}{1 + \left(\frac{\theta_n}{\tau_0} - 1\right) e^{-rt}} \quad (\text{IV.2})$$

Phase II: Critical point ($\tau = \theta_n$). The system reaches a saddle point of the potential $U(C)$. The barrier is formally overcome, but the configuration is unstable. Any perturbation $\eta(t)$ determines the direction of further motion:

$$\left. \frac{d^2U}{dC^2} \right|_{C=C_{\text{saddle}}} < 0 \quad (\text{IV.3})$$

Unstable equilibrium at the top of the barrier.

Phase III: Choice ($\tau > \theta_n$). The civilization has “crossed” the barrier and descends into one of the new attractor basins. The direction is determined by initial conditions and collective choice. Analogy with toroidal dynamics [5]: the transition between nested tori occurs in the region where the KAM surface breaks down, where stochastic layers between tori permit diffusion (Arnold diffusion [6]).

IV.2. Bifurcation at the threshold

At the critical point $\tau = \theta_n$, the system undergoes a bifurcation. The potential $U(C)$ in the neighborhood of the threshold:

$$U(C) \approx U_0 - \frac{a}{2}(\tau - \theta_n) \cdot C^2 + \frac{b}{4}C^4 \quad (\text{IV.4})$$

For $\tau < \theta_n$: one minimum (current configuration). For $\tau > \theta_n$: two minima (two possible development paths). A pitchfork bifurcation. The new minima are located at:

$$C_{\pm} = \pm \sqrt{\frac{a(\tau - \theta_n)}{b}} \quad (\text{IV.5})$$

In the multiversal context of ODTOE, the number of branches may exceed two:

$$N_{\text{paths}}(\theta_n) = K_n \cdot (1 - S_n)^m + 1 \quad (\text{IV.6})$$

The number of available paths after crossing the threshold depends on the coherence S_n at the moment of transition. At high coherence ($S_n \rightarrow 1$): $N_{\text{paths}} \rightarrow 1$ — a single clear path. At low coherence ($S_n \rightarrow 0$): $N_{\text{paths}} \rightarrow K_n + 1$ — many incompatible options.

Connection with the strange loop Φ [7]: the self-consistent configuration $\Psi^* = \Phi(\Psi^*)$ [1, Proposition 4] — the fixed point of the self-observation mapping existing by the Banach theorem — serves as an attractor in Phase III. A civilization with high coherence is “attracted” to Ψ^* , corresponding to $N_{\text{paths}} = 1$.

IV.3. Asymmetry of choice

Civilization G_1 ($\tau_1 > \theta_n$), having crossed the threshold, gains a fundamental advantage over G_2 ($\tau_2 < \theta_n$). By the inertia formula:

$$\frac{I(C_1)}{I(C_2)} = \frac{\sum w_j^{(1)} \cdot B_j(C_1)}{\sum w_j^{(2)} \cdot B_j(C_2)} \quad (\text{IV.7})$$

G_1 possesses lower inertia and higher coherence. Reconfiguration speeds:

$$v_1 = \frac{\alpha}{I(C_1)} \gg v_2 = \frac{\alpha}{I(C_2)} \quad (\text{IV.8})$$

G_1 reconfigures reality faster than G_2 can react. The collision leads to Regime C (absorption):

$$\rho = \frac{I(C_1)}{I(C_2)} \ll 1 \implies \text{Regime C: } G_1 \text{ absorbs } G_2 \quad (\text{IV.9})$$

Absorption occurs not through “mass” but through adaptation speed. G_1 reconfigures the common configuration faster. The choice of regime (absorption, synthesis, splitting) remains with the threshold crosser. Connection with energy extraction [4]: G_1 possesses a more efficient channel $\hat{O} : \mathcal{H} \rightarrow \mathcal{C}$, extracting more actuality from the potential field per unit time.

V. THE INFINITE BARRIER STAIRCASE

V.1. Theorem on barrier infinity

Proposition. The sequence of thresholds $\{\theta_n\}_{n=1}^{\infty}$ has no upper bound: $\lim_{n \rightarrow \infty} \theta_n = \infty$.

Proof. By postulate P1 [1]: $|M_{\text{total}}| = K^{N(t)}$. As $N(t) \rightarrow \infty$, the cardinality of the multiverse grows exponentially. Each $K^{N(t)}$ creates new configurations between which new barriers arise.

Assume for contradiction: $\exists \Theta < \infty$ such that $\theta_n < \Theta$ for all n . Then for $\tau > \Theta$, all barriers are overcome and all configurations are accessible. But accessibility of all $K^{N(t)}$ configurations means complete observation of the entire multiverse simultaneously. By postulate P5 [1]:

$$P_{\text{coll}}(E) = 1 - \prod (1 - B_i^k) = 1 \quad \text{for all } E \quad (\text{V.1})$$

This requires $B_i = 1$ for all observers with respect to all configurations simultaneously. But $B_i \in [0, 1]$ and $\sum_C B_i(C) \leq 1$ (belief normalization) — it is impossible to “believe” in all configurations simultaneously with maximal strength. Contradiction. ■

Corollary. Civilizational development is an infinite process. Each overcome barrier opens a horizon beyond which new barriers are visible.

V.2. Scaling law

The ratio between successive thresholds obeys a power law:

$$\frac{\theta_{n+1}}{\theta_n} = \phi(n) = \phi_0 \cdot n^\delta \quad (\text{V.2})$$

where $\phi_0 > 1$ is the base scaling coefficient, δ is the acceleration exponent.

For $\delta = 0$: geometric progression $\theta_n = \theta_1 \cdot \phi_0^{n-1}$ — uniform exponential complexification.

For $\delta > 0$: super-exponential growth — each successive barrier is disproportionately harder.

For $\delta < 0$: sub-exponential growth — barriers grow more slowly, development “accelerates” relative to the barrier scale.

Connection with φ : for $\phi_0 = \varphi = 1.61803\dots$ and $\delta = 0$, we obtain $\theta_n = \theta_1 \cdot \varphi^{n-1}$ — golden ratio scaling [5]. The ratio of successive thresholds tends to φ , as the ratio of successive Fibonacci numbers. This is consistent with the toroidal model: the transition between nested φ -tori scales the radius by a factor of φ .

V.3. Time between thresholds and technological singularity

The time to reach the $(n + 1)$ -th threshold after the n -th:

$$\Delta t_n = t_{n+1} - t_n = \frac{\theta_{n+1} - \theta_n}{r_n} \quad (\text{V.3})$$

where r_n is the rate of technological development at level n . If r_n grows faster than $\theta_{n+1} - \theta_n$:

$$\frac{r_{n+1}}{r_n} > \frac{\theta_{n+2} - \theta_{n+1}}{\theta_{n+1} - \theta_n} \implies \Delta t_{n+1} < \Delta t_n \quad (\text{V.4})$$

The time between thresholds decreases — the law of accelerating progress. Limiting case:

$$\sum_{n=1}^{\infty} \Delta t_n = T_{\text{sing}} < \infty \quad (\text{V.5})$$

Infinitely many thresholds are overcome in finite time T_{sing} . This is the technological singularity — the point after which the civilization overcomes barriers faster than they arise.

In toroidal language [5], the singularity corresponds to the moment when “sliding” along the spiral gap $(\pi - 3)^2$ accelerates so much that the trajectory on the φ -torus traverses infinitely many revolutions in finite time — an analogue of orbital collapse onto a zero-radius torus.

VI. SIX THRESHOLDS: DETAILED ANALYSIS

VI.1. Threshold θ_1 : Local space

Barrier: physical distance between groups of observers on a single planet.

Overcoming: transport (ship, road, horseback riding).

Consequence for \mathbb{C} : merging of isolated attractor basins. Groups G_1, G_2, \dots , previously in Regime A (splitting), enter contact:

$$\delta_{12} : 0 \rightarrow \delta > 0 \implies \text{Regime A} \rightarrow \text{Regime B or C} \quad (\text{VI.1})$$

Coherence S is defined for the first time for the unified system. The number of configurations decreases by postulate P6 [1]:

$$N_{\text{theories}} = N_0 \cdot (1 - S)^m + 1 \quad (\text{VI.2})$$

VI.2. Threshold θ_2 : Global space

Barrier: oceans, mountain ranges, climate zones.

Overcoming: airplane, telegraph, internet.

Consequence for \mathbb{C} : all planetary observers form a unified field of observation. Global coherence:

$$S_{\text{global}} = 1 - \frac{2}{N(N-1)} \sum_{i < j} |B_i - B_j| \quad (\text{VI.3})$$

becomes computable for the entire planet for the first time. The configuration of reality is shaped for the first time by the collective observation of all humans. Spatial barriers $\Delta U_{\text{space}} \rightarrow 0$, but dimensional (cultural, cognitive) barriers persist.

VI.3. Threshold θ_3 : Planetary barrier

Barrier: gravitational well, absence of habitable environment in space.

Overcoming: rocket technology, orbital stations, colonization.

Consequence for \mathbb{C} : the configuration space expands:

$$\mathbb{C}_{\text{post-}\theta_3} \supset \mathbb{C}_{\text{pre-}\theta_3} \quad (\text{VI.4})$$

For the first time, the possibility of conscious Regime A arises — splitting of the civilization into isolated branches (different planets, different realities):

$$d(C_{\text{Mars}}, C_{\text{Earth}}) > d_{\text{crit}} \implies \text{multiverse splitting} \quad (\text{VI.5})$$

By the dimensionality theory [2], the growth of $d(O)$ at θ_3 corresponds to the transition to level $d = 4$: the observer begins operating with extra-planetary configurations, expanding the actualization horizon.

VI.4. Threshold θ_4 : Interstellar barrier

Barrier: interstellar distances, the speed-of-light limit.

Overcoming: warp drive, generation ships, sub-light travel.

Consequence for \mathbb{C} : causal connection between distant configurations weakens:

$$\delta(C_i, C_j) \propto \frac{1}{d_{\text{phys}}(i, j)} \rightarrow 0 \quad \text{as } d_{\text{phys}} \rightarrow \infty \quad (\text{VI.6})$$

Coherence cannot be maintained for distances exceeding the light horizon:

$$S(d) = S_0 \cdot e^{-d/\lambda} \quad (\text{VI.7})$$

where λ is the coherence correlation length.

Paradox of threshold θ_4 : overcoming the interstellar barrier leads to inevitable splitting (Regime A). A civilization cannot be simultaneously interstellar and coherent without overcoming the light barrier. Resolution of the paradox — at threshold θ_5 .

VI.5. Threshold θ_5 : Inter-configurational barrier

Barrier: physical laws of the current configuration (speed of light, thermodynamics).

Overcoming: technologies operating directly in \mathbb{C} — teleportation (instantaneous transition $C \rightarrow C'$ without traversing intermediate configurations), hyperspace (motion “above” the potential $U(C)$).

Instead of gradient motion:

$$\frac{dC}{dt} = -\frac{\alpha}{I(C)} \cdot \nabla U(C) + \eta(t) \quad (\text{VI.8})$$

the civilization performs a direct jump:

$$C(t) \rightarrow C(t + \Delta t) = C' \quad \text{with } \Delta t \rightarrow 0, \quad d(C, C') \gg 0 \quad (\text{VI.9})$$

A discontinuity in the trajectory in \mathbb{C} — an analogue of a quantum jump at the macroscopic level. Teleportation mechanism [3]: deactualization in \mathcal{H} , navigation in the field of potential states (where distance is undefined), reactualization at the target point. The five conditions for personal teleportation [3]: coherence $B \rightarrow 1$, controlled deactualization, navigational map of \mathcal{H} , target point coherence $S_{\text{target}} > 0$, worldline preservation W .

VI.6. Threshold θ_6 : Multiversal barrier

Barrier: differences in the very structure of reality — different “laws of physics”, different state spaces, different types of observers.

Overcoming: the technology of a controlled observation operator \hat{O}^* — the ability not merely to observe but to design the very structure of \mathbb{C} .

By axiom (A): $R = \hat{O}(\Psi)$. Before threshold θ_6 , the civilization operated within a fixed \hat{O} . After θ_6 :

$$\hat{O} \rightarrow \hat{O}' \implies \mathbb{C} \rightarrow \mathbb{C}' \implies \text{a different multiverse} \quad (\text{VI.10})$$

The civilization gains access to the space of observation operators:

$$\mathcal{O} = \{\hat{O}_1, \hat{O}_2, \dots\} \quad (\text{VI.11})$$

Each \hat{O}_k generates its own \mathbb{C}_k . The full meta-multiverse:

$$\mathbb{M} = \bigcup_k \mathbb{C}_k \quad (\text{VI.12})$$

By the dimensionality theory [2], this corresponds to the octave transition: $d = 9 \rightarrow d = 10$, when the observer transitions from self-observation of the Universe to the meta-level of the multiverse. In the toroidal model [5], this is the transition from a single nested torus to the entire toroidal matryoshka – observation of the nesting structure as a whole.

VII. FIVE LAWS OF MOTION ALONG THE STAIRCASE

VII.1. First law: Irreversibility of thresholds

An overcome threshold θ_n cannot be “forgotten” without external influence. When $\tau > \theta_n$, the system enters a new attractor basin \mathcal{A}_n with depth:

$$\Delta U_{\text{well}}^{(n)} = U(C_{\text{saddle}}) - U(C_{\text{min}}^{(n)}) \quad (\text{VII.1})$$

For return, energy $\Delta U_{\text{well}}^{(n)}$ is needed, which grows with each level:

$$\Delta U_{\text{well}}^{(n+1)} > \Delta U_{\text{well}}^{(n)} \quad (\text{VII.2})$$

Each successive level is a deeper “well” in the potential. Regression becomes increasingly improbable.

Exception: Regime E (death of reality) – if $B_{\text{avg}} \rightarrow 0$ and $S \rightarrow 0$, the civilization may “fall” through several levels. By postulate P3 [1], the configuration lifetime $T_{\text{life}}(C) = \kappa/(1 - S)$; as $S \rightarrow 0$, the lifetime tends to κ , and the configuration disintegrates.

VII.2. Second law: Growth of coherence

The minimal coherence necessary for overcoming threshold θ_n grows monotonically:

$$S_{\text{min}}^{(1)} < S_{\text{min}}^{(2)} < \dots < S_{\text{min}}^{(n)} < \dots \quad (\text{VII.3})$$

For overcoming barrier ΔU_n , the collective probability must satisfy:

$$P_{\text{coll}}^{(n)} = 1 - \prod (1 - B_i^k) \geq P_{\text{min}}^{(n)} \quad (\text{VII.4})$$

$P_{\text{min}}^{(n)}$ grows with n , and P_{coll} is proportional to S . Corollary: a civilization ascending the staircase must become increasingly coherent. Fragmentation ($S \rightarrow 0$) is incompatible with high levels.

VII.3. Third law: Decrease of inertia

The maximal admissible inertia decreases with each threshold:

$$I_{\max}^{(1)} > I_{\max}^{(2)} > \dots > I_{\max}^{(n)} > \dots \quad (\text{VII.5})$$

The civilization must become less attached to the current configuration. Dogmatism (high $I(C)$) is a blocking factor.

Inertia-coherence paradox: simultaneously high S (synchronization) and low $I(C)$ (readiness for change) are needed. Resolution: observers are synchronized not in belief in a specific configuration but in readiness for reconfiguration:

$$S_{\text{meta}} = 1 - \frac{2}{n(n-1)} \sum |F_i - F_j| \quad (\text{VII.6})$$

where $F_i = 1 - B_i$ is the observer's "flexibility". High S_{meta} at low \bar{B} — synchronized flexibility. In strange loop language Φ [7]: this is coherence not of the content of observation but of the process of observation itself — alignment of the meta-level $\hat{O}(\hat{O}(\dots))$, rather than fixation on a specific configuration.

VII.4. Fourth law: Expansion of the choice space

The number of accessible configurations after threshold θ_n grows super-exponentially:

$$|\mathbb{C}_{\text{accessible}}^{(n)}| = K^{N(t)} \cdot \prod_{k=1}^n \Omega_k \quad (\text{VII.7})$$

where Ω_k is the expansion factor upon overcoming the k -th barrier. For lower thresholds: $\Omega_1 \sim 10^2$ (neighboring territories), $\Omega_2 \sim 10^4$ (planet), $\Omega_3 \sim 10^{10}$ (Solar System). For upper thresholds: $\Omega_5 \sim K^N$ (full access to \mathbb{C}), $\Omega_6 \sim |\mathcal{O}| \cdot K^N$ (access to the meta-multiverse).

VII.5. Fifth law: Responsibility proportional to access

A civilization that has overcome threshold θ_n bears responsibility for $|\mathbb{C}_{\text{accessible}}^{(n)}|$ configurations. Upon collision of G_1 (level n) and G_2 (level $m < n$):

$$\frac{|\mathbb{C}_1|}{|\mathbb{C}_2|} = \prod_{k=m+1}^n \Omega_k \gg 1 \quad (\text{VII.8})$$

G_1 sees more variants of the future than G_2 can imagine. The choice of interaction regime is entirely determined by G_1 . The responsibility formula:

$$\mathcal{R}_n = \frac{|\mathbb{C}_{\text{accessible}}^{(n)}|}{|\mathbb{C}_{\text{accessible}}^{(0)}|} = \prod_{k=1}^n \Omega_k \quad (\text{VII.9})$$

Responsibility grows as the product of all expansion factors — faster than any exponential.

VIII. FOUR DEVELOPMENT SCENARIOS

VIII.1. Scenario α : Coherent expansion

The civilization maintains $S > S_{\min}^{(n)}$ at each level. Development proceeds as a unified front:

$$\frac{dS}{dt} > 0, \quad \frac{dI}{dt} < 0, \quad \frac{d\tau}{dt} > 0 \quad (\text{VIII.1})$$

All three laws are satisfied simultaneously. The civilization moves along the optimal trajectory:

$$\gamma_{\text{opt}} : \quad S(t) \rightarrow 1, \quad I(t) \rightarrow 0, \quad \tau(t) \rightarrow \infty \quad (\text{VIII.2})$$

Sequential passage through all thresholds. Time between thresholds decreases. Approach to singularity T_{sing} .

In toroidal language [5]: the trajectory on nested φ -tori sequentially transitions from inner tori to outer ones, scaling by φ each time. The spiral gap $(\pi - 3)^2$ ensures non-closure — continuous development instead of cyclic repetition.

VIII.2. Scenario β : Fragmented expansion

At threshold θ_n , coherence is insufficient ($S < S_{\min}^{(n)}$). The civilization splits:

$$G \rightarrow G_1 \cup G_2 \cup \dots \cup G_k \quad (\text{VIII.3})$$

Each fragment G_i continues development independently from level θ_{n-1} . A “multiverse of civilizations” — many independent branches of development with different technological levels. The meeting of branches at higher levels generates a collision of realities.

VIII.3. Scenario γ : Stagnation

The civilization reaches a ceiling $\tau \rightarrow \theta_n^-$ but cannot overcome the barrier due to excessively high inertia:

$$I(C) > I_{\max}^{(n)} \quad \forall t \quad (\text{VIII.4})$$

The system gets stuck in the attractor basin of the current level:

$$\frac{dC}{dt} = -\frac{\alpha}{I(C)} \cdot \nabla U(C) \rightarrow 0 \quad \text{as } I(C) \rightarrow \infty \quad (\text{VIII.5})$$

An attractor-civilization: stable but incapable of progress. Exit is possible only through external influence or crisis ($B_{\text{avg}} \downarrow$).

VIII.4. Scenario δ : Collapse (Regime E)

While attempting to cross the threshold, the civilization loses coherence and enters a collapse regime:

$$B_{\text{avg}} \cdot S \cdot \ln N < \theta_{\text{crit}} \quad (\text{VIII.6})$$

Death of reality. Regression by several levels. Recovery requires external injection ($B_0 > 0$).

IX. CONNECTIONS WITH FUNDAMENTAL ODT OE STRUCTURES

IX.1. Barriers and the strange loop Φ

The self-consistent configuration $\Psi^* = \Phi(\Psi^*)$ [1, Proposition 4] — the fixed point of the self-observation mapping existing by the Banach contraction theorem — plays a key role in barrier dynamics.

At each threshold transition, the civilization passes through a mini-cycle of the strange loop: observation of the current configuration \rightarrow awareness of the barrier \rightarrow observation of the process of observation (meta-level) \rightarrow reconfiguration of the operator \hat{O} . The number of such recursive layers equals the dimensionality $d(O)$ [2]: the triple recursion $\hat{O}(\hat{O}(\hat{O}))$ corresponds to the minimal level of consciousness ($d = 3$), and the growth of d with threshold passage is the deepening of recursion.

At threshold θ_6 , the recursion closes: the observer observes the very process of observing the observation — infinite depth $\hat{O}(\hat{O}(\hat{O}(\dots)))$. This is the limiting operator of the strange loop, corresponding to Ψ^* .

IX.2. Barriers and the spiral gap $(\pi - 3)^2$

The spiral gap $(\pi - 3)^2 \approx 0.02005$ — the measure of “imperfection” of spiral trajectory closure on a torus [5]. In the context of barrier dynamics:

Between a full revolution (2π) and closure ($6 = 2 \times 3$), there remains a gap $2\pi - 6 \approx 0.28318\dots$, whose square $(\pi - 3)^2$ sets the minimal “leakage” from the current level to the next. This gap is the reason a civilization cannot remain eternally at one

level: trajectory non-closure generates slow but inevitable “sliding” toward the next threshold.

The energy of transition between adjacent thresholds:

$$\Delta E_{\text{trans}} \propto (\pi - 3)^2 \cdot \varphi^n \quad (\text{IX.1})$$

The gap $(\pi - 3)^2$ sets the base energy, and the scaling φ^n sets the growth with level number. By the energy extraction theory [4], this energy is extracted from \mathcal{H} through the coherence channel: the higher S , the more efficient the channel and the more accessible the transition energy.

IX.3. Barriers and toroidal topology

Each threshold θ_n corresponds to a transition between nested φ -tori [5]. The minor radius r_n sets the scale of internal dynamics at level n ; the major radius $R_n = \varphi \cdot r_n$ sets the scale of transition to level $n + 1$.

The KAM theorem [6] guarantees the stability of quasiperiodic trajectories on tori with sufficiently irrational frequency ratios. The golden ratio φ is the most irrational number (by continued fraction approximations), ensuring maximal stability. The destruction of the KAM surface under perturbations exceeding a critical value corresponds to threshold overcoming: stochastic layers between tori permit Arnold diffusion [6], and the civilization “flows” to the next torus.

Infinite nesting of tori is the infinity of the barrier staircase. Each torus is wrapped in a non-closing spiral (gap $(\pi - 3)^2$), generating time, energy, and development.

IX.4. Barriers and teleportation

Personal teleportation [3] is a specific mechanism for overcoming spatial barriers (ΔU_{space}). The three-phase process — deactualization \rightarrow navigation in \mathcal{H} \rightarrow reactualization — bypasses the potential saddle through the space \mathcal{H} , where the concept of distance is undefined.

This is fundamentally different from gradient motion (VI.8): instead of overcoming the barrier “head-on”, the observer exits \mathbb{C} into \mathcal{H} and returns at a different point in \mathbb{C} . Analogy: an ant on the surface of a sphere can walk along the surface (gradient motion) or “dive” through the volume (teleportation).

At threshold θ_5 , this mechanism becomes available for entire configurations, not just individual observers. This nullifies ΔU_{space} and ΔU_{time} , leaving only ΔU_{dim} — the barrier between fundamentally different organization regimes.

X. LIMITING RESULTS

X.1. Limit of the infinite staircase

As $n \rightarrow \infty$ under scenario α :

$$\lim_{n \rightarrow \infty} S_n = 1, \quad \lim_{n \rightarrow \infty} I_n = 0, \quad \lim_{n \rightarrow \infty} |\mathbb{C}_{\text{accessible}}| = |\mathbb{M}| \quad (\text{X.1})$$

The civilization approaches the state of the absolute observer:

$$\hat{O}_\infty : \Psi \rightarrow \mathbb{M} \quad (\text{X.2})$$

Complete observation of the meta-multiverse. Coherence tends to 1, inertia to 0, accessible space to the entire meta-multiverse. But by the barrier infinity theorem (Section V), this limit is unreachable in finite time (except for the singularity case).

X.2. Fundamental normalization constraint

Even as $n \rightarrow \infty$, the belief normalization constraint remains:

$$\sum_{C \in \mathbb{C}} B_i(C) \leq 1 \quad (\text{X.3})$$

An observer cannot “believe” in all configurations simultaneously. Complete observation of the multiverse requires distributed belief — infinitesimally small $B_i(C)$ for each configuration at unit total normalization. The state is formally identical to a quantum superposition: the observer is “everywhere and nowhere”, with observation probability:

$$P(C) = B_i(C) = \frac{1}{|\mathbb{C}|} \rightarrow 0 \quad (\text{X.4})$$

X.3. The completion paradox

The absolute observer observes everything — and therefore observes nothing specific. The configuration ceases to be definite. Reality returns to the state Ψ — pure potential before the act of observation.

The circle closes: from Ψ through the infinite barrier staircase — back to Ψ .

$$\Psi \xrightarrow{\hat{O}} C_1 \xrightarrow{\theta_1} C_2 \xrightarrow{\theta_2} \dots \xrightarrow{\theta_\infty} \hat{O}_\infty \xrightarrow{\text{normalization}} \Psi \quad (\text{X.5})$$

The cycle “potential — observation — reality — development — potential” is the fundamental structure of ODT OE, manifesting at all scales. In toroidal language [5]: the toroidal matryoshka closes upon itself, forming a higher-order torus — a torus of

tori. The structure of the infinite staircase is identical to the structure of the strange loop Φ [7]: infinite recursion closing upon the starting point.

X.4. Generalized equation of motion

$$\frac{d\tau}{dt} = r(\tau) \cdot S(\tau) \cdot \left[1 - \frac{I(\tau)}{I_{\max}(\tau)} \right] \cdot \Theta(\tau - \tau_{\text{crit}}) \quad (\text{X.6})$$

where $r(\tau)$ is the internal rate of development, $S(\tau)$ is coherence, $[1 - I/I_{\max}]$ is the flexibility reserve, Θ is the Heaviside function (development is possible only above the critical survival threshold).

Four factors determine four ways to “get stuck”: $r(\tau) \rightarrow 0$ — exhaustion of resources; $S(\tau) \rightarrow 0$ — fragmentation (Regime E); $I \rightarrow I_{\max}$ — freezing (stagnation); $\tau < \tau_{\text{crit}}$ — insufficient level for survival.

XI. DISCUSSION AND LIMITATIONS

XI.1. Demarcation

Follows from the theory (mathematical results): the theorem on barrier infinity (V.1); monotonicity of $S_{\min}^{(n)}$ and $I_{\max}^{(n)}$ (VII.3, VII.5); the completion paradox (X.3–X.5); the structure of the generalized equation of motion (X.6).

Follows from ODTOE postulates (requires acceptance of axiom A): classification of barriers (II.2–II.4); observer dependence (II.5); bifurcation formula (IV.4–IV.6); five laws (VII.1–VII.9).

Speculative (requires experimental verification): the specific sequence of six thresholds (Table 1); the empirical exponent $\delta \approx -0.3$; specific values of Ω_k ; the connection of β with $(\pi - 3)^2$.

XI.2. Falsifiability

The theory generates testable consequences. The acceleration law (V.4): $\Delta t_{n+1} < \Delta t_n$ — the time between technological revolutions should decrease; testable on historical data. The coherence growth (VII.3): $S_{\min}^{(n)}$ should grow; testable through measurement of global synchronization (globalization indices, communication network density). The bifurcation at thresholds (IV.4): the number of development paths after a technological breakthrough depends on coherence; testable through analysis of civilizational forks in history.

XI.3. Connection with existing theories

The Kardashev scale [8] classifies civilizations by energy consumption (I – planetary, II – stellar, III – galactic). In ODTOE terms, this is a rough approximation of thresholds θ_2 – θ_4 , not accounting for coherence S and inertia $I(C)$. The ODTOE barrier model supplements the Kardashev energy scale with a cognitive dimension.

The Landau phase transition theory [9] describes bifurcations in thermodynamic systems through a potential of the form (IV.4). ODTOE transfers this apparatus to the configuration space \mathbb{C} , where the role of the thermodynamic order parameter is played by coherence S .

The KAM theorem [6] and Arnold diffusion provide the mathematical apparatus for describing the stability and destruction of toroidal structures, directly applicable to transitions between levels.

XII. CONCLUSION

The mathematical apparatus of reality barrier overcoming within ODTOE has been developed. Main results:

1. Unified field: all realities are configurations in a single space \mathbb{C} , separated by barriers ΔU of different nature (spatial, temporal, dimensional).
2. Technology = barrier reduction: each technology is a decrease in effective height $\Delta U_{\text{eff}} = \Delta U / f(\tau)$.
3. Infinite staircase: the sequence of thresholds $\theta_1 < \theta_2 < \dots$ has no upper bound.
4. Five laws of overcoming: irreversibility of thresholds, growth of coherence, decrease of inertia, expansion of the choice space, proportionality of responsibility.
5. Generalized equation of motion (X.6) with four factors determining development regimes.
6. Completion paradox: the limiting state of the absolute observer ($S \rightarrow 1, I \rightarrow 0, |\mathbb{C}| \rightarrow |\mathbb{M}|$) is identical to the return to indeterminacy Ψ . The infinite staircase closes into a ring – a strange loop Φ , realized on the toroidal geometry of φ -tori.

$$\Psi \xrightarrow{\hat{O}} C_1 \xrightarrow{\theta_1} C_2 \xrightarrow{\theta_2} \dots \xrightarrow{\theta_\infty} \hat{O}_\infty \xrightarrow{\text{normalization}} \Psi \quad (\text{XII.1})$$

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