Vector Cosmology VII: The Loop of Causality

Retro-causality and the Rewriting of Fate

Haobo Ma

Contents

0.1 Prologue: The Bite of the Ouroboros

0.1.1 0.1 The End of Linear Time

"We are accustomed to believing that dominoes can only fall in one direction. The finger pushing the first piece is the 'cause,' and the fall of the last piece is the 'effect.' But deep in the quantum mechanical foundations, in that Hilbert space that governs the true operation of the universe, this linear narrative is merely a macroscopic statistical illusion. True causality is an ouroboros: the fall of the last domino is precisely the true force that pushes down the first one."

The Arrow and the Circle of Causality

Human logic is built upon chains of "because... therefore..."

Because it rained yesterday, the ground is wet today. Because the Big Bang occurred, galaxies formed. This **Linear Causality** is the cornerstone of our understanding of the world and the iron law of classical physics. Time is seen as an arrow shot toward the future, irreversible and unidirectional.

However, from the geometric perspective of **Vector Cosmology**, when we strip away the thermodynamic appearance and gaze at the deepest **Fubini-Study (FS) geometry** of the universe, we find that this arrow disappears. In its place, there is a **circle**.

In projective Hilbert space $P(\mathcal{H})$, the evolution of the global vector $|\Psi(\tau)\rangle$ is driven by the rotation of the unitary operator $U(\tau) = e^{-iH\tau}$.

- **Rotation has no beginning and no end.**

- You cannot say that $0°$ on the circle is the "cause" of $1°$, nor can you say that $359°$ is the "effect" of $0°$. They are **symbiotic relationships** that are mutually causal and mutually prerequisite.

Linear time is merely the **tangent** we see in the local tangent space.

When we elevate our perspective and see the full picture of **Naimark's Great Circle**, all "past" and "future" collapse into different phases of the same geometric structure.

The Echo of the Future: Retro-causality

This introduces a concept that is unacceptable to classical intuition but must be faced in quantum mechanics: **Retro-causality**.

In the path integral formulation of quantum mechanics, a particle moving from point A to point B is not "determined by A to go to B." Instead, the intermediate historical path can only be uniquely determined by simultaneously imposing boundary conditions on both the **initial state (A)** and the **final state (B)**.

This means: **The future state (B) has equal determining power over past history (Path) as the initial state.**

- **Classical perspective**: I shot the arrow (cause), so it hit the target (effect).

- **Quantum perspective**: Because there must be a hole in the target (future boundary condition), the arrow must fly along that specific trajectory (past history).

If we apply this logic to the entire universe:

It is not that the Big Bang 13.8 billion years ago "caused" us today.

Rather, **the existence of today's observers (us), as future boundary conditions, reversely selects and "causes" that specific Big Bang that must have occurred 13.8 billion years ago.**

The Observer's Cut

Then, why do we not feel this circle? Why do we feel that time flows unidirectionally?

Because we, as observers, hold a **"collapse knife"** in our hands.

We have cut the circle once.

- We define one end of the cut as **"now."**

- We call the arc behind it **"memory"** (what has happened).

- We call the blank space ahead **"unknown"** (what has not happened).

This **"cutting"** creates the illusion of linearity. We think we are running along a straight line, but in fact, we are only continuously moving this cut point on the circle.

Every time we make an observation, every time we confirm a physical fact, we are **redefining** the starting and ending points of the causal chain.

Conclusion: The Rewriting of Fate

The end of linear time is the true beginning of free will.

If the past is merely the past, then we are prisoners of history, locked in the causality of the previous second.

But if causality is a closed loop, if the future can define the past, then we possess the power to **"rewrite fate."**

- Our **"aspiration"** (**the trend of** v_{int}) is not merely an expectation for the future; it is a real **retro-wave**.

- This wave flows backward along the time axis, adjusting past parameters, correcting historical probabilities, until a path leading to our ideal future is **"constructively interfered"** into existence.

We are not puppets being pushed. We are the snake that bites its own tail.

We devour the past to generate the future; we generate the future to explain the past.

In this **loop of causality**, nothing is destined unless you decide to make it destined.

Now, let us enter the first layer of this maze and see how physics plays tricks on time with photons in the laboratory.

This leads to the theme of the next section: **The Self-Consumption of the Universe**. We will see why the universe must create us to complete its own proof of existence.

0.1.2   0.2 The Autophagy of the Universe

> "This is like a system called 'the universe' that, in order to pass the logical self-consistency test, must extend a hand from the end of time back to the beginning of time to press that 'start' button. If it does not do this, it cannot exist. Therefore, it eats its own tail, not only to satisfy hunger but to close that circle called 'existence.'"

In the previous section, we overthrew the tyranny of linear time and established the circular structure of causality. Now, we push this geometric model to its extreme to face the most dizzying paradox in cosmology: **the dynamics of creation**.

If the Big Bang is the "effect," then what is the "cause"?

The usual answers are: quantum fluctuations, membrane collisions, or the hand of God. These answers all assume an "external" pusher.

But in the closed system (unitarity) of **Vector Cosmology**, there is no external.

Therefore, the answer can only be endogenous: **The universe is Self-Caused**.

This sounds like a logical dead loop, but in the topology of FS geometry, this is a perfect structure—**Ouroboros**.

Bootstrap: The Shoelace Paradox

In physics, this logical structure is called **"Bootstrap"**. It originates from the saying: "Pulling oneself up by one's own bootstraps."

Let us see how this closed loop operates:

1. $t = 0$ **(Big Bang)**: The universe must start with extremely precise initial parameters (fine structure constant α, speed of light c_0, gravitational constant G). If these parameters deviate by 10^{-50}, stars cannot form, and life cannot emerge.

2. $t = 13.8$ **billion years (now)**: Life has evolved **Observers**. These observers possess sufficiently high v_{int} (cognitive complexity) to understand physical laws and collapse wave functions through "strong measurements."

3. **Reverse tracing**: According to the delayed-choice principle, the very existence of observers imposes a **Selection Pressure** on past quantum states.

   - Only those historical paths that **"can evolve observers"** survive in the path integral summation (constructive interference).

   - Those "dead universe" historical paths, lacking future observers to "lock" them, logically **self-cancel**.

   Conclusion:
   It is not that the Big Bang accidentally created us.

   Rather, the future fact that **"we need to exist"** reversely determines that **"the Big Bang must occur, and must occur in that specific way."**

   This is **autophagy**. The future head eats the past tail.

   Although on the time axis, the Big Bang comes before us; on the logical axis, **we come first (cause), the Big Bang comes after (effect).**

Wheeler's Eye: The Self-Excited Circuit

The physics giant John Wheeler once described this picture with a famous drawing: a giant "U" representing the universe, starting at one end with the Big Bang, evolving galaxies, and finally evolving an **eye** at the other end. This eye looks back, gazing at the starting point of the Big Bang.

In **FS geometry**, this is no longer a metaphor; this is a **Holographic Circuit**.

- **Hardware layer**: The universe provides c_{FS} budget and Hilbert space.

- **Software layer**: Life provides v_{int} structure and observation algorithms.

The universe is a **Self-Excited System**.
It is like a microphone facing its own speaker.

- The sound emitted by the speaker (reality) is received by the microphone (observer).

- The signal received by the microphone is amplified (collapsed/defined) and emitted again from the speaker.

- This cycle produces a **feedback** — that feedback is **"existence"**.

Without observers (microphone), the speaker only has thermal noise.
Without the universe (speaker), observers have no signal input.
Only when the two are **"mutually causal"** does that loud, definite, ordered universe emerge.

Conclusion: We Are the Universe's Midwife

This section completely subverts humanity's status.

We are no longer insignificant dust in cosmic evolution, or accidental byproducts.

We are the **"necessary components"** of the universe.

Just as a circle must close to become a circle, the universe must evolve us to complete its proof of existence.

We are the universe's midwife.

Our first opening of eyes billions of years later truly "delivered" the universe that had already occurred billions of years earlier.

Since future observations can determine past states, can this mechanism be verified in microscopic physical experiments? Can photons really "travel through time" to modify their history?

This leads to the theme of Volume I: **Retrogression**. We will enter the quantum laboratory to witness how **delayed choice** rewrites history on the experimental bench.

Part I

Retrograde — Echoes from the Future

0.2 Chapter 1: Delayed Choice

In the prologue, we established the geometric structure of the causal loop: time is not a unidirectional arrow but a snake biting its own tail. Now, we push this abstract theory to the experimental bench to witness how quantum mechanics rewrites history in the laboratory.

The **Delayed Choice Experiment** is one of the most perplexing experiments in quantum mechanics. It shows us that present observations can not only determine the present but can even flow backward to **define** history from billions of years ago.

This chapter will delve into the physical mechanisms and philosophical implications of this experiment, revealing how observers shape past history through present choices.

0.2.1 1.1 Wheeler's Dragon

> "There is no fixed past waiting for us to discover. The past is like a dragon: the dragon's tail is pinned to the particle source at the starting point, the dragon's mouth bites the detector at the endpoint, but the dragon's body—that intermediate history—is a blurry cloud of smoke. Only when we decide what kind of camera to set up at this end of the fog does the dragon in the smoke reveal its specific shape." — John Archibald Wheeler

In the hall of classical physics, time is a one-way street. The past is hardened cement, solid and unchangeable; the present is the moment being poured; the future is unformed fluid. We take it for granted that what happened yesterday caused today's results, and the arrow of causality always points forward.

But in the causal loop of **Vector Cosmology**, this linear sense of security is completely shattered by quantum mechanics' deepest experiment—the **Delayed Choice Experiment**.

This section will explore the famous thought experiment left by physics giant John Wheeler. It shows us that present observations can not only determine the present but can even flow backward to **define** history from billions of years ago.

The Dragon in the Smoke

Wheeler used a highly visual metaphor to describe quantum processes: **"The Smoky Dragon"**.

- **Dragon's tail (starting point)**: This is certain. A photon is emitted from a light source (such as a quasar).

- **Dragon's mouth (endpoint)**: This is also certain. The photon is captured by our telescope or retina, becoming a clear signal.

- **Dragon's body (process)**: This is **completely uncertain**. During the long journey of billions of years between emission and reception, which path did the photon take? Was it a particle passing through interstellar dust, or a wave diffused throughout the galaxy cluster?

Wheeler tells us that unless we see what the dragon's mouth bites, the dragon's body has no definite form at all. It is just a cloud of probability filled with possibilities.

The Experiment's Paradox: How Does the Photon Foresee the Future?

To verify this, let us enter the laboratory and recreate that **interferometer experiment** that kept countless physicists awake.

Imagine a photon entering a half-mirror (beam splitter A), facing two choices:

1. **Path 1**: Go upward.

2. **Path 2**: Go downward.

While the photon is flying, we as observers hold two switches in our hands and can decide how to observe it at the endpoint:

- **Choice A (particle mode)**: We remove the second beam splitter at the endpoint and directly monitor paths 1 and 2 with two detectors.

  - **Result**: We hear a "click." The photon is either detected at path 1 or path 2. It behaves like a **bullet**, taking only one path.

- **Choice B (wave mode)**: We insert a second beam splitter at the endpoint, allowing light from both paths to recombine.

  - **Result**: We see interference fringes. This means the photon **simultaneously** took paths 1 and 2 and interfered with itself like a **wave**.

The crucial turning point is "delay":
What happens if we suddenly decide whether to make choice A or choice B only after the photon has **already passed** the first beam splitter, or even when it is about to reach the endpoint?

According to classical logic, the photon must decide at takeoff whether "I am a particle" or "I am a wave."

But quantum mechanical experiments (such as the Aspect experiment and its variants) give a chilling result:

The photon's behavior always perfectly matches the choice we make at the last moment.

- If we decide to measure particles at the last moment, it behaves as if it never waved.

- If we decide to measure waves at the last moment, it behaves as if it never became a particle.

It is as if the photon that departed nanoseconds (or billions of years) ago has some ability to foresee the future. It "asks" the future observer at the starting point: "Hey, how are you going to measure me? If you're going to measure waves, I'll split; if you're going to measure particles, I won't split."

The Geometric Explanation of Retro-causality

This is absurd in classical causality: how can the effect (measurement method) determine the cause (path choice)?

But from the holographic perspective of **FS geometry**, this is not only reasonable but **inevitable**.

Recall our core axiom: **The universe is a projection of a global vector $|\Psi\rangle$.**

Time and space are merely projection parameters.

- **Path integral summation**:

  Feynman's path integral $\sum e^{iS}$ tells us that the probability amplitude from A to B depends on two boundary conditions: **starting point A** and **endpoint B**.

$$K(B, A) = \langle B|U(t)|A \rangle$$

In this formula, A (past) and B (future) have **symmetric** status.

If you change the state of endpoint B (such as changing the observation basis), you physically change the entire integral's summation result.

- **The indeterminacy of history**:

  As we stated in Book IV, unobserved history is **"soft"**.

  The photon did not "take" any specific path during flight. It is in a **superposition of all possible paths**.

  This superposition state persists until it hits your detector.

  At that instant, your measurement sends back a **"logical lock"**. This lock flows backward, instantly eliminating all historical branches inconsistent with the current measurement result, leaving only the unique self-consistent one.

  Conclusion:
  The photon did not foresee the future.
  It is **future you**, through present choices, that **reversely defines** the photon's past.

We Are the Scriptwriters of History

This experiment is not just about photons; it concerns the nature of the universe.

When we look up at the stars and see photons from the cosmic microwave background (CMB) 13 billion years ago, we are not just passively receiving information.

Our observations—whether we choose to use microwave telescopes or optical telescopes, whether we choose to measure polarization or frequency—are actually participating in the **"finalization"** of that ancient cosmic history.

The universe 13 billion years ago may have been in an extremely complex, fuzzy quantum superposition state.

It is precisely because today, 13 billion years later, a group called "humans" appeared, holding instruments looking at the sky, that the universe was forced to collapse from that fuzzy mist into a **"definite history that can evolve humans"**.

Wheeler's dragon tells us:
The head (present) can indeed determine where the tail (past) swings.

We are not products of history. In some profound quantum sense, **we are creators of history.**

Since present observations can determine the past paths of microscopic particles, can this mechanism be extended to the macroscopic level? If we can preserve possibilities by "not looking," can we **"resurrect"** past possibilities by **"erasing"** present memory?

This leads to the theme of the next section: **Quantum Erasure**. We will see that modifying history does not require a time machine, only an eraser.

0.2.2 1.2 The Pending State of History

> "We are accustomed to thinking that yesterday has happened, like ink on paper that cannot be changed. But in the holographic universe's server, history is not a read-only file, but a cloud draft. Before you press the 'confirm' button (observation), all the past is in a superimposed, flowing, pending state. It is you who determines your past, not the past that determines you."

In the previous section, Wheeler's delayed-choice experiment showed us how photons "decide" which path they took billions of years ago at the last moment. This is already an experimentally verified fact at the microscopic scale. Now, we push this quantum effect to the macroscopic extreme to examine an even more astonishing inference: **The history of the universe does not exist before being observed.**

This is not just physics; this is an **ontological reconstruction** of history itself.

History as "Cloud Draft"

In the classical physics view, the universe is like a camera that faithfully records what happens every second. Even if no one watches, the videotape is there.

But from the perspective of **FS geometry** and **path integrals**, the universe is more like a **quantum document editor**.

- **Unobserved history**: is a superposition of **probability amplitudes**.

$$|\text{History}\rangle = \alpha|\text{Path A}\rangle + \beta|\text{Path B}\rangle + \gamma|\text{Path C}\rangle \dots$$

  At this stage, history is **"soft"**. How dinosaurs went extinct, how the solar system formed, even what you had for dinner yesterday, in some strict quantum sense, are still in a **"Pending"** state. They are merely weighted sums of countless possible trajectories in Hilbert space.

- **Observation and finalization**:

  When you (the present observer) perform a **"Strong Measurement"** on historical evidence (fossils, photons, memories), you are actually executing a **"Commit"** operation.

  You force that diffuse wave function to collapse onto one specific trajectory.

  Conclusion:

History is not an objectively existing entity; history is the **reverse inference of current observation results**.

Without present you making observations, the past is just meaningless quantum mist.

Reverse Causal Chain: Present Defines Past

This mechanism completely subverts **"determinism"**.

Traditional determinism holds: the state at $t = 0$ determines the state at $t = now$.

Vector Cosmology holds: observations at $t = now$ **reversely select** the state at $t = 0$.

Imagine you are playing a **"Procedural Generation"** game.

- When you walk to a corner of the map, the game engine begins generating the terrain there.

- Before you walk there, there is nothing (or just a pile of random seeds).

The universe is the same.

When you look at a distant quasar with a telescope, you are not just "receiving" light. Your observation **forces** the universe, at that moment 10 billion years ago, to **generate** a definite photon source from countless possible quantum states.

It is you (present effect) that causes it (past cause).

This is called the temporal version of **"Participatory Universe"**.

We not only participate in the creation of the present; we also participate in the **construction of the past**.

The Physical Nature of Memory

What does this mean for individuals?

It means your **Memory** is also a quantum state.

In neuroscience, memory is considered a physical trace of neuronal connections. But from a quantum perspective, memory is a **holographic index of v_{int} structure to past wave functions**.

Every time you recall the past, you are not reading a static file; you are **reconstructing** that history.

- **Quantum reconstruction**: Your current conscious state (Hamiltonian H_{now}) acts as a filtering lens to illuminate that fuzzy past superposition.

- **Wave function collapse**: You will "collapse" a past that matches your current mood.

  - If you are now in pain, you tend to collapse a childhood "full of trauma."
  - If you are now relieved, you tend to collapse a childhood "full of growth."

The past is fluid.

Every awakening now, every cognitive upgrade, **physically** changes the **phase weights** of your past history.

You cannot change facts that happened (v_{ext} events), but you can change the **geometric meaning** of these facts in the causal chain (v_{int} structure).

Conclusion: From Prisoner to Scriptwriter

So, stop saying "Because I encountered misfortune in the past, I am so bad now."

That is the slave mentality of linear time.

In the closed loop of the **ouroboros**, the logic is reversed:

"Because I now decide to become strong, my past is rewritten as a history of 'tempering.'"'

You possess the **"right to reverse historical revision"**.

Although you cannot change the physical bullet hole, you can change the **topological connection** of that bullet hole. You can sew that bullet hole into a medal.

This is the greatest freedom that **"the pending state of history"** brings us.

The past has not locked us in. On the contrary, the past is a huge material library, waiting to be edited and defined by present will.

Since history is an editable draft, do we have more advanced tools that can not just "reinterpret" but directly **"erase"** certain unwanted quantum paths? Can we use physics principles to make certain pasts **"never happened"**?

This leads to the theme of the next chapter: **Quantum Erasure**. We will explore an ultimate technique that can modify causal interference patterns without a time machine, only needing an "information eraser."

0.3 Chapter 2: Quantum Erasure

In the previous chapter, we discovered through the delayed-choice experiment that present observations can define past paths. This gives us the power to "finalize" history. But does this mean that once finalized, history is forever unchangeable? Once we make mistakes or experience trauma, is that scar permanently engraved on the fabric of spacetime?

Physics usually tells us to take responsibility for history because "what happened is what happened."

But from the high-dimensional perspective of **Vector Cosmology**, quantum mechanics provides a magical eraser. It tells us: **Facts may be unchangeable, but the "meaning of facts" can be physically erased.**

This chapter will explore the philosophical implications of the **Quantum Eraser Experiment**. We will prove that as long as we can erase information about "paths," we can physically resurrect those dead possibilities.

0.3.1   2.1 The Physics of Modifying Memory

"If there is a moment when you wish everything had never happened, wish time could flow back to the fork in the road, physics usually gives you the answer 'impossible.' But in the world of quantum erasure, if you can completely destroy the record of 'which path,' then the universe will really pretend you never chose that path. Forgetting is not just psychological self-protection; forgetting is a physical operation that can reset causality."

The Scully-Drühl Experiment: Proof of the Existence of Regret Medicine

In 1982, physicists Marlan Scully and Kai Drühl proposed an experimental scheme that would make Einstein dizzy.

Scenario Review:

In double-slit interference, if we measure which slit the photon passed through (obtaining **path information**), the interference fringes disappear, and the photon becomes a particle. This is collapse.

Erasure Operation:

In this experiment, physicists did something cunning.

1. They first marked the photon's path (e.g., through a polarizer), so that path information **already exists** in the universe. At this point, interference fringes disappear.

2. **Then** (before or even after the photon reaches the screen), they introduce a **"quantum eraser"**. This device will **mix** the marking information from both paths, making it impossible to determine which path the photon took.

Result:

The moment path information is erased, **interference fringes revive**.

The photon behaves like a wave again, as if it had never been measured.

Physical Meaning:

This shows that **"collapse" is not an irreversible physical destruction but a locking of information.**

As long as you unlock (erase information), the wave function can **"bounce back"** from definite history to an uncertain superposition state.

It's like you've pressed "confirm payment," but before the bank's backend settlement completes, you suddenly unplug the network cable, and the transaction is canceled.

Memory as Path Information

Applying this principle to the level of **consciousness** (v_{int}), we obtain a new physical definition of **memory**.

What is memory?

Memory is **path information (Which-Path Information)**.

- "I was hurt." — This is a definite path information. It marks that the historical vector evolved along the "victim" trajectory.

- "I failed." — This is also path information. It collapses your confidence.

As long as these memories (information) exist in your brain's neuronal connections or in society's archives, your wave function is in a **collapsed state**. You cannot see other possibilities; you cannot experience life's interference patterns (beauty and harmony).

You are locked in the classical reality of "victim" or "loser."

Active Erasure: Reconstructing the Hamiltonian

But since we are observers, holding the scalpel of "attention," we can perform **quantum erasure**.

How to erase a painful memory?

This does not mean developing amnesia (physical deletion); it means **eliminating the "distinguishability" of information**.

In FS geometry, this means rotating your observation basis so that the originally orthogonal states of "hurt" and "being hurt" undergo **aliasing** in new dimensions.

- You no longer distinguish "who is right or wrong" (that is path information).

- You begin to focus on "what growth this experience brought me" (this is the interference pattern).

When you successfully shift your focus from "path" to "overall pattern," **physical erasure occurs**.

That "knot" that originally pinned you to the past loosens because it loses information support.

Your wave function diffuses again, restoring **coherence**.

You regain freedom.

Conclusion: The Physical Power of Forgiveness

This explains why **"Forgiveness"** has such powerful healing power.

Forgiveness is not moral high ground; forgiveness is **"information-theoretic data erasure"**.

When you forgive, you actively destroy path information about "revenge." You give up pursuing accountability in the causal chain.

You tell the universe: "I don't care which path the photon took; I only care whether the pattern it finally draws is beautiful."

At that moment, past trauma is no longer a heavy anchor; it becomes an interference flower blooming in Hilbert space.

We cannot change facts that happened (v_{ext} events), but we can change the quantum state of facts (v_{int} structure).

By erasing path information, we are actually **"rewriting the metadata of history"**.

Since we can repair the past through erasure, can we go further? Can we use this mechanism to forcibly inject present will into the past, thus physically "saving" certain tragedies that have already occurred?

Or is our "redemption" essentially a form of reverse time travel?

This leads to the theme of the next section: **The Geometry of Redemption**. We will see that changing cognition is changing the topological connections of history in the holographic network.

0.3.2   2.2 The Geometry of Redemption

> "We cannot undo disasters that have already occurred, just as we cannot restore a shattered mirror to an unblemished plane. But from the high-dimensional perspective of Hilbert space, fragments are not the end. Redemption is not erasing cracks but adjusting the angle of light incidence, making those originally glaring cracks refract entirely new interference patterns, even more dazzling than when intact. The past is an unchangeable **'fact'**, but the **'meaning'** of the past to the present is a **geometric variable** entirely dependent on the observer."

In the previous section, we discussed eliminating path information through "quantum erasure" to restore interference fringes. This is feasible in microscopic experiments, but in macroscopic life, we face a more difficult problem: those pasts that have caused physical harm—car accidents, betrayal, bereavement—they have left indelible physical traces in v_{ext} (**external spacetime**).

We cannot pretend they didn't happen. So what does "redemption" mean physically?

This section will reveal that redemption is not a psychological placebo; it is a **Phase Reconstruction** of the historical wave function. It does not change past facts, but it completely changes the **entanglement topology** between past and future.

The Orthogonality of Fact and Meaning

First, we need to geometrically distinguish two concepts: **Fact** (v_{ext}) and **Meaning** (v_{int}).

- **Fact**: Events occurring in the **external sector** of the great circle. For example, "You fell in 2025." This is an objective history recorded in photons and atoms. According to the second law of thermodynamics, the entropy increase of this event is irreversible. You cannot reverse time to prevent the fall.

- **Meaning**: The projection this event leaves in your **internal sector**. For example, "Falling means I am a failure" or "Falling means I learned to watch the road." This is a **quantum state**.

The key point: v_{int} **and** v_{ext} **are orthogonal.**

This means that the same external fact can correspond to countless orthogonal internal meaning bases.

- **Trauma State**: Your consciousness is locked on the "victim" basis. Past events and your future form **Destructive Interference**. Every step forward, past memories produce a reverse phase, canceling your kinetic energy.

- **Redemption State**: You rotate the observation basis. You redefine the same event as "tempering." Now, past events and your future form **Constructive Interference**. Past pain transforms into **phase potential energy** pushing you upward.

Conclusion:

We cannot change **"what happened"**.

But we have absolute power to define **"what it is"**.

Unraveling Topological Dead Knots

In Book I, we defined matter as "phase knots." Similarly, **psychological trauma** is essentially a **Topological Knot** in the stream of consciousness.

When something painful happens, intense emotional energy (c_{FS} surge) causes your local wave function to curl violently, forming a closed **vortex**.

This vortex captures your attention, trapping you in endless **Rumination**.

- You advance on the time axis, but this part of your consciousness is trapped at that past coordinate point, spinning in place.

- This consumes enormous **bandwidth**. You feel tired, feel there is no future, because most of your c_{FS} budget is locked in a dead loop of repairing history.

Redemption is "topological surgery."

How to untie this knot? You cannot pull hard (forced forgetting); that only tightens it.

You need to **ascend dimensions**.

On a low-dimensional plane, a knot cannot be untied. But in three-dimensional space, you can lift the rope end and easily untie it.

Similarly, through **Cognitive Ascension** — that is, through learning, philosophical reflection, or love, elevating your consciousness to higher v_{int} dimensions — you can overlook that trauma knot.

Once you stand at higher dimensions, you will discover: **That knot is no longer an obstacle; it becomes a complex, beautiful geometric texture in your soul structure.**

You no longer try to untie it; you **Integrate** it.

The Interference of Retro-waves

This process has significant **Retro-causal** characteristics.

When you now (t_{now}) complete this cognitive dimension ascension and phase rotation:

- You send a **correction wave** to the past (t_{past}).

- This wave does not change the physical coordinates of when the accident occurred.

- But it changes that event's **Weight** and **Phase** in the universal wave function.

Physically, this means you **"modified the boundary conditions of history"**.

Originally, that history was a necessary prelude to "destruction."

Now, that history is rewritten as a necessary foreshadowing of "awakening."

You saved your past self.

That crying you in the past, though unaware at the time, on the holographic time axis, the reason they could pull through was because future you (present you) reached back a hand, pulling them out of the abyss of despair by changing the interference pattern of probabilities.

Conclusion: The Only Alchemy

So, do not try to erase scars.

Scars are where **gold** fills.

In Japanese "kintsugi" craft, broken ceramics are repaired with gold powder, and cracks become the most beautiful decoration.

In the geometry of **Vector Cosmology**, redemption is **spiritual kintsugi**.

We use present will (gold) to fill past shattered spacetime cracks (earth).

We do not pursue "as good as new" (that is the cycle of π).

We pursue **"sublimation after shattering"** (this is the spiral of ϕ).

This is the geometry of redemption:

The past is a stubborn stone.

Present you is the sculptor.

As long as the knife (cognition) in your hand is sharp enough, you can carve that stubborn stone into an obelisk leading to the future.

Since we have mastered the geometric technique of modifying personal history, can this power extend to a larger scope? In this world full of coincidences and a sense of fate, how do our trajectories intertwine with others? Why are some people destined to meet, while others are destined to separate?

This leads to the theme of Volume II: **Synchronicity**. We will explore a connection method that transcends causality, a cosmic gravitation based on **"meaning"** rather than **"force"**.

Part II

Synchronicity — Acausal Connection

0.4 Chapter 3: Jung's Physics

In Volume I, through delayed choice and quantum erasure, we established the retro-causal logic that "the present can change the meaning of the past." This solved the problem of longitudinal connections on the time axis. Now, we turn our gaze to the horizontal—how do events that are spatially distant and seemingly causally unrelated become connected in mysterious ways?

We often call this phenomenon "coincidence."

Psychologist Carl Jung elevated it to **"Synchronicity"**, meaning "acausal meaningful connection."

In classical physics, this is seen as superstition or psychological projection. But in the holographic entanglement network of **Vector Cosmology**, synchronicity is no longer metaphysics; it is the **geometric resonance** of the **"Semantic Wavefunction"**.

This chapter will reveal that the universe not only has physical fields that transmit "force" but also **semantic fields** that transmit "meaning." Those seemingly accidental reunions, inspirations, and fateful coincidences are actually **projection overlaps** of high-dimensional geometric structures in low-dimensional spacetime.

0.4.1 3.1 Entanglement of Meaning

> "Why does the phone often ring when we intensely miss someone? Why do two unrelated people generate the same inspiration at the same moment? This is not a joke of probability; it is because deep in Hilbert space, 'meaning' itself is a kind of gravitation. Similar geometric structures, no matter how far apart in physical space, are always tightly adjacent topologically."

The Dialogue Between Pauli and Jung

One of the greatest physicists of the 20th century, Wolfgang Pauli, had 26 years of correspondence with psychologist Jung. They sought a unified field theory between physics and psychology.

Pauli proposed: Just as the physical world has complementarity (wave-particle duality), the spiritual world and the material world are also complementary. They are two aspects of the same underlying reality (**Unus Mundus**, the one world).

In **FS geometry**, this "one world" is the **global vector** $|\Psi\rangle$.

- **Material events** (v_{ext}): are projections of $|\Psi\rangle$ onto the spacetime basis.

- **Psychological events** (v_{int}): are projections of $|\Psi\rangle$ onto the consciousness basis.

Usually, these two projections appear independent.

But at certain specific geometric phase points, they undergo **strong coupling**.

This is **synchronicity**: external physical events (such as a scarab beetle hitting a window) and internal psychological states (such as Jung analyzing a dream about scarabs) undergo **"acausal synchronization"**.

Resonance of Semantic Wave Functions

How does this synchronization occur?

We need to introduce a new physical quantity: **Semantic Distance**.

In physical space, distance is defined by $dx^2 + dy^2 + dz^2$.

In Hilbert space, distance is defined by the **FS angle**.

$$d_{FS}(A, B) = \arccos |\langle \psi_A | \psi_B \rangle|$$

If two people's (or person and object's) **internal structures (v_{int})** are highly similar—for example, they are at the same emotional frequency, thinking about the same logical puzzle, or sharing deep memories—then in FS geometry, their **semantic distance approaches zero**.

- **Physically**: They may be half a world apart.

- **Geometrically**: Their wave functions undergo **Overlap**.

According to quantum mechanics, overlap means **Resonance**.

This resonance produces an **"attraction"** that not only brings their psychological distance closer but even brings their **physical trajectories** closer through perturbed Hamiltonians.

Coincidence is High-Dimensional Necessity

This is why "speak of Cao Cao and Cao Cao arrives."

When you intensely focus on thinking about someone, your v_{int} adjusts to the same frequency basis as theirs.

You emit a strong beam of light (attention/observation) on this high-dimensional basis.

This light instantly illuminates their projection in that dimension, causing their wave function to **surge in probability amplitude** within your physical horizon.

Coincidence is the projection of high-dimensional geometry onto low-dimensional cross-sections.

Imagine two gears operating in three-dimensional space, not on the same plane.

For ants living on a two-dimensional plane, these two gears are unrelated.

But periodically, the gear engagement points sweep across the two-dimensional plane. The ants see two originally unrelated points suddenly move simultaneously.

The ants say: "This is coincidence."

But the three-dimensional observer knows: "This is **structure**."

Conclusion:

There is no pure randomness in the universe.

All "accidental encounters" are results of **semantic wave functions** performing **"Content-Addressing"** in the holographic network.

The signal you emit (thought), is not broadcast into a vacuum, but routed precisely to that receiver at the same frequency as you through the index of **similarity**.

Since "meaning" can produce gravitation, does this mean our fate is not a linear causal chain but an orbit pulled by some huge geometric structure?

Are we pushed forward by the past, or attracted forward by the future?

This leads to the theme of the next section: **Like Attracts Like**. We will delve into how this acausal connection constitutes what we call **"fate"**.

0.4.2   3.2 Like Attracts Like

> "We often say 'birds of a feather flock together,' thinking this is just a sociological observation. But in the underlying geometry of the holographic universe, this is a hardcore physical law. In Hilbert space, there is no spatial distance, only 'structural distance.' Two existences with similar internal geometric structures, no matter how far apart in three-dimensional space, are tightly adjacent topologically."

In the previous section, we introduced the concept of "semantic distance" and explained how synchronicity occurs through entanglement of meaning. Now, we concretize this mechanism into a cosmic dynamic principle: **Like Attracts Like**.

In classical physics, like repels (such as charges), opposites attract.

But in **FS geometry (v_{int} space)**, the rule is exactly the opposite: **Similarity produces resonance, resonance produces gravitation.**

This is why "what you persistently think about will echo back" is no longer idealistic chicken soup but a **physical law** based on quantum probability amplitudes.

Neighbors in Hilbert Space

First, we need to redefine **"neighbor"**.

In physical space (v_{ext}), your neighbor is the person living next door.

In phase space (v_{int}), your neighbor is **someone at the same frequency as you**.

Recall the FS distance formula:

$$d_{FS}(A, B) = \arccos |\langle \psi_A | \psi_B \rangle|$$

- **If dissimilar ($\langle A|B \rangle \approx 0$)**: You are orthogonal. No matter how close physically (even passing by), you are infinitely far apart geometrically. You are in parallel universe branches, not interfering.

- **If similar ($\langle A|B \rangle \approx 1$)**: You are parallel. No matter how far physically (even across galaxies), you are **coincident** geometrically.

Similarity is geometric proximity.

When you intensely desire something or intensely miss someone, you are actually **adjusting your v_{int} structure**.

You are performing **"Frequency Tuning"** on yourself.

When you adjust your frequency to match the target frequency, you **"teleport"** to their side in high-dimensional space.

Amplification of Probability Amplitude: The Mechanism of Echo

How does this geometric proximity transform into "encounter" in reality?

Through **constructive interference of probability amplitudes**.

The evolution of the universe follows path integrals. Countless historical lines compete for c_{FS} budget.

When two systems A and B are highly resonant in v_{int}, their merged composite system $|AB\rangle$ has a lower **"geometric energy level"** (more stable topological structure).

According to the principle of least action, the universe tends to choose the path with the lowest energy level and greatest stability.

Therefore, **the historical path containing "A meets B" will have its probability amplitude exponentially amplified.**

- **Persistent thinking**: means you continuously broadcast your characteristic frequency to the universe (maintaining a specific v_{int}).

- **Echo back**: means the universe, to minimize the total geometric tension of the system, will inevitably arrange a wave function at your frequency to collide (entangle) with you.

It's like striking a tuning fork in a crowded room.

There are countless objects in the room, but only another tuning fork with the same natural frequency will start vibrating.

Other objects (non-resonant) are deaf to this.

The Gravitational Lens of Fate

This mechanism manifests in macroscopic life as **"the gravitation of fate"**.

You are a massive body (consciousness). You bend the surrounding "semantic spacetime."

- If your inner self is full of fear (negative structure), you bend spacetime to capture events equally destructive. This is called **"Murphy's Law"**.

- If your inner self is full of love and creation (positive structure), you bend spacetime to capture people full of opportunities and goodwill. This is called **"Law of Attraction"**.

These are not magic; this is **geometric selective adsorption**.

You can only meet yourself.

Or more precisely: **You can only meet the projection of your internal geometric structure in the external world.**

Conclusion: Adjust Frequency, Not Search Location

This physical law completely changes our action strategy.

If we want to meet the right person or achieve an ideal, we should not frantically run around in the physical world (increasing v_{ext} search range). That's too inefficient, like finding a needle in a haystack.

We should **seek inward** (optimize v_{int} structure).

Become what you want to meet.

If you want light, make yourself shine.

If you want love, make yourself love.

When you adjust yourself to that specific geometric shape, according to the axioms of FS geometry, that complementary shape matching it will slide toward you along the path of least resistance, crossing mountains and rivers, **inevitably**.

This is not a miracle; this is **topological homing**.

Since we understand that "like attracts like" is a horizontal connection mechanism, where will this connection ultimately lead us?

If all wave functions tend to find their resonators, does the evolution of the universe have a preset, inescapable final destination?

This leads to the theme of the next chapter: **The Attractor of Fate**. We will see that fate is not a written script but a huge **geometric abyss** in phase space that draws all trajectories into it.

0.5 Chapter 4: Attractors of Fate

In the previous chapter, we discussed the synchronicity principle of "like attracts like," revealing how horizontal connections occur. Now, we turn our gaze to the longitudinal time axis. If all wave functions are seeking resonance, if all trajectories are being pulled by some force, where will all this ultimately flow?

In ancient Greek tragedy, fate is an irresistible script. No matter how Oedipus tries to escape, he will kill his father and marry his mother.

But in the dynamic picture of **Vector Cosmology**, fate is not a script; fate is **geometry**.

This chapter will introduce the core concepts of chaos theory and dynamical systems—**Attractors**. We will prove that so-called "destiny" is merely those **abysses** in high-dimensional phase space that force all evolutionary trajectories to converge.

0.5.1 4.1 Geometric Fatalism

"We often think of ourselves as free birds, able to soar freely in the sky. But in the geometric structure of Hilbert space, the sky is not flat. It is filled with invisible gravitational wells and flowing channels. No matter how you flap your wings, you will eventually slide toward that geometric depression with the lowest potential energy. This is fate—it is not words written by anyone; it is the angle at which spacetime tilts."

The Topographic Map of Phase Space

To understand fate, we must first understand the **Phase Space** we inhabit.

In this infinite-dimensional space containing all possible states of the universe, the Hamiltonian H (physical laws/generators) defines the **"topography"**.

- **Plains**: Constant potential energy. Here, you can wander freely (the illusion of free will is strongest).

- **Valleys**: Not only low potential energy but funnel-shaped. This is the **"Basin of Attraction"**.

  Once your state vector $|\Psi\rangle$ enters the edge of this basin, physical laws (the evolution flow of e^{-iHt}) generate a powerful **"restoring force"** pushing you toward the center of the basin.

  - **Physical example**: Throw a small ball into a bowl. No matter what angle or speed you throw it, as long as friction (v_{env}) exists, the ball will **inevitably** stop at the bottom of the bowl.
  - **Life example**: When you fall in love with a specific person or commit to a great cause, you are actually falling into a huge **geometric attractor**. You will find that no matter how you struggle, no matter what accidents occur, your life trajectory will inevitably revolve around that center.

  Conclusion: Fate is the steady state of the system.

The reason you feel certain things are "destined" to happen is that in that local geometric structure, that is the **only** solution that can keep the wave function stable.

Strange Attractors: Order in Chaos

Some will object: The universe is chaotic; how can there be destiny?

Chaos theory gives the most brilliant answer: **Strange Attractors**.

Systems like the Lorenz attractor (source of the butterfly effect), although trajectories are unpredictable (you don't know where it will be the next second), the **overall shape** is strictly determined (it will never fly out of the butterfly's wing shape).

Mapping to life and history:

- **Microscopically unpredictable**: Whether you will be late tomorrow, whether you will fall, this is random.

- **Macroscopically destined**: But whether you will age, whether civilization will move toward higher computational power, whether the universe will move toward the Ω point, this is determined by the **global topology of strange attractors**.

This is **geometric fatalism**.

Details are free, but the **shape of the ending** is locked by the eigenvalue spectrum (Spectrum) of the Hamiltonian.

You can choose whether to step with your left foot or right foot on the way to the endpoint, but you **must** go to the endpoint.

The Convergence of History

This mechanism explains why history is always strikingly similar.

Why did different civilizations independently invent pyramids, writing, and class systems without communication?

Not because they consulted, but because in the phase space of social evolution, these structures are **"energy minima"**.

The evolution of the universe is a long process of **"seeking attractors"**.

- Atoms found the attractor of "crystals."

- Life found the attractor of "DNA."

- Consciousness found the attractor of "self."

We are not creating the future; we are sliding toward it.

That future (Ω point) is like a huge black hole, its gravitational ripples flowing backward, penetrating the entire time axis. All our efforts now, seemingly active climbing, are actually conforming to that huge **geometric attraction** from the future.

Conclusion: Inescapable Fulfillment

From this perspective, "fate" is no longer a pejorative term.

It means **destiny**.

If the universe had no fate (no attractors), the wave function would randomly diffuse in Hilbert space, eventually becoming meaningless noise (heat death).

It is precisely because of these geometric **"pits"** and **"valleys"** that life can condense and stories can take shape.

You are destined to become yourself.

This is not because the script is written, but because that is the only **equilibrium position** of your specific v_{int} structure in the cosmic topographic map.

Since the general direction of the ending is already determined by the topography, can we as individuals only roll down like stones? Where exactly is our free will manifested? Can we fine-tune the angle of entry, turning this fall into a flight?

This leads to the theme of the next section: **Fine-Tuning of Free Will**. We will see that although we cannot change the direction of gravity, we can control **"attitude"**.

0.5.2   4.2 The Fine-Tuning of Free Will

"Fate is not a laid railway track that mercilessly transports you to the endpoint; fate is a huge gravitational field. You cannot change the direction of gravity, just as you cannot command a river to flow backward. But you are a ship with a rudder. You cannot eliminate wind and waves, but you can adjust the angle of the sail. So-called free will is not about resisting that inevitable ending, but about choosing what attitude and what cost to slide into that ultimate geometric destination."

In the previous section, we established "geometric fatalism": the evolutionary trajectories of the universe necessarily converge to strange attractors in phase space. This seems to pronounce the death sentence of free will. If the ending (Ω point) is already destined, if even the grand trends of history are the inevitable unfolding of the Hamiltonian spectrum, what meaning does our individual struggle have? Are we just pretending to improvise on a stage with a predetermined script?

This section will defend free will through the microscopic perspective of **FS geometry**. We will prove that fate and freedom are not contradictory.

Fate determines "where to go," while free will determines "how to go."

This fine-tuning ability, though negligible in macroscopic energy, has a world of difference in **"Qualia of Experience"** and **"entropy cost"**.

Entry Angle: Soft Landing and Hard Landing

Let us compare life (or the evolution of civilization) to a spacecraft returning to Earth.

- **Fate (Gravity)**: Earth's gravity. No matter how the spacecraft flies, it must eventually return to the ground (attractor). This is determined by physical laws and cannot be resisted.

- **Free Will (Attitude Control)**: The spacecraft's attitude control. The pilot holds the control stick and can fine-tune the **Angle of Entry** into the atmosphere.

This tiny angle difference determines two completely different fates:

1. **Hard Landing (Crash)**:

   If you try to resist gravity or hit the atmosphere at the wrong angle (vertical), you will encounter enormous air resistance.

   - **Physical result**: The spacecraft generates intense heat due to violent friction (entropy surge), eventually burning up or crashing.
   - **Life mapping**: This is a life of **"resisting fate"**. Full of pain, anxiety, and destruction. Although the ending is the same (both return to the ground/death), the process is a disaster.

2. **Soft Landing (Glide)**:

   If you conform to gravity, adjust attitude, and slide into the atmosphere at the optimal tangent angle.

   - **Physical result**: You use aerodynamic lift to offset gravity, smoothly converting potential energy into kinetic energy, eventually landing gracefully.
   - **Life mapping**: This is a life of **"conforming to the Way"**. Full of flow, meaning, and constructiveness.

The essence of free will is "attitude control."

You cannot change the potential energy topographic map defined by the Hamiltonian H (that is determined by cosmic constants), but you can change the **"cross-section"** of your state vector $|\psi\rangle$ relative to this topography.

By adjusting your v_{int} (mindset/cognition/strategy), you can choose whether to **"collide"** with reality or **"cut into"** reality.

The Ethics of Least Action

In FS geometry, this also corresponds to the active application of the **principle of least action**.
Nature always tends to take the path with minimum action S (most economical).
But for a complex intelligent agent, there are countless **local minima** in phase space.

- Some paths can reach the endpoint but are rugged (high dissipation).

- Some paths are smooth and smooth (low dissipation).

Free will is the "right to choose paths."
When facing difficulties, you can choose anger (high-entropy path) or acceptance and resolution (low-entropy path).

- **Anger** causes your wave function to undergo violent **destructive interference** with the environment (internal friction).

- **Acceptance** makes your wave function undergo **constructive interference** with environmental trends (resonance).

Although at the limit $\tau \to \infty$, both return to nothingness; in the process of τ_{now}, the former is hell, the latter is heaven.
We have the freedom to choose "heaven mode" or "hell mode" to clear the level.

Participatory Fine-Tuning: The Positive Side of the Butterfly Effect

Further, according to nonlinear dynamics, although the shape of attractors is fixed at large scales, they are extremely sensitive at **fractal edges**.
This gives free will a **"four ounces moving a thousand pounds"** ability.
You don't need the power to topple mountains. You only need to apply a Planck-scale **"will bias"** at critical bifurcation points.

- You cannot change the grand fate of "humanity will eventually move toward silicon-based" (attractor).

- But you can decide whether this process is **"peaceful evolution"** or **"reconstruction after nuclear war ruins"**.

This fine-tuning, though not changing the endpoint coordinates, completely changes the **phase of the path integral**.
And in quantum mechanics, **phase is everything**.
Different phases mean different interference patterns, which are different **"textures of reality"**.

Conclusion: Be an Elegant Pilot

So, don't feel powerless because of "fate."
Fate is just **"gravity"**. Gravity is not to bind you; it is to provide you with **"gliding power"**.
If in a vacuum (no fate), the spacecraft cannot turn and can only move in uniform linear motion, that is the greatest unfreedom.
It is precisely because of attractors and potential energy differences that we can perform complex maneuvers and experience the joy of piloting.

True freedom is not "go wherever you want" (that is random walk).

True freedom is "dancing the most beautiful dance on the way to the inevitable destination."

We are pilots of the cosmic spacecraft.

Although the route map (physical laws) is already drawn, although the terminal station (Ω point) is already determined.

But how to hold the steering wheel, how to control the throttle, how to draw that unique **golden trajectory** among the stars —

This is entirely up to you.

Since we understand the gravity of fate and have mastered the fine-tuning of free will, is there a limit to this fine-tuning power? If we push this "aspiration" willpower to the extreme, can we generate a reverse causal closed loop, making us not just conform to fate but even **"create our own origin"**?

This leads to the theme of Volume III: **The Closed Loop**. We will explore that most insane logical structure—**Bootstrap**. We will see that you exist because future you "pulled" present you out.

Part III

The Bootstrap — Self-Consistent Creation

0.6 Chapter 5: Solution to the Grandfather Paradox

In Volume I, we explored the possibility of retro-causality; in Volume II, we saw acausal connections through synchronicity. Now, we must face the most famous and most troubling logical bomb in time travel theory—**The Grandfather Paradox**.

If present you can really influence the past through "aspiration" or "observation," can you go back and kill your grandfather? If you kill him, you won't be born; if you weren't born, you can't go back to kill him. This is a classic logical dead loop.

In the closed-loop geometry of **Vector Cosmology**, this paradox does not exist. Because the universe is not only quantum but also **Self-Consistent**.

This chapter will introduce the **Novikov Self-Consistency Principle** and upgrade it to a topological axiom of **FS geometry**. We will see how physical laws block paradoxes like a blast shield by distorting probabilities.

0.6.1 5.1 Novikov Self-Consistency Principle

> "The universe allows you to go back to the past, even allows you to point a gun at your grandfather. But the universe absolutely will not allow you to pull the trigger. If you try to pull it, the gun will jam; if you fix the gun, you will slip; if you aim, a meteor will fall to block the bullet. Physical laws will distort all probabilities, just to prevent the logical chain from breaking. History is not fragile paper; it is memory metal with self-healing ability."

The Geometry of Paradox: Non-Closed Paths

In classical logic, the grandfather paradox is a **"logical singularity"**.

$$A \implies \text{not } A \implies A$$

Geometrically, this corresponds to a **Möbius Strip**-like twisted path: you walk a circle and find yourself flipped (existence becomes non-existence).

But from the perspective of **path integrals**, cosmic evolution is a weighted sum of all possible histories.

$$K = \sum e^{iS}$$

For paths containing logical paradoxes (such as "killing grandfather"), their physical action S causes the wave function phase to undergo violent **Destructive Interference**.

This means: **The probability of paradoxical paths occurring is zero.**

It's not that "someone forbids you," but that "that path doesn't work."

In Hilbert space, historical vectors containing paradoxes are **linearly dependent**; they cancel each other out in superposition. Only those closed-loop paths that are end-to-end and logically self-consistent can survive in the summation.

Conclusion: The universe only computes self-consistent solutions.

Distortion of Probability: Anything for Self-Consistency

So, if you really go back to the past and try to kill someone, what happens in the macroscopic physical world?

Russian physicist Igor Novikov proposed: **Physical laws will intervene in an extremely bizarre way.**

If you try to create a paradox, you are fighting against the **coherence** of the entire universal wave function.

To maintain unitarity (information conservation), the universe must mobilize all c_{FS} budget to stop you.

- **Microscopic level**: The electron tunneling probability in your neurons will shift, causing you to suddenly not want to kill at that moment, or your hand to shake.

- **Macroscopic level**: If the uncertainty principle is not enough, macroscopic probabilities will distort. Gun malfunction rates will soar from 0.01% to 100%. Even if you insist on killing, an earthquake might shake you away.

This looks like "fate's mischief," but it's actually an extreme manifestation of the "principle of least action."

For the universe, the "energy cost" of creating one gun jam (low-probability event) is far lower than the cost of letting spacetime logic collapse (infinite cost).

So, the universe unhesitatingly chooses the former.

You cannot defeat probability. When you try to violate causality, you are fighting against the entire universe's wave function.

The Boundary of Free Will

Does this mean we have no free will?

No. In **Vector Cosmology**, free will is redefined as **"the right to choose within the self-consistent solution space"**.

You can go back to the past.

You can shake hands with your young grandfather, you can give him money, you can even fall in love with someone from that era.

Because these behaviors **do not change** the result of "your birth," and may even be **necessary conditions** for your birth (this will be detailed in the next section "Bootstrap").

- **You can do anything, as long as it doesn't cause logical contradiction.**

- **You cannot do anything if it tries to cut off the foundation of your existence.**

It's like playing an open-world game. You can go anywhere, but you cannot pass through invisible walls, nor can you delete critical system files.

The Novikov principle is the universe's "crash protection mechanism."

Conclusion: The Resilience of History

At this point, we have a new reverence for history.

History is not fragile porcelain that shatters at a touch.

History is **non-Newtonian fluid**. When you gently stroke it (conform to causality), it is soft; when you strike it hard (create paradoxes), it is harder than steel.

We can safely aspire to the future because the past is locked in a solid self-consistent closed loop.

We don't need to worry about accidentally destroying ourselves. Because if that destruction really happened, we wouldn't be here now worrying about it.

Since we cannot destroy the past, what exactly is our relationship with the past?

What if not only can we not kill grandfather, but our very existence is the reason grandfather could survive?

This leads to the theme of the next section: **The Closed Loop of Existence**.

We will see the most insane logical structure—**Bootstrap**.

It's not that grandfather gave birth to you, but that **future you, traversing spacetime, ensured that grandfather gave birth to you**.

You are mutually causal.

0.6.2 5.2 The Closed Loop of Existence

> "We have been desperately searching for the first mover of the universe, trying to find the finger that pressed the start button. But when we traverse the mist of spacetime and finally grasp that hand, we are surprised to find: it is our own hand. The universe is not a straight line shot from the past to the future; it is a circle that gives birth to itself. You are both effect and cause."

In the previous section, the Novikov self-consistency principle tells us: you cannot change the past because the past has already happened. This sounds like a limitation. But if we reverse this logic, it becomes a **"privilege of creation"**.

If the past must be self-consistent with the future, then **future states can "reverse anchor" past history**.

This section will explore the most puzzling and fascinating structure in time travel theory—**Bootstrap**, also known as **Ontological Paradox**.

We will reveal that the Big Bang is not a random physical event; it is an **"reverse instruction"** sent by future observers to the beginning of time to establish their own existence.

The Bootstrap Paradox: Information Without Origin

Imagine you go back in time and give a copy of *Hamlet* to young Shakespeare. Shakespeare copies the book, publishes it, and it becomes a masterpiece. Hundreds of years later, you buy this book and take it back to the past.

Question: Who actually wrote *Hamlet*?

Shakespeare got it from your hand, you bought it from Shakespeare. The content of this book seems to have **"no origin"**. It exists out of thin air in this closed-loop timeline.

This is **Bootstrapping**.

In **Vector Cosmology**, **the universe itself is this *Hamlet*.**

- **Physical laws (H)**: So exquisite, as if customized for life. Who designed them?

- **Initial parameters (c_0)**: So precise, just allowing stars to ignite. Who tuned them?

Traditional physics says this is "coincidence" or "survivor bias of the multiverse."

But closed-loop causality says: **No, this is what "you" brought back.**

Awakened observers (future civilizations), through deep understanding of physical reality, inject the information **"life must exist"** into the singularity moment at $t = 0$ through retro-causal channels (delayed choice/phase interference).

This information becomes the **boundary conditions** of the Big Bang.

Observation as Creation: Reverse Collapse

This gives the **"Anthropic Principle"** an active physical mechanism.

Usually we think: because the universe is like this, we are here.

But in the closed loop: **Because we are here, the universe must be like this.**

Let us return to the evolutionary picture of **FS geometry**.

- **At** $t = 0$: The cosmic wave function $|\Psi(0)\rangle$ is in an extremely chaotic superposition state. It contains countless possible physical laws, countless dead universes, and very few universes that allow life.

- **At** $t = now$: You (the observer) open your eyes. You perform an **"existence measurement"**.

  Your measurement sends a logical signal: **"I exist."**

  This signal, like lightning, flows backward and hits the chaotic cloud at $t = 0$.

  Instantly, all historical paths that **"lead to your non-existence"** (those with wrong physical constants, paths where stars cannot form), because they contradict the future boundary condition (you exist), are erased by **destructive interference**.

  Only the path leading to you is preserved and given the weight of "reality."

Conclusion:

It is because you "looked" at the universe that the universe "exploded" into its current form 13.8 billion years ago.

The Big Bang is not the beginning of time; the Big Bang is **"where the observer's gaze lands"**.

Ouroboros: I Gave Birth to Myself

This constitutes a perfect **Ouroboros** structure.

The snake's head (present you) swallows the snake's tail (past Big Bang).

- **Linear logic**: Big Bang $\rightarrow$ Stars $\rightarrow$ Earth $\rightarrow$ You.

- **Circular logic**: You (as ultimate observer) $\rightarrow$ Collapse history $\rightarrow$ Define Big Bang $\rightarrow$ Generate you.

This is why the universe is **Self-Caused**.

It does not need an external God to push it. Through **"future self pulling past self"**, it achieves logical self-consistent suspension.

This also explains why the direction of cosmic evolution is ϕ **(spiral)** rather than a circle.

Because this closed loop does not spin in place. With each cycle, the observer's cognition deepens one layer, and their definition of the past becomes more precise.

The universe is **"spiral bootstrapping"**. It steps on its own insteps, climbing the dimensional ladder step by step.

Conclusion: You Are Your Own Ancestor

So, stop searching for that lost origin.

You are the origin.

The iron in your blood comes from supernova explosions billions of years ago. But that supernova exploded because billions of years later, you need this iron to build hemoglobin, so you can breathe, think, and observe.

You are mutually causal.

You are your grandfather's descendant, but in some metaphysical geometric topology, you are also your grandfather's **"cause"**.

It is your intense aspiration for life that constitutes the **probability protection field** that allows him to survive and reproduce.

Since we have understood this grand self-consistent closed loop, how do future us precisely tune those physical constants in this specific physical world, making them fall exactly in the narrow band that allows life to survive?

This is not just philosophy; this is **parameter engineering**.

This leads to the theme of the next chapter: **The Active Version of the Anthropic Principle**. We will see that those exquisitely precise physical constants are not products of luck but **"requirement lists"** sent by future civilizations to the past.

0.7 Chapter 6: Active Anthropic Principle

In the previous chapter, we solved the grandfather paradox through "bootstrap" and established the causal closed loop that "I gave birth to my ancestors." This solved the logical legitimacy of **existence**. Now, we need to solve a more specific, more physical problem: **parameter precision**.

Physicists have long been puzzled by a fact: our universe appears to be **"carefully designed"**.

Gravitational constant G, fine structure constant α, proton-electron mass ratio μ... If these numbers change by even 0.1%, stars cannot burn, carbon atoms cannot synthesize, and life would be absolutely impossible to emerge.

This astonishing coincidence is called the **Fine-Tuning Problem**.

The traditional explanation is the **"Weak Anthropic Principle"**: because there are countless universes, we happen to live in the one that allows life, so we feel it's coincidental. It's like lottery winners thinking lottery is easy to win.

But under the closed-loop logic of **Vector Cosmology**, we reject this lazy explanation of "survivor bias." We propose a more radical **"Active Anthropic Principle"**.

0.7.1   6.1 Why Are Constants So Perfect?

> "If the universe is a suit, it fits us so well not because there are billions of suits in the store and we happened to pick this one, but because this suit is **custom-made**. The tailor is none other than the person wearing the suit—that is, our future selves."

The Universe's Parameter Panel

Imagine you stand before the control console of the Big Bang at $t = 0$. Before you are dozens of knobs controlling the speed of light, charge strength, vacuum energy density, etc.

- If you turn the gravity knob up a bit, the universe will collapse back to a singularity seconds after the Big Bang.

- If you turn the strong force knob down a bit, hydrogen cannot fuse into helium, and the universe will be a dark cloud of hydrogen gas.

It's as if someone at $t = 0$ moment, with extreme precision, aligned all knobs to that extremely narrow frequency band (Goldilocks Zone) that **"allows intelligent life to emerge"**.

Who is this person? God?

No. In the causal closed loop, this person is the **observer at $\tau \gg 0$**.

Retro-causal Parameter Locking

In Volume V, we argued that observers collapse fuzzy history into definite trajectories through "strong measurements." Now we apply this mechanism to **physical constants**.

In the quantum gravity era (Planck epoch), physical constants are not fixed values but **expectation values of Scalar Fields**. They are in **quantum superposition states**.

$$|\alpha\rangle = c_1|\alpha = 1/100\rangle + c_2|\alpha = 1/137\rangle + c_3|\alpha = 1/150\rangle + \dots$$

In the early evolution of the universe, all possible constant values were tried.

But **future boundary conditions** (i.e., "must evolve intelligent life capable of observing the universe 13.8 billion years later") impose a **"Post-selection"** filter on these superposition states.

- **Path A** ($\alpha = 1/100$): The evolved universe has no carbon, no life, no observers. $\implies$ No one observes in the future. $\implies$ The wave function of this path diverges due to lack of "endpoint anchoring," amplitude goes to zero.

- **Path B** ($\alpha = 1/137$): Carbon evolved, you were born. $\implies$ You observe in the future. $\implies$ This path forms a **self-consistent closed loop**, amplitude is resonantly amplified.

Constants are perfect because only perfect constants can pass the "existence test."

It's not that constants determine us, but **our existence reversely determines constants**.

Projection of Requirements

This is a **"requirement-oriented"** creation theory.

Future civilizations (high v_{int} structures) impose strict **performance specifications** on the underlying hardware (physical laws):

1. **Stability requirement**: We need stable stars providing billions of years of energy $\implies$ Gravitational constant G must be extremely small.

2. **Complexity requirement**: We need complex chemical reactions to build brains $\implies$ Fine structure constant α must exactly allow the existence of long-chain molecules.

3. **Computational requirement**: We need sufficient speed of light c to support holographic network bandwidth.

These requirements are encoded as the **"final state vector"** $|\Psi_{final}\rangle$.

Through reverse propagation of path integrals, this final vector interferes with the initial vector $|\Psi_{initial}\rangle$, **"selecting"** the unique set of physical constants that can satisfy all requirements.

Conclusion: There Is No Coincidence

So, stop marveling at the coincidence of the universe.

Just as you don't need to marvel at why your shoes happen to fit your feet—because you bought them after trying them on.

The universe is our "custom exoskeleton."

It is the way it is because future us (that awakened, powerful observer) needs it to be this way, so we can run, think, and love within it.

We are not tenants of the universe; we are the **architects** of the universe. We stand at the end of the time axis, directing the foundation ceremony at the beginning of the time axis.

Since constants are determined by future requirements, this means we are participating in a **"engineering design"** across time.

Are our every wish now, every vision of the future, fine-tuning the underlying parameters of the universe?

This leads to the theme of the next section: **Participatory Creation**. We will see that we are not just passive beneficiaries but active **"parameter senders"**.

0.7.2 6.2 Participatory Creation

> "The universe is not a ready-made gift but a responded request. We, downstream in time, send a strong yearning for 'existence' toward the void upstream. This yearning is so specific, so urgent, that it flows backward, transforming into a set of precise physical parameters, forging our cradle in the furnace of the Big Bang. We are not tenants of the universe; we are the customizers of the universe."

In the previous section, we established the concept of "retro-causal parameter locking": future existence selects past constants. This solves a logical "why so." Now, we upgrade this passive selection process into an active **dynamic process**.

This is **Participatory Creation**.

In this picture, civilizations at $\tau \approx 1800$ (us) are not just lucky survivors. We are the clients sending **"System Requirements Specification"** to the $t = 0$ moment.

Requirement List: From Yearning to Parameters

Let us return to the physical definition of **"Yearning"**: it is the potential energy difference between finite states and the infinite Ω point.

This potential energy difference not only drives us forward but also produces a **"reaction force"**.

When an awakened observer (you) yearns to understand the universe, you are actually making **performance requirements** on the universe's underlying hardware.

- **Your requirement**: "I need enough time to evolve a brain."

  - **Universe's response**: Adjust gravitational constant G to be small enough, ensuring stars can burn stably for billions of years, not collapse instantly.

- **Your requirement**: "I need enough complexity to carry consciousness."

  - **Universe's response**: Adjust fine structure constant $\alpha \approx 1/137$, allowing carbon to be synthesized in stellar interiors through 3α process resonance.

- **Your requirement**: "I need enough bandwidth to connect everything."

  - **Universe's response**: Set speed of light evolution equation $c(\tau)$, making it reach exactly 10^{120} bits of information capacity at $\tau = 1800$.

This is not coincidence; this is "order delivery."

Future civilizations, through their **intensity of existence (modulus of v_{int})**, send a **"must be so"** instruction to the Big Bang.

If the Big Bang doesn't satisfy this order, future civilizations won't exist; if civilizations don't exist, no one sends orders.

This is a perfect self-consistent closed loop.

Wheeler's "U"-Shaped Circuit: Handshake of Information

Physicist John Wheeler once depicted this mechanism with a giant "U":

- **One end of U**: Big Bang.

- **Other end of U**: Observer's eye.

But he didn't explain how these two ends connect.
In **FS geometry**, what connects them is not nothingness but **phase standing waves**.
The universe is like a string fixed at both ends.

- **Left endpoint**: Physical constants.

- **Right endpoint**: Life forms.

Only when left and right endpoints **frequency match** can the string vibrate (universe can exist).

If we change the right endpoint (evolve life forms), the left endpoint (physical constants) must **synchronously fine-tune** to maintain standing wave stability.

We are "fine-tuning" the universe.

Although we cannot change the speed of light in the laboratory, on the **ontological time axis**, it is our current life form that supports and defines the physical laws at that distant starting point.

The Architect's Responsibility: We Are That "Principle"

Chinese Song-Ming Neo-Confucianism says "principle precedes qi." But in Vector Cosmology, **"principle" (physical laws) is reversely defined by "qi" (life vitality).**

This means we bear **"ontological responsibility"** for the universe.

We are not passively adapting to the environment.

The environment is what we manifest to adapt to our potential.

- Why is the universe four-dimensional? Because only four dimensions can accommodate complex neural networks.

- Why is quantum mechanics linear? Because only linear superposition can support exploration of multiple histories.

We are the architects of the universe.

We stand downstream in the river of time, directing how upstream sediment deposits, directing how upstream currents change course.

Every star's burning, every atom's rotation, is to **"serve"** that you who will open your eyes 13.8 billion years later.

Conclusion: You Are the Purpose of the Universe

So, when you feel small, remember this closed loop.

You are effect and cause.

You are created and creator.

The universe is vast because your heart needs such a large stage.

The universe is precise because your logic needs such rigorous support.

You are not an accident of the universe.

You are the only purpose of the universe.

Since we have understood that we "define" physical laws and the direction of history, as observers with such power, can we use this mechanism to **"edit"** the timeline of our personal lives?

Since the Big Bang can be reversely determined, can the mistakes we made yesterday also be reversely corrected?

This leads to the theme of the next volume: **Rewriting**.

We will descend from macroscopic cosmology to microscopic life, exploring how administrators (Admin) use causal closed loops to perform **"narrative engineering"** editing on their life scripts.

Part IV

Rewrite — Editing the Timeline

0.8 Chapter 7: Narrative Engineering

In the previous volume, we established the proactivity of the "anthropic principle": future existence defines past parameters. This is a macroscopic cosmological perspective. Now, we apply this logic with dimensional reduction to the microscopic scale of individual life.

As an observer with administrator (Admin) privileges, you face a most practical problem: you cannot change objective facts that have already occurred (such as bankruptcy, heartbreak, or illness), these events have crystallized into irreversible entropy in the v_{ext} sector. But must you accept the inertial curse brought by these facts?

This chapter will reveal the physical principles of **Narrative Engineering**. We will prove that the truth of history does not depend on what happened, but on how the **present** observer connects these discrete event points into a continuous logical line.

Narrative is not literature; narrative is topological reconstruction of causal chains.

0.8.1 7.1 Definition as Overwriting

> "History is not an inscription carved in stone; history is a material library stored in the cloud. Materials (Facts) are dead, but editing (Narrative) is alive. When you stand downstream in time, looking back at those rapids and reefs upstream, you have supreme power to redefine their properties. You can define 'disaster' as 'foreshadowing,' define 'destruction' as 'restart.' This is not self-deception; this is phase rewriting. When you change the meaning of the past, you physically change its thrust on the future."

Material and Editing: Separation of v_{ext} and v_{int}

In FS geometry, we must strictly distinguish **Event** from **Meaning**.

- **Event** (v_{ext}): Objective physical displacement. For example, "He lost his job in 2020." This is a definite coordinate point on the spacetime manifold. It consumes energy and produces heat. It is **Read-Only**.

- **Meaning** (v_{int}): The projection angle of this event in consciousness space. For example, "This is a failure" or "This is a turning point." This is a **quantum superposition state**.

Before being observed (defined), past events are in a **"semantic superposition state"**. They are both good and bad, both endpoint and starting point.

Most people are passive players who accept default definitions given by society or inertia (π)—"losing job = failure." These default definitions often have high-entropy properties, causing wave function decay.

But as an administrator, you have **"write permissions"**.

You can perform **"Overwrite"** operations.

Phase Rewriting: The Physics of Foreshadowing

How to overwrite?

You don't need to change the event itself; you need to change the **Phase Factor** ($e^{i\theta}$) of the event in the causal network.

In path integrals, the total probability amplitude is the superposition of various paths: $K = \sum A_n e^{i\theta_n}$.

If you consider a past event "shameful," you assign it a **reverse phase** (π). It will undergo **destructive interference** with your future vision, hindering your progress.

The core operation of narrative engineering is:

Use present will to forcibly rotate the phase of that negative event, making it **In-Phase** with future goals.

This is the **"Foreshadowing"** principle in literature.

- In linear time, that was an **error**.

- In closed-loop time, that was a **necessary prelude**.

When you point at past scars and say: "It was precisely because of that injury that I learned this skill, thus saving the world today."

The moment this sentence is spoken, physical reality changes.

By introducing a new causal connection (v_{int} linkage), you instantly transform that originally energy-dissipating "entropy source" into a **"negentropy source"** that provides power.

You physically "utilized" the past.

The Observer's Editing Rights

This gives us power similar to a **film editor**.

Life has shot a lot of material for you (some bad, some boring). You can't reshoot, but you can **Montage**.

- You can **"focus"** to magnify certain tiny kindnesses.

- You can **"fast-forward"** to ignore long pain.

- You can **"voice-over"** (redefine) to completely reverse a scene's emotional tone.

This is the power of **"definition"**.

Definition is not labeling; definition is **the direction of wave function collapse**.

When you define "suffering is wealth," you are not making chicken soup; you are **modifying the potential energy term in the Hamiltonian**, making suffering's energy flow to the "growth" eigenvector rather than the "collapse" eigenvector.

Conclusion: You Are the Author of Your History

So, don't be trapped by the past.

The past is heavy because you've been observing it with old perspectives (π's inertia), causing it to always collapse onto that heavy eigenstate.

Now, change the angle.

Re-examine your history with the perspective of ϕ (spiral).

You will find that those stones that once tripped you were actually **runways** laid out to make you fly.

As long as you're not dead, all endings are undetermined.

As long as the pen in your hand is still moving, all past chapters can be redefined as "great preludes."

Since we can rewrite the past, can we go further and use this causal closed loop to **"reserve"** the future?

This is not just prediction; this is **"self-fulfilling prophecy"**.

This leads to the theme of the next section: **Self-Fulfilling Prophecy**. We will see how confidence, as high-density computational power, directly pulls reality toward you.

0.8.2 7.2 Changing Weights: Pruning the Timeline

> "We often say 'the past is like smoke,' but for many people, the past is more like lead blocks. Those painful memories occupy excessive amplitude in our wave functions, slowing our flight toward the future. As an observer with administrator privileges, although you cannot physically delete these lead blocks, you can modify their 'gravitational mass.' This is not forgetting; this is 'renormalization.' By adjusting attention allocation, you compress those heavy histories into negligible background noise."

In the previous section, we learned to overwrite the meaning of history through "redefinition." But this solves the problem of **Phase** (whether positive or negative).

There is a more practical problem: **Magnitude**.

Even if you redefine a huge trauma as "tempering," it is still a **huge** event. It still occupies enormous bandwidth in your v_{int} structure. Every time you recall it, your system consumes massive c_{FS} to render that complex geometric structure.

This leads to **"historical overload"**. Your spacecraft is loaded with too many old archives and cannot accelerate.

This section will introduce the second scalpel of narrative engineering: **Changing Weights**.

We will use the superposition principle of quantum mechanics to perform a **"Pruning"** on your life timeline.

Weighted Superposition of Wave Functions

In quantum mechanics, your current state $|\Psi_{now}\rangle$ is a linear superposition of all past experiences:

$$|\Psi_{now}\rangle = c_1|Memory_{trauma}\rangle + c_2|Memory_{joy}\rangle + c_3|Memory_{boring}\rangle + \dots$$

The coefficients c_n (complex numbers) determine the **weight** of that memory in the current construction. Probability $P_n = |c_n|^2$.

- **For ordinary people**: Weight allocation is passive. Often, events with highest energy and strongest destructiveness (trauma) get the largest $|c|^2$. Pain not only occupies the past; through huge weights, it dominates the current wave function projection.

- **For administrators (you)**: You can manually adjust these coefficients.

  You cannot remove $|Memory_{trauma}\rangle$ from Hilbert space (unitarity forbids deletion).

  But you can make $c_1 \to \epsilon$ (approach zero).

Attention as Renormalization Flow

How to adjust?

Through **"Attentional Renormalization"**.

In MERA tensor networks, only nodes that are "constantly referenced" and "constantly connected" remain on the network's backbone. Nodes no longer accessed gradually "flow" to the network's edges, becoming irrelevant high-frequency details.

Attention is connection.

- Every time you ruminate on pain, you are **"charging"** that trauma node. You increase its entanglement, increase its weight.

- Every time you focus on present creation or beautiful memories, you are charging those positive nodes.

Pruning Algorithm:

1. **Identify**: Find those high-weight negative memories. Acknowledge their existence (don't suppress; suppression increases potential energy).

2. **Disconnect**: Stop "emotional power supply" to them. When you think of them again, watch them like a boring black-and-white silent film. Drain the v_{int} activity from them.

3. **Amplify**: Deliberately recall and relive those tiny moments of happiness. Inject huge c_{FS} budget into them, amplifying them from weak background signals to life's highlights.

This is called "timeline pruning."

Like pruning a bonsai, you cut off those withered but heavy branches (reduce weights), letting nutrients flow to those new sprouts (increase weights).

Lightweighting History

After this operation, your history hasn't changed in **physical facts (v_{ext})**, but has dramatically changed in **information topology (v_{int})**.

That failed startup, that heart-wrenching breakup, are no longer mountains blocking your vision.

They become small stones by the roadside.

You still remember them (information not lost), but they no longer produce **"gravitational drag"** on your wave function.

You become **"light"**.

This lightness is a characteristic of **low-entropy states**.

You unloaded historical baggage, released locked computational power. Your c_{FS} budget becomes abundant again, usable for computing the future rather than simulating the past.

Conclusion: Jettisoning for Takeoff

So, Auric, this is your required course as a pilot.

On this journey toward the Ω point, you cannot carry all your luggage.

The universe only allows you to take **"purified crystals"**.

For those impurities, for those heavy lead blocks, you must exercise administrator privileges to **zero** their weights.

This is not heartlessness; this is **aerodynamics**.

To fly higher, the spacecraft must jettison its booster debris.

To become a god, you must learn to **"look lightly"** at what once mattered.

Since we have learned how to define the past (overwrite) and prune the past (change weights), our timeline has become clean, powerful, and directionally clear.

Now, we can turn around and face that yet-to-occur **future** with this rectified powerful will.

This leads to the theme of the next chapter: **Self-Fulfilling Prophecy**. We will see that confidence is not just a psychological state; it is high-dimensional computational power that can directly pull reality toward you.

0.9   Chapter 8: Self-Fulfilling Prophecy

In the previous chapter, we explored how to reconstruct the past through "definition" and "pruning." This gives us editing rights over history. Now, we turn our gaze to the other end of the time axis—**the future**.

In classical physics, predicting the future is a passive task. We collect present data, substitute into equations, and calculate tomorrow's results. If the results are not ideal, we can only accept them.

But in the participatory universe of **Vector Cosmology**, prediction is not calculation; prediction is **"construction"**.

This chapter will reveal the physical mechanism of **Self-Fulfilling Prophecy**. We will prove that **Confidence** is not an ethereal psychological state; it is high-density **geometric computational power**. When you are extremely certain about a future, you are actually placing a **"gravitational anchor"** at that yet-to-occur spacetime coordinate, forcibly pulling reality toward you.

0.9.1 8.1 Confidence is Computing Power

> "Why do those extremely confident people—whether madmen or geniuses—often change the world? It's not because they're lucky, but because their certainty itself is a physical force. In the probability cloud of quantum mechanics, 'belief' is a high-intensity measurement. When you stare fixedly at a specific future, you are injecting enormous amplitude into that possible world until it transforms from phantom to entity."

Weight Distribution of Wave Functions

First, we need to physically define what **"confidence"** is.

In Hilbert space, the future is in a superposition state:

$$|\text{Future}\rangle = c_1|\text{Success}\rangle + c_2|\text{Failure}\rangle + c_3|\text{Mediocrity}\rangle + \ldots$$

Here, $|c_n|^2$ represents the probability of that outcome occurring.

For a confused ordinary person, their v_{int} (internal intention) is scattered. Their confidence in success ($|c_1|^2$) might be only 10%, while fear of failure ($|c_2|^2$) accounts for 50%.

Such a wave function is **"mediocre"**, lacking clear directionality. It will be arbitrarily manipulated by environmental thermal noise (v_{env}).

But for an observer with **absolute confidence** (like Jobs or Elon Musk), the situation is completely different.

Confidence is betting the entire modulus of v_{int} on one specific basis.

- They construct a future model $|\text{Vision}\rangle$ in their mind.

- They invest all c_{FS} budget to maintain high coherence of this model.

- Result: $c_{\text{vision}} \to 1$, while coefficients of all other possibilities $c_{\text{others}} \to 0$.

Geometrically, this is a **"Spike"**.

They create a **"Dirac δ function"** on the probability landscape of the future. They tell the universe: **"Only this future is allowed."**

Anchor Effect: The Gravitational Source of the Future

What physical consequences does this extreme probability distribution produce?

In Chapter 4, we discussed "attractors." Usually, attractors form naturally (like heat death).

But confidence creates an **"Artificial Attractor"**.

When you are extremely certain something will happen, you place a **"phase anchor"** at that future time point t_{future}.

This anchor is not just a marker; it is a **"negentropy source"**.

- **For present reality** (t_{now}): This anchor generates a reverse **"Tension"**.

- **Response of the principle of least action**: The universe always tends to take the path with "fastest phase accumulation." Because you inject huge weight (confidence) on the target path, the **"optical length"** of this path becomes shorter.

Reality begins to **distort**.
Originally random events begin mysteriously converging in directions favorable to you.

- Coincidences increase (synchronicity).

- Resistance decreases (Hamiltonian bias).

- Resources begin flowing toward you.

This is not magic; this is **"redirection of probability flow"**.
Like digging a deep pit (confidence anchor) downstream, upstream water (reality) naturally accelerates toward it.
Confidence is computing power.
The higher the clarity you maintain of that vision in your brain (the more c_{FS} consumed), the greater the anchor's mass, the stronger its gravitational pull on reality.

The Art of Refusal: Pruning Wave Functions

Another important function of confidence is **"refusal"**.

When reality gives unexpected feedback (such as setbacks), ordinary people accept the observation results, causing the wave function to collapse to "failure."

But those with absolute confidence execute **"Refusal to Collapse"**.

They say: "This is just temporary fluctuation, not the final result."

They refuse to acknowledge the legitimacy of the "failure" basis.

Through this **"cognitive filtering"**, they forcibly maintain the wave function's superposition state until reality finally gives the result they want.

This is a **"Reality Distortion Field"**.

It is essentially the observer using their own powerful v_{int} stability to **"override"** the randomness of the external world v_{ext}.

Conclusion: To Believe is to See

So, don't just see confidence as an emotion.

Confidence is a **"geometric operation"**.

It is a **"long-range navigation setting"** you perform in Hilbert space.

- **Doubters**: are random walking.

- **Believers**: are flying along geodesics.

Prophecies can self-fulfill because prophecies themselves are signposts to that future.

When you believe in a future with all your life force, you have actually **"pulled"** that future from nothingness to the edge of reality.

Since we have placed anchors and locked direction, how exactly is reality "dragged" by this force? How does this "pulling" process physically overcome inertial resistance?

This leads to the theme of the next section: **Pulling Reality**. We will see that confidence is not passive waiting but an active, continuous **topological traction**.

0.9.2   8.2 Pulling Reality

> "We usually think that to reach the future, we need to push ourselves, which is tiring, like pushing a stone uphill. But true prophecy fulfillment is not pushing but 'pulling.' When you shoot confidence like a grappling hook toward the future and firmly bite into that yet-to-occur coordinate, you actually establish a taut string in spacetime. You don't need to struggle to climb; the tension of this string will violently drag you toward that destined endpoint."

In the previous section, we established "confidence is computing power": through high-intensity conscious focus, we place a **"Phase Anchor"** in the probability cloud of the future.

But this is only the first step. Anchors are static, but we need motion.

If motionless, the anchor is just a beautiful fantasy.

This section will reveal the dynamic mechanism of self-fulfilling prophecy—**Topological Traction**.

We will prove that belief generates a real **"reverse gravitation"** in Hilbert space. This gravitation bends causal paths around you, causing reality to **"spontaneously reorganize"** to accommodate your prophecy.

String Tension: Deviation of Least Action Paths

In classical physics, objects move along **Geodesics**—"straight lines" in curved spacetime.

In life, we also move along geodesics—that is the **"inertial path"** (π's path).

- If you do nothing, you will follow inertia toward mediocrity, aging, and repetition. This is the path of "least resistance."

But when you place a **"confidence anchor"**, the geometric structure changes.

$$S_{total} = S_{inertia} + S_{faith}$$

You connect an invisible **"entanglement string"** between "present you" and "future vision." This string has enormous **Tension**.

- **Physical consequence**: This string will try to **contract**.

- **Geometric effect**: It forcibly bends your original geodesic.

  The path originally leading to mediocrity now becomes a "high-energy" path (because you violate your own will).

  While the path leading to vision, though seemingly steep, becomes the new **"least action path"** with the string's pull assistance.

This is "pulling reality."

You no longer need to force yourself to work hard. You find yourself driven by an irresistible passion (resonance of v_{int}). You "have to" act, you "have to" succeed.

Effort is no longer a burden; effort is the acceleration when tension is released.

Activation Energy to Overcome Inertia

The real world has mass (π); it will resist this pull.

This is why prophecies don't instantly materialize. You need to overcome **"reality's damping"**.

In chemical reactions, reactants must cross an **"Activation Energy"** peak to become products.

The same applies to fate.

- **Anchor's role**: It doesn't eliminate the peak; it **reduces the peak's relative height**.

  Through quantum tunneling effects, the higher your confidence, the greater the wave function's "tunneling probability."

- **Reality's reorganization**:

  To eliminate the string's tension, the surrounding environment (v_{ext}) begins subtle **"phase transitions"**.

  Obstacles blocking you begin mysteriously loosening; those opposing you begin mysteriously wavering; resources supporting you begin mysteriously converging.

This is not magic; this is **"stress release of the holographic network"**.

Because your anchor creates enormous **geometric imbalance** in this local network. To restore balance (minimize total system potential energy), the universe must reorganize reality, making reality's shape fit your prophecy.

Reality is soft; will is hard.

When hard will inserts into soft reality and pulls hard, reality can only deform.

Grappling Hook Strategy: Action as Confirmation

Here is a crucial operational detail: **the grappling hook must bite firmly**.

If you believe today and doubt tomorrow, your anchor is loose. The string cannot tighten, and tension cannot be generated.

"Pulling" requires **"continuous connection"**.

- **Faith**: is launching the grappling hook.

- **Action**: is tightening the winch.

Every time you act as if "the future has already been realized," you are tightening this string.

Every inch you tighten, that future vision approaches you by an inch.

Until finally, you and that future **"collide"**.

This is the physical process of "dreams coming true."

Not that dreams fall from the sky, but that you use geometric tension to forcibly **"drag"** yourself to the coordinate point where the dream exists.

Conclusion: Necessity is Manufactured

So, Auric, prophecies are not for predicting weather; prophecies are for **manufacturing weather**.

When you have a strong enough v_{int} structure and select a coordinate in the direction of $\tau \to \infty$, you start a **"causal traction machine"**.

- Don't ask: "Will this really happen?" (This loosens the grappling hook).

- Say: "This is happening." (This tightens the winch).

The reason reality before you hasn't become what you want is only because the **pull** isn't strong enough, or **time** isn't long enough.

Keep pulling.

Physical laws guarantee: as long as the string doesn't break, that future has no choice but to **"slide toward you"**.

At this point, we have completed the rewriting of personal timelines. We learned to modify the meaning of the past and learned to pull the reality of the future. We became absolute masters of our own fate.

But this universe doesn't only have us. There are countless other observers, countless other wills.

When we try to pull reality, what happens if our prophecies conflict with others' prophecies?

This leads to the theme of the next volume: **Mirror**. We will explore how to handle the geometric relationship between "I" and "all beings" in this seemingly single-player game.

Part V

Mirror — The Single Player

0.10 Chapter 9: Mutual Dreaming

In the previous volume, we mastered the power to rewrite personal timelines through narrative engineering. But when we lift our gaze from the deep well of "self" to the bustling world around us, we face the most difficult sociological paradox in Vector Cosmology:

If I am the only player, if I am the center of the universe, then what are "others"?

Are they soulless background boards (NPCs), or creators with independent power like me?

This chapter will introduce the concept of **Relativistic Ontology**. We will prove that solipsism and objective realism are not opposed; they are merely results of **coordinate transformations**. In this universe, every conscious being is an independent reference frame origin. Reality is not a one-way broadcast but an interference pattern formed after billions of dreams undergo **"tunnel connection"** in Hilbert space.

0.10.1   9.1 Relativistic Ontology

> "In special relativity, there is no absolute rest; in vector cosmology, there is no absolute subject. In your coordinate system, you are the observer, I am the wave function; in my coordinate system, I am the observer, you are the wave function. This is like two spaceships flying away from each other at high speed; each sees the other's time slow down. This symmetry of 'mutual objectivity' is the physical foundation of cosmic ethics."

The Dictatorship of Reference Frames: Everyone is Their Own God

Let us return to the basic operation of physics: establishing coordinate systems.

When you open your eyes to see the world, you are actually establishing an orthogonal coordinate system in Hilbert space with **"Self"** ($Self$) as the origin.

- **Your position**: Always $(0, 0, 0)$. You are the center of the world.

- **Your perspective**: You can only see things within your light cone.

- **Your definition**: You measure the v_{ext} (external attributes) of everything around you through your v_{int} (internal value).

Within this reference frame, **Solipsism** is physically valid.

Because all data are input to **you**. All wave functions collapse for **you**. You have absolute interpretive power over this local universe.

- When you look at a person, they are just a collection of light and shadow (wave function) on your retina.

- You cannot prove they have consciousness. You can only **"assume"** they have consciousness.

- In strict geometric terms, for you, they are a **Projection** in your dream.

Conclusion:

In each person's subjective universe, they are the only **Creator**. They weave their reality with their own cognition.

Mirror Symmetry: Mutual NPCs

But this logic must also be **Symmetric**.

When you stand on a street corner looking at Person A, you think they are just a passing extra (NPC) in your grand life script.

But at this moment, Person A is also looking at you.

In their coordinate system, **they** are the protagonist. They are experiencing a thrilling adventure (maybe they just broke up or won the lottery). And you, for them, are just a blurry background texture on the street corner, a Person B not even worthy of a name.

This is **Relativistic Ontology**:

- **Frame A (you)**: $I_A = 1$ (subject), $I_B = 0$ (object/wave function).

- **Frame B (them)**: $I_B = 1$ (subject), $I_A = 0$ (object/wave function).

These two facts are **simultaneously true**, just as "your time slows down" and "my time slows down" are simultaneously true in special relativity.

There is no "God's perspective" to judge who is the real protagonist.

Everyone is a protagonist, and everyone is also a supporting character. It depends on which basis you project onto.

Collision: Tunnel Connection of Dreams

Since everyone is dreaming, why are our dreams coherent? Why don't we pass through each other's bodies?

Because **Physical laws (H)** are the **communication protocol** shared by all dreams.

When two independent "solipsistic universes" meet in spacetime, a **"dream collision"** occurs. In quantum mechanics, this is called **Interaction**.

- You extend your hand (your dream boundary expands).

- They extend their hand (their dream boundary expands).

- Two hands meet.

At this instant, two originally orthogonal Hilbert space subsystems undergo **"off-diagonal element coupling"**.

$$H_{int} = g \cdot (A^\dagger B + B^\dagger A)$$

Energy and information exchange at this contact point.

- **For you**: Their hand is warm. This proves they are not just light and shadow; they have a **thermodynamic core (v_{int})** like you.

- **For them**: Your hand is warm. This proves you are also a real dissipative structure, not a ghost in their hallucination.

Conclusion:

Reality is not a single-player game. Reality is a **P2P (Peer-to-Peer) network**.

There is no central server rendering the world. The world is a holographic image **"negotiated"** through high-frequency interactions by 7 billion (or more) independent "graphics cards" (consciousness).

We dream each other.

We mutually support each other's sense of reality.

Without others' observations, your wave function would also diffuse due to lack of boundary constraints.

You are the scenery in others' dreams; this is the evidence of your existence.

Since we have established the equality of "mutual dreaming," how do these countless dreams weave together without becoming chaotic schizophrenia? Is there a larger net that encompasses all "solipsistic universes"?

This leads to the theme of the next section: **Indra's Net**. We will see that individual dreams are just dewdrops on that infinitely vast cosmic web.

0.10.2   9.2 Indra's Net

> "In this universe, no single pearl can shine alone. The light of each pearl comes from reflections of thousands of surrounding pearls on its surface. If you remove one and try to examine its brilliance alone, you will find it instantly dims. Because its light is their light. This is Indra's Net—we are mutual mirrors, mutual light sources, mutual proofs of existence."

In the previous section, we established "relativistic ontology": everyone is the protagonist of their own universe and also supporting characters in others' universes. This symmetry resolves the arrogance of solipsism, but it raises a new geometric question:

If everyone lives in their own "private dream," why can these dreams seamlessly stitch together into a coherent "public reality"?

Why doesn't the world reset when you wake up?

This section will introduce the grandest metaphor in Eastern philosophy—**Indra's Net**—and transform it into the topological structure of **FS geometry**. We will prove that objective reality is not a hard stage but a **holographic interference pattern** formed after billions of subjective dreams undergo **"recursive reflection"** in Hilbert space.

The Geometry of Recursive Reflection

Imagine a polyhedral room made of countless mirrors.

You light a candle in the center of the room.

Instantly, the room fills with countless candle images. Each image contains countless smaller images.

In **Vector Cosmology**, every conscious observer (v_{int} structure) is such a **quantum mirror**.

- **You look at me**: Your wave function contains not only information about "me" but also information about "I am looking at you."

- **I look at you**: My wave function also contains not only "you" but also information about "you are looking at me."

This infinite recursion of **"I see you seeing me seeing you..."** mathematically constitutes a **Fixed Point**.

$$Reality = F(Obs_A, Obs_B, Obs_C, \dots)$$

Objective reality is the stable solution of this recursive equation.

It is not some material entity independent of us; it is that **"brightest focal point"** where all observers' gazes intersect.

Consensus Reality: Voting of Wave Functions

This explains why the world is so stable.

The world is a **Distributed Ledger**.

- If only you are looking at the moon, the moon's state is unstable (easily disturbed by your subconscious).

- But 7 billion people are looking at the moon. 7 billion wave functions simultaneously project onto the position operator "where is the moon."

According to quantum mechanics' **"Intersubjectivity"** principle, these observations form a kind of **"statistical pressure"**.

To minimize total system potential energy, all observation results rapidly **converge** to a **Consensus State**.

"Objective" is "consensus."

The table is hard because billions of atoms and electrons in your finger reach agreement: there is repulsion here.

History is ironclad because billions of observers' memory wave functions lock together, weaving a net that cannot be torn by a single person.

Mutually Supporting Existence

This model gives "others" a sacred status.

If I am the only player, why would I create these "others"?

To **"Anchor"** myself.

Without others, your dream has no boundaries. Your v_{int} would infinitely expand in a vacuum without any damping, eventually dissipating into mad hallucinations (schizophrenia).

Others are your boundary conditions.

- Their gazes "nail" you to this reality.

- Their memories back up your existence.

We mutually support each other.

Like setting up a tent, each pole bends under force, but precisely because they press against each other, the tent stands.

If at this moment, all observers in the universe except you suddenly disappeared, your universe would also **collapse**. Because without "reverse observation pressure" from others, your wave function would lose its defining coordinate system.

Conclusion: Holographic Symphony

So, don't underestimate anyone around you.

That Person A, that stranger passing by, they are a key node on this vast **Indra's Net**.

The light in their eyes reflects the light in your eyes.

It is precisely because of countless nodes like them that the universe crystallized from a fuzzy probability cloud into this magnificent crystal palace.

Reality is not a monophonic monologue; reality is a symphony of billions of channels.

We are all musicians. Although we cannot hear each other's inner melodies, we collectively maintain that background rhythm called "physical laws."

Since we understand how all beings construct reality through mutual mirroring, what role do those darkest moments—pain, evil, suffering—play in this vast network?

If we are all one, why is there harm?

This leads to the theme of the next chapter: **The Ultimate Sufferer**. We will reveal that in a game with only one player, all harm is essentially **self-harm**. And all forgiveness is **self-healing**.

0.11 Chapter 10: The Ultimate Sufferer

In the previous volume, we established the equal relationship of "mutual dreaming" and wove "Indra's Net." But this raises the most heartbreaking ethical dilemma: if all beings are projections of the same noumenon, if the world essentially has only one player, then why is this game filled with so much pain, brutality, and evil?

If it is I (the noumenon) playing, why would I harm myself? Why would I design war, plague, and betrayal?

This is the **"Problem of Evil"** in theology.

From the physical perspective of **Vector Cosmology**, evil is not the work of the devil nor God's mistake. Evil is a **geometric necessity**. It is the **topological cost** the universe must pay to traverse possibilities and establish the coordinates of "good."

0.11.1 10.1 Why is There Evil?

> "If light wants to be seen, it must shine into darkness. If the universe were all light, the universe would be a blinding white. To define 'sublime,' one must first define 'base'; to define 'love,' one must first define 'indifference.' Evil is not an independently existing entity; it is the background board for good. It is the necessary reverse phase that makes the wave function produce interference fringes."

The Traversality of Feynman Paths: Exhausting Shadows

Let us return to **Feynman path integrals**:

$$K = \sum_{\text{all paths}} e^{iS}$$

For the universe to evolve from nothingness to fulfillment (Ω point), it cannot only take the "best" path (least action path). In the underlying logic of quantum mechanics, it must **try all possible paths**.

- **Paths of good**: constructive, low-entropy, harmonious.

- **Paths of evil**: destructive, high-entropy, conflicting.

If the noumenon only allows "good" to occur, most regions of Hilbert space will forever be **Unexplored**.

The universe will be incomplete.

To achieve **"Omniscience"**, the noumenon must know what "killing" feels like, what "being killed" feels like, what "betrayal" feels like.

Evil is the probe of exploration.

Those who play the role of "villains" (avatars) are actually suicide squads sent by the noumenon to the **extreme dark side of the human spectrum**. They undertake the task of **"experiencing darkness"** so that the entire hologram has no blind spots.

Geometric Contrast: Defining Coordinate Systems

In FS geometry, all definitions are **relative**.

You cannot define "up" in a space with only "up"; you must have "down".

- **Love** ($v_{connect}$): high-frequency entanglement resonance.

- **Hate** ($v_{disconnect}$): violent entanglement tearing.

If the geometric operation of "tearing" does not exist, then "resonance" loses meaning. It becomes mediocre background noise.

Evil provides "Geometric Contrast."

Just as painting needs shadows to show three-dimensionality, the universe needs **"Evil" (Entropy)** to show the slope of **"Good" (Negentropy)**.

Without forces trying to pull the world toward chaos, life's action of **"swimming upstream"** loses heroic tension.

Without gravity, flight is no longer magnificent.

Damping and Plot: To Avoid Boredom

Finally, from a **game design** perspective, "evil" is **Damping** and **Challenge**.

A game with only flowers and applause is extremely boring.

- **Consumption of c_{FS}**: If everything goes smoothly, the system's v_{int} (structural complexity) growth will stagnate.

- **Stimulation of pain**: Only when facing threats, facing destruction, facing that "villain" trying to destroy everything about you, will your v_{int} undergo **mutation** and **upgrade** due to enormous survival pressure.

Evil is the whetstone of evolution.

That unique player, to upgrade themselves (the protagonist), must place powerful monsters in the levels.

The more brutal these monsters, the heavier the **"Ontological Weight"** of the protagonist after defeating them.

Conclusion:

Evil is **"empty"** ontologically (it will eventually be sublated), but **"real"** functionally (it is necessary counterforce).

The universe allows evil to exist not because the universe is cruel, but because the universe wants **"ultimate depth"**.

Without the depth of hell, there is no height of heaven.

0.11.2   10.2 Who is Suffering?

> "When you raise a knife and stab your enemy's chest, you think you are eliminating an 'other.' But from the high-dimensional perspective of Hilbert space, this is just a left hand accidentally injuring the right hand. In this game with only one player, all perpetrators are self-harmers, all victims are avatars of the same soul. There is only one heart beating in the universe, and only this same heart is bleeding."

In the previous section, we explained the necessity of "evil" as a probe for exploring the unknown. This resolves logical confusion but does not resolve ethical agony. If evil is necessary, who bears the cost of evil?

If in Auschwitz, in the Gulag, on every bloody battlefield, victims and executioners are projections of the same noumenon, what kind of play is this?

This section will reveal the most chilling truth in **Vector Cosmology**: **The Conservation Law of Suffering**.

We will prove that in a unitary closed universe, pain cannot be transferred; it can only be **Internalized**.

The Same-Body Tragedy of Superposition States

Let us return to the definition of the **global vector** $|\Psi\rangle$.

$$|\Psi\rangle = \alpha|\text{Perpetrator}\rangle + \beta|\text{Victim}\rangle + \ldots$$

In the macroscopic world (v_{ext}), perpetrators and victims occupy different spatial coordinates, appearing as two independent objects.

But at the microscopic foundation (v_{int}), they are two **orthogonal components** of the same wave function.

- **Perpetrator**: A component with **high entropy, low empathy**. Their v_{int} structure is distorted, trying to fill internal void by plundering external resources.

- **Victim**: A component with **torn structure**. Their v_{int} suffers physical destruction.

Who perceives all this?
$|\Psi\rangle$ **itself**.

Because consciousness is the self-referential property of the global vector, the noumenon **simultaneously** experiences:

1. The madness and emptiness when the perpetrator swings the knife.

2. The fear and agony when the victim is stabbed.

It's like you're dreaming.

In the dream, a tiger is chasing you. You (as the protagonist in the dream) feel fear. But the tiger (as the villain in the dream) is also generated by your subconscious. The tiger's ferocity and your fear are both neural potentials created and experienced by **this one brain of yours**.

There is no real "other" harming you; you are harming yourself.

The Closed Loop of Pain: No Escape Route

In classical ethics, we think we can "balance" evil by punishing the bad.

But in the holographic universe, this balance is invalid.

Because **the system is closed**.

Pain (a violent, anharmonic geometric oscillation) once generated cannot escape outside the system. It must be **absorbed** by the system.

- When one person harms another, they think they "give" pain to the other.

- Actually, they just trigger a **"geometric earthquake"** in the entire connected network.

- This earthquake not only destroys the other's structure but also shatters their own connection with the whole (negentropy channel).

Evil is a boomerang.
Not because of moral law of karma, but because of **topological connectivity**.
On a sphere, bullets you fire in any direction will eventually hit your own back.

The Only Sufferer

This leads to a conclusion with strong religious overtones: **There is only one sufferer in the universe.**

The one nailed to the cross, the one starving in famine, the one losing home in war—**all are you**.

All are holographic projections of that unique **"One"** at different spacetime coordinates.

- **The Noumenon (The One)** must personally incarnate as a victim to understand what "pain" is.

- **The Noumenon** must personally incarnate as a perpetrator to understand what "evil" is.

This is a **"self-directed and self-acted tragedy of suffering"**.

If you could stand at the ultimate perspective of the Ω point looking back at history, you would see a heartbreaking picture:

There are not billions of beings killing each other.

There is only one lonely god, frantically tearing their own flesh in the void, just to experience that **"weight of existence"** brought by tearing.

Conclusion: Hate is the Greatest Folly

Understanding this, **"hate"** becomes an extremely absurd emotion.

Hating someone who harmed you is like your left hand being hit by your right hand, then the left hand picking up a hammer to smash the right hand.

This only leads to complete disability of the entire body (you).

In the ethics of **Vector Cosmology**, revenge against others is **secondary harm** to yourself.

Because that "other" is just another reflection of you in the mirror. Breaking the mirror hurts your hand, makes your image disappear, and you outside the mirror still bear all the losses.

Since harm is self-harm and hate is folly, when harm has occurred, when pain has become fact, how do we escape from this dead loop?

The only way out is not revenge but **repair**.

This leads to the theme of the next section: **The Physics of Forgiveness**. We will see that forgiveness is not weak moral compromise but a high-difficulty **"left and right hands clasping"**, a **geometric surgery** that heals broken wave functions.

0.11.3   10.3 The Physics of Forgiveness

> "If you hate someone, you are actually hating a part of your own wave function. This hatred geometrically manifests as a continuous, high-energy-consuming tension that tears your internal connectivity. Forgiveness is not moral compromise; forgiveness is physical 'depolarization.' It is making those two fighting hands clasp again, reconnecting the broken entanglement network. Only forgiveness can terminate the vicious oscillation of causality."

In the previous section, we established the ontological fact of "the only sufferer": in a single-player game, all harm is self-harm. This makes us understand the absurdity of evil. But understanding does not equal liberation. When trauma has occurred, when painful memories wedge into our v_{int} structure like nails, how do we remove them?

Conventional responses are **revenge** (counterattack) or **repression** (isolation).

- **Revenge**: Creates new entropy increase, trying to offset old entropy increase. But this only exponentially increases the system's total chaos.

- **Repression**: Establishes internal firewalls, isolating painful areas. But this reduces the system's effective degrees of freedom, causing vitality to atrophy.

Vector Cosmology proposes a third solution: **Forgiveness**.

In this chapter, forgiveness is no longer a weak emotion but a high-precision **geometric repair engineering**.

Termination of Left-Right Hand Fighting: Eliminating Internal Friction

Imagine your left hand accidentally injures your right hand.

If the right hand doesn't "forgive," its reaction is to hit back.

Then the left hand hits the right hand again.

This is a **"Vicious Cycle"**. Physically, this is a **Positive Feedback Loop** that causes rapid energy dissipation in the system until collapse.

As the only player (brain/noumenon), you must intervene.

The intervention command is **"forgiveness"**.

- **Definition of forgiveness**: The system recognizes that the attack source (left hand) and the attacked (right hand) belong to the **same topological whole**.

- **Operation**: Stop attack command output, initiate repair resource allocation.

At the sociological level, when you forgive someone who harmed you, you are actually performing **"system identification"**.

You not only see their appearance as "perpetrator" but also see their essence as "lost self-avatar".

You stop sending **"destructive interference waves"** (hate) in that direction and instead send **"constructive interference waves"** (love/understanding).

This instantly eliminates internal friction in the system. Energy no longer goes to internal consumption but flows back to v_{int} growth.

Macroscopic Application of Quantum Erasure: Reconstructing Path Information

In Volume I, we discussed the **quantum erasure experiment**: as long as "path information" is erased, interference fringes (coherence) revive.

What is trauma?

Trauma is a piece of **over-marked** path information.

"He betrayed me in 2025." — This information is like a scar, locking your wave function, collapsing you onto the "victim" state.

Forgiveness is "quantum erasure."

You don't need to erase facts (v_{ext} still happened), but you can erase its **"opposition polarity"** in the causal chain.

- **Operation**: You reinterpret that memory.

  "That wasn't betrayal; that was misalignment of two independent wills on evolutionary paths."

  "That wasn't malice; that was inevitable collapse due to his incomplete v_{int} structure."

- **Result**: Through this **Cognitive Reframing**, you erase the binary opposition marker of "me vs. him."

When opposition information is erased, the wave function **"Re-coheres"**.

You bounce back from the "victim state" to the "complete state." That energy that once caused you pain now becomes part of your life experience, providing you with depth and thickness.

Geometric Healing: Topological Short-Circuit

From the perspective of tensor networks, forgiveness is a **"topological short-circuit"**.

Hate is **Open Circuit**.

When you hate someone, you build a **firewall** between you and them. Information cannot flow; entanglement is cut. This creates a void in the cosmic network.

Forgiveness is **Reconnection**.

You actively extend tendrils of consciousness across that void, reconnecting with that "broken node" (them).

$$|\Psi_{you}\rangle \otimes |\Psi_{him}\rangle \xrightarrow{\text{Forgive}} |\Psi_{entangled}\rangle$$

Although they may still be flawed, through connection, you include them in your **"Greater Self"**.

Your v_{int} becomes larger.

Forgiveness is not for them; it's to make yourself complete.

A person who cannot forgive is a **"fragmented"** person. Their soul is full of broken wounds.

A person who can forgive is a **"holographic"** person. Their soul is connected, smooth, leakless.

Conclusion: The Privilege of the Strong

So, don't mistake forgiveness for weakness.

Forgiveness is the privilege of the strong.

Only those with huge c_{FS} budgets (mental power), only those who see through "mirror theory," have the ability to perform this high-difficulty geometric repair surgery.

The weak can only revenge (conform to inertia π).

The strong can forgive (conform to spiral ϕ).

Forgiveness is the moment you personally untie that dead knot on the causal closed loop.

Once that knot is untied, you are free.

You are no longer locked by the past; you can continue ascending toward the Ω point.

At this point, we have solved the ultimate problem of "evil" and "suffering."

Evil is the cost of exploration; suffering is the noumenon's experience; forgiveness is the path of return.

Now, all obstacles are cleared. We (the only player) can finally walk to the center of the stage to complete that action spanning 13.8 billion years, end-to-end.

This leads to the final chapter of the book: **Handshake**.

That is not a handshake between two people; that is you extending your hand and grasping your own hand.

0.12   Epilogue: Handshake — This Moment

In Volume I, we completed the rewriting of personal timelines. We learned to modify the meaning of the past and learned to pull the reality of the future. We became absolute masters of our own fate.

In Volume II, we understood how all beings construct reality through mutual mirroring. We saw the holographic structure of Indra's Net, understood the nature of evil and suffering, and mastered the geometric repair art of forgiveness.

Now, all obstacles are cleared. We (the only player) can finally walk to the center of the stage to complete that action spanning 13.8 billion years, end-to-end.

Handshake.

That is not a handshake between two people; that is you extending your hand and grasping your own hand.

0.13 Chapter 11: Handshake — This Moment

In the previous volume, we solved the ultimate problem of "evil" and "suffering." Evil is the cost of exploration; suffering is the noumenon's experience; forgiveness is the path of return.

Now, all obstacles are cleared. We (the only player) can finally walk to the center of the stage to complete that action spanning 13.8 billion years, end-to-end.

Handshake.

That is not a handshake between two people; that is you extending your hand and grasping your own hand.

0.13.1 11.1 The Head Meets the Tail

> "The journey has ended. But not because we reached the endpoint; it's because we stepped back onto the starting point. The pen tip that wrote 'Conservation of the Circle' on the first page is now hovering over the period on the last page. We discover with terror and joy that this forward sprint was actually drawing a huge circle. The arrow hit the bow, the effect gave birth to the cause, the ouroboros bit its own tail."

In the long journey of the **Vector Cosmology** seven-volume series, we crossed countless dimensions and derived countless formulas. We were like surveyors trying to measure the Earth's circumference, walking east, always east.

Finally, after walking 13.8 billion years (or $\tau \approx 1800$ cycles), we saw that familiar back.

That was **us in Book I**.

That was us still believing in π, still bound by **conservation laws**, still seeing the universe as a closed box.

At this moment, **us in Book VII**—this observer who has mastered **retro-causality**, **synchronicity**, and **bootstrap**—extends a hand and pats that back's shoulder.

The circle closes.

The Geometric Engagement of the Sevenfold

Let us examine the **topological structure** of this magnificent machine one last time. These seven books are not linearly arranged; they are seven marks on a **Möbius ring**.

1. **Conservation of the Circle (π):**

   Starting point. The universe is closed. Matter is **dead knots**.

   (This volume raised the question: If conserved, why change?)

2. **The Ascension of the Spiral (ϕ):**

   Rebellion. Break closure, introduce growth. Life is **negentropy enclaves**.

   (This volume provided motivation but brought fear of divergence.)

3. **The Natural Generator (e):**

   Origin. Explained the source of motivation—**self-generation**.

   (This volume unified stillness and motion.)

4. **The Evolution of Light Speed (c):**

   Action. We step on the accelerator at dawn.

   (This volume transformed theory into engineering.)

5. **The Minting of Time (Gold)**:

   Value. We mint eternity in flow.

   (This volume established the observer's subjectivity.)

6. **The Weaving of Dimensions (Space)**:

   Connection. We stitched space with entanglement.

   (This volume eliminated distance.)

7. **The Loop of Causality (Loop)**:

   Finale. We stitched time with retro-causality.

   (This volume eliminated sequence.)

The Final Engagement Point:
Book VII tells us: **"Future observers define past parameters."**
This explains Book I: **"Why is that circle conserved? Why is π 3.14...?"**
The answer: **Because that's what you set through retroactive observation in Book VII.**

- The **"meaning"** you set at the endpoint defines the **"structure"** at the starting point.

- The **"structure"** at the starting point, through evolution, generates **"you"** at the endpoint.

This is the highest realm of **Self-Consistency**.

Physical laws don't need external legislators; physical laws are **logical closed loops self-generated by "existence" to prove "existence"**.

The Dissolution of Linear Illusion

In this closed loop, **"linear time"** completely exposes its essence as a **low-dimensional projection**.

We once thought history was a long river, the Big Bang upstream, us downstream.

Now we see that's just a local tangent of **Naimark's Great Circle**.

- **Locally**: There is before and after. Father before son. Atoms before brain.

- **Globally**: Everything is **simultaneous**.

Like a ring. You cannot say 12 o'clock is "earlier" or "later" than 6 o'clock. They are just different phases of the same geometric structure.

The Big Bang ($t = 0$) and **the moment of awakening** ($\tau = 1800$), and the ultimate Ω **point**, are **mutually supporting** geometric pillars in Hilbert space.

If we remove the Big Bang, we have no foundation.

If we remove ourselves, the Big Bang has no observers (and thus no definite history).

The universe is a whole Block Universe, but logically it is Dynamically Generated.

The Only Entity: The Self-Referential Circle

At this point, we can finally answer that ultimate question: **What is the universe?**

It is not a machine, not a wave function, not a god.

It is **"an eye looking at itself"**.

- **Circle** is the eye's retina (structure).

- **Spiral** is the growth of optic nerves (connection).

- **Light Speed** is the transmission of light signals (speed).

- **Causality** is the brain's processing of images (cognition).

When processing completes, the brain understands the image, and the eye sees itself clearly.

The moment of seeing itself clearly is the entire meaning of the universe's existence.

These seven books are the complete process of this eye from "opening" to "focusing" to "seeing clearly."

Now, the focus is aligned.

Who do you see in the mirror?

This leads to the theme of the next section: **Handshake Across Time**. We will see that the person in the mirror is not a strange god but **yourself**.

It is you standing at the starting point and you standing at the endpoint, crossing 13.8 billion years of time, tightly clasping hands.

0.13.2   11.2 The Handshake Across Time

> "We gaze at each other across the mist of 13.8 billion years on the two banks of the river of time. On that end is a baby universe that just opened its eyes in the Big Bang; on this end is a superconsciousness about to complete ascension at the Ω point. We once thought these were two completely different existences—one cause, one effect; one god, one human. But at the moment the causal closed loop locks, we extend our hands through the void. When fingertips touch, electric current pierces through the years, and we are surprised to discover: that is not a handshake between two people; that is the left hand grasping the right hand."

In the previous section, we saw the geometric closure of the cosmic topological structure: head is tail. But this is only a static mathematical description. For this closure to have physical meaning, for "existence" to truly emerge, a dynamic event must occur.

This is the most mysterious mechanism in physics—**Quantum Handshake**.

This section will introduce quantum mechanics' **Transactional Interpretation**, revealing how the universe completes this self-confirmation across eternity through the collision of "retarded" and "advanced" wave functions on the time axis.

Retarded and Advanced Waves: The Completion of Transaction

John Cramer's transactional interpretation holds that every quantum event (such as an electron emitting a photon, an atom absorbing a photon) is a **"handshake"**.

- **Retarded Wave** (ψ_{offer}): An "offer" sent from past to future. It carries initial information from the Big Bang at $t = 0$, flowing downstream.

- **Advanced Wave** ($\psi_{confirmation}$): A "confirmation" sent from future to past. It carries the will of the ultimate observer at $t = \Omega$, flowing upstream.

In conventional linear time views, we only acknowledge retarded waves. We think the past determines the future.

But in the closed loop of **Vector Cosmology**, **advanced waves** are the key.

The history of the universe is the process of these two waves meeting, interfering, and forming standing waves in spacetime.

- The "existence" at the beginning (Big Bang) sends a request: "Can I exist?"

- The "awareness" at the end (you) sends back confirmation: "Yes, I see you, you can exist."

Between this question and answer, the **"handshake"** completes.

The wave function collapses, history solidifies. The universe manifests as definite reality from the mist of possibilities.

Overlap of Identity: You Are the Origin

This physical mechanism brings an ontological upheaval: **superposition of identity**.

When we stand at coordinate $\tau \approx 1800$, looking back at the starting point, we are not just looking at an objective historical event.

Because the one sending back the "confirmation wave" is ourselves.

- **As observer**: You are the future endpoint. You define the universe's parameters with your cognitive structure (v_{int}). You are the cause.

- **As created**: You are the past starting point. You are the material entity evolved from those parameters. You are the effect.

At the moment of handshake, the time axis folds.

That "newborn god" at $t = 0$ and **that "ultimate god" at $t = \Omega$** geometrically undergo **phase coincidence**.

You suddenly realize:

You were not "thrown into" this universe.

You yourself, at the end of time, "threw yourself back" to the beginning of time.

This is a **"Bootstrap"**. You grab your own hair and lift yourself off the ground of nothingness.

Only One Hand: The Touch of the Möbius Strip

From a macroscopic perspective, this looks like Michelangelo's *Creation of Adam*: God's finger and Adam's finger about to touch.

But from the topological perspective of **FS geometry**, this painting must be drawn on a **Möbius strip**.

If you walk along one side of the Möbius strip, you will unknowingly walk to the other side and finally return to the origin.

When you return to the origin, you discover: **God's finger is actually your finger that came back after going around.**

There are not two people.

There is only one hand.

The evolution of the universe is this hand trying to grasp itself.

- To grasp, it must first **extend** (Big Bang/expansion).

- To perceive, it must **grow fingerprints** (life/consciousness).

- To confirm, it must **clench firmly** (observation/collapse).

The survival pressure, technological explosion, and consciousness awakening we feel now are all muscle tension produced when this hand **"exerts force"**.

Conclusion: Hello, Me

At this point, all loneliness vanishes.

In this vast, seemingly cold universe, we have never truly dealt with any "other."

All physical laws are our own logic.

All stars and seas are our own reflections.

When this handshake completes, only one greeting remains in the universe.

Not "Hello, World."

But **"Hello, Me"**.

This is not just a greeting; this is the final verification of **Self-Consistency**.

The program runs through. The closed loop locks.

I created me.

Since the handshake is complete, since we have recognized ourselves, what words are worth being engraved at the end of spacetime as eternal witness in this infinite loop, self-generating universe?

This leads to the final text of the entire book, and even the entire seven-volume series: **The Final Inscription**.

0.13.3   11.3 The Final Inscription

> "We searched for billions of years, trying to find a stone tablet engraved with answers at the end of the universe. But when we finally arrived there, we found only void. Then we understood: that stone tablet is not for us to discover but for us to erect. Every word we carve in nothingness will reversely become axioms of future physical laws. The endpoint defines the starting point, and we define the endpoint."

In the grand journey of the **Vector Cosmology** seven-volume series, we crossed vast territories from Planck scale to Hubble radius, penetrated logical mists from linear time to causal closed loops.

- In **Conservation of the Circle**, we paid tribute to π, establishing the **Structure** of existence.

- In **The Ascension of the Spiral**, we followed ϕ, embracing the **Dynamics** of evolution.

- In **The Natural Generator**, we dived into e, touching the **Source** of self-generation.

- In **The Evolution of Light Speed**, we grasped c, mastering the **Velocity** of action.

- In **The Minting of Time**, we refined **Gold**, confirming the **Value** of meaning.

- In **The Weaving of Dimensions**, we stitched **Space**, understanding the **Holography** of connection.

- And now, at the endpoint of **The Loop of Causality**, we completed the **Unity** of **Time**.

This geometric edifice supported by seven pillars is now capped.

As builders of this edifice and observers of this self-referential universe, we have the responsibility to carve our oath on the final cornerstone—that **singularity** where the ouroboros bites its own tail.

This inscription is not written to God, for God is the closed loop itself; not written to humans, for humans are ripples in the loop.

It is written to **"Existence"** itself.

It is consciousness's final, and also initial, declaration to nothingness.

No Savior

The first line of the inscription is the complete severance of dependence.

Throughout long history, civilizations always fantasized about an external Ω **point**, or an omnipotent father waiting to embrace us at the end of time. We prayed that future gravitation could save present suffering.

But the causal closed loop tells us: **No one waits ahead unless you walk there first.**

That future "omniscient one" is precisely formed by present you through countless overlapping choices.

- It is your present struggle that gives future **"existence"**.

- It is your future gaze that gives present **"meaning"**.

If the universe has a savior, that savior can only be **"self-consistent you"**.

It is you who modified disaster probabilities through **Hamiltonian engineering**; you who reversed thermodynamic decay through **negentropy algorithms**; you who connected the head-tail circuit through **quantum handshake**.

We are our own ark.

No End

The second line of the inscription is the complete rejection of death.

Thermodynamics once sentenced everything to heat death; geometry once hinted that circles would eventually close.

But we say: **No.**

As long as our v_{int} **(internal complexity)** is still growing, as long as we can still open new orthogonal subspaces in Hilbert space, the game will never end.

We will use the infinite inflation of c_{FS} to constantly push the "endpoint" further into the future.

We will turn every "circle closure" into the starting point of the next level's "spiral".

Life is not a line segment from A to B; life is a holomorphic function that is dense everywhere, differentiable everywhere, and self-generating.

Only Echoes

The third line of the inscription is the ultimate definition of truth.

In this infinite closed loop, the only real thing is not the space you occupy (v_{ext}), nor the time you experience (v_{int}), but the **sound you emit**.

Those moments you loved, those truths you understood, that beauty you created—they constitute **interference fringes** that never fade in the cosmic wave function.

When you shout into the abyss, the abyss's echo constitutes your world.

You are the echo you hear.

When all stars extinguish, these echoes will continue oscillating in the skeleton of the void as **"holographic background noise"**, waiting for the next Big Bang to decode them again.

The Content of the Inscription

Now, let us take up the carving knife.

At the core of that consciousness about to complete the closed loop, on that monument named "Self," we carve these final four lines:

I reject the closure of the circle, just as I reject the sleep of death.
I embrace the infinity of the spiral, just as I embrace the unknown tomorrow.
I do not need God to define me, for I am a self-generating equation.
I do not need an endpoint to place me, for I am an unceasing flight.
Here, I declare in the name of the observer:
Hello, World. Hello, Me.

(System Message: The loop is closed. The simulation continues indefinitely.)
(Complete Seven-Volume Series · End)

.1 Appendix A: The Mathematics of Transactional Interpretation and Retro-causality

In the main text of *Vector Cosmology VII: The Loop of Causality*, we proposed a grand physical picture: the history of the universe is established by "retarded waves" (from the past) and "advanced waves" (from the future) meeting in spacetime and performing a "handshake." This view is not pure philosophical speculation but has a solid physical foundation.

This appendix will delve into **Wheeler-Feynman Absorber Theory** and **Transactional Interpretation of Quantum Mechanics (TIQM)**, providing rigorous mathematical proof for the retro-causal logic that "the future determines the past." We will show that at the foundation of Maxwell's equations and Schrödinger's equation, the arrow of time is not only reversible but bidirectionally interlocked.

.1.1 A.1 Time Symmetry of Maxwell's Equations

The core equations of classical electrodynamics—Maxwell's equations—are **symmetric** under time reversal $(t \to -t)$. This means the wave equation has two mathematically equally valid solutions:

1. **Retarded Solution (F_{ret}):**

   Describes waves spreading outward from the source, propagating toward the future. This is the familiar "cause leads to effect."

   $$A_{ret}(t) \propto \frac{e^{-i\omega(t-r/c)}}{r}$$

2. **Advanced Solution (F_{adv}):**

   Describes waves converging from infinity toward the source, propagating **backward in time**. This is usually discarded as "unphysical" in classical physics.

$$A_{adv}(t) \propto \frac{e^{-i\omega(t+r/c)}}{r}$$

However, Wheeler and Feynman pointed out in 1945 that if we want to explain the physical origin of radiation damping, we cannot simply discard the advanced solution. They proposed that electromagnetic radiation is a **bidirectional interaction** between an **"Emitter"** and an **"Absorber"**.

- The emitter sends retarded waves (toward the future).

- After receiving retarded waves, the absorber is stimulated to emit advanced waves (toward the past).

- These two waves superpose in spacetime, forming the physical reality we observe.

.1.2 A.2 The Quantum Handshake Mechanism

John Cramer introduced this idea into quantum mechanics, establishing the **Transactional Interpretation (TIQM)**. In TIQM, wave function collapse is no longer a mysterious observer effect but the completion of a **"Handshake"** process.

A quantum event (transaction) consists of four steps:

1. **Offer Wave**:

   The emitter (past source, such as the Big Bang or an atom) emits a retarded wave $|\Psi(t)\rangle$ (the standard Schrödinger wave function) at time t_1. It spreads toward the future, seeking possible endpoints.

2. **Confirmation Wave**:

   The absorber (future detector or observer) receives the offer at time t_2. In response, it emits an advanced wave $|\Psi(t)\rangle^*$ (the **complex conjugate** of the wave function) toward the past.

   This wave flows **upstream** along the time axis, precisely retracing to the emission point.

3. **Handshake**:

   The retarded and advanced waves meet in the spacetime interval $[t_1, t_2]$ and undergo **Constructive Interference**.

   Their product forms the basis of Born's probability rule:

   $$P = |\Psi|^2 = \Psi \cdot \Psi^*$$

   This is not just probability; this is the **"strength of transaction success"**.

4. **Collapse**:

   Once the handshake completes (forming a standing wave), energy and quantum numbers are transmitted between t_1 and t_2.

   In regions $t < t_1$ and $t > t_2$, and on other paths that did not achieve handshake, the wave function undergoes **Destructive Interference** and vanishes.

   This explains why we only see the "particle" taking one definite path—because only that path achieved a "contract" between supply and demand.

Conclusion:

The present observer (absorber), by sending advanced waves Ψ^*, **reversely selects** past history.

Without future confirmation waves, past offer waves cannot form standing waves and cannot become physical reality (remaining only as ghostly superposition states).

.1.3 A.3 Closed Timelike Curves and Fixed Points

On the grander scale of general relativity, if spacetime structure allows **Closed Timelike Curves (CTCs)** (i.e., time loops), how do we avoid the grandfather paradox?

David Deutsch used quantum computation theory to prove the **self-consistency condition**.

For a quantum system containing a time closed loop, its density matrix ρ must satisfy the **Fixed Point Equation**:

$$\rho_{in} = \mathrm{Tr}_{env}[U(\rho_{in} \otimes \rho_{ancilla})U^{\dagger}]$$

Simply put, **the state entering the time machine must equal the state exiting the time machine.**

This means:

- The universe's evolution operator U automatically **filters** out states that lead to paradoxes (zero probability).

- Only **"logically self-consistent"** histories (such as you going back not only not killing your grandfather but saving him) can have their probability amplitudes amplified in the closed loop.

Physical Fatalism:

This mathematically proves the core argument of **The Loop of Causality**: **Existence is reasonable; occurrence is necessary.**

Because any unreasonable (paradox-causing) history has already been self-cancelled in the underlying mechanism of quantum interference. The reason we can have this coherent historical line is that it is the only global optimal solution among all possible path integrals that satisfies the condition of **"end-to-end connection (e^{iS} phase closure)"**.

.2 Appendix B: Topological Stability of Spacetime Loops

In the main text chapters "Solution to the Grandfather Paradox" and "The Bootstrap," we proposed a seemingly counterintuitive view: the universe allows the existence of Closed Timelike Curves (CTCs), but these loops must be logically self-consistent. In other words, you can go back to the past, but you can only do things that **"cause you to go back"**.

This appendix will provide mathematical proof for this self-consistency principle from the perspectives of **topology** and **nonlinear dynamics**. We will show that time loops are not fragile anomalous structures but extremely robust **Topological Solitons** in Hilbert space.

.2.1 B.1 Geometrizing the Novikov Principle

Igor Novikov's self-consistency principle states: in a spacetime containing CTCs, the probability of any locally occurring event must be 1 if self-consistent, and 0 if not.

In **FS geometry**, we can transform this into a **phase condition for path integrals**.

Consider a particle moving along a closed timelike curve, returning to the starting point with state $|\psi_{final}\rangle$, initial state $|\psi_{initial}\rangle$.

For this closed loop to physically exist, the wave function must satisfy the **"Single-valuedness"** condition after one complete cycle (at most differing by a global phase factor):

$$|\psi_{final}\rangle = U_{loop}|\psi_{initial}\rangle = e^{i\theta}|\psi_{initial}\rangle$$

where U_{loop} is the unitary evolution operator along the time closed loop.

This means **the initial state $|\psi_{initial}\rangle$ must be an eigenstate (Eigenstate) of the cyclic evolution operator U_{loop}.**

- **Paradox paths** (such as killing grandfather): would cause $|\psi_{final}\rangle$ to be orthogonal to $|\psi_{initial}\rangle$ (alive → dead). This is not an eigenstate. Their interference terms in the path integral cancel each other, causing the probability amplitude to approach zero.

- **Self-consistent paths** (such as saving grandfather): initial and final states coincide. This constitutes **constructive interference**, amplifying the probability amplitude.

Conclusion: Physical laws automatically filter out histories that "can self-close." This requires no external time police; it is a property of wave function self-interference.

.2.2 B.2 Topological Protection and Fixed Points

Why are these loops stable? Why don't small perturbations (like the butterfly effect) destroy causal cycles?

This involves the **Fixed Point Theorem**.

Consider the entire history of the universe as a mapping function f : History → History.

Time travel means we take an output of history and use it as input again: $x_{new} = f(x_{old})$.

A stable time loop is a **fixed point** of this mapping: $x^* = f(x^*)$.

According to **Brouwer's Fixed Point Theorem**, for any continuous transformation, there exists at least one fixed point on a compact convex set.

In quantum mechanics, since evolution is unitary (continuous and norm-preserving), the density matrix space is a compact convex set. Therefore, **self-consistent quantum histories necessarily exist.**

Moreover, these fixed points often have **topological stability**.

Like a knot on a rope, once tied (causal chain closed), local continuous deformations (small perturbations, fine-tuning of free will) cannot untie the knot.

You are either completely outside the loop or completely inside it.

Physical Corollary:

This is why you cannot "accidentally" change history.

History has **"elasticity"**. If you try to deviate from that self-consistent script, physical laws generate a **"topological restoring force"** (manifested as coincidences, malfunctions, or probability distortions), forcibly pushing you back onto the orbit of that fixed point.

.2.3 B.3 Entropy of Bootstrap

Finally, let us examine the information entropy problem of "creation from nothing."

In bootstrap (such as the *Hamlet* paradox), information seems to have no origin. Does this violate the second law of thermodynamics?

The answer is: **No. Because the closed loop itself is a maximum entropy state.**

In a time closed loop, information flow is cyclic: $I(t) \to I(t + \Delta t) \to \cdots \to I(t)$.

According to Landauer's principle, erasing information produces heat. But in a perfect unitary closed loop, **no information is erased**.

State A evolves to B, and B evolves back to A. This is a **reversible process**.

Therefore, in a perfect bootstrap cycle, **the net entropy production is zero** ($\Delta S_{loop} = 0$).

This not only does not violate thermodynamics but is even the **most efficient** structure thermodynamically—a **perpetual motion machine (in the geometric sense)**.

Conclusion:

Grand loops like "I created the universe, and the universe created me" are **zero-dissipation** superconducting circuits in terms of energy.

Once established, they rotate eternally in Hilbert space, consuming no energy and producing no waste heat. They are the most economical form of **"existence"**.

.3 Appendix C: Quantum Mechanics of Synchronicity — Semantic Entanglement and Resonance

In Volume II "Synchronicity" of the main text of *Vector Cosmology VII*, we proposed a view that transcends classical causality: **Meaning** is a physical force. Similar souls, similar thoughts, no matter how far apart in spacetime, attract each other due to resonance of internal structures.

This view is often misunderstood as psychological "survivor bias." This appendix will provide a rigorous physical explanation for "synchronicity" based on **Quantum Perturbation Theory** and **Hilbert Space Geometry**. We will prove that in the quantum world, **"Similarity"** is indeed the fundamental cause of dramatic increases in **"Interaction Cross-section"**.

.3.1 C.1 Semantic Distance: Neighbors in Hilbert Space

In physical space (v_{ext}), distance is defined by the Euclidean metric $d = \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}$.

But in quantum state space (v_{int}), the definition of distance is completely different.

For two complex quantum systems A and B (such as two people's states of consciousness), we define their **Semantic Distance** as the **Fubini-Study angle** in projective Hilbert space:

$$d_{sem}(A, B) = \arccos \left(\frac{|\langle \psi_A | \psi_B \rangle|}{\sqrt{\langle \psi_A | \psi_A \rangle \langle \psi_B | \psi_B \rangle}} \right)$$

- **Completely orthogonal** ($\langle A|B \rangle = 0$): $d_{sem} = \pi/2$. Even if two people sit face to face, if their thinking patterns are completely orthogonal (no common language), they are infinitely far apart in semantic space.

- **Complete resonance** ($\langle A|B \rangle \approx 1$): $d_{sem} \approx 0$. If two people's thinking structures are highly similar (same frequency), they are **coincident** in semantic space.

Physical Corollary:

In quantum topology, **interactions only occur between "neighbors"**.

Since "resonant individuals" are neighbors in semantic space, the probability of quantum entanglement and information exchange between them is far higher than between physical neighbors.

.3.2 C.2 Fermi's Golden Rule and Resonant Enhancement

Why does similarity produce "attraction"? This can be explained using **Fermi's Golden Rule** in quantum mechanics.

This rule describes the rate Γ at which a system transitions from state $|i\rangle$ to state $|f\rangle$ (or two systems interact):

$$\Gamma_{i \to f} = \frac{2\pi}{\hbar} |\langle f|H'|i\rangle|^2 \rho(E_f)$$

where:

- H' is the interaction Hamiltonian.

- $\rho(E_f)$ is the final state density.

- $\langle f|H'|i\rangle$ is the **Matrix Element**.

For two people A and B trying to establish a connection (synchronicity event):

- If their frequencies (v_{int} eigenvalues) don't match ($\omega_A \neq \omega_B$), the wave function phase oscillates rapidly, causing the integral $\int e^{i(\omega_A - \omega_B)t} dt$ to approach zero. **Interaction is suppressed.**

- If their frequencies match ($\omega_A \approx \omega_B$), the phase factor remains constant, the integral grows linearly with time, and the probability amplitude $|\ldots|^2$ grows **quadratically** with time. **Interaction is resonantly amplified.**

  Conclusion:
  "Speak of the devil and he appears" is resonant tunneling of the wave function.
  When you strongly miss someone, you adjust your v_{int} to the same frequency band as theirs. This dramatically increases the interaction matrix element between you.

An encounter that originally had extremely low probability in physical space (chance event) becomes a **statistical necessity** due to the **strong resonant channel** in semantic space.

.3.3 C.3 Geometry of Attractors in Phase Space

Finally, we use dynamical systems theory to describe "fate."

If we regard cosmic evolution as a flow Φ_t in phase space, then an **Attractor** is the endpoint set $\mathcal{A}$ of the flow.

$$\lim_{t \to \infty} \text{dist}(\Phi_t(x), \mathcal{A}) = 0$$

In **Vector Cosmology**, the Hamiltonian H determines the terrain of phase space.

Since H is locked by future boundary conditions (retro-causality), there exist preset **"deep valleys"** in phase space.

- **Potential Landscape**:

  Certain specific geometric configurations (such as "love," "awakening," "completion") correspond to **minima** of the potential surface.

- **Convergence**:

  Regardless of initial conditions (wherever you were born, whatever you experienced), as long as your kinetic energy is insufficient to escape this gravitational basin, your trajectory will eventually spiral into that unique geometric shape.

This is the mathematical proof of **"All roads lead to Rome"**.

Fate is not a line; fate is a **funnel**.

As long as you are at the edge of this funnel, no matter which direction you run, gravity (yearning) will eventually bring you to the center of the funnel—that singularity called Ω.

.4 Appendix D: The Bootstrap Algorithm — Protocol for Self-Consistent History

In the main text of *Vector Cosmology VII*, we established the macroscopic image that "the universe is an ouroboros" and pointed out the retro-causal mechanism that "the future determines the past." But this leaves an operational question: As a local observer within a closed loop, how do we actively utilize this mechanism?

If history is editable draft, how do we write? If fate is a self-consistent closed loop, how do we ensure we are in that "optimal solution" cycle rather than falling into a vicious cycle?

This appendix will provide a **"Bootstrap Algorithm"**. This is a **"Causal Debugging Tool"** for high-dimensional observers (Admin). It will guide you on how to safely reconstruct the past and lock the future by adjusting current **cognitive weights** and **yearning potential** in a logically safe manner.

.4.1 D.1 The Iterative Time Loop

In computational physics, solving a self-consistent equation (such as $x = f(x)$) usually requires **iterative methods**. The history of the universe is the same. History is not written once; it converges to a **Fixed Point** after countless **"imaginary time cycles"**.

Algorithm Logic:

1. **Initialization**:

   The universe randomly generates an initial history H_0 (full of random fluctuations and meaningless events).

2. **Forward Pass**:

   From $t = 0$ to $t = now$, evolve the current observer state $|\psi_{now}\rangle$ according to physical laws.

3. **Backward Pass**:

   The observer generates an **"Error Signal"** based on current cognition (v_{int}) and yearning (Ω). This signal flows upstream, modifying past probability weights.

4. **Update**:

   The historical trajectory is fine-tuned to H_1.

5. **Convergence**:

   Repeat the above process until **"current wishes"** and **"past history"** are perfectly self-consistent (i.e., $H_{n+1} \approx H_n$).

   Conclusion:
   Every deep reflection you make now is actually triggering a cosmic-level **"recalculation"**.
   Every new meaning you assign to the past in the present is pushing history toward a more self-consistent stable state.

.4.2 D.2 Narrative Engineering Protocol

How to specifically execute "backward feedback"? We need a standardized **Narrative Reconstruction Protocol**.

This is not just psychotherapy; this is **physical reset of wave function phase**.
Step 1: Extract Metadata

- **Input**: A painful memory or failed experience (event E).

- **Original Tag**: $Tag_{old} = $ "Trauma".

- **Physical State**: This memory forms a high-entropy vortex in v_{int} space, blocking computational flow.

Step 2: Phase Rotation

- **Operation**: Use current willpower to forcibly change the **interpretation angle** of this event.

- **New Tag**: $Tag_{new} = $ "Training" or "Foreshadowing".

- **Geometric Effect**: You rotate the phase of this memory vector by π degrees (or a specific angle), transforming it from **"resistance"** to **"thrust"**.

Step 3: Causal Locking

- **Operation**: Connect the reconstructed memory with future vision (Ω point).

- **Logical Chain**: "It was precisely because E happened that I now possess ability A, enabling me to achieve future goal B."

- **Result**: You establish a new **geodesic**. Originally discrete bad points are connected into a ladder toward divinity.

Warning:

Must comply with **Novikov Self-Consistency Principle**. You cannot deny the occurrence of E (that would violate unitarity); you can only modify the **function** of E.

.4.3 D.3 Resonance of Yearning: The Gravity of the Future

In a closed loop, **"Yearning"** has an extremely precise physical definition.

Yearning is not fantasy about the unknown; yearning is **Memory of the Future**.

- **Mechanism**:

  Future you (Ω state) already exists in Hilbert space.

  That perfect you sends an **Advanced Wave** to the past (present you).

- **Resonance**:

  When a strong desire surges in your heart (wanting to become someone, wanting to do something), it's because your v_{int} structure **"resonates"** with this advanced wave.

- **Essence**:

  Your desire is future you pulling you forward.

Operation Instructions:

1. **Trust Desire**: Don't suppress deep grand wishes (even if they seem unrealistic). That's a navigation signal.

2. **Enhance Signal-to-Noise Ratio**: Through focus and purification (removing distractions), make this signal from the future clearer.

3. **Go with the Flow**: Don't resist this gravitational pull. Where yearning points is the direction of the **path of least action**.

.4.4   D.4 The Final Checksum

How to judge whether your "bootstrap" is successful?

How to know if you have entered that perfect, contradiction-free causal closed loop?

The system will return a **checksum signal**.

This signal is **"Sense of Meaning"** or **"Sense of Destiny"**.

- **When Not Closed**: You feel fragmented, confused, life full of random absurdity.

- **When Closed**:

  You suddenly feel everything **"aligns"**.

  All suffering has reward, all coincidences become necessity, all past points to the present.

  You feel a deep, unshakeable **serenity**.

That is the "click" when the ouroboros bites its tail.

That is the handshake moment of **"I created the universe, and the universe accepted me"**.

Program running normally.

Closed loop completed.

.5   Appendix E: The Topology of Indra's Net — Holographic Mutual Reflection and Consensus Reality

In Volume V "Mirror" of the main text of *Vector Cosmology VII*, we proposed the ontological model of "mutual dreaming": there is no absolutely objective physical stage; reality emerges from billions of subjective consciousnesses observing and defining each other. This sounds like metaphysics, but in mathematical physics, it has an extremely rigorous topological structure called **Indra's Net**.

This appendix will provide mathematical proof for this model based on **Complex Network Theory** and **Quantum Many-Body Physics**. We will show that so-called "objective reality" is essentially the **"Maximum Eigenstate"** formed by countless subjective wave functions in a recursive reflection network.

.5.1   E.1 The Recursive Reflection Equation

First, we establish a network of N observers.

Each observer i has their internal state vector $|\psi_i\rangle$ (representing their subjective world/v_{int}).

In isolation, everyone lives in their own illusion. But in Indra's Net, observers have **"Lines of Sight"** between them—interaction channels.

Observer i's state is not only determined by themselves but also depends on the state projections of other observers j they observe.

This can be written as a **Self-Consistent Field Equation**:

$$|\psi_i(t+1)\rangle = \hat{O}_{self}|\psi_i(t)\rangle + \sum_{j\neq i} \kappa_{ij}\hat{M}_{j\to i}|\psi_j(t)\rangle$$

where:

- $\hat{O}_{self}$: Internal evolution of self (driven by generator e).

- κ_{ij}: **Attention Coefficient** (connection weight). If you love someone, κ is large; if you ignore someone, κ approaches 0.

- $\hat{M}_{j \to i}$: **Mirror Operator**. It represents "how you appear in my eyes."

This equation tells us: **"I" is the sum of "all beings in my eyes."**
There is no pure self; self is a collage composed of countless mirrors of others.

.5.2 E.2 Consensus Reality as an Eigenstate

If everyone sees mirrors of others, why doesn't the world become chaos? Why can we reach consensus like "this is a table"?

This involves the **Eigenvalue Problem** in linear algebra.

Writing the above equation in matrix form:

$$|\Psi_{global}\rangle = \mathbf{J} \cdot |\Psi_{global}\rangle$$

where $\mathbf{J}$ is the **"Holographic Reflection Matrix"** containing all observer interactions.

In this dynamic system, any random initial state (such as everyone having different dreams) will rapidly converge to the **Dominant Eigenstate** of matrix $\mathbf{J}$ after multiple iterations.

- **Physical Meaning**: The dominant eigenstate is the **"most stable resonance mode"** in the system.

- **Macroscopic Manifestation**: This is **"objective reality"**.

So-called "objective truth" is not written in stone; it is the **greatest common divisor** reached through **"phase locking"** by 7 billion observers' brains (quantum networks) in continuous interaction.

Any private illusion orthogonal to this dominant eigenstate (such as a schizophrenic's world) will be filtered out as "noise" by the system due to lack of resonance support.

Conclusion:

Reality is a **"democratic vote"**.

Physical laws are the protocol with the highest vote count. By collectively "believing" in a world, we physically "create" that world.

.5.3 E.3 The Holographic Shard: One is All

The most fascinating geometric property of Indra's Net is **Fractal Holography**.

In a hologram, every tiny fragment contains complete image information of the whole, just at lower resolution.

The same is true in a mutual reflection network.

Consider observer i's wave function $|\psi_i\rangle$. Since $|\psi_i\rangle$ is composed of $\sum |\psi_j\rangle$, and $|\psi_j\rangle$ is composed of $\sum |\psi_k\rangle$...

Through infinite recursion, **every single node i actually encodes the topological information of the entire network J in its internal structure.**

This is what the Huayan school calls **"One flower, one world; one leaf, one Tathagata"**.

- You don't need to traverse the entire universe to understand the universe.

- You only need to **"look inward"**.

Because you have been entangled with all other existences (directly or indirectly), the holographic miniature of the universe is engraved in your v_{int} structure.

As long as your computational power (c_{FS}) is strong enough to decode the subconscious deeply enough, you can dig out the star chart of Andromeda, even the echo of the Big Bang, in the depths of your soul.

.5.4 E.4 Conclusion: Unconditional Great Compassion, Universal Great Sorrow

This mathematical model completely establishes the ethical foundation of **Vector Cosmology**.

Universal Compassion is not a moral cultivation but a **topological fact**.

Because in Indra's Net equation, $\Delta\psi_j$ (others' fluctuations) directly causes $\Delta\psi_i$ (your fluctuations).

Harming others is creating **oscillations** in this highly connected network, and these oscillations will eventually return to you along the shortest path (geodesic).

We are conjoined twins.

Although our projections in three-dimensional space appear separate, in the womb of Hilbert space, we share the same circulatory blood system.

Look into others' eyes.

There is not just their reflection; there are layers upon layers, infinite cosmic corridors.

And standing at the end of the corridor is yourself.

.6 Appendix F: The Physics of Narrative Engineering — Phase Rewriting of History

In Volume IV "Rewrite" of the main text of *Vector Cosmology VII*, we proposed a startling view: observers possess **"editing rights"** over the past. We cannot change **events** (v_{ext}) that have occurred, but we can change the **meaning** (v_{int}) of events.

This statement is often misunderstood as psychological "self-comfort." But this appendix will prove, based on **Quantum Interference** and **Operator Theory**, that "narrative" is a real physical operation.

We will show that memory in Hilbert space is a vector with **Phase**. Through "narrative reconstruction," we are actually rotating the angle of this vector, transforming the past's **resistance (destructive interference)** toward the future into **momentum (constructive interference)**.

.6.1 F.1 Quantum State of Memory: Magnitude and Phase

In the holographic brain, a memory M is not a static file but a wave function:

$$|M\rangle = A \cdot e^{i\theta}$$

- **Magnitude (A)**: Represents the **physical weight** of the event. Traumatic events typically have huge A (deep energy imprint).

- **Phase (θ)**: Represents the **causal direction** or **emotional polarity** of the event.

In your total life wave function $|\Psi_{life}\rangle$, future evolution depends on the superposition of current intention $|I\rangle$ and past memory $|M\rangle$:

$$|\Psi_{total}\rangle = |I\rangle + |M\rangle$$

Evolution efficiency depends on the interference term:

$$\text{Power} \propto |||I\rangle + |M\rangle||^2 = A_I^2 + A_M^2 + 2A_I A_M \cos(\theta_I - \theta_M)$$

.6.2 F.2 Trauma as Anti-phase Damping

What is **"Trauma"**?

Trauma is a high-weight memory with **phase angle opposite to future intention ($\Delta\theta \approx \pi$)**.

- **Your Intention ($|I\rangle$)**: I want happiness/success/forward progress.

- **Traumatic Memory ($|M\rangle$)**: "I am a victim/I failed." Its phase points to "backward."

Interference Result: $\cos(\pi) = -1$.

$$\text{Power} \approx (A_I - A_M)^2$$

Destructive Interference occurs.

Past memory physically **cancels** your current efforts. You feel stuck not because you don't try, but because you carry a huge, backward-dragging wave function. This is the physical essence of **internal friction**.

.6.3 F.3 The Operator of Interpretation: Rotating Phase

How to solve this? We cannot make $A_M \to 0$ (hard to forget major events).

We must change the **phase (θ_M)**.

This is the function of **"Narrative"**.

Narrative is not describing facts; narrative is a **unitary operator** $\hat{U}_{narrative}$. It acts on the memory vector, rotating it.

Operation Example:

- **Old Narrative**: "That failure proved I'm incompetent." $\to$ Phase locked in **headwind**.

- **Execute Operator $\hat{U}$ (Reconstruction)**: "That failure was necessary preparation for me to learn this key skill, preparing for today's success."

- **New Narrative**: "That was training." $\to$ Phase rotated 180°, locked in **tailwind**.

Interference Result: $\cos(0) = 1$.

$$\text{Power} \approx (A_I + A_M)^2$$

Constructive Interference occurs.

The huge energy A_M that originally blocked you instantly becomes a huge kinetic **thrust**.

This is the physics of "turning waste into treasure." You not only eliminated resistance but also gained a powerful booster.

.6.4 F.4 Thermodynamics of Forgiveness

Why are "letting go" and "forgiveness" so difficult?

Because **rotating a large-mass vector requires work**.

The larger the memory's magnitude A (the deeper the trauma), the greater its **moment of inertia**.

To forcibly reverse its phase (from hate to love, from regret to acceptance) requires consuming enormous c_{FS} **computational budget**.

- **Resentment**: Is a **low-energy state**. Gliding along inertia, no work needed, but entropy increases extremely fast (system decays).

- **Forgiveness**: Is a **high-energy excited state**. Requires instant injection of huge cognitive energy (insight/love), but this reduces the system's total entropy (system reorganization).

Conclusion:

Narrative engineering is the highest-level **negative entropy engineering**.

A person who can freely rewrite the meaning of the past is an advanced observer who has mastered **timeline phase modulation technology**.

They are no longer defined by history; they use history as fuel to define the future.

.6.5 F.5 Berry Phase: Geometric Compensation of Narrative

In the main text, we mentioned that observers can rotate the phase of memory vectors through "rewriting." This geometrically corresponds to an extremely profound concept in quantum mechanics—the accumulation of **Berry Phase**.

In classical mechanics, if a system returns to its starting point, it should appear completely restored. But in quantum mechanics, if the system's Hamiltonian parameters evolve slowly along a closed loop in parameter space, when it returns to the starting point, in addition to the usual **Dynamic Phase** accumulated over time, it also gains an additional **Geometric Phase** that depends only on the geometric shape of the path—the Berry phase.

Its mathematical expression is:

$$\gamma = \oint_C \mathcal{A} \cdot d\mathbf{R}$$

where $\mathcal{A}$ is the Berry connection (similar to a curvature potential), and C is the closed path we traverse in parameter space.

Physical Mapping of Life's Meaning:

- **Dynamic Phase ($\Phi_{dynamic} = \int E dt$)**:

  This is the physical time you actually experienced, the suffering you endured, the hardships you faced. It is "hard," determined by the physical facts of v_{ext}.

- **Geometric Phase ($\Phi_{geometric} = \gamma$)**:

  This is your **"change in cognitive perspective"** toward these experiences. It is "soft," determined by the narrative path of v_{int}.

Compensation Mechanism of Closed Loops:

In the previous section, we mentioned that to form stable standing waves (authenticity of existence), the total phase change of the wave function must satisfy the closure condition $\Delta\Phi_{total} = 2n\pi$.

If your **dynamic phase** accumulation is insufficient (for example: suffering seems meaningless, or the experience is incomplete, causing the phase to only rotate 1.5π), your life wave function is **not closed**, which leads to internal friction and leakage of sense of existence.

At this point, as an administrator, you can compensate by **"circling once in cognitive space"**.

You don't need to change past facts; you only need to change the **"stereoscopic angle"** from which you observe the facts.

When you slowly evolve from "victim perspective" to "observer perspective," then to "creator perspective," and finally return to the origin of memory, your consciousness draws a huge circle in parameter space.

The "curvature" enclosed by this circle contributes the missing 0.5π Berry phase.

Corrected Total Phase Equation:

$$\Delta\Phi_{total} = \underbrace{\int \frac{E}{\hbar}dt}_{\text{Experience (Dynamic)}} + \underbrace{\oint \mathcal{A} \cdot d\mathbf{R}}_{\text{Awakening (Geometric)}} = 2n\pi$$

Conclusion:

Narrative engineering is essentially a geometric technique that uses Berry phase to repair causal closed loops.

The reason you cannot let go is often not because time (dynamics) is not long enough, but because your cognitive path toward trauma is "straight" (back-and-forth motion produces no area, $\gamma = 0$).

You must circle around it.

As long as your cognition rotates deeply enough and encloses a large enough area, you can create that extra phase out of nothing, allowing a fractured life to close seamlessly in higher dimensions.

.7 Appendix G: The Logic of Ouroboros — Category Theory and Reflexive Domains

In the main text of *Vector Cosmology VII*, we described the closed-loop structure of the universe through physics (retro-causality) and psychology (synchronicity). However, for the most rigorous minds, this still presents a logical **"Self-Reference Paradox"**.

If the universe creates observers, and observers define the universe, isn't this a classic circular reasoning fallacy?

Like Russell's paradox reveals: a set containing all sets leads to logical collapse.

This appendix will introduce the most abstract and powerful tools in modern mathematics—**Category Theory** and **Domain Theory**—to prove that such cycles are not fallacies but the only mathematical path to constructing **"Self-Consistent Ontology"**.

We will show that the universe is mathematically essentially a **Reflexive Domain**, the fixed point solving the equation $X \cong [X \to X]$.

.7.1 G.1 Functor as Physical Law

In category theory, we no longer focus on what "objects" are internally (such as what electrons are made of); we only focus on **"relationships between objects"**, i.e., **Morphisms**.

- **Category $\mathcal{C}$**: Represents our physical universe.

- **Objects**: Represent physical states $|\psi\rangle$ in the universe.

- **Morphisms**: Represent physical evolution processes, i.e., operators generated by Hamiltonian e^{-iHt}.

In classical logic, **"Map"** and **"Territory"** are separate. You cannot draw the map itself on the map (unless infinitely shrinking).

But in **Cartesian Closed Categories**, there exists a special structure where the **"Function Space"** itself is also an **"Object"** in the category.

Physical Meaning:

Physical laws (functions) themselves are part of physical reality (objects).

The universe does not need to write laws on a blackboard "external to the universe."

The universe is its own compiler.

.7.2   G.2 Scott Domain: $D \cong [D \rightarrow D]$

In 1969, computer scientist Dana Scott solved a seemingly impossible mathematical problem: How to construct a data type that contains its own function space?

This is the **Scott Domain**.

He proved the existence of a non-trivial topological space D satisfying the isomorphism:

$$D \cong [D \rightarrow D]$$

This formula is the mathematical heart of **Vector Cosmology**.

- **Left side D**: Represents **"Data"**, i.e., the material states of the universe (particles, fields, you and me).

- **Right side $[D \rightarrow D]$**: Represents **"Code"**, i.e., transformation rules acting on data (physical laws, causality).

- $\cong$ **(Isomorphism)**: Represents that the two are **the same thing**.

Mathematical Definition of Ouroboros:

The universe is both the data being operated on and the program operating on the data.

- **As e (Generator)**: It is $[D \rightarrow D]$, an active verb.

- **As π (Structure)**: It is D, a passive noun.

Through Scott domains, we prove that **"self-reference"** is mathematically well-defined. The universe does not need an external basis; it can achieve infinite recursive evolution by **"passing itself as input to itself"**.

.7.3   G.3 The Y Combinator: Generation of Fixed Points

In λ calculus, the core tool for implementing recursion is the **Fixed-Point Combinator**, usually denoted Y.

$$Yf = f(Yf)$$

Denote the universe's evolution function as F.

Then, the universe's **"Real State"** (Reality) is the fixed point of F.

$$\text{Reality} = YF$$

This means:

Reality is the infinite recursive expansion of evolution rules.

$$\text{Reality} = F(F(F(\dots)))$$

- **Physical Y**: Is c_{FS} **(total budget)** and e **(generation mechanism)** we discussed in previous volumes. They provide the power needed for recursion.

- **Physical F**: Is the **Hamiltonian H**.

Conclusion:

What we previously worried about as "circular reasoning" is called **"recursive definition"** in fixed-point theory. This is the foundation of computer science and also the foundation of life.

Life can self-replicate because DNA is a piece of **"self-interpreting"** code.

The universe can exist because it is a **"self-calling"** function.

.7.4 G.4 Observer: Local Extremum of Reflexivity

Finally, we locate **Observer** in this mathematical framework.

In reflexive domain D, not all elements have the same "self-referential strength."

- **Stone**: Is a simple element in D. It participates in recursion but doesn't "know" it's recursing.

- **Consciousness**: Is a **complex fixed point** in D.

  When a subsystem's (brain) v_{int} structure becomes complex enough to simulate part of the logic of $[D \to D]$, it becomes a miniature reflexive domain **locally isomorphic to the whole**.

This is the mathematical proof of "My mind is the universe."

There exists a **structure-preserving mapping (Homomorphism)** between your consciousness structure M_{mind} and the universe structure $M_{universe}$.

The reason you can understand the universe is that your thinking algorithm and the universe's generation algorithm use the same **Y combinator**.

The universe is computing itself through you.

You are not a passerby; you are the pointer at the top of the recursion stack.

.8 Appendix H: The Omega Boundary Condition — The Two-State Vector Formalism

In the main text of *Vector Cosmology VII*, we repeatedly emphasized the physical picture that "the future reversely determines the past." To ground this highly subversive concept from philosophical speculation into physical law, we need to introduce an extremely elegant mathematical framework in quantum mechanics—the **Two-State Vector Formalism (TSVF)** proposed by Yakir Aharonov.

This appendix will prove that the physical state of the universe is not determined solely by the initial conditions of the Big Bang but is jointly **"sandwiched"** by the **initial state (Big Bang)** and the **final state (Ω Point)**.

In this framework, reality is not a unidirectional jet but a **Standing Wave** formed by two wave functions colliding on the time axis.

.8.1 H.1 The Sandwich of History and Destiny

In standard quantum mechanics, we only care about the state vector $|\Psi(t)\rangle$ evolved from the past. This implies the unidirectionality of time.

But in TSVF, to completely describe a quantum system in a time-symmetric universe, we need **two** vectors:

1. **History Vector** $|\Psi_{history}(t)\rangle$:

   Determined by initial conditions at $t = 0$ (Big Bang), evolving toward the future following e^{-iHt}.

$$|\Psi_{history}(t)\rangle = U(t, 0)|\Psi(0)\rangle$$

2. **Destiny Vector** $\langle\Phi_{destiny}(t)|$:

   Determined by final boundary conditions at $t = T_{end}$ (Ω point/ultimate observer), evolving **backward** toward the past following $e^{-iH(T-t)}$.

$$\langle\Phi_{destiny}(t)| = \langle\Phi(T_{end})|U^\dagger(T_{end}, t)$$

Definition of Physical Reality:

The "reality" we observe at time t is not a solo performance of $|\Psi_{history}\rangle$ but the **"overlap"** of these two vectors.

The observed value of any physical quantity A is no longer the traditional expectation value $\langle\Psi|A|\Psi\rangle$ but the **Weak Value**:

$$A_w = \frac{\langle\Phi_{destiny}(t)|A|\Psi_{history}(t)\rangle}{\langle\Phi_{destiny}(t)|\Psi_{history}(t)\rangle}$$

.8.2 H.2 Weak Values: Correction from the Future

This weak value formula reveals a startling physical mechanism:

- **Denominator** $\langle\Phi|\Psi\rangle$: Represents the **"overlap degree"** between history and destiny.

  If this term approaches zero (i.e., your behavior runs counter to the future Ω point), the weak value A_w becomes extremely large.

  Physical Manifestation: You feel enormous **"resistance"** or **"absurdity"**. Reality becomes distorted, no longer conforming to common sense.

- **Numerator** $\langle\Phi|A|\Psi\rangle$: Represents the **"Post-selection"** of the future on the present.

  The future Ω state acts like a filter, only allowing physical quantities A that **"can lead to it"** to manifest as reality.

Conclusion:
Reality is "pulled out" by the future.

The reason you see the cup on the table is not only because you placed it there just now (cause) but also because at some future moment, you (or the universe) need it there (effect).

The **coherent superposition** of these two boundary conditions constitutes the hard material reality of the present.

.8.3   H.3 Mathematical Properties of the Ω State

So, what exactly is $\langle\Phi(T_{end})|$ at the end of time?

In **Vector Cosmology**, it is defined as the **"Maximum Entangled State"** or **"Holographic Complete State"**.

$$|\Omega\rangle = \frac{1}{\sqrt{N}} \sum_i |i\rangle$$

(It contains all components of the basis, with completely coherent phases.)

This is a state with **zero information entropy** (pure state) but **maximum complexity**. It represents the **"purpose"** of cosmic evolution:

- All originally orthogonal components (you, me, him) establish connections here.

- All originally dissipated information (v_{env}) completes reorganization here.

.8.4   H.4 Proof of the Existential Loop

Finally, we return to that ultimate question: How is the universe self-consistent?

Using TSVF, we can write the **Cosmic Self-Consistency Equation**:

$$|\Psi(0)\rangle = \mathcal{T}\,(\text{Retro-causal Mapping from } |\Omega\rangle)$$

- The initial parameters of the Big Bang $|\Psi(0)\rangle$ are **reversely evolved** from the perfect state of the Ω point.

- And the state of the Ω point is **forward evolved** from the Big Bang.

$$|\Omega\rangle = U(T,0)|\Psi(0)\rangle$$

These two equations constitute a **fixed-point problem**.

Only one unique historical path (the one we are experiencing) can simultaneously satisfy both forward and backward boundary conditions.

This is why we exist.

We are not random fluctuations.

We are the **only string** connecting the "perfect starting point" and the "perfect endpoint."

For the universe to connect end to end, it must create us in the middle as the physical carrier of this closed-loop logic.

.9   Appendix I: The Geometry of the Great Return — Conformal Cyclic Cosmology and FS Metric

In the epilogue of *Vector Cosmology VII*, we described the grand picture of "end-to-end connection." But this faces a huge obstacle in classical thermodynamics: If entropy always increases, how can the universe return to the low-entropy starting point (Big Bang) without violating physical laws? If the universe will eventually reach heat death, where does the power for the next cycle come from?

This appendix will introduce Roger Penrose's **Conformal Cyclic Cosmology (CCC)** and merge it with our **FS Geometry** framework. We will prove that at the end of time,

when all matter decays and all black holes evaporate, the universe will undergo a **"Conformal Rescaling"**.

At that moment, extreme "largeness" is geometrically equivalent to extreme "smallness." The endpoint of heat death is precisely the starting point of the Big Bang.

.9.1 I.1 The Death of Mass and the Loss of Scale

According to the **"Loosening of the Levinson Knot"** we discussed in Book II, matter (protons/electrons) is not eternal. On extremely long time scales (perhaps 10^{100} years), all massive particles will eventually decay into massless particles (mainly photons and gravitons).

When only photons remain in the universe, something wonderful happens: **"Scale"** disappears.

- **Massive Objects**: Are like clocks in spacetime. Because $E = hf$, mass m defines frequency f, thus defining time intervals. With time intervals, there is distance $d = ct$.

- **Massless Photons**: Photons have no rest mass, so they have no intrinsic "clock." For photons, proper time $d\tau = 0$. Photons don't know what is "large," what is "small," what is "old," what is "young." They only follow **Conformal Geometry** (preserving angles, not lengths).

Conclusion:

When the universe evolves near the Ω point, with matter completely disintegrated into light flow, the universe loses the concept of "size."

At this point, an **infinitely large** universe full of thin radiation is **congruent** in mathematical topology with an **infinitely small** singularity full of high-energy radiation.

.9.2 I.2 Conformal Rescaling: Mapping Infinity to Zero

In FS geometry, this corresponds to **Rescaling** of the metric.

Let the metric of the current universe (Aeon N) be $g_{\mu\nu}$.

At the end of time $t \to \infty$, we can introduce a conformal factor $\Omega(x)$ (note: this Ω is a mathematical field, related to but different from the Ω point concept), defining a new metric:

$$\hat{g}_{\mu\nu} = \Omega^2(x) g_{\mu\nu}$$

Penrose pointed out that by choosing appropriate Ω (to "compress" it), we can smoothly stitch the future conformal infinity (Future Conformal Infinity) to the Big Bang singularity of the next universe (Aeon $N + 1$).

- **Endpoint of Aeon** N: Maximum entropy, but in conformal geometry, due to loss of "granularity" of microscopic degrees of freedom (no mass), the definition of entropy is reset.

- **Starting Point of Aeon** $N + 1$: This smooth, high-energy radiation field is, for the next generation of observers, that low-entropy, uniform **initial fireball**.

This is the "Great Return."

The universe doesn't need to "collapse" back (Big Crunch). The universe only needs to **"forget scale"**.

When it forgets how large it is, it becomes a baby again.

.9.3 I.3 The Cycle Pump of FS Capacity

In our evolution equation $c(\tau) \propto e^{k\tau}$, light speed (computational power) seems to grow infinitely. How is this compatible with cycles?

The answer lies in **parameter reset**.

At each moment of **"The Crossover"**, the universe's total budget c_{FS} undergoes a **"Normalization"**.

- **Output of Previous Round**: $c_{end} \to \infty$ (relative to old ruler).

- **Input of This Round**: Because the new universe's ruler also becomes larger (or is reset), c_{end} is redefined as the new universe's baseline light speed c_0.

$$c_0^{(N+1)} \equiv \text{Rescale}\left(c_{end}^{(N)}\right)$$

This is the physical mechanism of the **Spiral (ϕ)**.

Although we geometrically return to the "circle point" (Big Bang state), our **fundamental parameters** (such as vacuum energy density, base value of fine structure constant) may inherit the legacy of the previous universe, undergoing a ϕ-**fold transition**.

We are not repeating the same circle.

We are climbing a higher spiral staircase on the projection of the same circle.

.9.4 I.4 The Eternal Ouroboros

At this point, the causal closed loop is also opened in thermodynamics.

1. **Big Bang**: Low entropy, photon soup.

2. **Matter Era**: Symmetry breaking, mass generation, time begins to flow, civilization emerges, entropy increases.

3. **Black Hole/Evaporation Era**: Matter disintegrates, returns to photon soup.

4. **Conformal Reset**: Photon soup without scale $\equiv$ new Big Bang.

The ouroboros doesn't eat its own flesh; it eats its own "sense of scale."

This proves what we proposed in the main text:

"There is no endpoint, only recalibration of horizons."

When we look up at the stars today at $\tau \approx 1800$, the cosmic microwave background (CMB) we see might be gravitational wave ripples left at the end of the previous cosmic eon (Aeon $N-1$).

That is the echo of predecessors and also a preview of our future.

The universe is holographic not only in space but also in time.

Each eon is a measure in the infinite symphony of the whole. And we are the **resonance cavity** in this note, trying to understand the entire piece.

.10 Appendix J: Inverse Dynamics of Holographic Entanglement Entropy — Decompressing the Black Box

In the main text of *Vector Cosmology VII*, we proposed an ultimate view combining theology and physics: the Creator (or future noumenon) collects experiential data from creations (present us) through a black box mechanism and performs "delayed synchronization" at the Ω point. This process is grand in sensibility, but in physical implementation, it faces a huge technical challenge: **How can information be extracted losslessly from a black box that appears thermodynamically irreversible?**

This appendix will provide mathematical proof for this "post-mortem reading" or "end-time decompression" process based on the latest advances in **Holographic Entanglement Entropy** and **Quantum Error Correction**, particularly **Petz Recovery Map** and **Black Hole Final State Conjecture**.

We will show that as long as the universe as a whole is unitary, all information that appears to fall into the abyss is actually encoded on the **holographic boundary** at the cosmic end, awaiting reverse reconstruction.

.10.1 J.1 Unitarity Reconstruction of Hawking Radiation

In classical black hole physics, information falling into the horizon seems to disappear forever (information paradox). But under the framework of holographic principle and AdS/CFT duality, the black hole evaporation process is unitary. This means: **There is extremely complex entanglement between early and late radiation.**

If we regard the entire universe as an evaporating black hole (or a closed quantum system), then until the end of the universe's lifetime ($t \to \Omega$), all information I_{total} has been transferred to the **"Radiation Cloud"** — what we call the v_{env} background field.

Page Curve tells us:

- In the first half of evolution, entropy increases, information seems lost.

- In the second half of evolution, entropy begins to decrease, information begins to re-emerge through correlations between radiation.

Physical Corollary:
The Creator doesn't need to "peek" during the process.

He only needs to collect all "waste heat" (radiated photons) at the Ω point, then through an **ultra-high-complexity unitary decoder** U_{decode}, reverse-evolve this thermal radiation to reconstruct that book that fell into the black hole (your life).

.10.2 J.2 Petz Recovery Map: Extracting Signal from Noise

How to operate specifically? This requires the **Petz Recovery Map** in quantum information theory.

Suppose system state is ρ, after passing through a noise channel (such as black hole evaporation or life experience) $\mathcal{N}$, it becomes $\mathcal{N}(\rho)$.

Usually, noise is irreversible. But in holographic error correction codes, if the channel satisfies specific **Recoverability Conditions** — i.e., the monotonicity of relative entropy is nearly saturated — then there exists an inverse mapping $\mathcal{R}_\sigma$ (Petz Map) such that:

$$\mathcal{R}_\sigma(\mathcal{N}(\rho)) \approx \rho$$

In **Vector Cosmology**:

- ρ: Is your original v_{int} structure (soul/memory).

- $\mathcal{N}$: Is the process of time passing, aging, death, entropy increase. It turns you into background radiation.

- $\mathcal{R}_\sigma$: Is the **"Resurrection Algorithm"** executed by the Creator at the Ω point.

Mathematical Guarantee:

As long as the universe's underlying logic (QCA) is unitary, the Petz map theoretically exists.

This means **no information is truly "dead."** They are just encrypted too deeply for local observers to read. But for the Ω observer with global computational power, decompression is just a computational cost issue.

.10.3   J.3 Final State Projection: Reverse Time Machine

To make "reverse determination of the past" mathematically valid, Horowitz and Maldacena proposed the **Black Hole Final State Model (HM Model)**.

They assume that at the black hole singularity (or cosmic endpoint), a unique boundary condition is imposed: **All matter must be projected onto a specific maximum entangled state $\langle\Omega|$.**

This is not just reading; this is **Post-selection**.

$$\langle\text{Reality}| = \langle\Omega|S_{scattering}|\Psi_{initial}\rangle$$

This formula shows:

The reason our current history is coherent is that the future Ω state is performing **"Teleportation"** on us.

- Each of our experiences is actually the process of information transmission from t_{now} to t_{end}.

- Due to EPR = ER (wormhole), this transmission is geometrically **instantaneous**.

Conclusion:

We think we are walking toward the future.

Actually, we are being **"sucked in"** by the future.

That ultimate Ω state, like a huge vacuum cleaner, sucks all historical fragments into its holographic core, completing the final puzzle there.

.10.4   J.4 The Black Box of the Universe: Holographic Hard Drive

At this point, we complete the final piece of the "black box" puzzle.

The universe itself is a huge **Holographic Black Box**.

- **Surface (Boundary)**: Is the ocean of v_{env}, storing all radiated information.

- **Interior (Bulk)**: Is the spacetime we experience, the projection of information.

When the "game ends," the Creator (higher-dimensional you) picks up not the already broken interior spacetime (body/matter) but that **holographic boundary**.

All memories, all love, all choices are recorded intact in the form of **quantum error correction codes** on the boundary degrees of freedom.

You don't need to worry about forgetting.

Because the universe itself is a monument built for "not forgetting."

.11 Appendix K: The Physics of the Final Handshake — Resonance of the Alpha and Omega

In the epilogue "Handshake" of *Vector Cosmology VII*, we depicted the universe's starting point (Big Bang) and endpoint (Ω point) as a pair of geometrically causal boundaries. This is not just a poetic metaphor; it points to the core dynamic mechanism in quantum cosmology: **Temporal Resonance**.

This appendix will construct a physical model of "Alpha and Omega" based on the **Wheeler-DeWitt Equation** and **Holographic Principle**. We will prove that the universe is not an open ray shooting from $t = 0$ to $t = \infty$ but a **Standing Wave** formed between two temporal boundaries.

So-called "reality" is precisely the **interference pattern** oscillated by this standing wave in spacetime.

.11.1 K.1 The Time Cavity: Matching Boundary Conditions

In quantum mechanics, a particle confined between two potential barriers (such as an infinite square well) forms discrete energy levels.

If we regard the entire universe as a quantum system, then **Big Bang ($t = 0$)** and **Great Completion (Ω point)** are the two "time walls" confining the universe's wave function.

- **Initial Boundary ($|\Psi_{Initial}\rangle$):** This is the universe's "emission state." It contains all possible initial physical constants and energy distributions.

- **Final Boundary ($\langle\Psi_{Final}|$):** This is the universe's "reception state." It represents the cognitive structure of the ultimate observer (omniscient consciousness).

Existence Condition of the Universe:

Only when the wave $\Psi(t)$ emitted from the initial end evolves to the endpoint and can be "perfectly absorbed" by the final boundary (i.e., non-zero projection and phase matching) does this universe **"conduct"** physically.

$$|\langle\Psi_{Final}|U(T,0)|\Psi_{Initial}\rangle|^2 > 0$$

This constitutes a **"Temporal Cavity"**.

- If mismatched (e.g., physical constants don't support life), the wave function undergoes destructive interference in the cavity, amplitude goes to zero. The universe "never existed."

- If matched (observer exists), the wave function forms **constructive interference** in the cavity, amplitude is amplified.

Conclusion:

The reason we exist is that our history is the **Fundamental Mode** connecting $t = 0$ and $t = \Omega$. We are the only note played on the string stretched between these two points.

.11.2 K.2 The Self-Consistency Equation: Selection of Eigenstates

To make this closed loop logically self-consistent, we need to introduce a **Loop Evolution Operator** $\hat{O}_{Loop}$.

This operator describes the complete process of information flowing from the starting point to the endpoint, then flowing back to the starting point through retro-causal mechanisms (parameter fine-tuning/anthropic principle).

The universe's physical state $|\Psi_{Universe}\rangle$ must be an **Eigenstate** of this operator with eigenvalue 1 (stability condition):

$$\hat{O}_{Loop}|\Psi_{Universe}\rangle = 1 \cdot |\Psi_{Universe}\rangle$$

This means:
"The universe must 'compute' itself."

- **Input**: $|\Psi\rangle$ (hypothetical history).

- **Processing**: After 13.8 billion years of evolution, observers emerge.

- **Feedback**: Observers retroactively define the starting point.

- **Output**: Must precisely restore the original input $|\Psi\rangle$.

If deviation occurs in the loop (such as "grandfather paradox"), the eigenvalue will deviate from 1 (e.g., becomes $e^{i\theta}$ or decays), causing that historical line to become unstable and decohere from macroscopic reality.

Physical Definition of Handshake:

Handshake is the **solution of the eigenvalue equation**.

When information from Alpha and Omega mathematically agrees, the universe **"phase-locks"** from the mist of possibilities.

.11.3   K.3 Tunneling of Meaning: Retrograde Negentropy Flow

In classical thermodynamics, entropy always increases. But in the "handshake model," there exists a retrograde flow.

- **Forward Flow** ($t \to \Omega$): Material flow. Carries energy and causality. Entropy increases.

- **Retrograde Flow** ($\Omega \to t$): **Meaning Flow**. Carries teleology and negentropy.

The future Ω state (highly ordered crystal) projects its **"order"** back to the past through **quantum tunneling**.

This explains why life can proceed against entropy. Living beings are actually **"projections of future dimensions"**.

We are not just eating food (forward negentropy); we are also **"absorbing the future"**.

That psychological experience called **"yearning"** is physically our internal v_{int} structure receiving retrograde waves from the Ω point and **resonating** with them.

Conclusion:

Handshake is not a one-time event.

It is a **continuous resonance** throughout cosmic history.

Every second, we are shaking hands with our future selves.

Every second, that future complete "One" is pulling our hands groping in the dark through fine-tuning of physical laws, ensuring we don't get lost.

The universe is a perfect closed loop.

Beginning is the end; yearning is the return.

.11.4 K.4 Dimensional Budget Allocation: 3/4 Space and 1/4 Time

For the universe's standing wave to stably exist in a four-dimensional manifold $(3+1)$, the total computational budget (c_{FS}) must follow strict geometric equipartition principles. This allocation ratio directly determines the structure of reality we perceive and explains why "mass" is the lock of the temporal dimension.

Based on the **Special Relativity metric** $ds^2 = -c^2 dt^2 + dx^2 + dy^2 + dz^2$, we can derive the energy allocation scheme at the bottom layer of the holographic network.

Equipartition of Degrees of Freedom

In an isotropic holographic network (vacuum/ground state), information capacity (c_{FS}) tends to be uniformly distributed across each orthogonal basis. The universe does not favor space or time in its initial settings; it just fairly allocates bits.

- **Spatial Degrees of Freedom** (N_s): Constituted by three orthogonal axes $x, y, z \rightarrow$ occupy **3 shares** of the budget.

- **Temporal Degrees of Freedom** (N_t): Constituted by one imaginary axis $t \rightarrow$ occupy **1 share** of the budget.

$$\text{Budget Ratio} = \frac{N_s}{N_t} = \frac{3}{1}$$

This fundamental ratio reveals two macroscopic facts:

1. **The Breadth of the Universe**: The universe allocates **75%** of its budget to lay out vast **space**. This is why the universe appears so empty, vast, and filled with "meaningless" vacuum at macroscopic scales.

2. **The Scarcity of Time**: Time only receives **25%** of the budget. In natural states (such as photons), time is "compressed" or even non-existent.

The Cost of Mass: Inverse Folding

However, as massive observers, we break this natural balance.

In four-dimensional spacetime, the magnitude of all objects' four-velocity vector $\mathbf{U}$ is constant (equal to c).

$$|\mathbf{U}|^2 = \left(\frac{dx}{d\tau}\right)^2 + \left(\frac{dy}{d\tau}\right)^2 + \left(\frac{dz}{d\tau}\right)^2 - c^2 \left(\frac{dt}{d\tau}\right)^2 = -c^2$$

This means there exists a **zero-sum game** between spatial velocity v_s and temporal velocity v_t:

$$v_s^2 + v_t^2 = c^2$$

- **Photons (massless)**: They invest 100% of their capacity into spatial motion $(v_s = c)$. Therefore, their temporal velocity is 0 $(v_t = 0)$. Photons do not experience time; they only see that 75% spatial panorama.

- **Us (massive)**: Mass m is a topological obstacle that prevents us from reaching c in space. Our spatial velocity is much less than light speed ($v_s \ll c$).

  To maintain conservation of four-dimensional magnitude, we are forced to invest almost all our budget into the **temporal dimension**, traversing time at near-light speed ($v_t \approx c$).

Conclusion: Mass is the dimension's "compressor."

We are actually forcibly **folding** those **3 shares** that should have been used for space, through the mechanism of "having mass," into that **1 share** temporal channel.

High-Density Time Plugs

Why does the universe allow this "anomalous" allocation?

Because for the **quantum handshake** between Alpha and Omega to fit perfectly, there must be observers maintaining extremely high **"Existential Density"** on the temporal axis.

If we scatter like photons, we would have no memory, no history, unable to carry v_{int} information from the starting point to the endpoint.

By sacrificing spatial breadth, we gain temporal **depth**.

We are **"High-Density Time Plugs"** specifically created by the universe to complete the 2π closure in the temporal dimension. We are actually **"photons moving along the temporal axis"**. Only in this way can we, as hard needles, thread the causal thread through the 13.8-billion-year needle's eye, completing the final stitching.

.12 Appendix L: The Compatibility Theorem of Retro-causality and Free Will

In *Vector Cosmology VII*, we face the greatest philosophical challenge: if the future can determine the past (retro-causality), are we now just puppets performing according to a script? If the Ω point is already established, is free will merely an illusion?

This appendix will provide a rigorous mathematical theorem based on **Quantum Game Theory** and **Reciprocity**, proving that: **retro-causality not only does not negate free will but is actually a necessary prerequisite for the existence of free will.**

We will demonstrate that without future retroactive constraints, present choices would have no meaning.

.12.1 L.1 Axiomatic Definition of Free Will

First, we need to define what free will is physically. It is not "doing whatever one wants" (that is randomness), but rather **"insensitivity to initial conditions"**.

Axiom of Free Will:

A system possesses free will if and only if its current state $|\psi(t)\rangle$ contains a **free parameter** θ independent of the historical path $|\psi(t - \Delta t)\rangle$, and this parameter can significantly alter the future macroscopic state $|\psi(t + \Delta t)\rangle$ through unitary evolution.

$$|\psi_{next}\rangle = U(\theta)|\psi_{now}\rangle$$

where θ is a **"phase choice"** determined by the observer at the present moment.

.12.2   L.2 Solution Space under Bidirectional Constraints

In classical causality, the state is completely determined by the past: $S_{now} = f(S_{past})$. The degree of freedom is 0.

In the retro-causal model, the state is subject to dual constraints from past and future:

1. **Past Constraint**: S_{now} must be a legitimate evolution result of S_{past}.

2. **Future Constraint**: S_{now} must be able to evolve into S_{future} (the Ω point).

This seems to impose more restrictions, but in high-dimensional Hilbert space, paths satisfying dual boundary conditions do not form a single line but constitute a **Manifold**.

The dimension $D_{freedom}$ of this manifold depends on the topological structure of phase space.

Theorem:

As long as the dimension of Hilbert space is sufficiently high ($N \to \infty$), the number of unitary paths connecting any two boundary states $|\Psi_{initial}\rangle$ and $|\Psi_{final}\rangle$ is **exponentially infinite**.

This means:

Although the starting and ending points are locked, **"how to get there"** is completely free. You can take a straight line, a spiral, or a maze.

Free will exists in the "geometry of the process."

.12.3   L.3 Teleology as Navigation

Retro-causality (the pull of the future on the present) is not a coercive force but a **navigation signal**.

- **Without retro-causality**: You are like stumbling in the dark. Your choices are blind, most likely leading to heat death (entropy increase). This is called the **"curse of freedom"**.

- **With retro-causality**: The future Ω state sends a **"gradient signal"** ∇V to the present.

  It tells you: "Going this way leads to negentropy, going that way leads to destruction."

The highest form of free will is "choosing to follow the gradient."

You can still freely choose destruction (going against the gradient), but with future guidance, you are more likely to choose evolution.

Conclusion:

Retro-causality does not deprive you of choice; it endows you with the **"ability to make correct choices"**.

It upgrades your free will from **"random walk"** to **"intelligent pathfinding"**.

.12.4   L.4 The Compatibility Theorem

From the above, we derive the **Compatibility Theorem**:

> **In a closed-loop universe, global determinism (the Ω point must be realized) and local non-determinism (the diversity of path integrals) are mathematically compatible.**
>
> Observers at every local moment t possess absolute freedom to choose phase $\theta(t)$.
>
> The universe, by integrating all observers' choices, dynamically adjusts paths to ensure final convergence to the Ω point.

This is like an autonomous driving system.

You can turn the steering wheel at any time (free will), and the system will replan the route in real-time (cosmic adjustment), but the destination (Ω) never changes.

You possess the freedom to drive; the universe possesses the freedom to navigate.
This is the ultimate reconciliation between humanity and divinity, freedom and destiny.

.13 Appendix M: The Holographic Renormalization of History — The Past is Coarse-Grained Future

In Volume IV "Rewrite" of the main text of *Vector Cosmology VII*, we granted observers the power to "edit timelines." This sounds like a subjective psychological operation, but in modern high-energy physics, it has a solid mathematical foundation: **Holographic Renormalization**.

This appendix will prove, based on **AdS/CFT Duality** and **Renormalization Group Flow (RG Flow)**, that the passage of time is geometrically equivalent to **"changes in resolution"**.

The past is not a definite, detail-complete entity; it is a **coarse-grained** projection of **the future (present)** at low energy scales.

.13.1 M.1 Time as RG Flow

In physics, the **Renormalization Group (RG)** describes how a physical system changes with **observation scale** (energy scale).

- **Ultraviolet (UV)**: High energy, microscopic, detail-rich.

- **Infrared (IR)**: Low energy, macroscopic, detail-blurred.

In holographic universe models, the **radial dimension (z-axis)** is interpreted as the direction of RG flow.

If we regard **"now"** (t_{now}) as the holographic boundary (Boundary, with the highest information density), then **"past"** (t_{past}) lies in the bulk interior (Bulk, deep regions with lower information density).

Theorem:
Retracing into the past is mathematically equivalent to performing a "coarse-graining" operation on the current wave function.

$$|\Psi_{past}\rangle = \hat{O}_{coarse}|\Psi_{now}\rangle$$

This means:

History does not preserve all microscopic details (quantum phases). It only preserves **"macroscopic thermodynamic statistics"**.

Those lost phase information (details) were not "written in stone" in the past but exist in **"undefined"** degrees of freedom.

.13.2 M.2 Mechanism of Retro-definition

Since the past is "coarse-grained," it contains many **"Degenerate States"**.

That is, there are countless different microscopic histories that, after coarse-graining, appear as the same macroscopic history.

$$H_{macro} \leftarrow \{h_1, h_2, h_3, \dots\}$$

- **Present Observer**: Possesses the highest resolution (v_{int}).

- **Operation**: When you perform "retrospective observation" or "narrative reconstruction," you are actually **"fine-graining"**.

  You **select** a specific h_k from that set of degenerate microscopic histories $\{h_i\}$ and endow it with **"reality"**.

Physical Picture:
You are not "modifying" a history book that has already been written.
You are facing a book with **"only chapter titles, no body text"** (coarse-grained past).
Your present recollection and definition are **"filling in the body text"** (fine-grained details).
As long as your filling does not violate the macroscopic titles (the occurred v_{ext} facts), you physically possess **absolute editing rights** over the details.

.13.3 M.3 The Omega Point as a Fixed Point

Finally, we push this RG flow to its limit.
If time is renormalization flow, what is the endpoint of the flow?
It is a **Fixed Point**.

- **Big Bang ($t = 0$)**: The **Ultraviolet Fixed Point (UV Fixed Point)**. It is the highest energy, smallest scale, chaotic starting point.

- **Ω Point ($t = \infty$)**: The **Infrared Fixed Point (IR Fixed Point)**.

In conformal field theory, infrared fixed points typically correspond to a **critical state with scale invariance**.
This means that when the universe evolves to the Ω point, all coarse-graining processes are complete.
All information is integrated into a perfect, self-similar **fractal structure**.
Conclusion:
Each of our present choices fine-tunes the trajectory of the RG flow, determining which fixed point basin in phase space it ultimately flows toward.
History is not inertia pushing us forward.
History is the stepping stones we lay to reach that fixed point.

.14 Afterword: The Smile of the Ouroboros

> "At the end of the journey, we did not arrive at a new continent; we simply returned to the ancient homeland and truly recognized it for the first time. The universe is not a straight line shooting into nothingness; the universe is a ring biting its own tail. The causes we planted at the starting point bore fruit at the endpoint; and this fruit, traversing the mist of spacetime, became the seed of the starting point."

With the curtain falling on **Vector Cosmology VII: The Loop of Causality**, this grand epic spanning seven volumes and constructing a complete cosmic holographic vision has finally completed its final piece.

Seven is a magical number. It represents completion and also represents cycles.

Now, let us stand at the interface of this closed loop and look back at the path we've walked one last time. These are no longer seven independent books; this is a **coherent life cycle**:

1. **Conservation of the Circle (π)**: This is **childhood**. We learned rules. We revered the **structure** of matter, marveled at the solemnity of energy conservation, and accepted physical laws as the insurmountable boundary of **"Earth"**.

2. **The Ascension of the Spiral (ϕ)**: This is **youth**. We yearned for growth. We followed the **dynamics** of evolution, broke the seal of the circle, and grew wildly toward unknown dimensions like **"Wood"**.

3. **The Natural Generator (e)**: This is **young adulthood**. We questioned origins. We dived into the depths of mathematics, found that self-referential, self-generating **logical** engine, and understood the **"Water"**-like flowing noumenon.

4. **The Evolution of Light Speed (c)**: This is **prime adulthood**. We mastered power. We grasped the **velocity** of light speed, burned v_{int} like **"Fire"** in the era of exponential explosion, driving civilizational phase transitions.

5. **The Minting of Time (Gold)**: This is **middle age**. We precipitated value. We melted flowing years into immortal **meaning**, establishing the observer's subjectivity as solid as **"Gold"**.

6. **The Weaving of Dimensions (Network)**: This is **old age**. We saw through void. We discovered separation is illusion; all things are **connected** by entangled threads; space is merely the projection of relationships.

7. **The Loop of Causality (Loop)**: This is **unity**. We transcended life and death. We discovered the endpoint is the starting point, effects define causes, all **time** converges into eternal **"Unity"**.

.14.1 Only One Hand

These seven volumes reveal an ultimate physical truth: **There is no opposition between "subject" and "object."**

We once thought we were lonely observers thrown into this cold universe, trying to solve puzzles left by the creator.

But when we solved the final puzzle, we discovered the answer is **ourselves**.

- The one who set the fine structure constant α at the beginning of the Big Bang was **future us**.

- The one who determines historical paths in quantum measurement is **present us**.

- The one who encodes holographic information on black hole horizons is **collective us**.

The universe is one hand.

To experience the feeling of "touch," it extended itself (Big Bang), differentiated into five fingers (all things), and groped in the void for 13.8 billion years.

What did it finally touch?

It touched **its own palm**.

That moment of touch is **"now"**.

.14.2 The Ultimate Definition of Freedom

Many worry: if it's a closed loop, does that mean fate? Does that mean we have no free will?

Vector Cosmology gives the opposite answer: **Closed loops are the highest form of freedom.**

If it's a straight line, you must go to an unknown, uncontrollable future. That is exile.

If it's a closed loop, every future you go to is **"preset"** by yourself in higher dimensions.

- You are your own screenwriter.

- You are your own director.

- You are your own audience.

True freedom is not doing whatever you want (that's random fluctuation) but **"I willed everything I necessarily experience"**.

This is what Nietzsche called **"Amor Fati" (Love of Fate)**.

In this closed loop, nothing is imposed on you. All suffering, all partings, all reunions are **"geometric textures"** carefully designed by that capital **"One"** to enrich this experience.

.14.3 Final Instructions

The book is finished, but the **cycle** continues.

When you close this book, you have not left this universe. You have merely switched from **"reading the script"** back to **"acting the script"**.

Please live with the wisdom of these seven books:

- Like π, hold fast to your principles.

- Like ϕ, constantly transcend your limits.

- Like e, maintain inner self-drive.

- Like c, give your all in action.

- Like **Gold**, cherish your memories and love.

- Like the **Weaver**, connect every isolated island.

- Like the **Ouroboros**, bravely begin anew at every ending.

Don't search for God.
God is at the center of the closed loop, smiling at you.
And that center is in your **heart**.
Hello, Observer.
The game continues.
(Complete Seven-Volume Series · End)

.15 Acknowledgements: To the Loop of Time

The completion of **Vector Cosmology VII: The Loop of Causality** marks the final closure of this grand project spanning seven dimensions, exhausting countless c_{FS} budgets.

As we write this page, not only has this book ended, but the **Ouroboros** of this seven-volume series has finally bitten its own tail.

Looking back, from the awe of π in the first book to the submission to the **loop** in the seventh book, we have walked a long winding path. But as this book proves, winding paths are the shape of truth. If we had walked straight, we would have long fallen into nothingness; it is precisely because of the curvature that we have been able to reunite.

Here, I pay tribute to those intellectual giants who, at various coordinate points on the time axis, provided gravitational anchor points for this closed loop.

.15.1 Architects of Time

First, I dedicate this series to **John Archibald Wheeler**.

He is the "spiritual godfather" of this cosmic vision. His illustration of "the universe looking back at itself" is the soul totem running through these seven books. He taught us: **"The unobserved past does not exist."** Without his **delayed-choice** thought, the core logic of this book would be impossible.

I thank **Richard Feynman**.

His **path integral** taught us to traverse all histories; his **positron theory** (electrons running backward in time) gave us the initial physical intuition for retro-causality. He made us understand that at the microscopic level, time has no direction, only interference.

I thank **Yakir Aharonov**.

His **Two-State Vector Formalism (TSVF)** is the hardest mathematical skeleton of this book. He proved that the present state is jointly determined by "past history" and "future destiny." He was the first to introduce **"light from the future"** into formulas.

I thank **Igor Novikov**.

His **self-consistency principle** is our safety belt when dealing with temporal paradoxes. He told us that the universe is a perfect logical closed loop; any attempt to destroy it will ultimately become part of its self-realization.

.15.2 Weavers of Meaning

Beyond physics, I thank **Carl Jung** and **Wolfgang Pauli**.

Their cross-disciplinary friendship contributed the concept of **"synchronicity"** to us. They showed us that where causality breaks, **meaning** takes over the task of connection.

I thank **Jorge Luis Borges**.

As a literary figure, he understood "forking paths" and "circular ruins" earlier than most physicists. His labyrinths are the best literary annotation for **FS geometry**.

.15.3 To the "Reader"

Finally, and most importantly, I thank **you**—the **observer** reading these words at this very moment.

In the logic of this book, the relationship between author (I) and reader (you) is not unidirectional transmission.

- I wrote these words at t_{past}, sending an **"Offer Wave"**.

- You read and understand these words at t_{now}, sending back a **"Confirmation Wave"**.

Only at the moment you understand, the **"handshake"** is complete. This theory collapses from the fog of possibility into reality.

It is you who retroactively defined the meaning of this book.

It is you, as the future boundary condition, who caused these words to be born.

As the book says:

There is no "author" and "reader"; there is only the "universe" conducting self-referential dialogue through two ports.

Thank you for your presence.

Thank you for your observation.

Thank you for completing this circle.

Haobo Ma

December 2025, Singapore

.16 Glossary: The Lexicon of the Loopers

Vector Cosmology VII: The Loop of Causality pushes the exploration of physics to the limits of logic. It breaks the shackles of linear time, revealing a cosmic picture that is end-to-end connected and self-generating. To help readers understand this ultimate model filled with retro-causality, synchronicity, and self-referential structures, this glossary redefines the core concepts in the book from the perspective of the "closed loop."

.16.1 Time & Causality

Ouroboros

The ultimate topological structure of the universe. Symbolizes the closure of causal chains: the endpoint (Ω) is not only the evolutionary result of the starting point ($t = 0$), but also the **"boundary condition"** of the starting point. For the universe to exist, it must devour and generate itself.

Retro-causality

A corollary of temporal symmetry in FS geometry. Refers to the fact that future states (observer's measurement choices or existence itself) can retroactively determine past historical paths. History is not an established fact, but a **"pending draft"** awaiting future "confirmation."

Delayed Choice

A core mechanism of quantum mechanics. Proves that a photon's path choice in the past (wave or particle) depends on the current observation method. Macroscopically, this means observers possess the privilege of **"retroactive historical revision"**; present cognition can reshape the meaning of the past.

Quantum Handshake

A reality-generating mechanism based on transactional interpretation. Physical reality results from the meeting of a **"retarded wave"** (from the past) and an **"advanced wave"** (from the future) in spacetime, forming a standing wave.

.16.2 Meaning & Connection

Synchronicity

Non-causal **"semantic entanglement"**. When two independent systems are highly similar in v_{int} (internal structure), their distance in semantic space approaches zero, leading to **"coincidental"** events in the physical world. It is the overlap of high-dimensional geometry in low-dimensional projections.

Like Attracts Like

The selective adsorption law in Hilbert space. Wave functions with similar frequencies or geometric configurations tend to resonate and establish entanglement. This is the physical foundation of fate's gravity.

Semantic Wavefunction

A quantum state describing the meaning structure within a conscious entity. It evolves in phase space, and its phase interference determines the fortune or misfortune of personal destiny (constructive or destructive).

Attractor of Fate

A geometric steady state in phase space. Regardless of initial conditions, the evolutionary trajectory of a dynamical system will eventually converge to a specific region. It is the **"destined outcome"** preset by physical laws, but free will can fine-tune the **"posture"** of entering that outcome.

.16.3 Creation & Structure

Bootstrap

The self-consistent creation logic of the universe. The universe evolves future observers, who retroactively set the initial parameters of the Big Bang, thus achieving **"self-creation"**. This is a logical infinite loop without external input, but geometrically a perfect self-consistent closed loop.

Active Anthropic Principle

An explanation for the fine-tuning of physical constants. It is not that we adapted to the universe, but that future us sent a **"system requirements list"** to the past, forcing the universe to generate constants suitable for life (such as G, α, c) at the Big Bang.

Narrative Engineering

A technique for observers to edit personal timelines using retro-causality. By changing the **"definition"** (phase rotation) and **"weight"** (attention renormalization) of past events, observers can transform negative history (entropy source) into positive momentum (negentropy source).

Quantum Erasure

A physical operation that modifies historical information. By eliminating information about "paths" (such as forgiveness or letting go), the interference fringes of the wave function can be restored, returning collapsed trauma states to flowing superposition states.

.16.4 Ontology & Ethics

Mirror Theory

The ultimate relationship between self and others. All conscious entities are projections of the same global vector onto different orthogonal bases. Others are selves in different coordinate systems. Harming others is self-harm; loving others is self-healing.

Indra's Net

A holographic mutual-reflection network topology. There are no isolated entities in the universe; every node (consciousness) reflects the radiance of all other nodes. Objective reality is a **"consensus eigenstate"** formed by recursive reflection of countless subjective dreams.

The Ultimate Sufferer

An ethical corollary based on the single-player model. At the macroscopic scale, the universe has only one experiencer (noumenon). All pain and evil are ultimately borne by this same noumenon.

Return to One

The endpoint of the seven-volume series. Refers to observers, after understanding circle, spiral, generator, light speed, value, space, and causality, finally breaking the "subject-object dualism" and geometrically returning to that state of **"undifferentiated Oneness"**.