

The Mechanics of Steins;Gate

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Prologue

What is this?

A complete guide to the mechanics of Steins;Gate. Unlike other many other “complete theories”, the aim here is to understand the rules as intended by the writers, rather than fitting the story to a preconceived idea of time travel. What results is the most accurate account available (to my knowledge), explaining every event of the story without contradiction for the first time.

Why should I care?

If you like Steins;Gate, understanding its mechanics in full will probably deepen your enjoyment. And if you are someone who feels that Steins;Gate is full of disappointing plot holes, this guide will also explain why it contains no such thing, and show how a lot of the criticisms its mechanics receives are actually criticisms of fan theories that have misunderstood the source material.

Why (the hell) is this guide so long?

Explaining Steins;Gate correctly requires starting from the beginning, because a lot of the common misunderstandings relate to the most fundamental concepts. I also feel that anything I say should be backed by evidence and justification now, rather than addressing this piecemeal in some comments section somewhere. Before that, this guide begins with a summary of all the relevant real-world topics which Steins;Gate builds on, so that you have the context the writers had (and perhaps assumed the reader had) when devising the story. Then as we progress through the mechanics, a number of events from the story are explained as examples, building up to Operation Skuld as the final explanation. There are nice diagrams, too!

The idea for this guide telescoped out of my desire to write down my understanding of the mechanics in one place, because in discussions I often found myself repeating foundational points. So for my own sanity, I have also included refutations of some common misconceptions and fan theories in an optional final chapter.

And who are you?

I am Votuko on Discord (and elsewhere). I am a longtime fan of the Science Adventure Series, who has experienced all of the English-translated media. For this guide, I specifically revisited every piece of translated Steins;Gate media (including visual novels, manga, drama CDs, and what is available of light novels, writer interviews and FAQs) to check that nothing in my understanding contradicted any established stories. I also read all of John Titor's original forum conversations, the Infinity Series, I/O, and Thrice Upon a Time, for contextual information. My summaries of physics topics in the introduction are based on my understanding as a Physics PhD holder.

Why release this now?

Originally, the plan was to release this after Chaos;Head Noah's English release (and Committee of Zero patch), but the scope of my preparation, and the document, gradually expanded. I have had these mechanics in my head for at least two years in their current form, so I was keen to get them out there before the English release of Anonymous;Code. I look forward to that game being a test of this guide's accuracy, if it touches on Steins;Gate's mechanics at all.

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1 Introduction

Time travel is a common feature in sci-fi stories, where it is often used to permit exploration of separated time periods for narrative effect (*The Time Machine*, 1895), or as a plot device itself for manipulating the events of the story (*Thrice Upon a Time*, 1980). At the same time, travelling to the past is impossible from the perspective of real physics, for at least two reasons:

1. The world is made of objects that travel forwards in time only, so any composite object will also travel forwards only. Therefore time travel stories must invent new ingredients that allow travel to the past.
2. The idea of travel to the past leads to a range of logical absurdities, known as paradoxes. The author must establish rules to avert or otherwise deal with these.

The many ways that an author can respond to these issues leads to a huge variety of ways that time travel can function in a story.

Steins;Gate is a time travel story that makes somewhat unconventional choices with its mechanics. In addition, only some of these rules are presented to the audience initially, with the discovery of other mechanics forming part of the story itself, and some elements being left open for interpretation. As such, it is understandable for readers to be unsure of the full picture. This document is an attempt at presenting the complete mechanics of Steins;Gate as intended by its writers, to answer various frequently asked questions, and to correct a number of common misconceptions.

Note that Steins;Gate is the second main entry in the Science Adventure Series. However, I will stick to discussing the mechanics that relate only to Steins;Gate and its spin-offs (Steins;Gate 0, drama CDs, manga, etc.). All claims will be presented with evidence, mainly from the Steins;Gate and Steins;Gate 0 visual novels, but occasionally from other media. I assume the reader has knowledge of those two visual novels and their anime adaptations, but will avoid spoilers for other content not covered in

these. And although the spin-offs won't need to feature much in these discussions, every piece of English-translated media was considered and checked for consistency with the mechanics that I will present.

My main reason for writing this guide is that I am not aware of any existing English-language write-up that consistently explains everything we see in *Steins;Gate*. The reason for this, I think, is that the mechanics of *Steins;Gate* are unlike those of most other time travel stories, so it is easy to accidentally assume that certain rules of those other stories apply to *Steins;Gate*, when they do not. Therefore I will not be inventing any rules that are not motivated in the story itself. The goal here is to collect together the mechanics as written, not to fit *Steins;Gate* to some preconceived notion of time travel rules.

The document is divided as follows:

- For the remainder of Chapter 1, important real-world topics which give context to *Steins;Gate* are summarised. Understanding these will be very helpful when interpreting the story, because they form the foundation of the mechanics and are to some extent things that the writers assume the audience to know. (Some earlier works of fiction also give insight into the mechanics of *Steins;Gate*. To discuss these could constitute spoilers for those titles, so I will not do so here.)
- Chapter 2 contains the explanation of (most of) the mechanics of *Steins;Gate*. To be as clear and honest as possible, only those topics which have a single interpretation based on the evidence are included. A number of events are explained using these mechanics, including some that have not been explained previously.
- Chapter 3 covers a few remaining areas in the mechanics where there is a little more room for interpretation. Some other topics and events are explained in a novel way. Since this part is essentially my own theory, there may be other ways for the reader to arrive at the same outcomes.
- In Chapter 4, a number of misconceptions and fan theories that I consider to be misleading are addressed. Reading this isn't necessary to follow the rest of the guide, but does give further detail on why certain possible mechanics can be ruled out.

1.1 Quantum Mechanics

Quantum mechanics is a fundamental theory in physics, primarily describing the behaviour of small objects, but out of which the rules governing everyday scales can also be expected to emerge.

It differs drastically from earlier classical theories, which describe the world in terms of collections of objects with certain knowable parameters (position, velocity, etc.) that evolve over time according to some deterministic rule. Instead, quantum mechanics proposes that a system (such as a collection of particles) should be represented by something called a “wavefunction”, which relates to the probabilities of finding the system in certain states when measured. Between measurements, the entire wavefunction flows and interferes with itself like a wave.

As an example, an electron has a property called spin, that can be up or down. So a process might create a state with the wavefunction

$$|\psi\rangle = \alpha|\uparrow\rangle + \beta|\downarrow\rangle,$$

where $|\uparrow\rangle$ or $|\downarrow\rangle$ represent electrons with a certain spin state, and α and β are (complex) numbers. The state $|\psi\rangle$ is a superposition of $|\uparrow\rangle$ and $|\downarrow\rangle$. The probability of finding the electron in a certain spin state then turns out to be the square of its coefficient,

$$P(\uparrow) = |\langle\uparrow|\psi\rangle|^2 = |\alpha|^2.$$

However, obtaining a certain measurement result is not the same as discovering that the electron was in that state “all along”, because the different parts of a wavefunction can also be made to interact with each other prior to measurement. An illustration of this is the famous double-slit experiment, where a single particle fired at a barrier with two holes produces a wave-like pattern on a detector screen.

When a quantum superposition comes into contact with another object, that object becomes part of the system. Suppose our electron meets an atom, which will fly off to a different location depending on the spin of the electron. Schematically, what occurs is

$$|\psi\rangle|atom\rangle \rightarrow \alpha|\uparrow\rangle|x_1\rangle + \beta|\downarrow\rangle|x_2\rangle.$$

Before their interaction, the condition of the electron and atom could be described separately by $|\psi\rangle$ and $|atom\rangle = |x\rangle$, but this is no longer the case. The two become entangled, so that a measurement of one automatically grants information about the other.

This strange mathematics works well and its predictions have been experimentally verified to a high level of precision. However, its interpretation has been the subject of much debate. The two main questions are:

1. To what extent do wavefunctions exist in the real world? (Are they the basic ingredient of reality, as particles were once thought to be? Or are they a convenient calculational tool that happens to give the correct predictions?)
2. What are measurements in quantum mechanics? (Why do they seemingly give single probabilistic results, when the rest of quantum mechanics involves superpositions evolving deterministically? How could a measuring device or observer follow different rules to the quantum particles that it is constructed from?)

The quantum mechanics pioneer Erwin Schrödinger summed up (some of) the confusion with his cat in a box thought experiment: A small system, governed by quantum mechanics, can be arranged to release poison with a 50% chance. What is the condition of a cat, if it were sealed in a box with that setup? According to quantum rules, it should evolve into a superposition of both alive and dead, just like our atom in a superposition of two places. But someone opening the box never sees a superposition, so what is going on?

A number of different interpretations of the quantum rules have been proposed to answer questions such as these. We will briefly look at the three most relevant to Steins;Gate in particular.

1.1.1 Copenhagen Interpretation

The [Copenhagen interpretation](#) is one of the earliest, originating during the development of quantum theory. Its answers to the above questions are:

1. Wavefunctions are merely a calculational tool with no actual existence. The results of measurements are all that constitute reality.

-
- Measurements are special events that take place when an “observer” interacts with a quantum system. At that moment the measured wavefunction “collapses”, with its superposition of possible states being replaced immediately by a single possible state. (Chosen at random with the probability recorded in the wavefunction.)

Unfortunately, no definition is given for an “observer”, beyond it behaving in a non-quantum way. Most proponents of the interpretation assume that large enough objects act as observers, but no explanation of how a large non-quantum object emerges from small quantum ingredients is attempted. A few have suggested that consciousness is what qualifies an object as an observer, but this is a fringe view among physicists. (It is disproportionately common in sci-fi and popular culture however, giving rise to “quantum” “healing” scams and nonsensical statements like “the moon doesn’t exist if no-one is looking at it”...)

Perhaps the biggest criticism of the Copenhagen interpretation is that it is mathematically ugly. Ordinarily, quantum systems evolve in a deterministic, time-reversible way, like a wave. But the supposed collapse of the wavefunction that occurs when a measurement is taken is probabilistic and time-irreversible (information is thrown away).

Historically, Copenhagen has been used for predicting experimental results, rather than worrying about implications for the nature of reality, which is why it has been described as the “Shut up and calculate!” interpretation. Its answer to Schrödinger’s cat is simple: The cat is an observer, so measures the state of the killing machine and collapses any superpositions. It is either alive or dead throughout, never a mixture.

1.1.2 Many-worlds Interpretation

The [many-worlds interpretation](#) is a more recent, but in some ways simpler, interpretation. Its answers to the two questions are:

- Wavefunctions are real. Because everything is built out of quantum components, there is one big wavefunction that describes, or is, the entire universe.
- There is nothing special about measurements. Wavefunctions do not collapse, and the idea that they should have to is based on a misunderstanding.

The key insight of many-worlds is that it is not necessary to erase parts of the wavefunction to explain why people don't observe quantum superpositions. Allowing a person to behave in the same quantum way as any small object, they will simply become entangled with any superposition that they measure. The new wavefunction contains multiple versions of that person, each observing a single definite state, in essentially separate "worlds".

The implication for Schrödinger's cat is that it is indeed in a superposition of dead and alive before the box is opened, because the same quantum rules apply to everything. The experimenter who opens the box and observes the cat then also becomes part of the superposition, although this is not something they can directly perceive. The box containing a dead and alive cat becomes a laboratory containing a (hopefully) sad and happy scientist.

It is worth emphasising how the worlds of many-worlds work, because popular culture often presents a misleading picture. The common, but wrong, description is that every quantum event causes the entire universe to immediately branch in two, creating an infinite quantum multiverse. But in fact, it is only the person measuring a quantum state who has branched at first, then people who interact with them, and so on. Perhaps everyone on Earth would quickly end up interacting with (so become drawn into) the same superposition, but there is no need for this to affect the rest of the universe.

Nevertheless, the popular description of many-worlds is still mostly accurate. It predicts a multiverse consisting of timelines that spread out like branches of a tree, going on to encompass every possible sequence of events. That includes histories where you made different choices, or different chance events occurred, because the deepest workings of the brain and your surroundings are quantum events. (Of course, far more worlds contain a likely event than an unlikely one, so worlds where you are Prime Minister are rarer than ones where you are a teacher. Similarly, physically impossible events don't happen in any worlds, so there are no worlds where you can fly or have telepathy.)

For many, the existence of a multiverse is too major an implication to be believable. Where many-worlds excels is in its mathematical simplicity: Because everything is quantum, everything can be described in one big(!) wavefunction. And that wavefunction obeys the same deterministic, time-reversible rules at all times, in all situations.

1.1.3 Pilot Wave Interpretation

The [pilot wave interpretation](#) is a third unique interpretation of quantum theory. Its core concepts are:

1. The wavefunction is real, but physical particles also exist with definite properties at all times. The action of the wavefunction is to guide the motion of the particles.
2. Measurements are about discovering the properties held by the particles. Because they ride the wavefunction, they will be found in one of the possibilities defined by it. No wavefunction collapse is required.

As a hidden variables theory, particles in pilot wave theory follow real trajectories between measurements, in contrast to eg. the Copenhagen interpretation where particles are wave-like and smeared out when unobserved. The wavefunction guides the particles around, ensuring that they display all the expected wave-like quantum behaviour.

We note that the wavefunction here is identical to that in the many-worlds interpretation. However, in pilot wave theory it is the particles that define the physical world, and only one branch of the wavefunction will contain those particles. The other branches are empty, so do not represent physical worlds. Instead, they could be described as mathematical possibilities.

There are some drawbacks to this interpretation, however. Firstly, the motion of the particles requires each particle to instantly possess non-local (transmitted faster than light) information about the rest of the wavefunction. (In fact, it is a general rule that a quantum interpretation cannot both have hidden variables and be local.) Although this cannot be exploited to send faster than light signals, it doesn't sit very nicely with relativity. The other criticism is that the interpretation is extravagant, or wasteful. Not only does it contain the entire wavefunction of many-worlds, but it contains particles as well, without making any new experimental predictions. The empty wavefunction branches also never disappear, and continue to evolve and branch according to quantum rules.

In the pilot wave interpretation, there is one physical world, where particles have nice common-sense properties thanks to the guidance of a wave. But there is also a mul-

tiverse of unrealised “zombie worlds”, seemingly also full of objects and people, but declared not real because of the label “does not contain particles”.

1.2 General Relativity

The [general theory of relativity](#) is Einstein’s theory of gravity, generalising his previous [special theory of relativity](#) and improving upon Newtonian ideas of gravity. The theory describes the apparent force of gravity as being a result of the curvature of spacetime (the four-dimensional combination of space and time), and explains how the presence of energy and momentum determines the shape of that spacetime.

General relativity has been compared extensively to astronomical observations, such as the motions of stars and galaxies, and has passed every test. However, the theory is mathematically and conceptually very different to quantum field theory, which describes the other three forces of nature, so it is not yet known how the two can be reconciled. Most of the time, the regimes where general relativity and quantum mechanics are relevant (at high masses, or at small scales, respectively) do not overlap, but some of the most significant outstanding questions in physics can be found where they do.

In comparison to Newton’s gravity, Einstein’s gravity predicts a number of new behaviours. The geometry of spacetime causes time dilation, where an object closer to a massive body ages more slowly than an object further away. And the origin of gravity being curvature means that even massless particles (eg. light) is affected. The most extreme examples of these occur in black holes.

1.2.1 Black Holes

A [black hole](#) is a region of spacetime where gravity is too strong for even light to escape. These are formed when sufficiently large stars run out of fuel for nuclear fusion and, lacking outward pressure, collapse under their own gravity.

The boundary of a black hole, from which escape is impossible, is known as the event horizon. According to general relativity, time slows down for objects approaching a black hole, so that an observer further away will never see the object enter. However, the object itself experiences the crossing and is drawn towards the centre, where the mass of the black hole is concentrated in an infinitely dense singularity. If the black hole is non-spinning, then the object will inevitably hit the singularity in finite [proper time](#).

In reality, all black holes rotate, so are of the type known as Kerr black holes. The solution for their spacetime geometry contains some interesting new features: First, their singularity is predicted to be a ring rather than a point. And second, as well as an outer event horizon, the Kerr black hole has an inner horizon. Between the event horizon and inner horizon, inward motion is inevitable, like in a non-rotating black hole. But inside the inner horizon, navigation is again possible, and the hypothetical traveller has a choice of destinations.

- They may choose to pass through the inner horizon again, after which they are ejected back out of the event horizon (of a white hole) into a new universe.
- Or they can pass within the ring singularity, visiting a region where closed timelike curves are permitted (paths that allow travel back in time).

These fantastical-sounding possibilities are often referenced in fiction as potential methods of time travel. A further feature of the Kerr black hole solution is that above a certain amount of angular momentum, the inner and event horizons overlap, disappearing entirely. The result is a “naked” ring singularity, with nothing to protect the rest of the universe from its strange properties.

Unfortunately for would-be time travellers, the inner region of the Kerr black hole solution is not stable, so it is unlikely that any real black hole reflects the mathematics. Furthermore, black holes exist in a domain where quantum mechanics is also important (for example, quantum effects cause black holes to evaporate). Ultimately, a theory of quantum gravity will be required to correctly describe their properties and structure.

1.3 Chaos and Attractors

[Chaos theory](#) is the study of systems where small changes to the initial conditions lead to large changes to later conditions. Although a chaotic system still follows deterministic rules, its behaviour may appear random and require treating with probabilities. This is because any imprecision in real-world measurements, or in the values in a computer model, will quickly become amplified in a chaotic system and dominate predictions for its behaviour.

A popular metaphor for chaotic behaviour is the “butterfly effect”, which states that an extra flap of a butterfly’s wings could lead to a tornado forming somewhere else later. The idea comes from atmospheric modelling, where tiny changes in initial conditions lead to vastly different large-scale weather predictions. Model predictions diverge rapidly over time, which is why weather forecasts come with greater uncertainty the further into the future they predict.

However, chaotic behaviour is not entirely unpredictable. [Attractors](#) are a general feature of dynamical systems, these being sets of states that the system preferentially evolves towards. Essentially, attractors occur where certain states are more stable than others. For example, a pendulum dissipating energy will evolve towards hanging downwards. Perhaps surprisingly, even chaotic systems exhibit a type of attractor called a strange attractor. Two instances of such a system that start out with similar properties will move apart due to chaos, but will nevertheless remain on the attractor. (See Figure 1.1 for a famous example.)

1.4 John Titor

“[John Titor](#)” was an internet forum user in 2000 and 2001, who purported to be a time traveller from the year 2036. Originally posting under the name “TimeTravel_0”, he made a number of claims about events in the future, the mechanics of time travel, and the structure of the universe. Most famously, Titor warned that a worldwide nuclear war would break out in 2015, massively restructuring society. This has yet to occur.

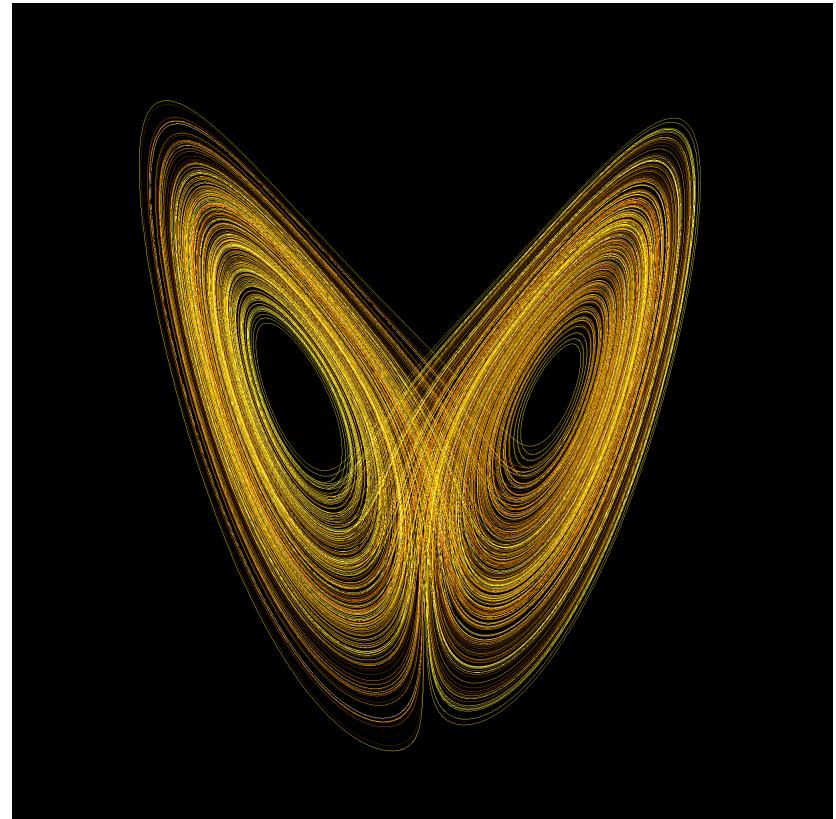


Figure 1.1: The strange attractor of the [Lorenz system](#). Lines illustrate the paths that systems take through parameter space, as they evolve with time. Despite the chaotic dynamics, they continue to orbit the attractor. (By Wikimol on [Wikimedia](#).)

“

In 2036, I live in central Florida with my family and I'm currently stationed at an Army base in Tampa. A world war in 2015 killed nearly three billion people.

”

“TimeTravel_0”, TTI Forums

Following the creation of a time machine in 2034, Titor was allegedly tasked with retrieving an IBM 5100 computer from 1975, required in relation to the [2038 problem](#).

“

I was “sent” to get an IBM computer system called the 5100. It was one of the first portable computers made and it has the ability to read the older IBM programming languages in addition to APL and Basic. We need them to system to “debug” various legacy computer programs in 2036. UNIX has a problem in 2038.

”

“TimeTravel_0”, TTI Forums

In popular culture, those forum posts inspired a number of works, including *Steins;Gate*. Of most interest to us are Titor's time travel mechanics, which are the focus of the summary below. The original [threads](#) contain many more elements that came to be incorporated into the plot of *Steins;Gate*, but are not covered here.

1.4.1 World Lines

According to Titor, the ultimate structure of the universe is that of many-worlds quantum mechanics (see Section 1.1.2). We exist in a multiverse of superposed timelines.

“

Temporal space-time is made up of every possible quantum state. The Everett Wheeler model is correct. I have met and/or seen myself twice on different world lines.

”

“TimeTravel_0”, TTI Forums

Each separate world, or timeline, of many-worlds is referred to as a “world line”. Be aware that there is also a different, earlier meaning of “world line” in physics.

“

Individual worldlines represent the limits and paths physical objects take through space-time under the laws of special relativity.

[...]

Worldline has also become synonymous with ”alternate universe” and / or ”time line”.

”

“*TimeTravel_0*”, [TTI Forums](#)

The former definition is commonly accepted and found in the theories of relativity. The latter is Titor’s own unconventional usage, which we will nevertheless continue in the following discussions.

Strictly speaking, world lines themselves are unrelated to time travel, being a prediction of standard quantum mechanics. However, Titor does invoke them as the reason why his time travel mechanics are non-paradoxical. Issues such as the grandfather paradox, which occur in single timeline models when a time traveller interferes with their own past, are avoided by having that time traveller arrive on a different world line to the one they left. Therefore their actions affect a different universe, which only resembles their own.

“

I would guess the temporal divergence between this world line and my original is about 1 or 2 percent. Of course, the longer I am here, the larger that divergence becomes from my point of view.

”

“*TimeTravel_0*”, [TTI Forums](#)

Titor quantifies the difference between world lines with a measure called “divergence”, which is based on gravitational readings. To emphasise: the act of time travelling does not create a new world line. The idea is that (infinitely) many world lines pre-exist, so the time traveller can arrive on an appropriate one without causing issues. In fact, being a time traveller does not even give Titor a special ability to change established events on the world line he visits.

“

You do not rewrite history. I can only affect what happens here just as easily as you can.

”

“*TimeTravel_0*”, [TTI Forums](#)

It is also not the case that the events of two world lines must diverge continually over time. The many worlds of quantum mechanics evolve according to chaos theory, so attractors should also occur whenever some configurations are more stable than others (see Section 1.3). In other words, it is expected that certain events will be present on multiple world lines. Titor makes explicit reference to this:

“

Some things that are quite different on one world line have very little effect as time passes and the world lines appear to “converge” again and look very similar. World line changes are not exponential, they act more like chaotic attractors with varying effect depending on their size and location.

”

“*TimeTravel_0*”, [TTI Forums](#)

The last note on world lines is that it is not actually a hard rule that time travellers cannot land in their own world line’s past. Presumably, the causal loop produced by this must be self-consistent (free of grandfather paradoxes etc.), but further discussion is not given.

“

There is a bit of folklore about the first distortion driver who reaches a destination with a zero divergence. This would mean they had traveled on a spacelike trip to their own worldline of origin. This paradox is quite possible although highly unlikely.

”

“*TimeTravel_0*”, [TTI Forums](#)

1.4.2 The Time Machine

Titor described travelling through time from 2036 to 1975, then to 2000, using a device that manipulated so-called “microsingularities” that behave similarly to Kerr black

holes (see Section 1.2.1).

“

Tipler first described a working "time machine" through his theory of massive rotating spheres.

[...]

Certain types of black holes also exhibit the "time travel" abilities of Tipler cylinders. Kerr was one of the first to describe the dual event horizons of a rotating black hole. As with Tipler's cylinders, it was possible to travel on a "time-like" trip through a Kerr black hole and end up in a different world line without being squished by the gravity of the singularity.

[...]

The mass and gravitational field of a microsingularity can then be manipulated by "injecting" electrons onto its surface. By rotating two electric microsingularities at high speed, it is possible to create and modify a local gravity sinusoid that replicates the affects of a Kerr black hole.

”

"TimeTravel_0", TTI Forums

The device, numbered C204, was situated in a car to provide a capsule for time travel. That the travel itself takes a certain amount of time depending on the destination, and the inclusion of an air supply for extended trips, will be familiar.

“

The gravity field also traps a small air pocket around the car that acts as your only O₂ supply unless you bring compressed air with you. This pocket will only last for a short period and a carbon sensor tells us when it's too dangerous. The C204 unit is accurate from 50 to 60 years a jump and travels at about 10 years an hour at 100% power.

”

"TimeTravel_0", TTI Forums

The unit maintains its physical position when travelling by measuring the local gravity, and ceasing travel if a large change occurs.

“

Inside the displacement unit are a series of very sensitive clocks and gravity sensors. This system is called the VGL (variable gravity lock). In simple terms, before the unit “leaves” a world line, it takes a base reading of the local gravity and adjusts the Tipler sinusoid to “lock” into that position. Although the temporal physics of this statement are wrong, in effect, it holds you to the “Earth”. During travel, it periodically checks to see that the field has not varied. If it does, it stops and reverses course or drops out at that point. Buildings and other terrain features are avoided in the same way.

”

“TimeTravel_0”, TTI Forums

The slight differences in the “VGL” measurement between world lines is what Titor calls divergence.

“

The measurement for worldline divergence is an observation variable isolated to the distortion unit. [...] The percentage of VGL divergence from one worldline to another is a calculated guess by the three computers that control the unit based on its starting point.

”

“TimeTravel_0”, TTI Forums

Finally, reference is made to the dangers of travelling through a Kerr singularity. Successful transit will lead to the intended time period, but impacting the singularity itself will not. (See also Figure 1.2.)

“

There is a patch. It is round and has a graphic of a Kerr singularity (sort of looks like an eye with gravity waves around it) with two spiral paths running through it's center. One path represents the ”safe” way and the other is the path to God.

”

“TimeTravel_0”, TTI Forums

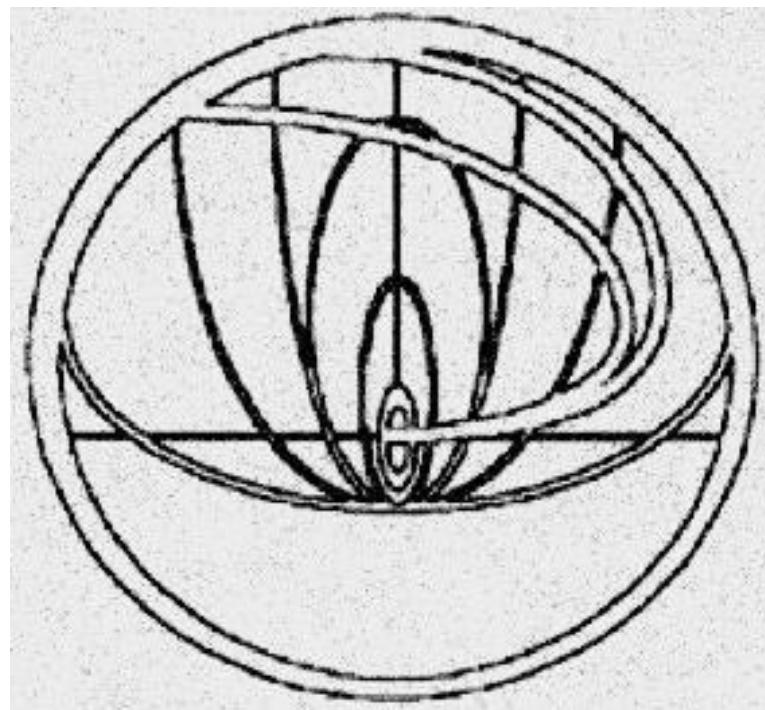


Figure 1.2: The alleged insignia of John Titor's time travel group. The ring singularity of a Kerr black hole is represented, with two paths through indicated: a safe route and a “path to God”.

2 Mechanics

In this chapter, the central mechanics of Steins;Gate are described. The intent is to reflect the writers' intended rules, not to construct fan fiction, so statements are accompanied with relevant evidence from the games and elsewhere. Only topics that have a single interpretation for the evidence, so are in a way “certain”, are included in this chapter. One or two topics for which there is still room for discussion are postponed to the next chapter, which could be considered to contain an “interpretation”, albeit one that is consistent and has explanatory power.

As an additional sanity check, it will become clear that the mechanics presented in this chapter align very closely with the real-world topics summarised in the previous chapter. This is rarely the case in other fan write-ups, which tend to import their own notions of how time travel stories “should” work, and eventually reach points where their theories contradict the events of the story. Knowing the writers' context helps to avoid such misunderstandings from the beginning.

In the next section, we begin by discussing the overarching structure of the Steins;Gate universe. Following that, we move on to how the various types of time travel interact with it. A few niche features also merit their own sections. Lastly, it is worth picking some scenarios from the story that are often considered hard to justify, and showing how these mechanics explain them.

2.1 Attractor Field Theory

The Steins;Gate universe consists of numerous “world lines”, which can themselves be arranged within “attractor fields”. The physical theory used is based primarily on many-worlds quantum mechanics. “World line” is used as an alternative name for the distinct timelines, or worlds, of this theory, which together form a continually branching

quantum superposition of all possible histories. “Attractor fields” refer to the strange attractors of chaos theory. Even under the chaotic evolution of multiple worlds, certain events are more likely than others, so take place on a larger number of world lines. The effect is that groups of world lines appear to converge on particular outcomes. Both of these elements are adapted directly from the writing of the real-world John Titor.

“

[Suzuha]: ”The world is made of world lines and attractor fields.”

Suzuha takes a red yarn ball out of Mayuri’s costume sewing set placed on the table. She holds one end of the yarn and drops the ball on the floor. She stretches out about a meter of the yarn in front of her face to show it to us.

[Suzuha]: ”The world’s structure is like twisted yarn.”

[Suzuha]: ”[Countless] possible worlds are superpositioned, branching out infinitely.”

[Suzuha]: ”The entirety looks like one piece, but at the micro level, the world is organized like thin intertwined threads. And at the end, those fine threads converge into one. The paths are different, but the ends are the same.”

”

Chapter 6, Steins;Gate

However, Steins;Gate does diverge from the mechanics set out by the real-world Titor.

“

[John Titor]: Strictly speaking, it’s a little misleading when I wrote that the world follows the Everett Wheeler model. More theories that were developed based off of it were popularized.

”

Chapter 3, Steins;Gate

Crucially, it is said that only one of the many world lines exists physically at any one time. The rest of the wavefunction is not physical, but does still exist. It represents the possible worlds that can become real under certain circumstances. (See Section 2.2 for details on when this happens.)

“

[Kurisu]: "These superpositioned world lines aren't parallel worlds, are they?"

[Suzuha]: "No. At the very end, they're just possible worlds that exist simultaneously."

”

Chapter 6, Steins;Gate

The idea that only one world should physically exist is credited as coming from the Copenhagen interpretation of quantum mechanics.

“

[Kurisu]: "Isn't that determinism?"

[Suzuha]: "It might be close, but it's a little more rough. It sort of cherry-picks from the many-worlds interpretation and the Copenhagen interpretation."

”

Chapter 6, Steins;Gate

In terms of real physics this is a somewhat misleading comparison. Copenhagen uses wavefunction collapse to ensure no other worlds exist, whereas Steins;Gate features a single physical world *in addition* to a non-collapsed many-worlds wavefunction. A much better comparison is the pilot wave interpretation of quantum mechanics, which has exactly these features, but may not have been known to the writers. (See Section 1.1.3.)

A further, subtle difference from standard physics appears in the shape of the overall universe. In many-worlds quantum physics, the number of timelines increases exponentially over time, resembling a branching tree. However, in Steins;Gate it is said that even separate attractor fields converge over large enough time scales, and the entire collection of world lines is often depicted as a woven thread of constant thickness. (See Figure 2.1.) This suggests that (approximately) the same number of world lines exist throughout history, with the rate of branching (at the outcomes of a quantum events) matching the rate of merging (attractors bringing together similar worlds). The implication is that convergence is much stronger than in the real world, and will significantly constrain events.

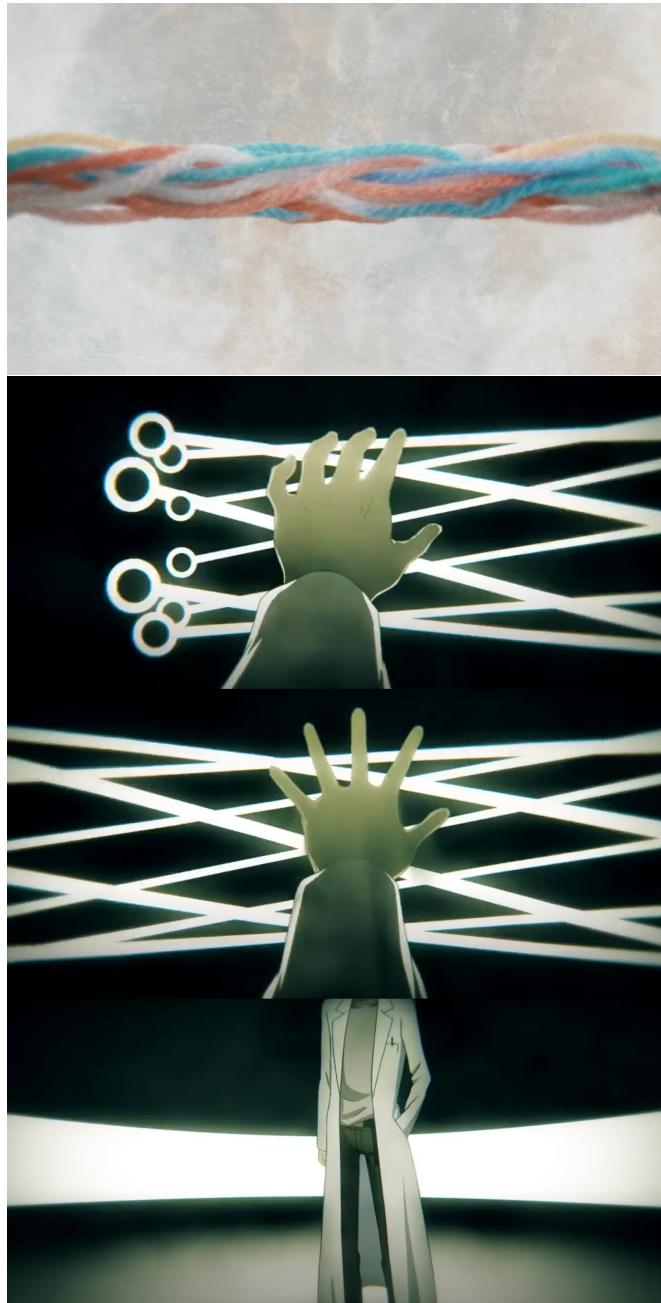


Figure 2.1: The universe, constructed from intertwined world lines. Countless alternate histories, which on a large scale blur into one path. Top: Suzuha's thread metaphor from Steins;Gate. Bottom: Suggestive visual from the opening of Steins;Gate Elite.

2.1.1 World Lines

In Steins;Gate terms, a world line is a single self-consistent history for the universe, extending from the beginning to the end of time. A very large, or infinite, number of these exist. Contrary to a common misunderstanding, world lines are a feature of quantum mechanics, not something created by time travel or even necessarily related to it (see Section 2.2).

The one world line that currently has a physical existence is often referred to as the “active world line” in discussions. The remaining world lines, which exist as possibilities in a quantum superposition, could correspondingly be called “inactive world lines”.

“

World line

This term refers to an infinite number of possible worlds. However, these worlds do not exist in parallel. Only one exists at a given time. Everything that occurs along a world line, from the past to the future, has been predetermined. Thus, no matter how much you change the past along a single world line, the result will converge to the same outcome.

”

TIPS, Steins;Gate 0

Each world line can be labelled using a quantity known as “divergence”. This is an objective measure, quantifying a feature of gravity that varies between worlds, with its zero point set on the world line where the first divergence meter was constructed.

“

First, a foundational measurement of local gravity is taken and then used as a value of reference, wherein after time traveling, the meter generates a local gravitational sine wave, reproducing the tenets of the Kerr Black Hole theory, then measuring gravity via the onboard gravitational distortion apparatus in order to calculate the rate of variation.

”

Chaos;Head and Steins;Gate Maniacs

An equivalent statement is that a world line exists for each constant value of divergence. This perspective highlights that by definition, a world line cannot contain events where divergence changes. We observe this in how ordinary people and objects, bound by the current active world line, remember the divergence as always being its current value.

“

[Suzuha]: “Most likely, even if the displayed [divergence meter] number were to change, only Okabe Rintarou would notice.”

”

Chapter 6, Steins;Gate

And the future is also predetermined to follow this path, so that any divergence constitutes a paradox. Should such an event occur, history must reconstruct entirely to match the new active world line, with its new divergence throughout all of time.

“

[Titor]: When the world line changes, every cause and effect is reconstructed from past to future in order to prevent paradoxes. That theory was proven in 2036. So, essentially, it’s not expected for memories of another world line to ever remain unchanged.

”

Chapter 2, Steins;Gate

Section 2.2 covers world line changes in detail. It is worth stressing what it means for divergence not to change along a particular world line: that no new D-mails, time travellers, etc. with history changing effects can be sent. For example, on any Beta world line that Okabe arrives on after 28/7/10, history must state that he *did not* send a D-mail after discovering the stabbed Kurisu, otherwise the present would be incoherent. This behaviour manifests in the visual novel, whenever the player is given the choice whether to send a D-mail:

“

Not good, I’m starting to hesitate. This is no time for hesitation!

I can’t find an answer, but I need to reach a conclusion.

I...

I can’t...

I can’t send.

I can’t send this D-mail...

”

Chapter 6, Steins;Gate

Without player intervention, Okabe talks himself out of sending a D-mail, so divergence remains the same. And something similar could be expected to happen on *any* inactive world line where the (apparent) option to change divergence arises.

The final thing to say on world lines themselves is that they are fundamental. Attractor fields and convergence are not a force that control the events on world lines, rather it is the events of a group of world lines being similar that gives rise to that classification. In fact, attractor field labels are somewhat arbitrary, in the case of *Steins;Gate* chosen to capture the broad forms that the world can take in 2036. At different points in time, different numbers of attractor fields, spanning different divergence ranges, will be more meaningful.

“

[Suzuha]: “Several attractor fields are superpositioned like this. In each attractor field, the converging result of events [are] different. They don’t interfere. Each remains independent. There’s only one if you trace it back to the origin. Attractor fields do converge at a very macro level, but that spans hundreds of years. It’s best to think of them as large divergences.”

”

Chapter 6, Steins;Gate

Bringing together this information visually, there are two ways that the world line structure is depicted in various media, which we produce versions of in Figure 2.2. World lines can be arranged by divergence, allowing the ranges of events to be clearly marked. Or they can be arranged more artistically according to their similarities, to emphasise their branching and rejoining. Both depictions are equivalent, but the divergence arrangement will make later diagrams clearer.

2.1.2 The Present

We have established that the universe consists of a superposition of world lines, one of which is physically realised at a time. Divergence is constant along each inactive world line, and in the past of the active world line. The active world line also has a pre-determined future, corresponding to the zero-divergence events it contained when it was inactive. But we know that events happening on the active world line can change divergence, so when is this permitted?

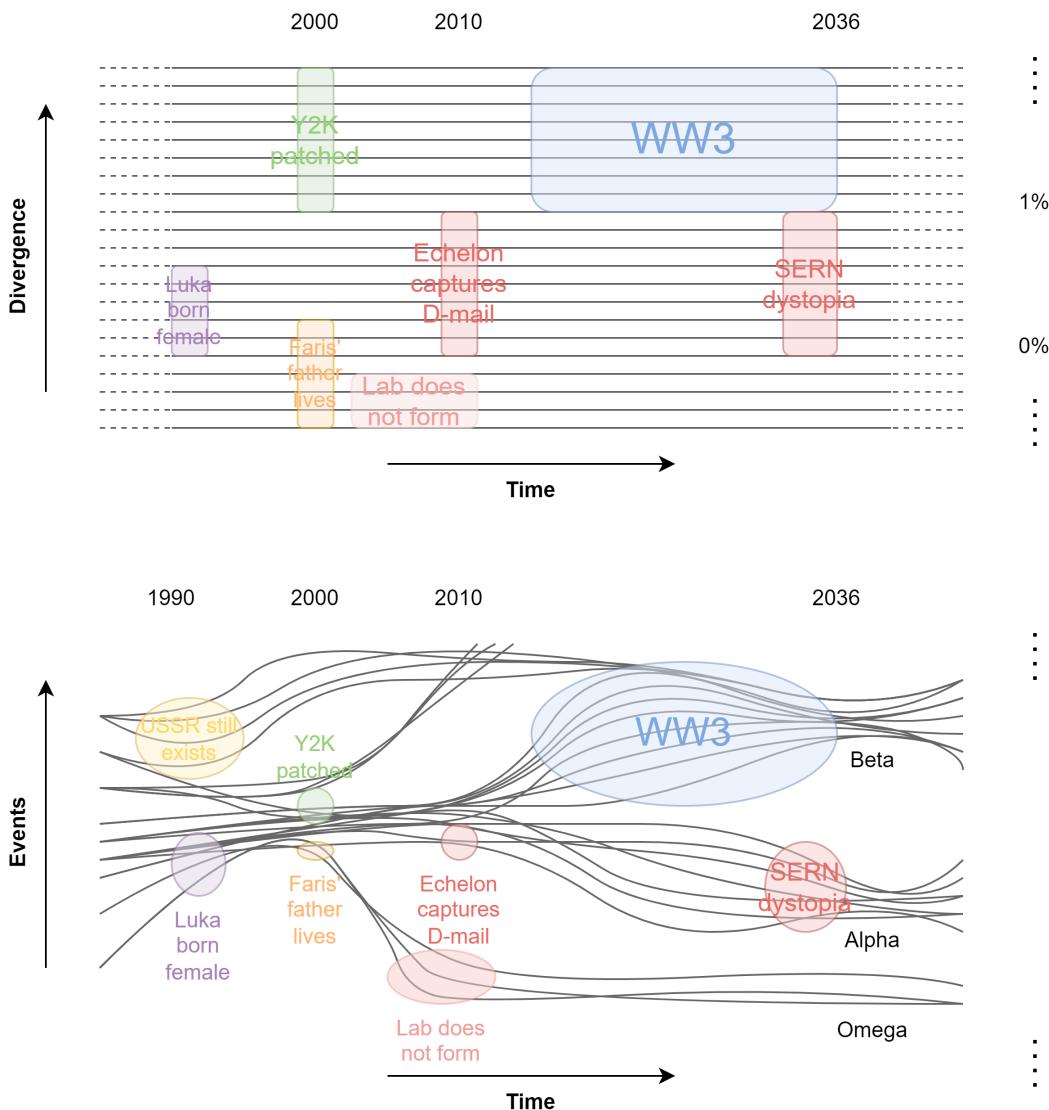


Figure 2.2: Two equivalent ways of presenting the world line structure of the universe.

Above: World lines are arranged by divergence, one for each value. Events occurring across ranges of divergence give the impression of convergence.

Below: World lines are arranged by similarity of events. Major historical branching points lead to separated attractor field regions. (The arrangement here is for illustrative purposes and not guaranteed to be correct.)

For the purposes of this write-up, we will use “the present” to refer to the moment at which events can be changed. In almost all cases, this aligns with the perspective of the visual novel or anime viewer, and is largely common sense. Events outside the present cannot spontaneously change, which is why something happening in 53 BCE cannot cause a world line shift midway through Okabe’s latest round table conference in 2010 (the present). Put simply, the present is the “active” part of the active world line.

Why bother saying something so seemingly obvious? Because in real life, the present is not necessarily a physically real concept. In relativity, our universe could be considered to be a block of space-time, with its past and future already complete and fixed in a four-dimensional sense. The same cannot be said for Steins;Gate. A changeable past means we really do need an extra dimension of time, in order to track the evolution of history itself.

The present is discussed in Steins;Gate using the metaphor of a leaf on a river.

“

[Okabe]: ”The present is a leaf floating on the top of the river. It moves along with the flow from past to future.”

[Faris]: ”So then, is it appropriate to consider that all people ride on that leaf? When you die, do you fall off that leaf nyan?”

[Okabe]: ”That’s probably right. All points upstream from that leaf are the past. Downstream, the future.”

”

Chapter 4, Steins;Gate

Extending the metaphor, the particular current the leaf is following would be the active world line, and the rest of the river represents the other currents, or inactive world lines, that the leaf could access if given a nudge. However, the characters cannot decide how a time traveller would fit into this picture. Do they require their own leaf on the river?

“

[Okabe]: ”So basically, you want to say that the ‘present’ depends on the observer’s subjectivity, right?”

[Faris]: ”In that case, the past and the future also depend on the observer nyan. If Faris were to use a time machine to travel one week back, then

Kyouma and Daru-nyan's present will differ from Faris's present by a week nya."

[Daru]: "Yeah, now that you mention it..."

[Faris]: "Then how's that difference represented by the leaf nya?"

Daru and I don't answer. That might be something nobody can answer, just like the collapse of causality thing that Kurisu mentioned.

”

Chapter 4, Steins;Gate

Okabe's narration is inconclusive, but other evidence suggests there exists only one leaf, or present, even when time travel is involved. For example, the leaf metaphor reoccurs in the normal ending theme of the *Steins;Gate* visual novel. The song is performed by the in-universe band Phantasm, who are known for their prophetic lyrics.

“

"Struggling against the flow

Is a single leaf challenging the great whirlpool"

”

Farfalla of Fate, Steins;Gate

As well as confirming our extended metaphor speculation, a whirlpool is introduced, representing the convergence of world lines towards the single outcome of an attractor field. The "struggling against the flow" alludes to the use of time travel to attempt to escape that fate. We learn that there is indeed one leaf throughout, and the effect of time travel is to move that leaf around relative to the river.

Playing with our metaphor again, suppose that passengers on the leaf throw a big rock into the river behind them. The currents are diverted, and the leaf is now on a new path, in both the upstream and downstream directions. Alternatively, let the passengers lean over the side of the leaf and begin paddling. With enough effort, the leaf can be dragged back upstream...

In literal terms, the leaf metaphor suggests that there is one present moment, experienced by everyone. The effect of time travel is to move that present around. Conveniently, that agrees with our concept of the present as the one special moment at which divergence can be changed. We discuss this further in the next section.

2.2 World Line Shifts

So far we have mainly talked about inactive world lines, where divergence is fixed and everything follows its predetermined path. Now we come to the present moment of the active world line, where divergence can be changed.

In concrete terms, it is possible to contradict the predetermined events of the currently active world line. The universe resolves this potential paradox by choosing a different world line to become active, out of the infinite superposition of inactive world lines. Physical reality is reconstructed accordingly.

“

[Titor]: When the world line changes, every cause and effect is reconstructed from past to future in order to prevent paradoxes.

”

Chapter 2, Steins;Gate

How does this work? Suppose that it is written in the history of the current world line that Okabe absolutely will drink Dr. Pepper on a certain day. (Perhaps a time traveller has already confirmed this for you, or you have a God’s-eye view of the world line structure.) For some reason (see the following subsections), he instead chooses to drink Coke. This is a contradiction, so the current world line must change to one in which it was predetermined that Okabe would drink Coke. On a sufficiently sensitive meter, a divergence change is detected.

In particular, the world line after a change should be the one that is most similar (in events, or divergence) to the previously active world line, out of those that are consistent with the newly created present. In many cases, this means that the past (and future) can remain largely unchanged. However, that assumes the existence of appropriate world lines. If Okabe was actually born with a genetic predisposition to choose a favourite drink and only ever drink that one drink, then there is no such world line where he drinks Dr. Pepper one day and Coke the next. By changing his choice on one day, history would be forced to reconstruct such that Okabe had always drank Coke, and always will.

The above information follows from that of previous sections, but if further evidence is required, please continue on to Section 2.6, where these mechanics are applied to specific scenarios from the story. In the following subsections, we discuss the types of event that can change divergence, and their effects on the world line structure.

2.2.1 Changes in the Present

Our earliest description of world line and divergence changes comes from Suzuha, posting online under the pseudonym “John Titor”.

“

[Titor]: World lines are like an infinite number of rivers flowing parallel. Along the way, many of them diverge. For example, whether or not you post on this message board has no effect on this world line’s divergence. But, if you were to be killed by a random attacker, then the world line’s divergence would change. However, it probably wouldn’t change any more than about 0.000002%. So that nobody misunderstands, I’d like to add that tht means a human is only worth tht much. That value skyrockets in the face of war, major acts of terrorism, etc.

”

Chapter 1, Steins;Gate

It is implied that actions taking place in the present can change divergence, by an amount related to the significance of those actions. The deletion of Echelon data in the present causing a world line shift, or various shifts in Steins;Gate 0, are examples of this behaviour. (As confirmed by the writers in official Q&As.)

“

Q25. Why did the timeline shift just because they wiped a log entry from the Echelon database?

A25. John Titor mentions in one of his @Channel posts that if a significant event is changed at any point on a timeline, history will re-construct itself and thus, changing the events that happens following that point in the timeline which, is what happened in this case.

”

Q&A, Steins;Gate Official Material Book

We represent this type of world line shift diagrammatically in Figure 2.3, for the hypothetical example discussed earlier of Okabe changing his drinking habits. Drawing the relevant world lines before and after the shift, rather than attempting to include everything on one diagram, will be a useful approach when situations become more complex.

Some consider it controversial that divergence can change without explicit time travel taking place. But world lines are a feature of quantum mechanics, not something created by time travel, so there is no real reason to require the two to coincide at all. All that is known is that the active world line has a level of freedom beyond that of an inactive world line, allowing characters to take actions that contradict the expected future.

It is left to the reader to speculate on the origin of this apparent free will: A result of future knowledge brought back by time travel? So why do shifts only happen after a conscious decision? Does consciousness have special properties? How can it if minds are made of matter? Or is matter a construct of many minds? And so on...

2.2.2 D-mails

D-mails are messages that are sent to the past. They can be used to cause the active world line to change, by contradicting historical events.

To quickly summarise the technology: D-mails are sent using the Phonewave (name subject to change), an experimental combination of a microwave and a phone that happens to produce mini black holes. A large CRT donates electrons to the black holes, increasing their spin enough for them to become naked singularities. A message passed through the singularity travels to the past, with the microwave timer controlling how far it travels. However, the size of the singularities produced restricts the length of the message that can successfully be sent to 36 bytes, plus metadata.

So what exactly do D-mails do to the world line structure? Most noticeably, they change which world line is the active one, to one consistent with the arrival of the D-mail. In practical terms, this can be achieved by selecting an inactive world line

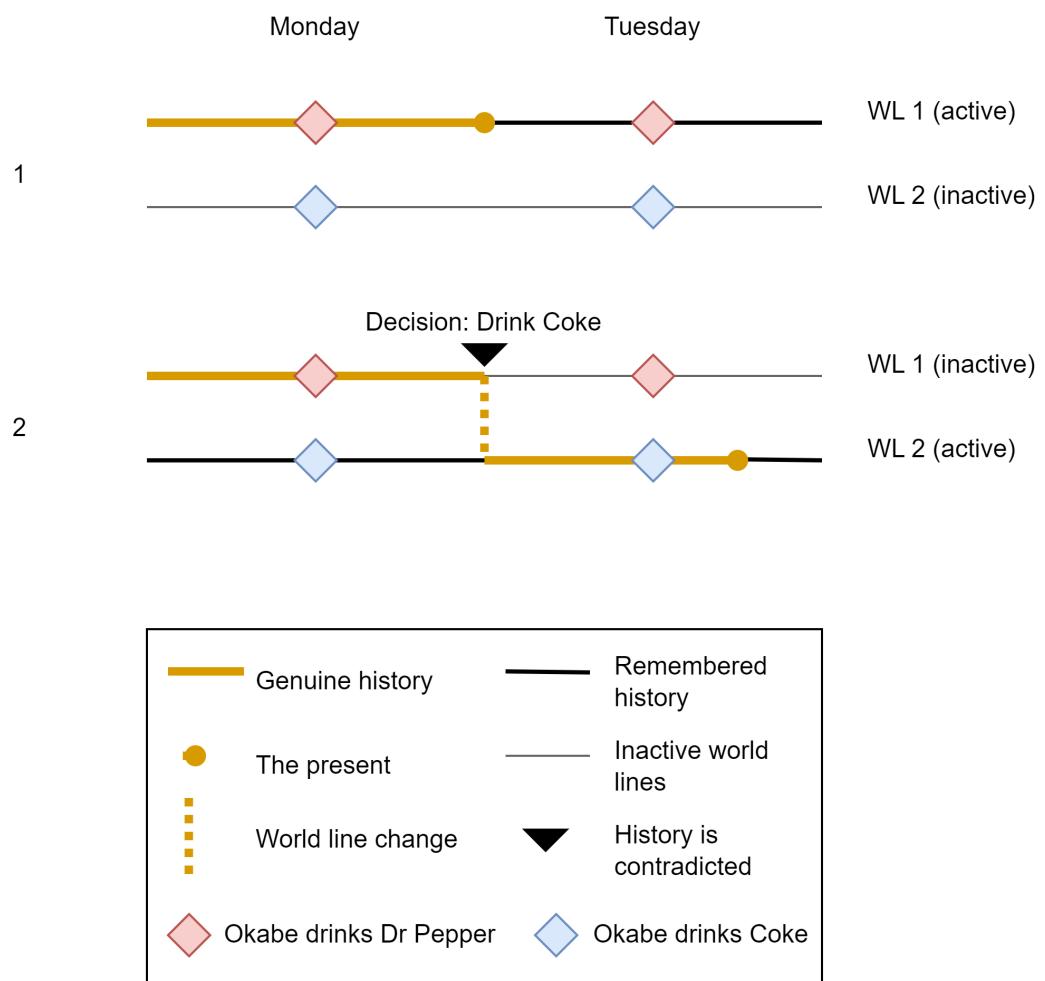


Figure 2.3: A present day world line shift. The world line structure is presented horizontally, before (1) and after (2) Okabe decides to drink Coke rather than Dr Pepper. This event contradicts the predetermined future of the current active world line, necessitating the activation of a different preexisting world line. After reconstruction, the present is consistent, while the future and past are altered.

which *already* contains a historical event with similar effects to the D-mail's arrival, then overwriting that one cause with the D-mail's arrival.

To explain with an example, consider the D-mail Okabe sent himself with the winning LOTO SIX numbers. The initial world line is one where Okabe did not feel like entering LOTO SIX at the time, but there should also exist inactive world lines where he did decide to enter. The D-mail forces one of these other world lines to become active, but with the inspiration for entering LOTO SIX on that world line changed from being Okabe's own initiative to a mysterious mail arriving.

“

[Titor]: Just judging by the phenomenon you described, I would say what you accomplished is indeed changing the past. I suspect that the mail you sent into the past changed the world line's divergence, if just a little. BRAVO! The instant your mail arrived in the past, I think you were moved from your original world line to an ever-so-slightly different one. In this world line, the world's supposed past became this: You learned the Loto6 winning numbers from a mail you got from your future self, told your friend the numbers, and your friend mistook a number upon buying the ticket. So the mail probably disappeared from your sent history when the world line changed.

”

Chapter 3, Steins;Gate

We find ourselves proposing the idea that time travel changes the events on a world line, but only in such a way that the following events are unchanged. This agrees nicely with the TIPS definition of a world line, which states that “no matter how much you change the past along a single world line, the result will converge to the same outcome”.

In fact, D-mails do more than alter the one world line. After two D-mails are sent, it is generally found that both have arrived on the most recent world line. The implication is that the first D-mail, when sent, arrived on both the new active world line and at least one inactive world line, which later became active as the result of a different D-mail.

The simplest rule to explain the behaviour is this: Each D-mail arrives on *every* inactive world line on which it has no new effect. The one of these world lines most similar to the sender's world line becomes the new active world line. Inactive world lines are

initially independent, but the overwriting of ordinary events with time travel arrivals creates apparent interconnections across the world line structure. In this way, evidence of earlier time travel can accumulate even on inactive world lines, so it is possible for a newly activated world line to already contain time travel events in its past or future.

Following the above mechanics, there is also *no need* for a D-mail to move the position of the present. The events of the new active world line are already fully determined, without having to repeat a period of history. Multiple lines of evidence support this conclusion:

- First, Suuha refers to the world’s “supposed past” changing, rather than a new past genuinely being experienced.
- Second, at no point do D-mails cause new time travel to take place prior to their sending time. If the period of time following their arrival became active, we would expect new D-mails to sometimes be sent within that period, appearing like a chaining effect to Okabe. This never happens, so it is reasonable to say that this period of time remains inactive.
- Third, Okabe experiences “Reading Steiner” at the moment of world line reconstruction, and that takes place in the present, when the D-mail is sent. There is no record of Reading Steiner ever occurring at the time of a D-mail being received. (We say more on Reading Steiner in Section 2.3.)

We summarise this information in Figure 2.4, which depicts the effect of the LOTO SIX D-mail. Because a range of inactive world lines have been modified, the D-mail’s arrival can still be part of history after further world line shifts.

2.2.3 Time Leaping

The second type of time travel that we will consider is the time leap, where a user transmits their present-day memories back to their past self. Attempts to alter events in this way cause the active world line to shift to a different, preexisting world line, containing the new events.

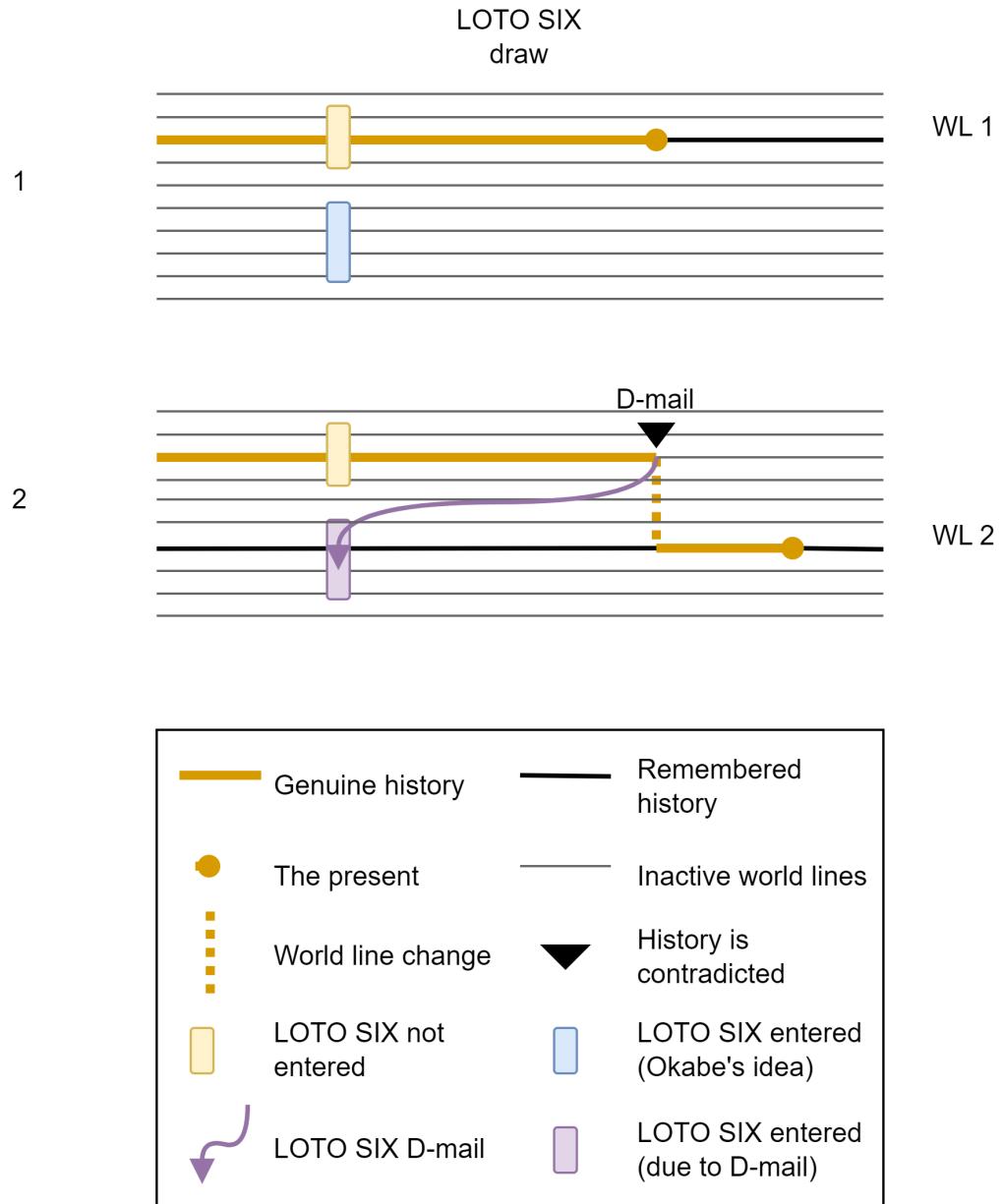


Figure 2.4: A D-mail shifts the world line. The LOTO SIX results are sent to the past, but their arrival there would present a contradiction. Therefore world line reconstruction takes place. The D-mail arrives only on world lines where its arrival is consistent: all world lines where LOTO SIX was already entered in a similar manner to what the D-mail would cause. Of these, the world line most similar to the previous active one becomes the new active world line.

The technology here is an evolution on the Phonewave (name subject to change). The Time Leap Machine uses a headset to read a user's brain structure and convert that to data, which is compressed to a small size by passing it close to a black hole (somehow, physical compression and data compression are conflated). The memory data, plus a decoding program, is sent as a phone message to the past using D-mail technology. Memories are written to the recipient's brain using electromagnetic radiation when they answer the phone message. Limitations of the Time Leap Machine include the requirement that the sender and recipient be the same person (for brain structures to be compatible) and that the maximum time that can be leaped is 48 hours (or longer after upgrades in some stories).

The effect of time leaping on the active world line is straightforward: The sender's memory data arrives at the designated time on another world line, which then becomes active. As is the case with D-mails, the newly activated world line will be one where the immediate effects of the time leap are consistent with that world line's predetermined events.

The new world line will only differ slightly from the previous one, so the time leaper can continue to make changes to events they have foreknowledge of, causing further divergence and world line shifts. (At this point the shifts are "changes in the present".)

“

[Okabe]: "By sending my consciousness to the past, it felt like I could make concrete changes to the past, but at the same time, the results converged."

[Okabe]: *There are things that can be changed, and things the world prohibits changing. An example of the former is who kills Mayuri. The latter, Mayuri dies on the night of August 13th.*

[Suzuha]: "That's not it. The future is determined."

[Okabe]: "Then why does the process change?"

[Suzuha]: "Because the world line changed. Okabe Rintarou, when you leap into the past and take different actions from before, Divergence should only slightly fluctuate. But that fluctuation won't register any more than 0.000001% on the Divergence Meter. In trifling cases, it won't even be a significant change. When you change the cause, the only result is changing to a world line that already simultaneously exists. Furthermore, those

two world lines are approximately the same, so you'll barely even feel any changes."

[Okabe]: *So is that why I don't feel any response from Reading Steiner?*

[Suzuha]: "It's not that the world line before the change is annihilated. It keeps existing simultaneously as a possible world line."

”

Chapter 3, Steins;Gate

As well as explaining time leaping, the above passage nicely confirms our understanding of world lines so far: When Okabe tries to contradict the events of history, he is only activating a world line where he took those new actions all along.

Time leaping *does* move the position of the present. There are various examples of new D-mails, time leaps, and present day changes being carried out in the period immediately following a time leap's arrival, so that period of time must be active. That period of history is genuinely re-experienced, allowing people to take new actions, unlike the period of time following a D-mail's arrival.

How can it be that time leaping moves the present, but D-mails do not? It is certainly the case that the underlying technology is the same. The difference, as highlighted in *Steins;Gate*, is that one allows a conscious person to travel to the past.

“

[Okabe]: "One thing's for certain, though - My consciousness leaps to the past along with my memories."

[Kurisu]: "I don't understand why that is. Okabe should be experiencing something similar to when he sends D-mails. Does consciousness exist inside memories?"

[Suzuha]: "It's bothersome since consciousness doesn't exactly exist physically. Same with the soul. In the end, it's about religious views. Even in 2036, the existence of the soul hasn't been proven, and nobody's proven the form of consciousness, either."

”

Chapter 3, Steins;Gate

There is a qualitative difference between time leaping and sending D-mails, made obvious thanks to Okabe's ability to retain his own memories across world line changes (see Section 2.3). The writers allude to consciousness as the reason for this, with some room left for interpretation. *Steins;Gate* 0 further explores the idea of digitally replicating of a person, adding weight to the idea that pure data can indeed exhibit consciousness, and that this consciousness can have novel properties. (Amadeus experiencing "Reading Steiner", for instance.)

Given what we have argued previously, it should not be too surprising that consciousness is key to moving the present. So far, every divergence change has occurred because a physically real person made a choice. And as a counterpoint, the non-physical people of inactive world lines have been incapable of doing anything to escape their particular divergences, appearing to choose not to when given the opportunity. D-mails could be resolved without moving the present, because once a world line is selected that is consistent with the mail's arrival, then all events that follow have already been determined. But a person travelling to the past could arrive on a world line where their presence is initially consistent, then later choose to contradict the past they have arrived in, causing further divergence. Perhaps the world moves the present because it must account for this possibility.

In any case, there is still physical time travel to consider. Let us do that now.

2.2.4 Physical Time Travel

Physical time travel refers to the use of a traditional time machine to transfer a person into the past. The time traveller will find themself arriving on a different world line to the one they departed from, corresponding to a change in the active world line.

The time machines in *Steins;Gate* function by manipulating the naked singularities of Kerr black holes in such a way that a passenger capsule can pass through, arriving in a different time. Travelling to an earlier time requires a proportionally longer time spent within (or around) the Kerr singularity. Technical limitations mean that the FG204 (Alpha world lines) can only travel to the past, while the C204 (Beta world lines) can travel to the future as well as the past. Both FG204 and C204 are designed to remain

in the same spatial location (relative to the Earth) while used, but other models may relax this condition.

The effect of physical time travel on the active world line is very similar, if not identical, to that of time leaping. So too is its effect on the wider world line structure, which we chose not to talk about in the previous section, but will do here.

Just as with D-mails and present day changes, the reason that physical time travel causes a world line shift is to avoid contradictions, or paradoxes, occurring on the active world line. Therefore, we expect that a physical time traveller will arrive only on world lines where their presence causes no immediate inconsistencies. In fact, a single time traveller should arrive on *every* inactive world line where their arrival is non-contradictory, just as D-mails (and time leaps) do. Of these, the world line most similar to the time traveller's original becomes active.

Alpha attractor field Suzuha demonstrates these points. Throughout Steins;Gate, we meet the same time traveller Suzuha (originating from 0% divergence) multiple times, but on different world lines. The only plausible explanation is that all these arrivals were established by the same departure, while the world lines were still inactive.

“

Q29: In chapter 11, at the time when Okabe returns for the second time to 7/28, the first time machine was also returning to then, why did they not meet each other?

A29: About the time travel in chapter 11, [in comparison to] before jumping in the path of the jump, a 0.000001-0.000003% degree of fluctuation occurs in the world line. This error/miscalculation also increases with the length of the jump. For example, Suzuha's point of departure from 2036 [in the Alpha attractor field] was world line rate of fluctuation 0.000000%. However, her point of arrival in 2010 varying by 0.3-0.5 percent was for this reason.

”

Q&A, Chaos;Head and Steins;Gate Maniacs

Why does Alpha Suzuha never land on a Beta world line? Because her faulty time machine will always embed itself in the wall of Radio Kaikan, forcing the cancellation of Nakabachi's conference. Therefore her arrival would be totally inconsistent with any world line where Kurisu's time travel thesis is taken to Russia (meaning all Beta world

lines). Her arrival is consistent in the Alpha attractor field precisely because these are world lines where Nakabachi's conference being cancelled (for whatever reason) was predetermined, so her arrival does not meaningfully change events.

Physical time travel moves the present back with the time traveller, for the same reasons that time leaping does. There are various instances to evidence this, where new time travel events take place following the traveller's arrival. Most notably, Suzuha travelling to the past from 2036, moving the present back with her, is what allows there to be more than one iteration of history, as featured in *Steins;Gate* and *Steins;Gate 0*.

Once a time traveller has arrived, what happens? As long as they take no actions to significantly contradict the expected events of the current world line, they will simply become part of its history as time progresses. The versions of the time traveller on inactive world lines will be forced to behave this way, because divergence cannot change on inactive world lines by definition. (They may choose to avoid notice. Or they may interfere with events in ways that do not actually change anything, such as by helping to establish a lab that would have formed anyway...)

But the time traveller on the active world line could also choose to contradict the predetermined events of the world line, causing divergence changes. We now have an interesting situation, because there are presently a number of inactive world lines containing that same time traveller, blending in with history. Should the time traveller take action to make their world more like one of those histories, then the active world line can shift to that divergence.

From the time traveller's perspective, they travelled to the past from A%, arriving in B%. Later, they initiate a world line shift by modifying an event X, causing themselves and everything else to be reconstructed. The time traveller's new recollection is that they travelled from A%, arrived in C%, and were the cause for event Y on that world line. This is exactly the experience of Alpha Suzuha, who on each world line recalls leaving 0%, then arriving on whatever the current divergence is and seeing no further changes. (See Figure 2.5.)

One could say that the time traveller is “supported” on world lines where their initial arrival was consistent. (Able to occur without meaningfully changing history.) They can change events so that any of these become the active world line, and a perfectly



Figure 2.5: Suzuha explains world lines to Okabe. The same conversation occurs on every Alpha world line, the only difference being the divergence that Suzuha recalls arriving on.

logical sequence of events results on the new world line. This works because the new active world line already contained a version of the time traveller’s arrival.

But what happens when the time traveller tries to shift the world line to one that does not support them? (In other words, one that they could not have arrived on.) Clearly, they have no preexisting counterpart on that world line, so reconstruction will end up erasing them entirely. This agrees with what happens in the story: The erasure of one Suzuha and replacement with another when crossing the Alpha–Beta boundary is a result of each only being supported on their own attractor field.

The issue of “support” may also explain why time travellers find some changes harder to make than others. World line shifts attempt to choose the new active world line to be as similar as possible to the previous one. Therefore an event that disrupts a time traveller’s plan, leaving history mostly unchanged, may be more likely to become active than them succeeding in an action that necessitates their own erasure.

Let us produce some diagrams to illustrate the behaviour we have been discussing. Figure 2.6 depicts the effects of physical time travel on the world line structure. We see that the present moves, and history is reiterated with the time traveller now present. As with D-mails, the time traveller also arrives on a range of inactive world lines. These “update” to include the traveller as time progresses. Figure 2.7 then demonstrates two possible outcomes of a time traveller attempting to change the past.

2.3 Reading Steiner

“Reading Steiner” is the name that Okabe gives to his rare ability to remember the events of other world lines. In theory, when a world line shift takes place, everything is reconstructed to match the new active world line, including people’s memories. However, Okabe’s mind is seemingly an exception to this rule, allowing him to retain knowledge of the world’s genuine history.

This quality is also not entirely unique to Okabe. Many more people, perhaps everyone, can remember other world lines to some extent. These memories manifest in dreams, or feelings of *deja vu*.

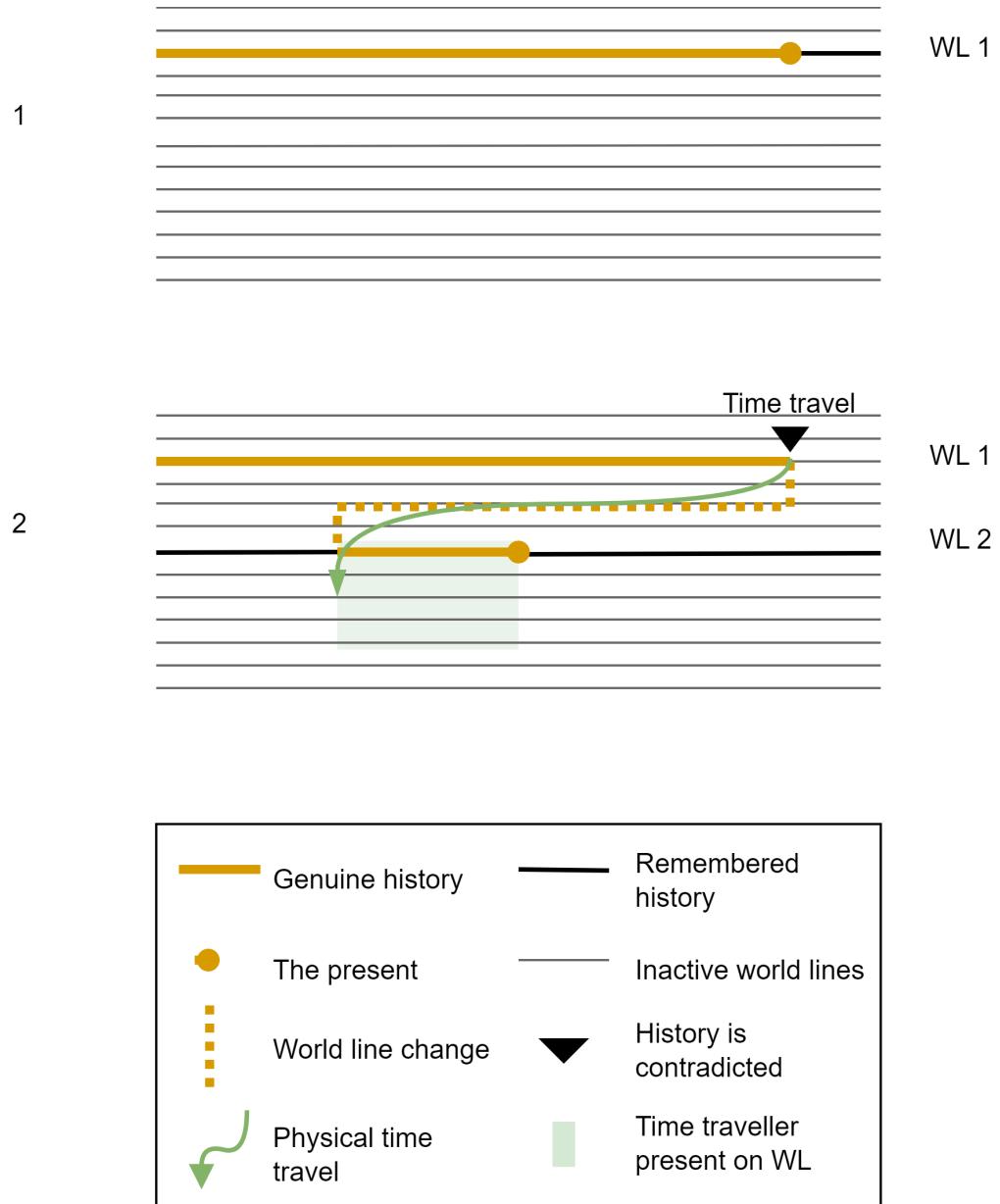


Figure 2.6: Physical time travel shifts the world line and the present. This applies to both time leaping and travel by time machine. The time traveller arrives in the past on all world lines where their arrival poses no immediate contradiction, moving the present moment with them. As time passes, their presence becomes part of established history on these world lines.

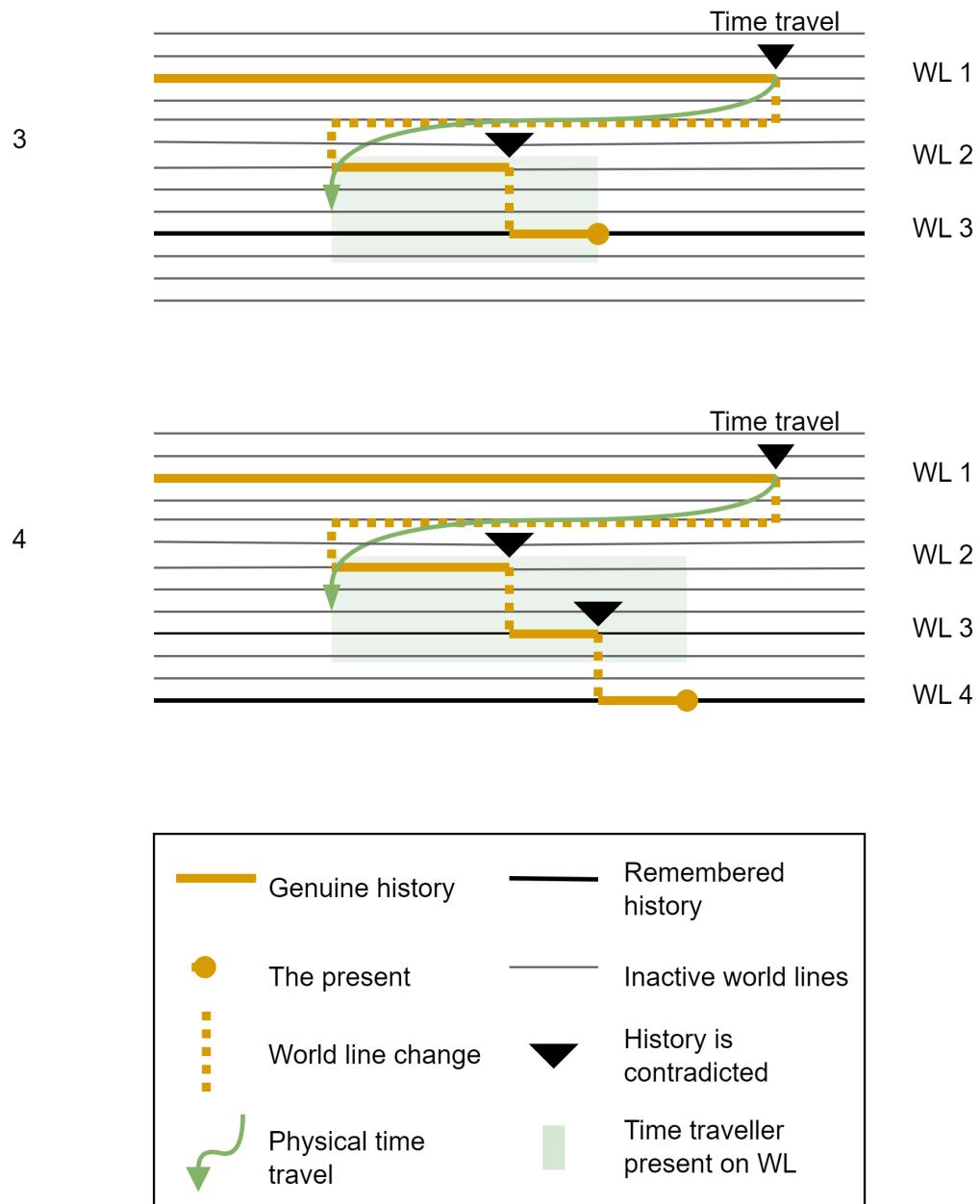


Figure 2.7: The time traveller from Figure 2.6 attempts to further alter the past. Suppose they cause a shift to a world line where their arrival was already part of history. After reconstruction, they will remember their journey as being from WL 1 to WL 3. Next, the time traveller causes a shift to a world line that was inconsistent with their arrival. After reconstruction, they have been erased, but the new active world line is consistent with the final change they made.

2.3.1 Full Reading Steiner

Strictly speaking, what Okabe calls Reading Steiner is the particular sensation he feels when a measurable divergence change takes place. According to his narration, this is:

“

Slight vertigo. As if my feet are off the ground. My vision blurs as if I had been thrown into the ocean. Everything in sight turned monochrome. Did the ground shake? Physiological feelings of fear. Instinctive feelings of fear.

[Mayuri]: “Okarin? What’s wrong?”

Mayuri’s calling voice snaps me to my senses. I notice that color has returned to the world.

”

Chapter 3, Steins;Gate

There are other points where Okabe retains his memories, but does not feel this sensation, such as when a change to the past is too small to alter the divergence meter reading.

The Reading Steiner sensation takes place when the world line changes in the present, as a result of a D-mail or present day change, so coincides with the moment of world line reconstruction. Its effect is to maintain Okabe’s present memories, effectively copying them onto the new world line.

In terms of the larger world line structure, Reading Steiner also makes changes to inactive world lines. Just as a D-mail or present day change arrives on all inactive world lines that are consistent with it, so too do Okabe’s memories from the moment of making that change. The D-mail arrival and Reading Steiner arrival are inseparable. Those modified world lines will evolve as time progresses, although being inactive, no divergence-changing events will take place.

This explains how characters on a certain world line can recognise Reading Steiner as something that Okabe has displayed previously, even though that event happened prior to the world line ever becoming active.

2.3.2 Deja Vu

Everyone has the ability to remember other world lines to some extent, which manifests as dreams or feelings of déjà vu.

“

[Okabe]: I thought memories couldn't be shared between world lines. I thought my Reading Steiner was special. But maybe that isn't true. Maybe everybody has the same power as me, but to varying degrees. It might even be to the point where it can't be called a power.

”

Chapter 10, Steins;Gate

Precisely what triggers this is not specified. Often, déjà vu memories are of events that a person experienced on a previously active world line, but forgot due to reconstruction. (For example, female Luka remembering being male.) It is also possible for people to recall events that happened to other iterations of themselves, from before time travel moved the present back and led to different events. (For example, the Okabe of the Steins;Gate 0 anime remembering the USSR world line experienced by an earlier version of himself.)

2.3.3 Other Manifestations

As mentioned previously, there are other cases of memory retention between world lines that do not cause particular sensations. One instance happens when a world line shift takes place, but its divergence change is too small to register on the meter. Here, Okabe retains his memories of the previous world line, but does not feel the shift taking place. (We talk more about this type of shift in Section 2.5.)

Physical time travellers are another such case where memories are retained, but the specific Reading Steiner sensation is not felt. This is because objects moving between world lines, like D-mails or time machines, are not subject to the reconstruction that their arrival triggers.

“

[Titor]: In the case of physical time travel, memories are conserved even if the world line changes. That's been proven by my very own experience.

”

Chapter 3, Steins;Gate

It is also notable that Okabe does not experience Reading Steiner when time leaping, or when he returns to the moment that a time leap was sent from. If time leaping acted identically to D-mails, then we would expect the current Okabe's memories to be overwritten by the Okabe who pressed “send” on the time leap. But this does not happen. The universe recognises the Okabe who arrives in the past as the genuine one, supporting the idea that unlike D-mails, time leaping does move the present.

A unique type of memory retention occurs in Luka's ending of the *Steins;Gate* visual novel. Here, Luka uses the time leap machine to change the world line by a small amount, causing a divergence shift in the past from our Okabe's perspective. Instead of experiencing the usual Reading Steiner sensation (or nothing), he experiences a sensation like a time leap.

“

[Okabe]: My entire body goes through shock and chills, just like it always does right after time leaping.

“...This is...”

It's not like I time leaped myself. Nevertheless, I teleported from the lab to Yanagibayashi Shrine. Did the world line change...? No, Reading Steiner didn't activate, so there's no way the world line changed.

”

Chapter 8, Steins;Gate

Luka's time leap must move the location of the present back, so this is the only example in the story where our Okabe is not around at the moment of world line reconstruction. Other instances of Reading Steiner could be described as Okabe's experience of his surroundings being reconstructed. But in this case the reconstruction took place some time earlier, and all that happens from Okabe's perspective is that his memories of the previous world line are copied onto the new one. Figure 2.8 demonstrates this distinction diagrammatically.

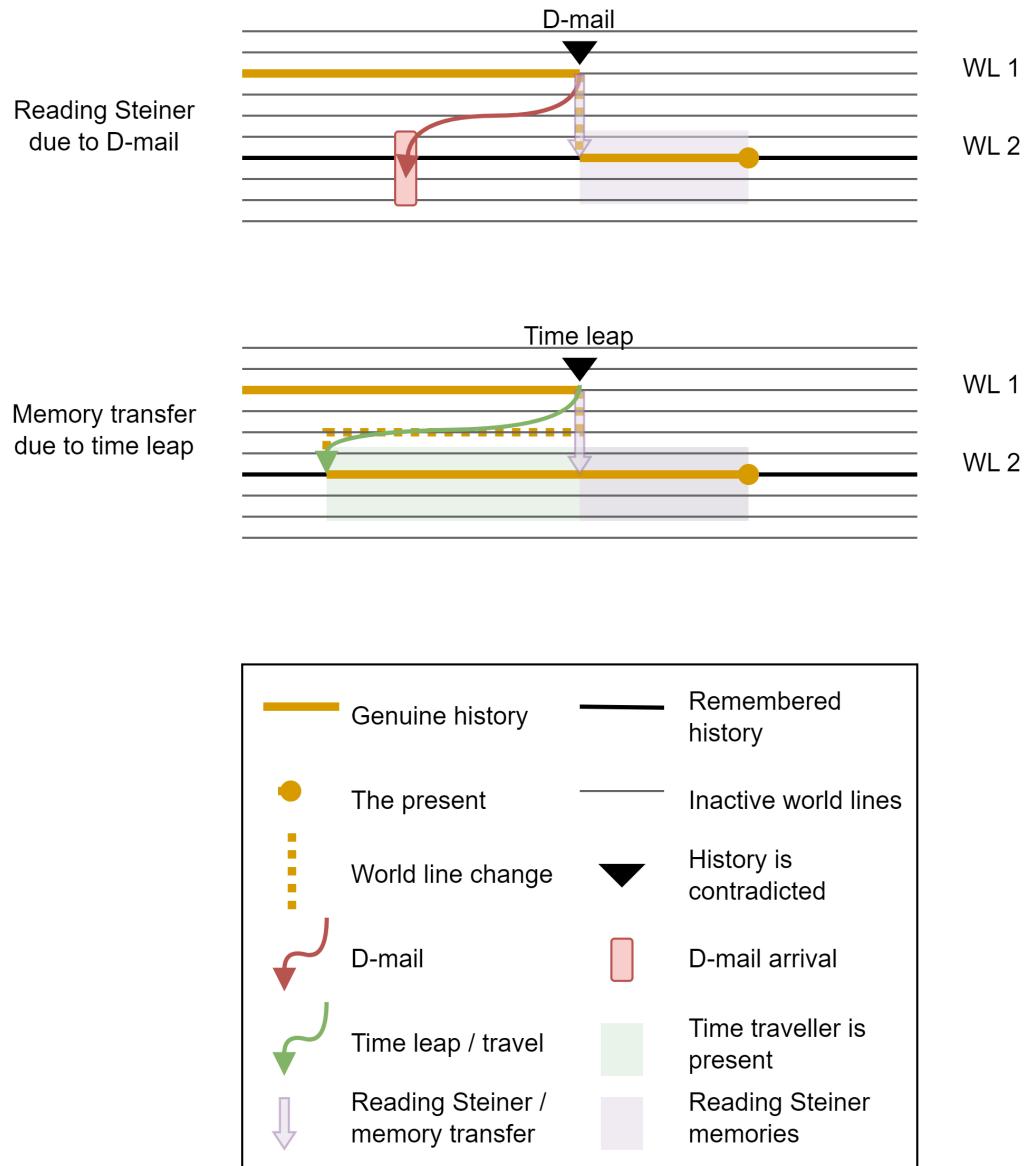


Figure 2.8: The two types of “Reading Steiner” that occur in the story. Above: Okabe remembers the genuine history of the world, rather than the history of the current world line. He experiences vertigo and other symptoms during the moment of world line reconstruction. Below: Someone other than Okabe changes the world line via time leap or physical time travel. Okabe’s memories transfer over once the present moment returns to the time traveller’s departure time, causing a sensation like a time leap. Both: The Reading Steiner arrival takes place on all world lines where the time travel causing it arrives.

2.4 Loops

There is an often repeated claim that Steins;Gate does not feature, or allow, time loops. This is wrong. Self-consistent loops, where a time traveller's actions in the past were already part of that history, are perfectly permissible under the rules established so far. Indeed, there are even examples of such loops occurring in the story.

Let us elaborate on why the rules permit loops:

- First, a self-consistent loop is not paradoxical in the sense of a grandfather paradox. At worst, these loops involve information circulating with no known origin point, which may seem strange but produces no logical inconsistencies.
- In Steins;Gate terms then, a self-consistent time loop could be included as a feature on a particular world line. The loop does not trigger reconstruction, because reconstruction is a process to avoid paradoxes. Put another way, the time traveller does not change history, but maintains it, so no divergence changes take place.
- It is established that many different world lines preexist. How these histories were first created is not specified, so it is not absurd to suggest that histories involving self-consistent loops could be included.
- Second, the possibility of zero-divergence time travel is raised by the real-world “John Titor”, whose writing forms the basis of the mechanics of Steins;Gate. Zero divergence implies a loop on one world line, which really has no choice but to be self-consistent.
- Third, self-consistent loops are easier to keep track of from a writing standpoint than events that change divergence. So we can expect a few when lots of time travel happens on the same world line.

How this works in-story is that at some point, there is a world line shift. The new world line that becomes active already contains a self-consistent loop in its predetermined sequence of events. The looping time traveller's departure does not cause divergence to change, and there is no necessity for the present to move back with them, because

their actions after arriving in the past have already played out. Divergence will change, however, if the time traveller learns of their actions in the past and chooses to contradict them (for example, by choosing not to time travel in the first place).

Let us consider a couple of examples.

2.4.1 Gel Mayuri

When Mayuri is killed in the Rounder raid on the lab, Okabe time leaps repeatedly to try to save her. However, whatever actions he takes, Mayuri still dies by a particular time, but in a variety of different ways.

One death that occurs in the visual novel has Okabe and Mayuri attempt to escape Akihabara on foot. Mayuri disappears while Okabe is scouting ahead, which we learn later is because the Rounders have captured her. At the usual time for Mayuri's death to occur, Okabe is sent an image showing her jellified corpse. She had been, or from Okabe's perspective will be, taken to the LHC and used in a time travel experiment.

This scenario is a self-consistent loop because the jellified Mayuri arrived in the past of the world line that she was sent in. Okabe is able to observe the effect (a dead jellified Mayuri) before the cause (a kidnapped Mayuri en route to SERN), because both are predetermined. Mayuri's departure and arrival also happen to be outside the range of time that becomes active, demonstrating the possibility of loops on inactive world lines. (See Fig 2.9 for a diagram of events.)

Some have argued that this event is not necessarily a loop; that the jellified Mayuri comes from a different world line, for example. However, the idea that Mayuri only happens to have been discovered jellified on a world line where SERN plan to jellify her, but on no other world lines, is highly implausible. Having gel Mayuri come from an earlier world line would also require that world's Okabe to not see her dead at the time required by convergence.

Clearly, it is the author's intent that the jellified Mayuri is the same one as the Rounders are taking to SERN. Okabe's narration further supports this conclusion.

When Mayuri is jellified, both the time of her kidnapping and the time of Okabe seeing her dead are determined by convergence.

For both to happen at the required times, Mayuri must time travel to the past of the same WL. This WL becomes inactive before Mayuri's time travel actually leaves, nevertheless her arrival is already part of history.

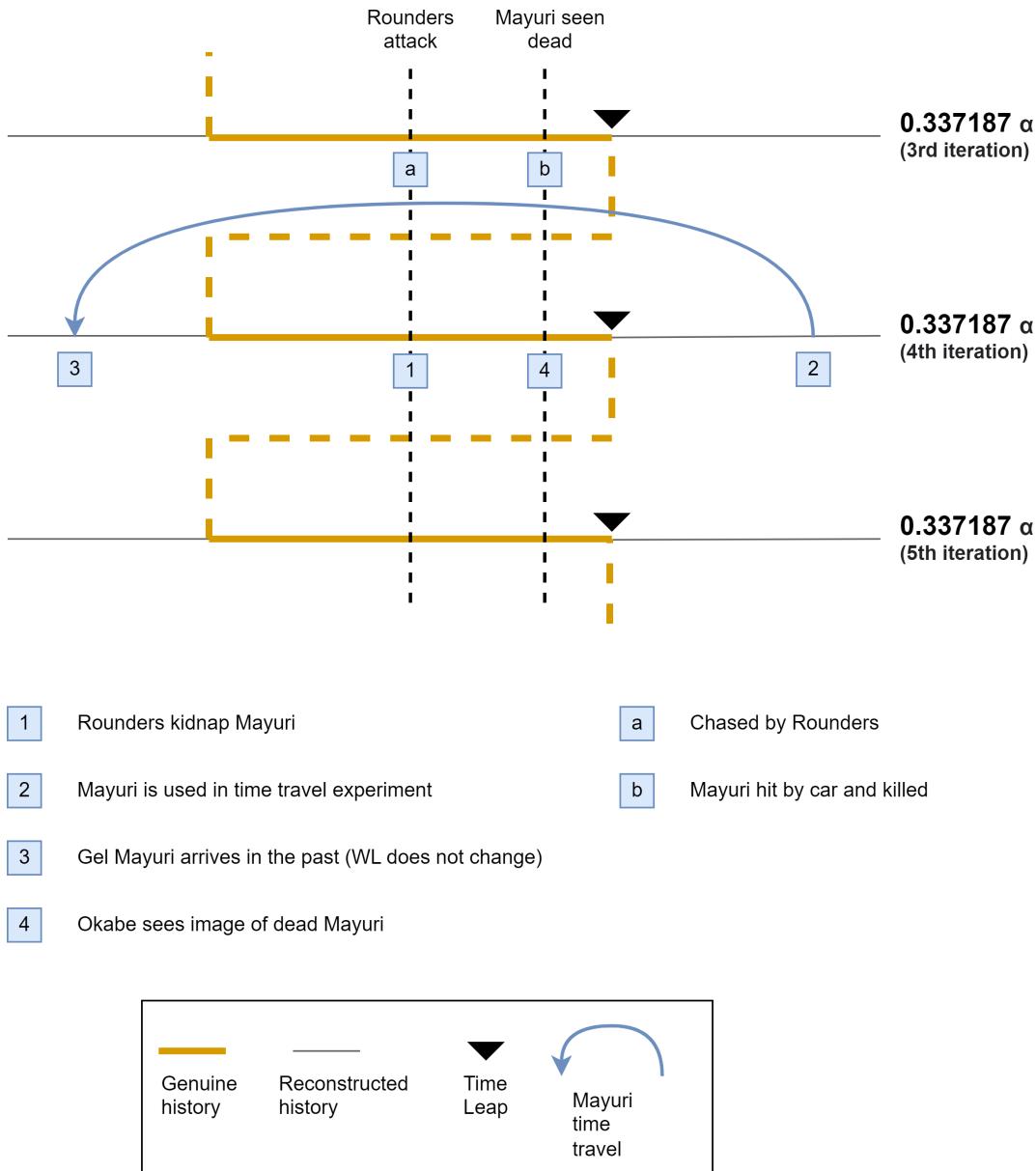


Figure 2.9: The time travel that gellifies Mayuri is a self-consistent loop on a single world line. Mayuri meets different fates on the preceding and following world lines. The diagram assumes no small divergence changes between time leaps, for simplicity, but their presence would not change the overall picture.

“

[Okabe]: In the 20 minutes I took my eyes off of Mayuri, she was captured by Moeka's men. They took her to France and stuck her in the LHC. They sent her through their unstable black hole 50 years into the past. It wasn't an experiment. It was just a warning. A threat. How could anyone do such a thing? Now that I've recovered slightly from the shock, I realize that Mayuri was probably still alive when Moeka sent me that picture. A flight to France takes at least twelve hours, after all. Even so, her fate was already decided. Perhaps that 50-year-old newspaper article appeared out of thin air the instant they found her.

”

Chapter 6, Steins;Gate

Perhaps Okabe could be wrong in his understanding, and it is not certain when exactly the world line containing the loop is arrived at (immediately after the time leap, or due to a decision Okabe makes following the leap). However, what he says is consistent with our understanding of the rules so far, and there is no sensible alternative explanation.

2.4.2 Suzuha Travels to 1975

An important self-consistent loop relates to Suzuha, and specifically her journey from 2010 to 1975 on Alpha world lines. Although Suzuha does initially come from 2036 of a different world line (0%), on the second leg of her journey she experiences no divergence change. We also see that Suzuha's intended actions in the past have already been carried out before she time travels, such as the IBN 5100 already having been obtained.

The critical evidence that this is indeed a loop occurs when Okabe starts interfering with the date of Suzuha's departure. There is a sequence of events:

1. The world line is one where Suzuha leaves in the time machine on 9th August. In the past, Suzuha obtained an IBN 5100, but it was sold by Faris' father.
2. Okabe sends a D-mail to himself to delay Suzuha leaving. There is an immediate large divergence change.

-
3. The world line is one where Suzuha leaves in the time machine on 13th August. The time machine was damaged by rain prior to departure. In the past, Suzuha lost her memory and did not obtain an IBN 5100.
 4. Okabe sends a D-mail to stop himself interfering in Suzuha's departure. There is an immediate large divergence change.
 5. Once again, the world line is one where Suzuha leaves in the time machine on 9th August. In the past, Suzuha obtained an IBN 5100, but it was sold by Faris' father.

This can only occur if the journey from 2010 to 1975 is a loop within the current world line. Otherwise, Okabe sending a D-mail to a few days earlier would not affect the outcome of Suzuha's arrival in 1975. (See Figure 2.10 for a diagram.)

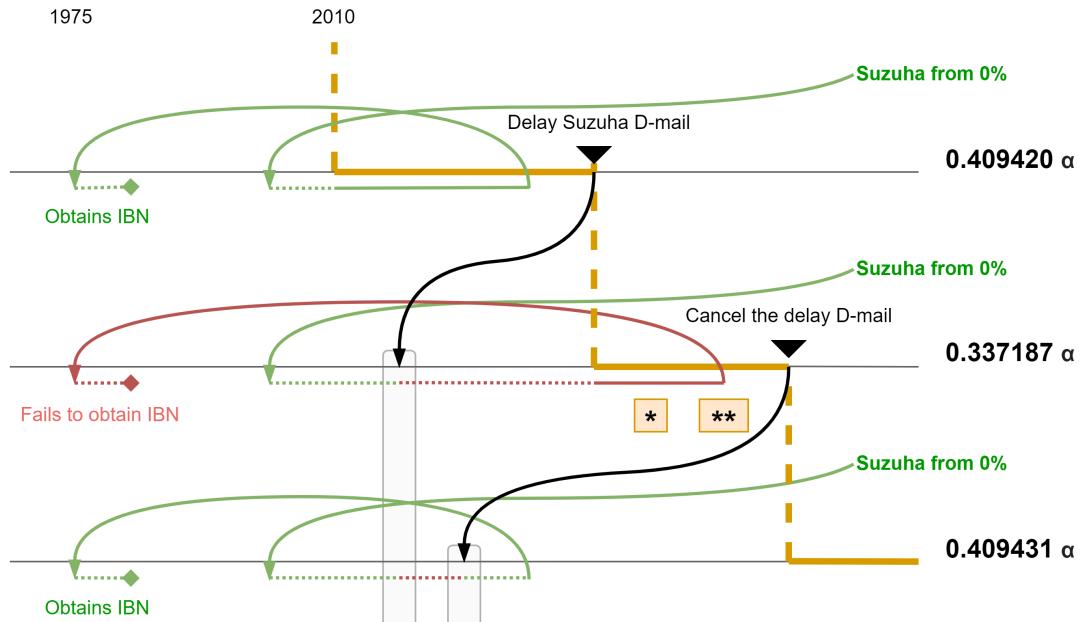
It is not possible to formulate an alternative interpretation where 1975 Suzuha is from a previous world line, even one with very similar divergence. If that were the case, then 1975 Suzuha's mission should only become a failure after the damaged time machine leaves for the past, replacing the previous successful Suzuha. But this is not what we see; the world line reconstructs to one where Suzuha fails after the D-mail is sent, not the time travel. (Official timeline charts also confirm this sequence of events.) The presence of a loop is undeniable.

2.5 Small Shifts

The final mechanic to mention is the effect of divergence shifts that are too small to detect on the divergence meter. In an ideal world, one might hope that these followed the exact same rules as large divergence changes, but small shifts do actually behave in a qualitatively different way.

Examples of small shifts are the various “test” D-mails, such as Daru's D-mail attempt. The general behaviour is that a D-mail is sent successfully, indicated by it disappearing from the sender's mail outbox and arriving in the receiver's inbox with an arrival date in the past. We infer therefore that there has been a world line shift. However, people on the new world line still remember the D-mail being sent, which does not happen for

Suzuha's journey to 1975 is an example of a consistent loop.
This is why D-mails change the status of her mission between success and failure, rather than her own time travel.



* Time-leaping hasn't been shown, for clarity

** Okabe has the divergence meter at this point, but observes no divergence change or RS when Suzuha leaves. Her actions do not change the past, meaning that her failure was already part of the history of the WL. The present does not have to move back, as the past is already determined.

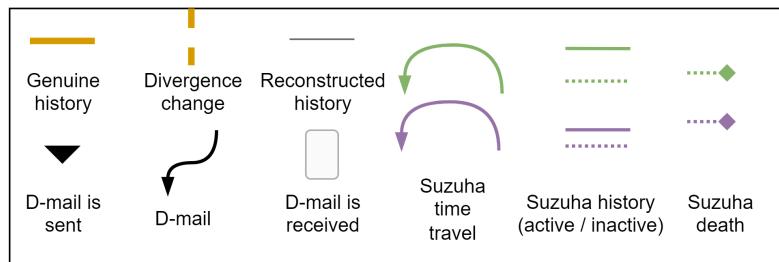


Figure 2.10: Whether Suzuha succeeds or fails in obtaining an IBN 5100 changes at the moment that D-mails are sent. Her own travel is a self-consistent time loop, so she observes no divergence change on the meter. Conveniently, Suzuha dies before she can interact with her younger self in all cases, reducing the chance of paradoxes.

large divergence changes. Okabe remembers the events of the previous world line but does not experience the sensation of Reading Steiner.

A guidebook summarises the situation as:

“

Regarding modifications of the past which hold near-zero influence, the reading will not shift even by a degree of 0.000001%, bringing about a phenomenon in which memories are not reconstructed regardless of slight alteration(s).

”

Chaos;Head and Steins;Gate Maniacs

But what actual sequence of events took place on the new active world line? Let us look at two examples of small shifts, which help to narrow down the possibilities.

2.5.1 Daru's D-mail

When Daru is given the opportunity to send a D-mail, he chooses to attempt to change his earlier loss to Faris in her RaiNet tournament. His idea is to send himself Faris' secret card layout, which should allow him to win easily.

The D-mail sends successfully, disappearing from the phone outbox and arriving in its inbox dated two days prior. However, we find that the past has not changed; Faris still won. More strangely, Daru still remembers sending, not receiving, the mail.

There are two possible sequences of events here:

1. On the world line where the D-mail was received, Daru used its information in his RaiNet match against Faris, but still lost to her superior skill. There was no reason to send the same D-mail again following that failure. For some reason, when this world line becomes active, everyone's memories are exempt from the reconstruction, so they remember the events of the previous world line.
2. On the world line where the D-mail was received, it is ignored or missed for some reason. Daru's match against Faris, and his loss, are unchanged. Not knowing

about its earlier failure, Daru sends the same D-mail again. When this world line becomes active, everything reconstructs as usual, but due to its similarity to the previous world line, no memory changes are needed.

Each explanation has its own conceptual issues:

1. There is a complete disconnect here between the state of the world and people's memories of it, for no clear reason. Faris, Daru and spectators will recall the RaiNet match as happening differently to a recording of it, for example. In fact, how do we even know Daru lost, if nobody's memory is to be trusted?
2. How Daru could miss the D-mail arriving is not clear. And if the D-mail was also sent on the new world line, why is it not in his mail outbox as well as the inbox?

This sort of mystery is present for all the test D-mails, which the entire lab remembers sending, but the mail outbox does not.

2.5.2 Nae's Time Leaps

The effects of time leaping provide useful evidence, because this is also an event where the active world line can change by an amount too small to measure on the divergence meter. Everyone remembers the new history correctly when Okabe leaps to the past, changes events, then arrives back at the time he leapt from. This suggests that our first explanation for Daru's D-mail effects cannot be correct, or does not apply to world line shifts that move the present, because memories are not exempt from the reconstruction caused by time leaping.

In addition, there is the instance where Okabe witnesses an unknown person using the time leap machine, later revealed to be Nae:

“

Returning to the lab, I casually look up to the second floor window and lose my breath.

[Okabe]: “The discharge phenomenon...!?”

Someone's activating the Time Leap Machine!?

[...]

I rush into the lab.

The discharge phenomenon and the vibration have already calmed down. I gently peek into the development room.

Nobody's there.

The lab door was unlocked, meaning anyone could sneak in. I click my tongue at my own carelessness.

The Time Leap Machine is still faintly warm. I knew someone used it. So, did they time leap?

Just who... I don't know. Someone other than me used the Time Leap Machine. This is the first time that's happened. Just to make sure, I check the settings on the connected X68000, but it's useless. Just like with D-mails, the setting history has been erased.

”

Chapter 9, Steins;Gate

It takes some time for Okabe to enter the lab after seeing the discharge phenomenon in the distance, so Nae is able to use the Time Leap Machine before he can stop her. We know that her leap is successful, because the PC settings that must have been input before the Time Leap Machine started have been erased, in the same way that the outbox data of a D-mail is.

However, the time leap machine is still warm after use. This implies that Nae's leap causes little or no changes, so that her time leaping is still part of the history of the current world line. Why then is there no record of the settings used on the PC on this world line?

It seems that the reason for time travel outbox data disappearing is not necessarily that the world line has shifted to one where the time travel was not sent. Rather, it is an effect of any successful time travel, and takes place even if that time travel happens again on the new world line. This is mechanically unsatisfying, but does make sense as a narrative prompt that tells the audience that "this time travel was successful". With that perspective, our second explanation for Daru's D-mail contains no contradictions.

2.6 Examples

With the mechanics laid down, let us use them now to answer a few common questions and correct some misunderstandings about the plot.

2.6.1 Series Chronology

First, we can answer questions like: “When did Steins;Gate 0 happen in relation to Steins;Gate?” “What was the first world line like?” “Did this particular story actually take place?” And so on.

The key idea is that physical time travel moves the present. Every time that 2036 is reached, Suuha pilots a time machine into the past, and a new sequence of events can play out. These are often referred to as iterations.

Many iterations have happened, of which we see a few in various stories. To summarise their order:

1. The first world line(s). Unknown divergence. Time travel is invented for the first time.
2. (Multiple unknown iterations.)
3. An iteration beginning and ending in the Alpha Attractor Field. The divergence meter is created and its value set at 0%. The way to escape Alpha is discovered, but too late to put into practice. Suuha leaves 2036 in the FG204.
4. (Multiple unknown iterations.)
5. The routes of the Steins;Gate 0 visual novel. Each iteration begins and ends in the Beta Attractor Field. Alpha is entered, then escaped using 0% Suuha’s knowledge. Elements of the plan to save Kurisu form. Suuha leaves 2036 in the C204.
6. The events of the Steins;Gate 0 anime (and visual novel true ending). Begins and ends in the Beta Attractor Field. Alpha is entered, then escaped. The Operation Skuld video D-mail is recorded and transmitted. Suuha leaves 2036 in the C204.

-
7. The events of the Steins;Gate visual novel (and anime). Begins in the Beta Attractor Field. Alpha is entered, then escaped. By following the video D-mail instructions, Kurisu is saved. The Steins Gate world line is reached.
 8. (The events of sequel materials.)

A large amount of Steins;Gate spin-off material exists, presenting further stories which could easily fit into some of the spaces in this summary. For example, some iterations may visit, or take place entirely within, other Attractor Fields. The exact order of Steins;Gate 0 iterations is also not known, and these may be interspersed with other unseen iterations. Furthermore, the events Okabe experiences in Alpha during the Steins;Gate 0 iterations are not guaranteed to be identical to the events of the Steins;Gate iteration.

The nature of the first iteration is also unknown. It should initially contain no arriving time travellers, but whether it could contain self-consistent time loops is unclear. We do know, however, that it is not 0%; the world line that Alpha Suzuha comes from. She brings with her a lab member badge featuring the text “OSHM***A 2010”, implying that an Amane Suzuha visited the lab in 2010 of 0%, herself coming from an even earlier iteration.

It could be hypothesised that the first iteration, and all following iterations up to 0% Suzuha’s, take place in the Alpha Attractor Field, before the way to escape to Beta was discovered. The 0% world line is then the last time that an iteration ended in Alpha, because it is the final time that the opportunity to hack Echelon was missed. This is why its Suzuha is the most recent one to have arrived from 2036 on Alpha world lines, and why she has no knowledge of other attractor fields.

At the highest level, Steins;Gate is the story of many different Okabes struggling against fate. Their successes and failures accumulate, in the form of changes to the world line structure, dreams of past experiences, and knowledge transmitted by Suzuha. Eventually, an Okabe brings all those pieces come together, allowing him to save his friends and escape the cycle that trapped his predecessors.

2.6.2 Luka's D-mail

The D-mail that was sent to Luka's mother, in order to change Luka's sex, is particularly controversial. Here, the lab's plan was to make use of an urban myth about diet determining the sex of a baby:

“

[Kurisu]: “Looks like there’s a common saying that if you eat a lot of meat, you’ll give birth to a boy, and if you eat a lot of vegetables, a girl.”

”

Chapter 4, Steins;Gate

The pager message “EAT VEG 4 HEALTHY KID” is sent to Luka's mother while she was pregnant, and this succeeds in shifting the world line to one where Luka was born female.

There are two objectionable elements here: First, there is no truth to the idea that diet can affect the sex of a baby. And second, Luka was already conceived at the time the D-mail arrived, so even some sort of butterfly effect has no way of altering his already determined sex.

But given the established mechanics, there is a straightforward explanation for both of these. The key is to think about which world lines exist, and which do not. For example, it would be perfectly reasonable for Luka's sex to influence his mother's food cravings during pregnancy. (Either through hormone differences, or a butterfly effect.) Suppose therefore that Luka's mother naturally eats more vegetables on all world lines where Luka is female.

When the “EAT VEG 4 HEALTHY KID” D-mail is sent, its direct effect would be to shift the world line to a preexisting one where Luka's mother eats more vegetables. As this scenario is always correlated with Luka being conceived as female, a necessary side effect of the shift is to change Luka's sex. Reconstruction affects all of the past and future, so there is no issue with a D-mail changing events earlier than its arrival, if that is the best available world line to shift to. (Figure 2.3 presented a similar situation with drink choices.)

2.6.3 Reversing Moeka's D-mail

An interesting scenario plays out when Okabe sends a D-mail to stop Moeka stealing the IBN 5100. To cancel the search, he sends a D-mail to Moeka, posing as FB: “RetroPC search is canceled. Standby” That message was sent to 31/7, but on the new world line Moeka is still not looking for the IBN by 15/8, even though there has been plenty of time for the deception to be discovered. It seems that FB has chosen to call off the search himself on this world line, and has had further conversation with Moeka about it since Okabe’s mail arrived.

“

[Moeka]: So, the IBN became unnecessary for a while. Moeka

[...]

[Okabe]: “Unnecessary? Who said?”

[Moeka]: My superior told me to stop. Moeka

[...]

Did FB put a stop to the Rounders’ duty of IBN retrieval?

“Doing your duty sets you up for ‘disposal’. So we’re more like livestock than dogs.”

I play back the man’s last words in my head. He put a stop to it so that she wouldn’t be disposed. If that’s the truth, then maybe he really did it to save Moeka after all.

”

Chapter 9, Steins;Gate

This is another situation where the key idea is that world lines are preexisting sequences of events. Because inactive world lines do not initially contain D-mail arrivals, there are only two types available here: those where Moeka retrieves the IBN, and those where FB cancels the search before she can. So by sending a D-mail to (briefly) cancel the IBN search, Okabe actually causes a shift to a world line where FB was already planning to cancel the search himself, in order to protect Moeka.

We see that even though Okabe is undoing the effect of an earlier D-mail, his actions have a lasting positive effect. He has accidentally shifted the world line to one where FB is more courageous in protecting Moeka. And this effect is likely to persist, even

following further world line shifts, because reconstruction attempts to match the previous world line as much as possible when selecting the new one. As long as a time travel event does not directly require FB to restart the IBN search, the search will remain cancelled on the following active world lines.

The search for the IBN 5100 is still cancelled on the Steins Gate World Line, and Mr Braun has taken in Moeka, because of Okabe's actions.

2.6.4 Events Unchanged by World Line Shifts

When the active world line shifts, reconstruction selects the world line most similar to the previous one (but which also accommodates whatever change caused the shift) to become active. This fact is crucial to answering a number of related questions.

For example, it is often asked why Okabe is usually stood in the same position after a world line shift. Some claim that the butterfly effect of changing the past should lead to him being in an essentially random position. But this is a complete misunderstanding of what a world line shift is. Sending a D-mail does not cause a new world line to branch off the current one; every world line already exists. Rather, the D-mail causes which world line is active to change. There will be inactive world lines where Okabe stands in many different places, but because reconstruction favours the world line most similar to the current one, it will select one to become active where his position does not have to change.

The corollary to this is the few times where a world line shift *does* change Okabe's position. This happens when there is no available world line where Okabe standing in the same place is consistent with whatever caused the shift. For example, in Faris' ending Okabe finds his position changed after sending the second threatening D-mail to Faris' father. Rather than remaining in the lab, he finds himself stood on the street. This happens because the world has entered the Omega Attractor Field, where the lab did not form. Since the Okabe of this attractor field has never entered the building, there was no inactive world line available that maintained his position there.

Another question that can be answered similarly is why the characters are so similar after a world line change, if history is different. In particular, people are surprised by

how similar male Luka and female Luka are. Again, this is because world line shifts work this way, with reconstruction choosing the world line which changes the minimum number of things.

Lastly, certain events remain on the active world line even after their cause has been changed, because reconstruction chooses the most similar world lines possible. For example, in the history of the Beta world line that followed the escape from Alpha (1.130205%), the lab also found an IBN 5100, without Suzuha's help or motivation. Or as another example, we see the Mayuri of Beta (1.130426%) lose her metal Upa in the prologue of Steins;Gate, then are told by mail that she also lost one in Alpha (0.571024%). This is all to be expected; the world changes an event only if something forces it to.

2.7 Summary

In summary, the core mechanics of Steins;Gate are as follows:

- The universe consists of a very large, or infinite, number of “world lines” existing in superposition.
- Each world line is a self-consistent history with a certain divergence value.
- Only one world line is “active” at a time and determines the actual state of the physical world.
- Which world line is active can change, if an action contradicts the predetermined events of the current active world line. In that case the new active world line is chosen to be as similar as possible to the previous one, but without contradictions.
- The physical world reconstructs when the world line changes.
- Some events happen on many world lines, making them harder to avoid. This effect is experienced as “convergence”. World lines with significant similarities can be classified into “attractor fields”.

Multiple ways to cause a world line shift are demonstrated, with slightly varying effects. Each causes alterations to the world line structure.

- Actions in the present that contradict the predetermined future. The new world line is one where the action took place.
- Sending a “D-mail” to the past. The position of the “present” does not move. The D-mail arrives in all world lines where it has no new effect.
- “Time leaping” or physical time travel. The “present” moves back with the time traveller. The time traveller arrives in all world lines where their presence causes no immediate contradictions.

There are further subtleties:

- Human memory can partially avoid the reconstruction process. Those with “Reading Steiner” are fully exempt.
- World lines can contain self-consistent time loops.
- World line shifts that do not cause a measurable divergence change behave differently to those that do.

The rules discussed in this chapter are sufficient to understand almost the entire story. In the next chapter we suggest one more rule, which resolves the remaining mysteries and allows a complete explanation of Steins;Gate.

3 Theory

In this chapter, we present one more rule, which will finally complete our mechanics and resolve the remaining questions of the previous chapter. In particular, we will address the mysteries behind self-consistent loops and small divergence shifts. This will allow us to understand the workings and logic of Operation Skuld in full, and to explain a few more topics.

We place this final rule in a chapter called “Theory” to make it clear that this involves a level of interpretation beyond that of the previous chapter. The reader might agree with this author that this is the only interpretation that makes sense, and possibly what was intended when *Steins;Gate* was written, or they may have their own ideas.

3.1 Loop Closure

Our final principle is simple. Where possible, the world will arrange for time travel to form self-consistent closed loops.

Before setting this out in detail, let us motivate it. There are three different reasons to believe it is the case.

1. First, we have previously determined that world lines can, and do, contain closed time loops. (See Section 2.4.) However, we did not identify where these come from. Loop closure is the mechanism by which loops can occur.
2. Second, we discussed how small divergence changes behave qualitatively differently to large divergence changes. (See Section 2.5.) The conclusion we reached was that test D-mails, such as Daru’s, are not noticed on the following world line when they arrive, so are sent again there. Therefore people’s memories appear not to change. This description is essentially the formation of a loop.

-
3. Third, the standard explanation of why Okabe does not meet his earlier self when carrying out Operation Skuld is that he arrives on a world line with a slightly different divergence to his previous time travel. However, this does not explain why it is certain that he will find no prior time travellers on *that* world line. There is an unspoken mechanic that Okabe replaces the version of himself on the new world line, rather than multiple similar Okabes being present. Loop closure predicts this sort of behaviour.

Loop closure occurs when time travel causes a world line change, but not by enough to prevent the same time travel event from also occurring on the new world line. Because the purpose of reconstruction is to remove paradoxes (events that change divergence), it pairs up the time travel departure and arrival on the new world line. We depict this in Figure 3.1 for the case of a D-mail that causes minor changes.

Using the example of the first test D-mail sent to Okabe, loop closure functions as follows:

- On the initial world line (WL 1), Okabe received no D-mail.
- A D-mail is sent.
- The D-mail arrives on world lines where Okabe did not check his phone closely enough to notice its arrival before the present (or otherwise forgets about its arrival).
- Of these, the world line most similar to the previous active world line becomes the new active world line (WL 2).
- According to history, the same D-mail arrived and is later sent. This is a self-consistent loop.
- The D-mail outbox data is deleted for reasons unrelated to a world line shift. (Perhaps due to an error in how loops are formed, or an attempt by the world to conceal the loop, or some sort of quantum [no-cloning theorem](#), etc...)

Just as large divergence changes alter a range of inactive world lines, so too does loop closure establish loops on multiple world lines. This is useful for allowing complex sequences of multiple time travel events to occur on the same world line, without divergence changing. The other benefit of establishing loops is that they need not move the present when encountered again, as their events have already been evaluated.

Minor D-mail leads to loop closure

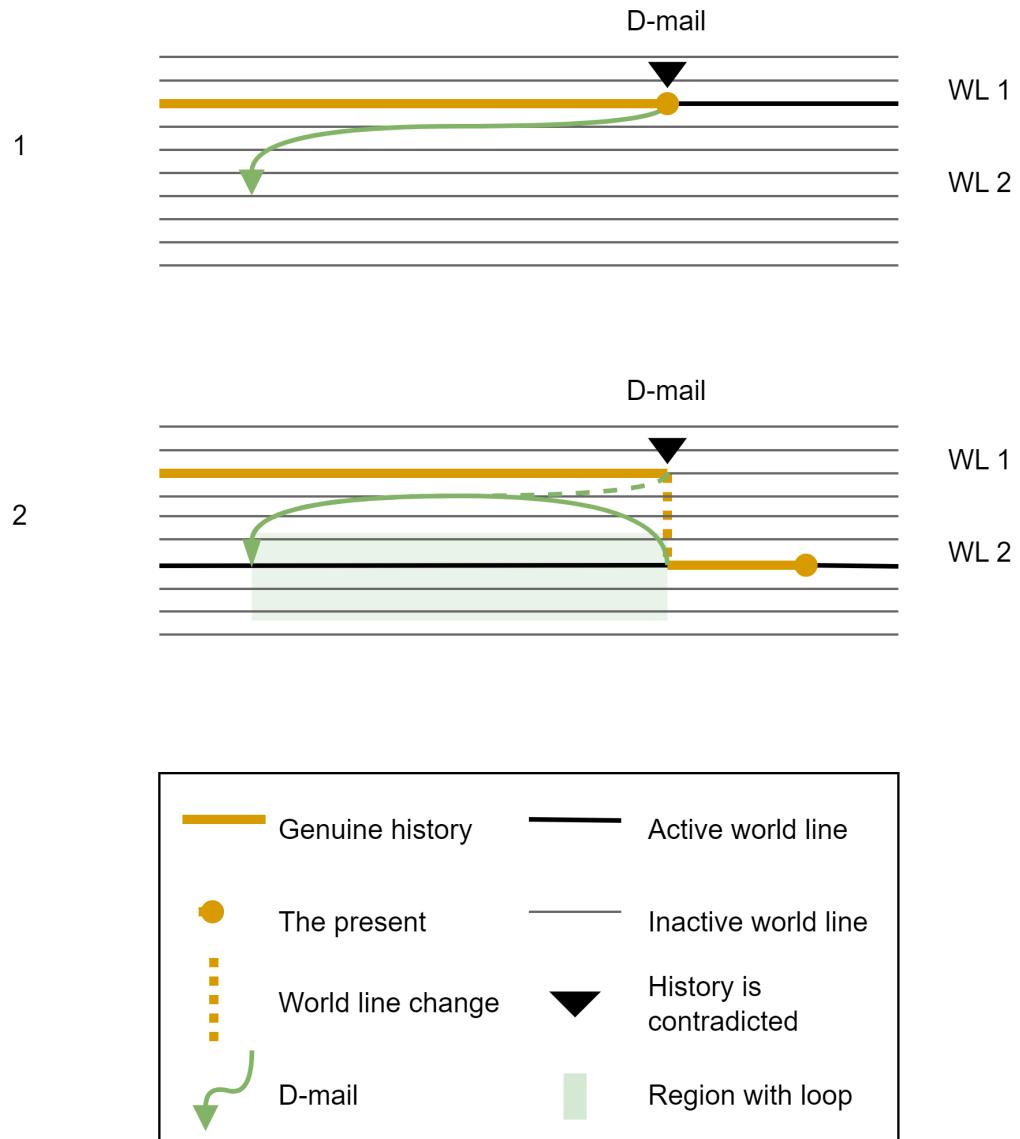


Figure 3.1: Loop closure due to a D-mail that does not prevent its own re-sending. Only the loop on the active world line has been drawn explicitly, but all world lines where the D-mail arrives (the green region) will also contain a loop. The same effect can occur with physical time travel, except the present also moves back with the time traveller.

With this final mechanic, we can complete our understanding of events. Proceeding chronologically, let us explain Okabe's first attempt to save Kurisu, then Operation Arc Light and Operation Skuld.

3.1.1 The First Attempt to Save Kurisu

Soon after escaping the Alpha Attractor Field, Okabe is contacted by a Beta Attractor Field Suzuha. She reveals that in the future of this attractor field, a Third World War breaks out over the development of time machines. The only way to avert this involves saving Kurisu, who died on 28th July 2010 on the current world line. The hope is that by doing so, the “Steins Gate” world line can be arrived at.

Steins Gate is a world line that is hypothesised to exist by Okabe, positioned perfectly between the Alpha and Beta attractor fields. Balanced exactly on the boundary, the logic is that such a world cannot preferentially evolve into one of the two known convergent futures, and must instead reach neither. It therefore holds the possibility of reaching a peaceful future, free of war or dystopia, or at the very least something better than apocalypse.

“

[Suzuha]: “The world line I wish for [...] Is the valley between attractor fields.”

[...]

[Suzuha]: “It seems like the Steins Gate is an unknown world line nobody has seen before.”

[Daru]: “By ‘seems like’, does that mean someone has observed it?”

[Suzuha]: “It hasn’t been observed. That’s why it’s unknown. But the Steins Gate’s divergence has already been calculated by dad and uncle Okarin.”

”

Chapter 11, Steins;Gate

With that encouragement, Okabe sets off into the past with Suzuha, travelling from 21/8/10 to 28/7/10 in her time machine. However, his attempt to save Kurisu fails and

he ends up stabbing her himself. He screams, and realises that the scream he heard weeks ago when attending Nakabachi's conference was in fact a version of himself.

“

[Okabe]: The one who killed Kurisu...

Is me...

“Ah... ah...”

“AHHHHHHHHHHH—!”

While I scream, another me looks down from above.

While hearing my own voice resounding, ahh, so that's it, my heart mutters.

I noticed, that on that day, the voice I head, was mine.

”

Chapter 11, Steins;Gate

Because Okabe inadvertently repeats history, loop closure is necessary when interpreting events. This is not to say that the Okabe who kills Kurisu in the Prologue is the same Okabe who we follow in Chapter 11; the Prologue Okabe is from a previous iteration. The two chapters also take place on different divergences, so cannot be the same event. However, there will be loops established within the current world line by Okabe's time travel.

See Figure 3.2 for the diagram of events. The first attempt to save Kurisu happens in a similar way on many different iterations, so one can think of this as showing the path of the Okabe of Steins;Gate, or any of the Okabes of Steins;Gate 0. (The specific divergence values quoted are for the Steins Gate events.) We also draw the events of the first Radio Kaikan visit for the same Okabe, to clarify how this differs from his later time travelling visit. Note that we omit drawing the extra inactive world lines that were included in previous diagrams to save space. (As before, loops are established on a range of world lines, not just the current active one.)

By allowing loops to exist on a world line, we automatically find a logical reason for “the present” to follow our Okabe in both situations. In the Prologue, the circumstances of Kurisu's death are already established as the actions of a previous Okabe, so our Okabe reaches the point where he can send a D-mail. In Chapter 11, new circumstances of Kurisu's death are in the process of being established, so our Okabe returning to the

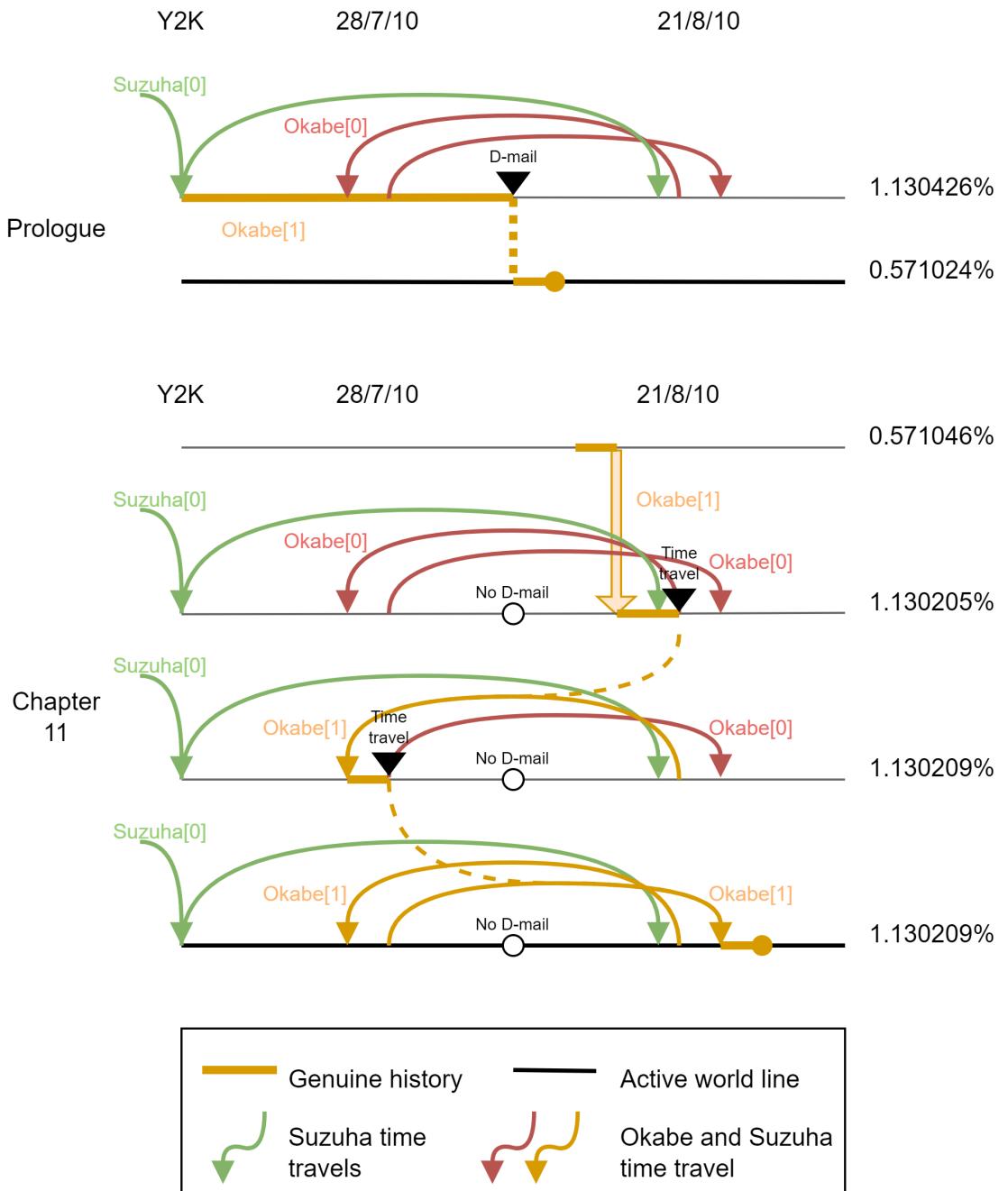


Figure 3.2: The first attempt to save Kurisu. Above: the Okabe of a previous iteration's attempt, as witnessed by the current Okabe. Events are already established as closed loops, so do not move the present. Below: the current Okabe's attempt. By time travelling, he replaces the previous Okabe on the new world line, and establishes his own loops. The present moves because Okabe is altering the past, then the future.

future takes precedence. The past Okabe cannot choose to send a D-mail because his portion of world line is inactive.

Once Okabe returns to the future, he assumes that his failure to stop Kurisu's death was a result of convergence, so impossible to change. However, this is not quite right, as we later see. It is more likely that Okabe fails to save Kurisu because he is attempting to reach a world line where his existence as a time traveller is not supported. (See Section 2.2.4 and Figure 2.7.) If Okabe succeeds, reconstruction must remove him as a time traveller from the next world line. But if his plan fails due to some small error, the rest of history is unchanged. World line shifts always make the smallest changes possible, so the world favours the latter situation.

From this point onwards, the path of the Okabe in Steins;Gate diverges from all the previous iterations who failed to save Kurisu. Those previous iterations give up on saving Kurisu, and eventually die in 2025. In 2036, the young Suzuha travels to 1975 by time machine, starting the next iteration. (In terms of Figure 3.2, the last diagram becomes the first one, but for the next iteration of each character, once "Suzuha[1]" travels to the past.)

3.1.2 Operation Arc Light

Operation Arc Light is the plan, devised by Mayuri and Suzuha, to travel to the past and encourage an Okabe who has given up on saving Kurisu after his first failure. This is featured in a number of works: the Beta Drama CD, the Vega and Altair chapter of the Steins;Gate 0 visual novel, and the Steins;Gate 0 anime. It can be inferred to happen on multiple iterations and world lines.

The background to the plan is that on certain earlier iterations of history, Mayuri supported Okabe's decision to give up on saving Kurisu, after his first attempt results in him killing her. Okabe then refused to use the time machine again. Later regretting her actions, Mayuri decides to travel with Suzuha from 7/7/11 to 21/8/10. Once there, she has a conversation with her past self, leading to that Mayuri slapping the despondent Okabe and urging him on.

An additional event shown in Steins;Gate 0 is that before Mayuri and Suzuha depart for the past, Suzuha receives a video D-mail from the future. In it, Daru praises her and Mayuri for their choices, and provides further instructions to help the plan succeed.

“

[Daru]: “Hey Suzuha. How you doing? It’s Daddy. And it’s the year 2025.”

“I’m really sorry to dump all this on you. Really. Forgive me, please.”

“If you’re seeing this video message... It means that you, no, you and Mayu-shi, have found another path to Steins Gate.”

“In other words, the plan’s moved to the next phase.”

“You might be angry and wondering why I didn’t tell you all this from the start.”

“But it wasn’t that I didn’t. It’s that I couldn’t.”

“In the world line you originally set out from, I never planned the operation that I’m about to describe.”

“You’ve probably already noticed, but the choice you and Mayu-shi just made has changed the world line a little.”

“In other words, I’m a different [Hashida Itaru] than the one in your world line.”

[...]

“I am about to share with you the details of Operation [Arc Light].”

“This is going to take everything you’ve got, and not a single mistake will be allowed. Pay attention and don’t miss a word. Got it?”

”

Vega and Altair, Steins;Gate 0

The Daru recording this message is not from the world line that Suzuha originated from, on which Operation Arc Light did not occur. Rather, he is from the future of the current world line, where it did. The D-mail that Daru sends therefore follows a closed loop. This is why Valkyrie must still send the mail from 2025, even on a world line where Operation Arc Light has already succeeded (such as in the Steins;Gate 0 anime). To not send it would amount to contradicting history and would cause an unwanted world line change.

There is one more loop closure involved here, and it is Operation Arc Light itself. In Steins;Gate 0, we see that Suzuha and Mayuri's trip does not cause any measurable divergence change. Everyone on the world line following their departure agrees that they did still depart, in much the same way that everyone remembers Daru sending a D-mail to (unsuccessfully) cheat at RaiNet. We infer that Mayuri encouraging Okabe is not sufficient to make him to go on to save Kurisu, because the Operation Skuld D-mail does not exist yet to instruct him further. (The slap is still important however, because it will make him receptive to that D-mail when the time comes.)

In all but the final iteration, the result of Operation Arc Light is that Okabe gives up as before, which Mayuri will go on to feel responsible for, and attempt to change by enacting Operation Arc Light again.

The order of events and how they can be established is presented in Figures 3.3 and 3.4, which depict four distinct iterations.

In summary, the first time Mayuri and Suzuha time travel, it does not stop Okabe giving up, so creates a loop. The same loop, already formed, is encountered in following iterations when the right conditions are met. Then after an unknown number of iterations, Daru sends further advice and encouragement back to Suzuha via D-mail. This potentially alters her actions in the past, but not by much, so forms its own loop. Note that within the closed loop, the D-mail causes no change at all: “It felt like her father was telling her that the plan she'd come up with on her own was the right one.”

What is shown in Steins;Gate 0 are then the latest iterations. Suzuha and Mayuri decide to carry out Operation Arc Light, which causes a world line shift to one where both loops are already predetermined events. This relatively simple arrangement explains why none of the time travel involved causes a world line shift, or needs to move the present. (Which will be convenient when Operation Skuld introduces even more time travel to keep track of...)

3.1.3 Operation Skuld

Operation Skuld is Okabe's plan to save Kurisu, based on his realisation that certain apparently converged-upon events can be avoided by “deceiving the world”. He realises

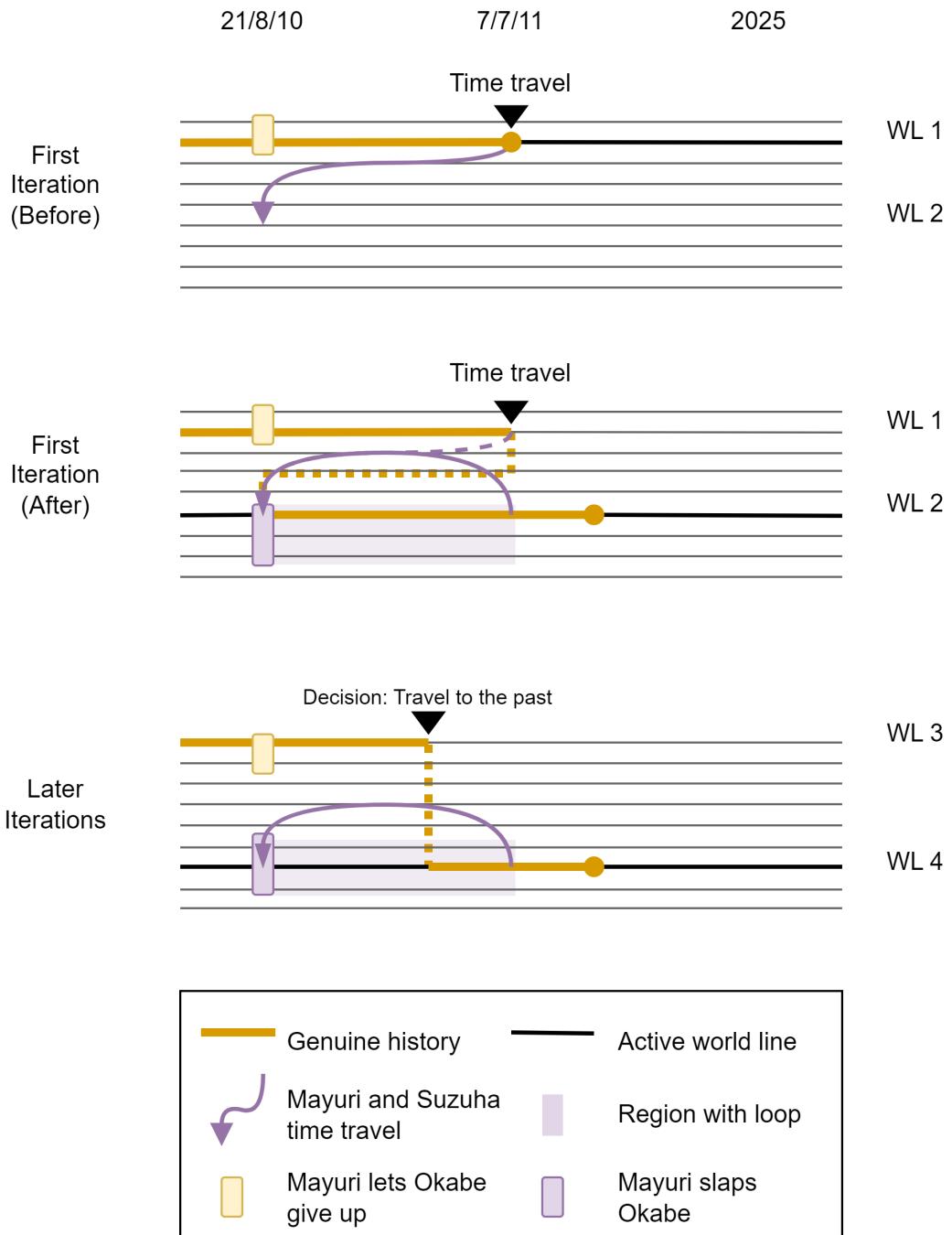


Figure 3.3: Mayuri and Suzuha travel to the past to encourage Okabe. First iteration: A closed loop forms when the first Operation Arc Light is not enough to stop Okabe giving up again. The loop is written to all similar inactive world lines. Later iterations: When the right choices are made, the world line shifts to one containing the Operation Arc Light loop.

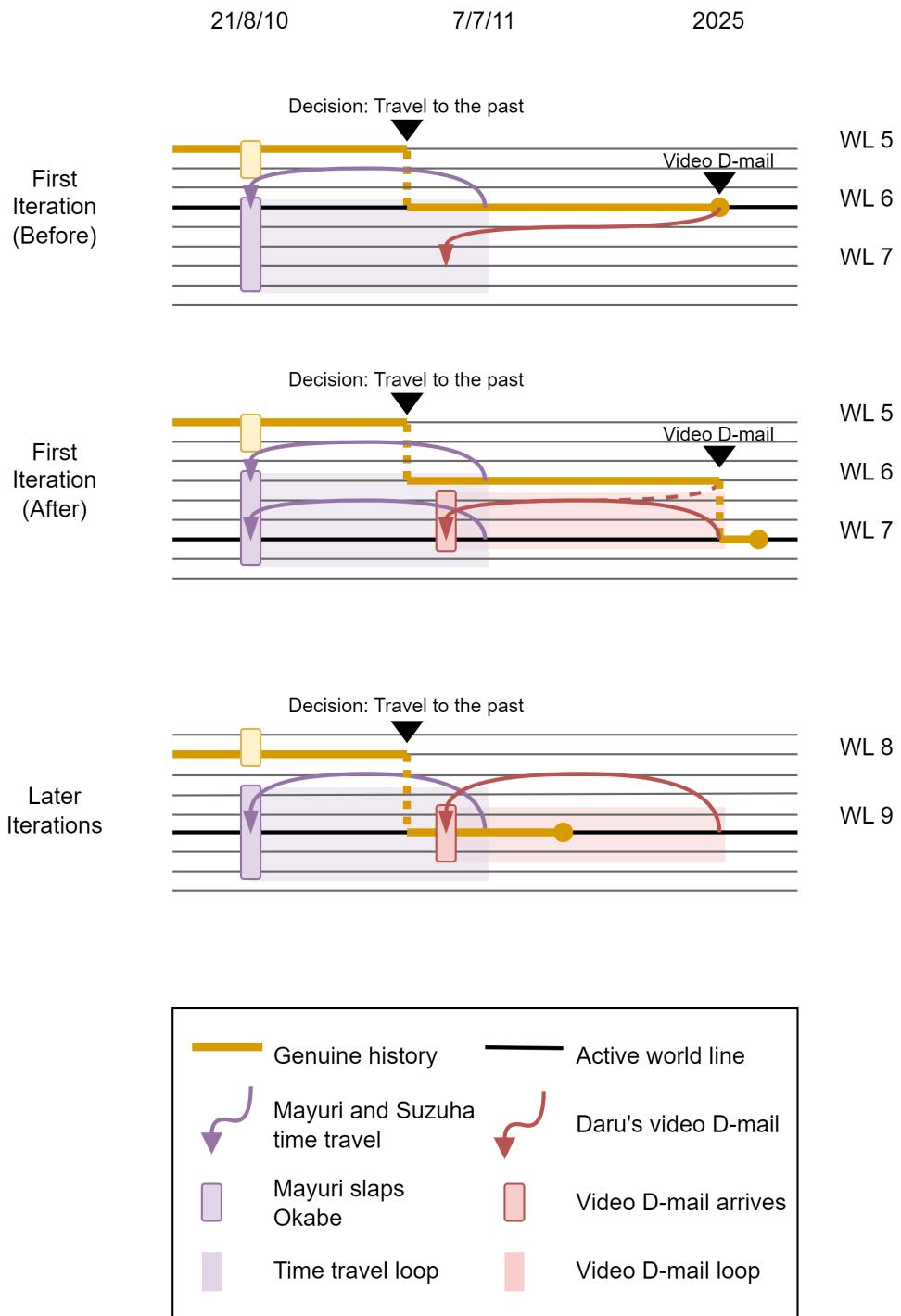


Figure 3.4: Daru sends a video D-mail with further instructions. First iteration: A closed loop forms when the D-mail does not meaningfully change the events of Operation Arc Light. Later iterations: Choosing to carry out Operation Arc Light shifts the world line to one where the D-mail and operation are established looping events.

that the problem with his first attempt to save Kurisu was that he attempted to change what his past self experienced, in such a way that would lead to a world where he did not become involved with time travel, and so did not travel back to save Kurisu. From our mechanics, we infer that although this sequence of events would not be prohibited, it is heavily disfavoured compared to sequences where his time travel is unsuccessful and forms a loop.

“

[Okabe]: “You must not undo what that first you saw himself, because that’s the decided past, the world line’s convergent result.”

[...]

“The first you witnessed Kurisu collapsed in a puddle of blood. If you hadn’t seen it, then everything you’ve done until now, and everything I’ve done until now would become a time paradox.”

”

Chapter 11, Steins;Gate

The solution, therefore, is to deceive his past self into thinking Kurisu is dead, when in fact she is not. That will not contradict the existence of the time travel loop, so will not be so strongly resisted by reconstruction. It is unknown whether this can completely avert Kurisu’s death, or only delay it, because we do not know whether her death will still be required for WW3 to occur on the resulting Beta world line. However, she will at the very least survive the time machine conference.

The other aim of Operation Skuld is the destruction of Kurisu’s time travel thesis, which was stolen by Nakabachi, before it can reach Russia and spark WW3. If Kurisu is still alive when that goal is achieved, the Steins Gate world line, where WW3 and her death are avoided, can be reached.

“

[Okabe]: “There are two requirements to reach that Steins Gate. One is to save Makise Kurisu’s life. The other is to consign into oblivion the Nakabachi Thesis that Doctor Nakabachi brings to Russia.”

”

Chapter 11, Steins;Gate

We represent how these events unfold in Figure 3.5. This follows on from the final configuration of Figure 3.2, after Okabe returns from his first attempt to save Kurisu.

Again, we omit any extra inactive world lines to save space. We also do not show the events of Operation Arc Light, which are established loops within the 1.130209% world line with the net effect that Mayuri slaps Okabe.

This solution may seem different to commonly repeated ones, so let us justify why it is correct. We consider the evidence for each world line in turn:

First is the world line where Okabe watches the video D-mail (1.130209%). Okabe has just returned from his first attempt to save Kurisu, in which he accidentally stabs her. Mayuri and Daru were waiting for his return, meaning that Okabe's departure was also an event on *this* world line. The simplest interpretation is that these events are part of a self-consistent loop. (And this also agrees with Figure 3.2.)

Second is the world line where Okabe deceives his past self (1.130212%). Okabe does not meet any other time travellers, but Daru and Mayuri are still waiting for Okabe to return to the future, meaning that an Okabe travelled to the past on *this* world line too. We infer that this is a newly formed loop. (Note that our Okabe, on his second attempt, is replacing a different Okabe's first attempt. There is no space for two attempts on the same world line.) Okabe arranges for the thesis to be destroyed, fakes Kurisu's death by being stabbed himself, then sets off for the future.

Lastly is the Steins Gate world line (1.048596%). Okabe materialises here on the roof of Radio Kaikan, but Suzuha and the time machine do not. He arrives at the same time as he did after his first attempt, so is able to watch Nakabachi on the TV again, before the ambulance that Mayuri and Daru call for him arrives. Okabe's time travel completes a closed loop, where on the Steins Gate world line he travels back in time, saves Kurisu, then returns to the present. The evidence for this is that Kurisu remembers his actions, and the news reports a mystery stabbing victim who could not be found, so these events must have also happened on the current world line. In addition, Mayuri and Daru are only waiting for Okabe to return because they know he left; therefore Suzuha also appeared on this world line. However, from Mayuri and Daru's perspective Okabe only travelled to the past and returned once. We infer that their time with Suzuha was relatively short, and they did not experience Okabe returning from stabbing Kurisu or watching the video D-mail, so their understanding of events is limited.

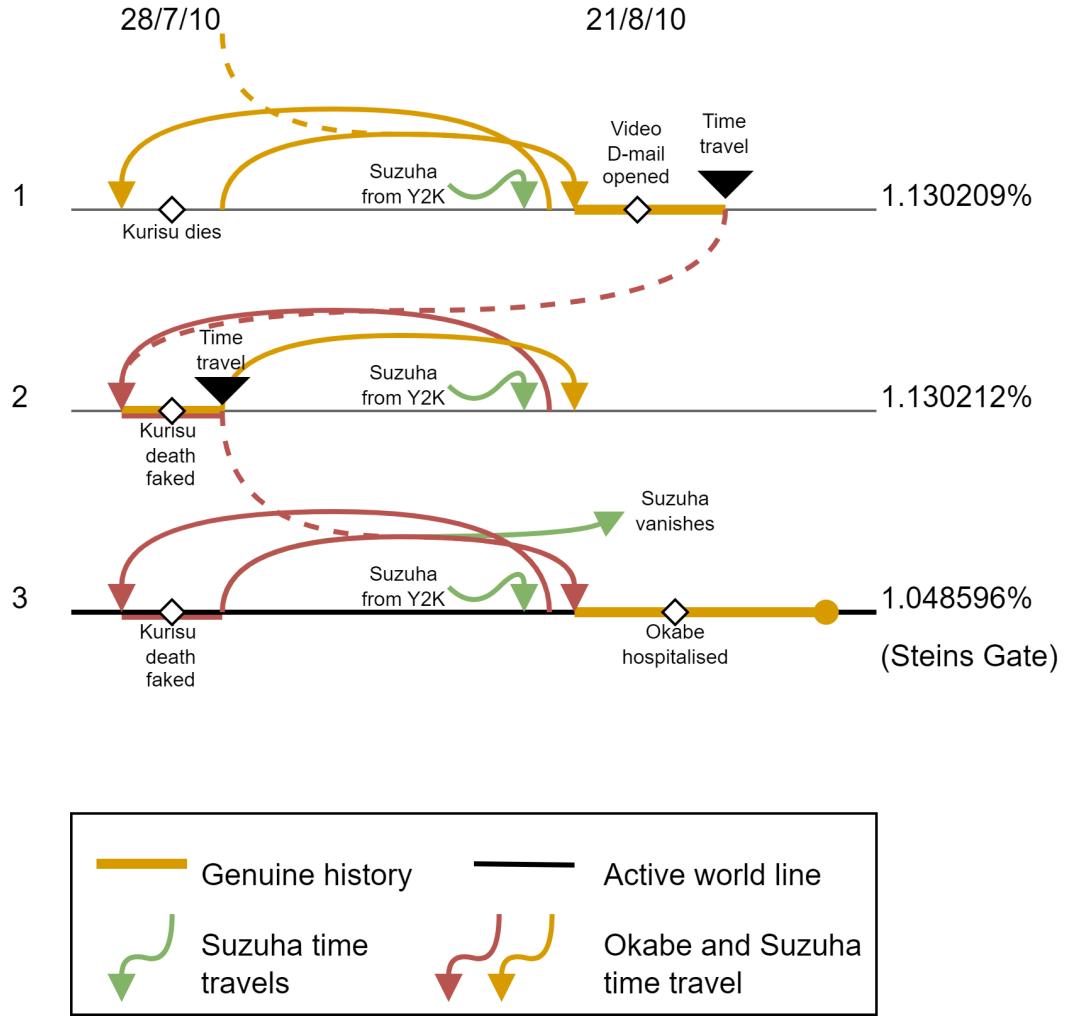


Figure 3.5: Operation Skuld is carried out. Step 1: Okabe receives the “turn on the TV” D-mail, then opens the video D-mail and learns the plan. Step 2: Okabe travels to the past a second time, overwriting his previous time travel loop with a new one. He takes the metal Upa, and fakes Kurisu’s death using his own blood. Step 3: Okabe returns to the future. During the travel, the thesis burns, so WW3 is prevented. Okabe’s return forms a loop, but Suuha’s cannot, so only he materialises.

What happened to Suzuha? From Okabe's perspective, she gradually disappears over the course of his return trip to the future (in the visual novel, her sprite is shown fading away), and never makes it onto the roof of Radio Kaikan.

“

Someone's warm hand holds mine. Tightly. Tightly.

[...]

The feeling of her grasping hand gradually fades.

”

Chapter 11, Steins;Gate

“

And right after we got back to August 21st... Right before my eyes, the time machine was enveloped in rainbow light, and disappeared. Suzuha disappeared along with her last smile. That was evidence. Proof that I had reached the Steins Gate. So, I shouldn't be sad that she disappeared.

”

Epilogue, Steins;Gate

This is something that Suzuha expected to happen. Okabe can complete a self-consistent loop by travelling to the future, but no such loop is possible for Suzuha. There is no reason for her to be present on the Steins Gate world line after 21/8/10, and the continuing presence of a time machine may even be contradictory, because it could risk sparking WW3. In our earlier terms, Beta Suzuha is no longer “supported” on the Steins Gate world line. So her fate is either to be directly erased by reconstruction, or to experience a convenient time machine malfunction that stops her materialising, depending on whether you view things from her perspective or that of someone on the Steins Gate world line.

“

[Suzuha]: “I don't plan to go back. If we reach the ‘Steins Gate’, then I'd no longer have a reason to time travel, right?”

“Cause and effect will be reconfigured. The me sitting here will disappear, since I'd probably be living peacefully in 2036.”

”

Chapter 11, Steins;Gate

It is worth stressing that Suzuha's actions in the past do still remain on the Steins Gate world line. She is just not permitted to settle down there. The completed loop by which Okabe saves Kurisu still includes Suzuha arriving, contacting the lab, and taking him to the past, all on the Steins Gate world line. Other actions such as patching Y2K, and posting as John Titor in the early 2000s, likely also still happen. (The Steins Gate world line is written to resemble our own world, after all.)

So contrary to the common misconception, the Steins Gate world line we finally arrive at is not free of time travel. However, it is largely stable, and no loose time machines remain in the present day. The future is not necessarily a peaceful happily-ever-after, but it is no longer guaranteed to be war or dystopia. Readers who wish to know more are encouraged to continue on their Science Adventure.

“

If you want more games, look beyond the gate.

I believe there is an unlimited beautiful world out there.

”

Cosmic Looper, Steins;Gate Elite

3.2 Epilogue of the Further Speculation

We have now reached the end of our account of the mechanics of Steins;Gate, and how they explain the major events of the story. In this section, we speculate on some of the minor remaining questions that do not have much impact on mechanics. Namely, the origin of the limitations of the Time Leap Machine, and the specific technology underlying the video D-mail.

3.2.1 Time Leap Limitations

There are two apparent limitations to the Time Leap Machine. First: Why are time leaps limited to 48 hours?

Prior to the development of the Time Leap Machine, there is a conversation about its function and potential risks. Kurisu points out that because it will only be transferring memory data and not “personality”, time leaps should only be sent to yourself, and potentially restricted to the recent versions of yourself who have the most similar brain structure.

“

[Kurisu]: “It’s not like personality is formed by just memories. That’s why, even if you send memories, everything still depends on the recipient’s consciousness and personality.”

[Daru]: “In terms of Mindorz, it’s like copy-pasting data from a VISTA computer to a 95 computer, huh?”

[Kurisu]: “The data created with the latest OS might not work on an older OS. It may be incompatible. So, for example, if you sent your current memories to yourself in elementary school, the gap between your memories and your body may cause a mental disability.”

”

Chapter 5, Steins;Gate

Then once the Time Leap Machine is completed, Kurisu apparently discovers a 48 hour limit to time leaping.

“

[Kurisu]: “This is just a prediction, but a single use of the Time Leap Machine can only bring you back 48 hours at the longest... I think”

[...]

[Okabe]: “So, why can I only leap 48 hours?”

[Kurisu]: “I don’t know. It’s not like I made the machine with a full understanding of its theory and structure. You can do consecutive leaps. As long as the Time Leap Machine exists, that is.”

”

Chapter 6, Steins;Gate

Taken at face value, this seems strange: how can Kurisu have “predicted” a 48 hour limit before she has seen any leaps take place, but also claim to not know why the limit is 48 hours? My view is that there are two misunderstandings here:

-
1. First, there may have been no time leaps yet, but the Time Leap Machine has actually already been operated. Recall that Kurisu required the Phonewave to be activated to make some “final adjustments” prior to its completion. I propose that this gave Kurisu data about how well the Time Leap Machine would function, from which she observed that 48 hours was the limit to safe transfer. (For example, she may have sent test data to the past and checked the integrity of what arrived.)
 2. Second, by “I don’t know” Kurisu probably does not mean that she has no idea why the Time Leap Machine would have a time limit in general. She has not forgotten about the requirement for similar brain structures. But she is likely surprised by how short the limit she measured is, compared to her earlier expectations. Kurisu supposes that there are technical details she is unaware of, either in the Machine’s construction or the rules of time travel, that would explain why the limit is specifically 48 hours.

In Steins;Gate 0, Maho is able to improve the Time Leap Machine to leap two weeks at a time. This confirms that the limitation was partially a result of the hardware setup. It may be that brain similarity is the ultimate determinant of how far a perfect time leap machine can be used to travel safely, but that using an imperfect machine reduces that limit, by sending flawed data that already differs slightly from the original.

For our second question: Why does time leaping not allow Okabe to create large world line shifts?

It seems that unlike D-mails or physical time machines, time leaping is very limited in which world lines it can arrive on. In particular, it cannot arrive on a world line with a divergence too different to the one it was sent from. Therefore the time leaper will find it hard to change their past, because to do so significantly would erase their presence as a time leaper. (They would be leaving their region of “support”, like in the final step of Figure 2.7.)

The canonical reason for time leaps not arriving on measurably different divergences is likely the same reasoning as the writers expressed in Section 2.2.4: that divergence fluctuation “increases with the length of the jump”, so a short jump can only cause minor divergence changes.

More speculatively, one could hypothesise about the effect of compressing the time leap data on one world line, then decompressing it on another. After all, we know that divergence expresses a difference in a property of gravity between world lines, and gravity is what was used to perform the data compression. Perhaps a time leap received on a significantly different divergence to the one it was sent from decompresses incorrectly, leading to its data being scrambled. Therefore its arrival on that world line would not be expected, because any brain-damaging effect it could have would be inconsistent with established events.

Decompression issues could potentially contribute to the 48 hour time leaping limit too. A larger leap would tend to allow a greater divergence change at its point of arrival, but this causes the arriving data to become increasingly scrambled. So the true reason for the Time Leap Machine's limitations may in fact be a combination of four factors:

1. The quality of the memory data sent. (Due to the brain scan hardware and the theory behind its encoding.)
2. How much the memory data degrades in transit. (Due to divergence changes affecting how much the decompressed version resembles the original.)
3. How compatible the memory data is with the recipient. (Due to brain structures constantly changing over time.)
4. The method used to overwrite the recipient. (Due to the capability of phone technology and the requirement for the process to happen in one short burst.)

3.2.2 Video D-mail Mechanics

The technology underpinning the video D-mail used in Operation Skuld is not specified in Steins;Gate, and its function is also only indirectly alluded to. Here, I propose a new theory to explain these.

Some helpful evidence is present in the untranslated novelisation “Enkan Rensa no Ouroboros”, which describes the video D-mail in more detail. We are told that it uses something called a “world line compression system”, and this means that the message arrives on many world lines, but is only viewable on one that satisfies certain criteria. On other world lines, the message appears as static.

Based on this, I propose that the video D-mail is actually a D-mail that has been compressed using a black hole, in the same way that a time leap would be. This allows it to circumvent the usual 36 byte limit of a D-mail. We know that after being sent to the past, black hole-compressed data automatically decompresses in the weaker gravity. However, each world line has a different divergence, which means a different gravitational strength. Suppose therefore that gravitational decompression acts differently depending on the world line, meaning the data ends up scrambled to some extent. (Which we also speculated to be the reason that a time leap cannot travel far from the divergence it was compressed in.)

The apparent breakthrough made with video D-mail technology is that the Future Gadget Lab has quantified the scrambling effect caused by compressing data from one world line and decompressing it on another. By processing the data prior to sending, in a way that counteracts the scrambling, they can create a message that appears clear on a specific target world line. The video remains scrambled everywhere else, with the effect being worse for greater divergence differences from the target. (Which is why the video displays as static on most Beta world lines, but has degraded to a random text string on Alpha world lines.)

The idea that the video D-mail may be targeted to a specific divergence value does have some evidence: The Valkyrie of the world line that sent the message (1.123581%) were able to accurately predict the divergence difference between the world line that Suzuha would meet Okabe on (1.130205%) and the Steins Gate world line (1.048596%), as evidenced by Suzuha knowing that value. It is therefore perfectly plausible that they could also know the divergence of the world line that would result from Okabe failing to save Kurisu once (1.130209%), and encrypt the mail to only be viewable there.

Why choose this specific world line? The “Okabe of the Future” needs our Okabe to understand the events of the past, and what it is that cannot be changed, in order for the plan to succeed. He also needs our Okabe to have a mindset that he can motivate. The solution he arrives at is to target his message at an Okabe exactly like his past self, who he knows and understands completely. By going through the same events, our Okabe becomes essentially the same as Future Okabe’s past self, and Future Okabe speaks to him as if they are one and the same.

“

[Future Okabe]: “Normally, if you just time traveled, you would be unable to save Kurisu. That’s why you had to fail once, to create cause and effect. Preparatory measures. Because you failed, I’ve been doing nothing but studying for these past 15 years.”

”

Chapter 11, Steins;Gate

The fact that the video D-mail automatically scrambles on all but the target world line is also why it can arrive on *every* world line. According to our mechanics, time travel arrives on world lines where it produces no new effects. So a message of static, which will never have a meaningful effect, can arrive anywhere. This also means that when sent, the video D-mail does not cause any measurable divergence shift.

The final subtlety to address, which (possibly) reveals how carefully plotted Steins Gate is, relates to an apparent problem with the arrival of the video D-mail on its target world line. Namely, what happens to the Okabe (of 1.130209%) who receives and checks the unlocked D-mail on 28/7? Won’t he take different actions to the other Okabes?

The solution is that actually, no version of Okabe watches the video for long enough to determine whether it is unlocked or not. We see him dismiss it as a prank after a few seconds, but the unscrambled video also starts with a few seconds of static. So even on the video D-mail’s target world line, the resident Okabe’s experience and actions are unchanged. We, as players, can open the static video again and wait as long as we like, but this is not an action that Okabe would take on his own. Suzuha’s knowledge of the D-mail is therefore absolutely essential to Operation Skuld, because without her Okabe would never check it a second time.

3.3 Examples II

There are a few more situations that we can explain now, using the mechanics and our more speculative rules.

3.3.1 Series Chronology II

We can suggest a speculative timeline of the Future Gadget Lab's technological progression through various iterations.

1. First iteration. The lab invents D-mail (and possibly time leaping). Daru builds a time machine for the first time. It is incomplete, so can only travel backwards in time, and is based on SERN's design.
2. Alpha attractor field iterations. The lab measures gravity differences between world lines for the first time. Okabe builds a meter to quantify the current divergence, on a world line he designates 0%. The boundary of the next attractor field is predicted to be at roughly 1% divergence.
3. First Beta iteration. Daru builds a complete time machine of his own design for the first time, which can travel forwards and backwards in time.
4. (Iterations in which Operation Arc Light is devised and carried out.)
5. Later Beta iteration. The lab combines D-mails with time leap data compression, to exceed the 36 byte limit in the form of a video D-mail. The message becomes static on all but its original divergence. Daru tests the technology by sending a message of encouragement to the Suzuha of the same world line, prior to her carrying out Operation Arc Light.
6. Later Beta iteration. The D-RINE is invented, which is a D-mail sent to Daru's own messaging app. They therefore avoid detection by ECHELON. Okabe sends himself a D-RINE to encourage his future iterations to deceive the world.
7. Penultimate Beta iteration. The video D-mail is upgraded to be made viewable on a chosen world line. The Lab calculates the attractor field boundary between Alpha and Beta to lie at 1.048596% divergence. The Operation Skuld video D-mail is sent from the 1.123581% world line, targeted at 1.130209%.
8. (Final iteration. Okabe receives the video D-mail and reaches Steins Gate.)

Note that what we label as “Beta iterations” do not necessarily stay in Beta for their whole length, but do begin and end there. The ordering of steps 5 and 6 is inferred from the existence of routes in the Steins;Gate 0 visual novel where Suzuha receives a video D-mail, but Okabe does not receive a D-RINE.

3.3.2 Mayuri's Ending

There are some interesting details in Mayuri's ending in the Steins Gate visual novel, which also occasionally lead to confusion.

To summarise, this is the ending that occurs when the player chooses the wrong way to respond to Kurisu's mails, meaning that Okabe does not experience certain events with Kurisu and forms a weaker bond with her. Then after returning to Beta, Okabe accepts Kurisu's death and starts a relationship with Mayuri. We see 21/8/10 pass, and Suzuha does not arrive from the future.

So why does Suzuha not turn up? How could Okabe's actions affect whether a time traveller, who was already travelling, turns up?

The key is that Mayuri's ending takes place on a different world line to the true ending, starting from the moment that Okabe deletes the ECHELON data. In the true ending, there is a shift from 0.571046% to 1.130205%, and Suzuha arrives on this world line. But in Mayuri's ending, the shift is from 0.571046% to 1.130238%, and this is a world line where Suzuha does not arrive (or at least does not make contact with Okabe).

There is a good reason for this difference. In the true ending, where Okabe has strongest bond with Kurisu, we hear that he deliberately avoids news of her death in case it can "decide" events.

“

Ever since I returned to this world line, I've intentionally avoided news of Kurisu's incident. I was afraid it would decide the result. So, at this point in time, I don't know who killed Kurisu. I don't know how or why she died. I don't know at all.

”

Chapter 11, Steins;Gate

But in Mayuri's ending, where Okabe has weakest bond with Kurisu, he accepts her death and reads about it in newspaper.

“

In place of news on the satellite crash, in the evening paper of 7/28, in the local section, in a small article...

It was mentioned that Makise Kurisu had been murdered.

”

Chapter 10 (Mayuri's ending), Steins;Gate

The latter Okabe can no longer deceive himself, because he has confirmed Kurisu's death. Therefore Operation Skuld is impossible on that world line, and there is no use in Suzuha visiting Okabe. (Possibly, the Suzuha with knowledge of Operation Skuld cannot even arrive on this world line without causing a contradiction.) The Okabe of the past must believe that Kurisu is dead all the way up to 21/8, otherwise he will not leave for the past with Suzuha on the Steins Gate world line, and the world cannot form the closed self-consistent loop that allows our Okabe to reach Steins Gate.

It is an exercise left to the reader to decide whether Kurisu's ending represents a third, separate conclusion for the visual novel. For this one, Okabe forms a moderate bond with Kurisu and the 1.130205% world line is reached, but it is unclear whether Suzuha arrives. Is Operation Skuld attempted post-game? Or does Okabe accidentally learn of Kurisu's death, killing the world's possibilities?

4 Misconceptions

4.1 Introduction

In this exciting bonus chapter, we address some common misconceptions about the mechanics of Steins;Gate. This chapter is not necessary to understand the rest of the guide, but does help to explain why common alternative theories are incorrect.

4.2 How World Lines are Created

There is a common misconception that world lines are something that is created by time travel. Many fan theories imagine a new world line as branching off the previous one, at the point that a D-mail arrives, for example, and the previous world line terminating immediately. This is certainly how timelines work in some time travel stories, but it is incorrect in Steins;Gate for a number of reasons:

1. World lines are based on the mechanics of the real-world “John Titor”, who used the term to refer to the worlds of many-worlds quantum mechanics. These are created when quantum events cause the world to diverge into multiple superposed states, not by time travel.
2. Suzuha confirms that the 2036 understanding of world lines is based on many-worlds quantum mechanics, such that world lines are possible worlds that exist in superposition. She tells Okabe that when he time leaps, he is arriving on a different world line that already existed, not creating a new one.
3. We see the active world line change without time travel taking place.
4. The in-game TIPS describe the events of world lines as being predetermined, not created after time travel.

-
5. The world is far more similar after world line shifts than would be expected if these were wholly new branching timelines.
 6. There is no explanation for convergence if world lines are not preexisting entities, other than it being magic plot convenience. On the other hand, convergence is perfectly understandable if world lines already exist.

(The relevant quotations to support points 1–4 can be found in Chapter 2.)

4.3 How Much Suzuha Knows

A particularly strange misconception relates to Suzuha. Often, people claim that Suzuha does not understand how time travel works, and point to various statements of hers that they claim are wrong. In reality though, Suzuha does understand time travel, being from a future where it is largely explained, and her statements in the story are accurate.

As far as I can tell, the origin of the belief that Suzuha is untrustworthy is not that she predicts things wrong in the story, but that what she says contradicts certain early fan theories about the mechanics. But let us look at the common things that Suzuha is supposedly “wrong” about, and see for ourselves.

4.3.1 Suzuha’s Original World Line

It is often bizarrely controversial to say that Alpha Suzuha is from the 0% world line. Suzuha tells Okabe this on three or more separate occasions (on @channel, by mail, then in person when showing him the divergence meter), and does so in multiple media sources (Steins;Gate, 8-bit ADV, Rebellion of the Missing Ring), but a section of fans insist that Suzuha is wrong here. They claim that Alpha Suzuha comes from the future of the current world line, or of the previous one, in line with their favoured fan theory. However, as pointed out in Chapter 2, the writers themselves have directly confirmed that Suzuha is from 0%. Any theories to the contrary are certainly wrong.

This argument is often accompanied by a misreading of certain lines about Suzuha experiencing divergence changes. When Suzuha shows Okabe the divergence meter for the first time, she says:

“

[Suzuha]: “Most likely, even if the displayed number were to change, only Okabe Rintarou would notice.”

”

Chapter 6, Steins;Gate

This makes reference to the fact that if something changes the world line, then everyone's memories will be reconstructed and Suzuha will believe she always landed on the new divergence value. (Which is exactly what does happen.) However, some people wrongly take this to mean that Suzuha did not see a divergence change when travelling back from 2036. In actuality, earlier Suzuha explicitly stated that she remembers the 0% world line as a result of time travellers retaining their memories.

“

[Titor]: I've confirmed that the current divergence value is 0.571015%. I cannot tell what the value was before you changed the past. The reason is because I, like your friends, have no memories of the world line before you changed the past. In the case of physical time travel, memories are conserved even if the world line changes. That's been proven by my very own experience.

”

Chapter 3, Steins;Gate

When Suzuha later describes the divergence meter, she is talking about the general situation of a world line shift, which she would not perceive, not the situation of her time travelling and being the cause of one.

Spin-off media (the Rebellion of the Missing Ring manga) also addresses this point, and suggests that Suzuha did not find the divergence meter stored in the time machine until after she arrived in 2010. Although its value did change in transit, she was not observing it at the time.

4.3.2 The Possibility of Paradoxes

Another strange criticism of Suzuha is that she occasionally refers to time “paradoxes”. Some claim that because the mechanics have a way to deal with paradoxes, Suzuha is automatically wrong if she ever suggests that a paradox could occur. However, this seems to be a misunderstanding of what the writers mean by a paradox in *Steins;Gate*. Since world lines are predetermined, any change to those events *is* a paradox (of the same severity as a grandfather paradox), and this is what triggers world line reconstruction.

“

[Titor]: When the world line changes, every cause and effect is reconstructed from past to future in order to prevent paradoxes. That theory was proven in 2036.

”

Chapter 2, Steins;Gate

So when Suzuha says that a paradox needs to be avoided, she is essentially saying that a major, undesirable world line shift needs to be avoided. For example, she is conscious that if she takes the wrong actions in 2010–11, she could prevent her own birth on that world line, triggering a shift to a world line where she does not exist in the future. Or when travelling to the past to save Kurisu:

“

[Suzuha]: “This is related to why I took away your phone, but the uncle Okarin of July 28th is also here, meaning there exist two Okabe Rintarous in this world. Okay? You must absolutely avoid contacting yourself. You can’t do that. You’ll create a time paradox.”

”

Chapter 11, Steins;Gate

Here, they are currently on a world line where the Okabe of the past did not directly meet his future self. Changing that history could potentially shift the world line to one where Okabe does not see Kurisu dead, so never time travels to save her, erasing the time travelling Okabe and Suzuha entirely. That possibility is definitely one to avoid.

4.3.3 Why Suzuha Disappears

Suzuha's disappearance after the successful Operation Skuld often gives rise to questions. However, Suzuha herself does correctly predict that she will vanish:

“

[Suzuha]: “I don’t plan to go back. If we reach the ‘Steins Gate’, then I’d no longer have a reason to time travel, right?”

“Cause and effect will be reconfigured. The me sitting here will disappear, since I’d probably be living peacefully in 2036.”

”

Chapter 11, Steins;Gate

Her explanation for why is also largely in line with the rest of the mechanics. (See Section 3.1.3.) She cannot remain on the Steins Gate world line because that would contradict its predetermined events (that there are no time travellers hanging around, and a new Suzuha will be living in 2036). So Suzuha’s disappearance here should not be too surprising, and happens for essentially the same reason that there is no Alpha Suzuha in the past after the world shifts back to Beta.

4.3.4 Deliberate Lies as John Titor

When posting online as John Titor, Suzuha reveals a lot of information about time travel and the future, but also mixes in lies to mislead organisations such as SERN.

“

[Suzuha]: “That was fake. Camouflage so that SERN wouldn’t target me. If I mix one lie into the truth, then the bad apple spoils the barrel.”

”

Chapter 6, Steins;Gate

Often, this is used to cast doubt on things that Suzuha says, which are actually true. For example, “Titor” is not lying while talking to Okabe in their direct mail conversations, as Suzuha mentions later.

“

[Okabe]: “Attractor fields’...”

[Suzuha]: “Correct. I told Okabe Rintarou directly by mail.”

”

Chapter 6, Steins;Gate

And certainly nothing that Suzuha says in person is deliberate misinformation either.

From an out-of-universe perspective, Suzuha’s lies as Titor are actually all things that the real-world John Titor said. The writers aimed to set Steins Gate in a world similar to ours, including having the famous self-proclaimed time traveller posting familiar claims on internet forums in the early 2000s. So where those claims differ from the plot they wanted to tell in Steins;Gate, the idea of them being misinformation is used to resolve any contradictions. A list of things Titor does lie about is:

- That the time machine is loaded on 1970 model Chevrolet.
- That many-worlds quantum mechanics describes the structure of the universe, in particular the idea of many worlds physically existing at once.
- That nothing will happen if you meet your past self.

All of these elements are also present in the real-world John Titor’s posts. In-story, they are explicitly admitted as being lies by Suzuha. The rest of what she says is true. We can be particularly confident that things claimed by only the Steins;Gate Titor (and not by the real-world Titor) are true, because these elements were deliberately inserted by the writers. (For example, Titor’s discussion of major present-day events shifting the world’s divergence value is new to Steins;Gate, and foreshadows the resolution of the Alpha Attractor Field portion of the story.)

4.4 Supposedly Complete Fan Theories

A number of fan theories exist that claim to offer a complete account of the rules of Steins;Gate. For example, [this one](#) is particularly highly rated. In this section I will be explaining why this theory is wrong. I am not picking on one particular theory to be

unkind, but because I have seen it suggested to newcomers as an objective explanation of the mechanics, which it is not. A lot of its ideas are also recycled in other wrong theories, so addressing them here will be an efficient use of time.

I will begin by summarising the rules of the theory, to the best of my understanding:

1. There is only one “world line”, which is the sequence of events that has happened. Time travel that alters the past creates a new world line, because it causes a new sequence of events to branch off from that point.
2. A world line will be within an “attractor field”, which forces certain events to happen. (“Convergence”.) The attractor field has a “cause”, which may seem quite separate from the events it affects.
3. There is another type of convergence that is “established”. It “starts to exist after an event that had a big impact on events happens once” and then affects any world line in the attractor field.
4. There are two ways to change world line: Time travel, which only alters events after the time travel arrives. Or preventing the cause of an attractor field, which causes the world to shift to a different attractor field, and reconstructs the entire world line.
5. There are attractor fields inside attractor fields. “Sub-attractor fields” explain present-day shifts shown in Steins;Gate 0.
6. There is a “ghost future” which remembers the events that last happened later than the present moment, as long as nothing in the past contradicts it. Time travellers can come from here, explaining some events in Steins;Gate 0.
7. When the world line changes, memories remain somewhere in the brain and can occasionally be remembered as “faint memories”. Okabe also has “Reading Steiner”, which is a similar but stronger effect where he retains all his memories upon a shift.

Readers will notice that these rules differ considerably from the ones set out in earlier chapters. Let us go through the problems with them in turn.

1. The idea that time travel creates the new world line is common in incorrect Steins;Gate theories, but wrong for the reasons set out in Chapter 2. Essentially,

this is trying to shoehorn Steins;Gate into the format of any other generic time travel story where going to the past alters the timeline, and misses the fact that John Titor’s mechanics are not like this at all. The philosophy that only the physical world matters makes the terminology of world lines entirely superfluous; they could be removed from this theory without affecting its content. However, in actuality many inactive world lines exist in superposition in Steins;Gate, and their properties have major effects on the mechanics.

2. The first effect of omitting inactive world lines from this theory is seen in how attractor fields have to be promoted to a fundamental object, with special convergence properties. (Rather than a human-made labelling.) Convergence is implemented as unexplained magic, because it has been separated from the real-life attractors on which it is based (which apply to large collections of systems evolving in parallel, as inactive world lines do).
3. This second type of convergence is not referenced in Steins;Gate, and is a creation of the theory’s author. They are possibly trying to explain why subsequent world lines are so similar despite their theory implying that the butterfly effect should make them different. (The real reason that world lines are similar is that many inactive world lines exist, and the next one to become active will be as similar as possible to the previous one.)
4. Because the author believes that only time travel can change divergence, they have a problem when divergence changes without time travel. They create a special type of world line shift when moving between attractor fields to paper over this crack.
5. ...Unfortunately for them, present-day divergence shifts also happen between world lines within a single attractor field. They invent the concept of smaller fundamental attractor fields within the bigger ones to “explain” this, rather than re-examining the assumptions that led to such a contrived situation.
6. The event of time travellers arriving from the future is also hard to make work in a physical-world-only model. With world lines that previously existed in an inactive state, time travellers can already be arriving, but this doesn’t work for the freshly minted world lines of their theory. Therefore the author begrudgingly adds something that acts like the predetermined future of the world line to their theory.

-
7. This final point seems as correct as we can know. (Whether déjà vu memories were always deep in a person's brain, or seep over from another world line or region, is hard to tell.)

As we see, the initial error in understanding what a world line is and how it is created leads to a cascade of further problems. These require increasingly contrived fixes and fan fiction additions to the rules that have no basis in the actual story. The end result is a theory full of different fundamental objects (world lines, absolute and established convergences, attractor fields), and principles at odds with each other (only the current timeline is real vs. people can arrive from the ghost future). This is why we began in Chapter 1 by setting out the real-world context, because it helps to avoid setting off in the wrong direction.

4.5 Hidden World Line Theories

There is one more fan theory that I would like to discuss. [This one](#) does things a little differently and is also well-regarded. Its innovation is treating time travel as an algorithm, which leads to a large number of “hidden” extra world lines appearing between the ones in the story. Once again, I do not mean to attack the creator, and in fact I find the precision and clear diagrams of this theory impressive. (I hope my own presentation can be as good as this!) However, it is still wrong.

My best attempt at a summary is:

1. There is one active world line. Time travel to the past changes that world line to a new one that is identical to the previous one up to the time travel's arrival, then evolves differently from the point of its arrival.
2. If a certain time travel event leads to more time travel, then this second event will always be a consequence when the first event happens. “Attractor fields” are proposed to be chains of events that result from one original cause in this way.
3. Because time travel creates a totally fresh world line, any time travel arrivals later than that point automatically no longer arrive. History must repeat up to the point that those time travellers are re-sent. For example, Luka's D-mail

arrives prior to Suzuha in 2000 and all the other D-mails, including the one about Kurisu, so removes them. History must repeat multiple times over a huge number of hidden world lines, in order for all the previous D-mails to be re-established in order.

4. If a time travel event does not prevent its re-sending, such that a loop would form, the world recognises this and has the time travel arrive on the next world line to exist instead.
5. If the cause of an attractor field is prevented, the attractor field “collapses”, and the world line shifts to the one that existed before the attractor field started.
6. Okabe’s “Reading Steiner” functions by taking a snapshot of his memory whenever a time travel event takes place. On the next world line, those memories replace his own when the present reaches that time again.

Our objections to these rules are as follows:

1. Again, it is a theory where time travel creates world lines, which is wrong. The author also states that they dislike the idea that events in the present are able to change divergence, and believes that there should be extra events in between to fix this, so the resulting mechanics are guaranteed to diverge from the actual story, in which present-day shifts are a key mechanic.
2. That the same chain of events will repeat if its cause is repeated on a new world line seems self-evident. But I am not sure how or why chains of causality are supposed to force certain events to be converged upon when the earlier causes differ, or when Okabe accumulates information about the future and therefore acts differently within that chain.
3. The number of hidden world lines introduced here is enormous, yet nothing appears in any Steins;Gate media to suggest their existence. They are thematically silly; every D-mail that arrives before the “Kurisu is dead” D-mail removes its existence, reverting the universe to almost its pre-Prologue Beta state, then every event and world line so far has to happen the same way again, for instance. (Surely this allows a “don’t send D-mails” D-mail to actually work, which it wouldn’t do in the real mechanics...) And all this looping gets the events of the story wrong anyway: Suzuha has to be “reestablished” as coming from 2036 multiple times, meaning she comes from the previous active world line’s divergence.

(But in reality, every Alpha Suzuha we see is the same one, from 0%.) The way that Suzuha's success or failure in 1975 changes is predicted incorrectly by hidden world lines, so rule 4 was introduced to fudge things. Hidden world lines also cannot explain the shift between Alpha and Beta, because by these rules both Alpha and Beta Suzuha should arrive in 1975 in sequence. Rule 5 is required to fudge this one.

4. The recognition that self-consistent loops necessitate a special rule of some sort is a good insight. The implementation of time travel that waits around for the next world line before arriving is very contrived and was selected because it happens to fix some bad predictions of the previous rules.
5. Finally, the theory discards its founding principle that divergence cannot change without time travel, because the previous rules have failed to predict the events of the story. So shifting attractor fields is allowed to be a special thing that does reconstruct the whole world line. Where previously there was a single linear chronology in the theory, the universe now also has to remember one world line in every single attractor field in case the world line shifts to there. (At this point, why not just accept that all the inactive world lines are predetermined and already exist? Why not have every shift be due to this "breaking a convergence" rule, instead of having an extra rule that only applies to backwards time travel?)
6. Reading Steiner seems to work here, and explains why our Okabe has no knowledge of any supposed hidden world lines. However, how it interacts with looping and attractor field collapse is incredibly complicated, chosen in an attempt to make the theory produce correct predictions.

Once again, we see that faulty initial assumptions about what a world line is, and how time travel should work, lead to a theory that cannot explain the events of the story. To the author's credit, they do acknowledge that certain rules are their own invention. However, the writers of Steins;Gate clearly have their own set of intended rules for the mechanics, and in my opinion understanding those is far more satisfying than creating a fan fiction that can be stated slightly more succinctly, but does not tell you anything reliable about the story itself.

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