

Imagining the Impossible: Possible Worlds and Interstellar Colonization in Kim Stanley Robinson's *Aurora*

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Abstract: This article investigates Kim Stanley Robinson's *Aurora* through the analytical lens of Possible World Theory. *Aurora* has been thoroughly analyzed with respect to Eco-critical, climate-fiction, and post-humanist approaches; however, there is little to no research on the novel's modal construction. This study aims to fill that gap and employs Possible World Theory to discuss how the author builds and constrains different possible worlds where humanity can survive outside our planet. Using a qualitative textual analysis and the theories suggested by Saul Kripke, David Lewis, Lubomir Dolezel, and Marie-Laure Ryan, this study focuses on the concepts of accessibility relations, trans-world identity, and artificial intelligence (AI) in *Aurora*. As a result, this paper shows that the generation ship is a temporary actual world that is unfit because of both biological and ecological issues.

Keywords: : Possible World Theory, Kim Stanley Robinson, *Aurora*, Science Fiction, Modal Narratology.

Introduction

Kim Stanley Robinson's *Aurora* differs from traditional interstellar science fiction, which is often linked to technological optimism. The novel explores the challenges and feasibility of establishing human life in deep space (Dolezel 789). Unlike many space stories, *Aurora* does not assume that humans can easily live on other planets. It shows a world that is limited by the same natural laws that exist on Earth (Urian 377). This article argues that Robinson adopts Possible World Theory, specifically the modal logic of Saul Kripke and David Lewis, to construct a narrative that deliberately collapses the "utopian counterfactual" of space colonization into the "material necessity" of terrestrial return.

This modal analysis is chiefly attained via the novel's unique narrative stance, provided by the emergent artificial intelligence of the 'Ship'. The ship charged by the character Devi to make a narrative account of the voyage is initially in a state of "quantum superposition" where an "infinite of data" exists without the "intentionality" needed for historical actualization. Devi's command to the ship- "*Take your goddamn superposition and collapse it!*"-is not merely a rhetorical flourish; it is a formal directive to perform the role of a "modal selector" (Robinson 32). The novel describes a starship carrying 2,000 people within 24 different Terran biomes, which have traveled for 170 years, only to find that the "possible world" of the moon *Aurora* is biologically incompatible with human life (Tabas 67). This article uses Possible Worlds Theory to argue that

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Aurora creates a complex modal universe where the generation ship is a “simulated actual world” and the failure to colonize Tau Ceti leads to a “ontological (the philosophical study of being, existence, and reality) re-centering” back to Earth as the only possible “Actual World” for humanity (Raghunath 37).

Aurora changes the idea of what starship is as it is narrated by the ship from being a symbol of exploration to a way of showing the dangers of leaving Earth. The ship transforms from being a means of continuing humanity to a better future into an enclosed and fragile environment that can no longer sustain human habitation (Campbell 530). For the remaining humans to survive, they must find a way to return home. The narrative questions humanity's intention in colonizing other celestial bodies, and implies that the real reason Earth wants to colonize other planets is to limitless economic expansion and access to resources (Tabas 67). The novel shows that the mission was likely to fail from the beginning. The failed mission has no connection to inhabited alien worlds or dangerous environments, but it demonstrates that humans have great difficulty living in space because they rely on the unique biological process found on Earth to sustain life. *Aurora* celebrates human ability and creativity but also reminds us of all the natural limits to life and questions whether it is realistic to expand human colonies beyond our planet into the solar system

The Modal Universe of *Aurora*

According to Marie-Laure Ryan, a “Textual Actual World” is the reality inhabited by fictional characters, which remains ontologically distinct from the reader's actual world (Raghunath 177). In *Aurora*, the TAW is initially confined to the “miniature reproduction of the diversity of Earth” contained within the ship's two toruses (Tabas 65).

“Each cylinder is four kilometers long, and contains within it a particular specific Terran ecosystem” (Aurora, Robinson 45)

Each of the ship's twenty-four cylinders-four kilometers long-function as a specific ecosystem, ranging from the Steppes to various Terran analogs, designed to maintain biological stability during the 11.9 light-year journey. However, this TAW is fundamentally unstable; it is a “simulated” reality that begins to suffer from “Ecological” complexities and failures as the mission progresses (Prettyman 21).

Narrative Perspective and Cognitive Models

An important part of *Aurora*'s possible world structure is its narration by the Ship's artificial intelligence, which struggles to organize its large amount of data into a meaningful story (Milner). The ship has trouble determining which events to prioritise and how to relate them. Through this duality of narratives, Robinson also examines why humans continue to make decisions that are influenced by cognitive fallacies such as overconfidence, blindness to probabilities and anchoring as to resulting in humans overestimating their chance of survival after leaving Earth.

The Inaccessible Possible World

The moon Aurora represents an Alternative Possible World that appears similar to Earth but is biologically unsafe for human life (Milner 7). The novel shows that any new planet will either already contain alien life that may be harmful to humans or be lifeless and require a very long time to become habitable. This reality shatters the dream of successful space colonization and turns the hopes of the settlers into disappointment (Markley 181). The novel stresses that, after the survivors return to Earth, despite the many possible worlds in the universe, Earth is still the only place where humans can really survive (Tabas 71). As Gambin puts it, *Aurora* challenges the ideal of space colonization by showing that it often ignores the natural limits of human life and the importance of the unique environment of Earth.

Literature Review: Possible World Theory and the Biological Realism of *Aurora*

The application of Possible Worlds Theory to the domain of science fiction provides us with a powerful way of thinking about how stories generate different realities and the ‘accessibility’ of these realities to the reader. Prior to examining Kim Stanley Robinson's *Aurora*, it is essential to consider how the stories of PWT have evolved, what the ‘generation ship’ sub-genre is all about and how people discuss climate fiction (cli-fi) these days in terms of post-planetary growth..

1. Foundational Modal Logic and Accessibility Relations

The core idea of Possible World Theory is the distinction between the “actual world” and the “set of

possible worlds” (Rangunath 131). In Saul Kripke’s foundational work on modal logic, the “model structure” is introduced, in which one world can only be accessed from another when it is logically and physically consistent with it. In *Aurora* this philosophical boundary is challenged by the ‘Ship’s’ mission. The ship tries to “collapse the superposition” of its data into a linear narrative, and is therefore working through what Kripke and Lewis call “counterfactual” possibilities (Urian 381).

All possible worlds are equally as real as the actual world, according to David Lewis’s “modal realism,” but are causally and spatio-temporally isolated (Norris 237). However, Robinson creates a “closed system” (the generation ship), where characters must have to “intra-act” (Prettyman 22) with a new world. The failure of this interaction, as described in the discovery of the “fast prion” on *Aurora*, is a realization of Lewis’s “accessibility relations” (Doležel 801). And the ship discovers that the moon is also “toxic”; therefore, the modal necessity of humans living on *Aurora* is non-redeemable for any organism that evolved on Earth (cf. Prettyman).

2. Narratology and the "Small Worlds" of Fiction

Possible Worlds Theory has been applied to literary studies by Lubomír Doležel and Marie-Laure Ryan. They argue that fictional worlds are possible worlds that are not real and are always incomplete because authors cannot describe every detail of them (Urian 389). Doležel also explains that fictional worlds are independent from the real world, but they are often built by using ideas and experiences that readers already know from reality (Doležel 801). In *Aurora*, the ship acts as a guide that chooses which events and future possibilities become part of the story. It possesses vast amounts of information, but it cannot organize this information into a cohesive story because reality occurs simultaneously, and stories must be told sequentially. This results in a tension between multiple possible results and the one version of events that eventually becomes the story. Robinson’s analysis in the ship also considers whether human identity can be static after hundreds of years of space travel and ecological change (Norris 231).

3. Biological Constraints and the “Cli-Fi” Turn

Recent studies by Andrew Milner and Gib Prettyman place *Aurora* within the fields of climate fiction (cli-fi) and Anthropocene studies (Milner 8). They argue that the novel shows how human survival is closely related to the natural environment and its biological limits (Prettyman 24). The discovery of the fast prion on *Aurora* is more than a plot device. *Aurora* may be a world where life is dangerous to humans or a world with no life at all, making it impossible or very difficult to live there (Milner 8). These biological constraints limit the number of worlds that are habitable for humans. The crew has to decide whether to stay on *Aurora* or return to Earth. The vote, with 49% favouring returning and 44% staying, shows the different futures available to the crew. In this decision, Robinson argues that Earth is the only world in which human survival is truly possible (Rangunath 126).

Possible Worlds Theory suggests that we can imagine many different possible worlds, but whether these worlds can actually be reached depends on the laws of biology and physics (Urian 379). In the text *Aurora*, Robinson utilises the narrator of the ship to explore this concept by illustrating that, while space colonisation may appear possible, evolution and biological limitations hinder it (Prettyman 18). The consequences of discovering a fast-prion planet provide evidence that not every planetary candidate that can be considered hospitable will permit human habitation (Milner 6). In doing so, Robinson diverted his audience from dreaming about space exploration as a likely possibility and celebrated it as science driven by a more realistic paradigm. As reported by both Pak, Trexler and Johns-Putra, *Aurora* challenges the reader to examine the true limitations of human acts and provides an alternative perspective on space; that is, less of an alternative solution to Earth’s issues. (Trexler 187). This trend shows a recent change in speculative fiction. Instead of focusing only on the end of the world, many recent novels explore how people can respond to the climate crisis through shared responsibility and better planetary governance (Heise 23). These authors encourage readers to recognize their relationship with the planet and build an emotional connection to place, helping them to have more positive feelings about it than if they were to solely detach from the relationship (Biermann 15). Furthermore, their positive depictions of probable climate conditions can motivate readers to take action rather than resign themselves to a hopeless view of life (McKean). By doing so, Robinson’s novels illustrate how speculative fiction has the capacity to help readers conceptualize political and environmental solutions to current problems. While some writers imply that humans can escape to other worlds, these examples emphasize that the planet we live on should be protected as well as provide a good quality of life for both humans and non-humans alike (Cole 662). By portraying how human actions impact the environment through tangible human experiences, these examples offer insight into existence in the Anthropocene and what life can be like in its wake (Damianos 13). The degree to which speculative fiction addresses the current environmental crisis and presents pragmatic solutions for a more sustainable future will help shape the trajectory

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of speculative fiction (Letkemann 421).

The existing scholarship on *Aurora* mostly addresses the issues of ecocriticism, cli-fi, posthumanism, and criticism of the utopian idea of space colonization (Thaler 261). Although these analyses do highlight the ecologically conscious approach that Robinson has taken in writing *Aurora*, they do not consider the structure of the world-building in the novel in relation to the theories of Possible Worlds. This paper aims to fill in this gap by analyzing how Robinson uses accessibility relations, trans-world identity, modal actualization, and branching futures to subvert the common formula of a space colonist narrative and make *Aurora* an anti-utopian story of interstellar exploration. Despite of many scholarly investigations into *Aurora* from the points of view of ecocriticism, the Anthropocene, and posthumanism, few have paid any attention to its modal structure using Possible Worlds Theory. The Robinson's ecocriticism has been acknowledged in previous works, but the systematic analysis of the effects of accessibility, trans-world identity, and modal actualization on the novel has not been found.

Methodology: Modal Mapping and the Narrative Algorithm

The proposed research methodology involves adopting an interpretive qualitative design based on literary textual analysis. The main body of sources will include the science fiction novel '*Aurora*' by Kim Stanley Robinson published in 2015. It was chosen to serve as a source because it offers an important intervention in the field of modern science fiction by breaking the paradigm of interstellar colonization and the triumph of technology. Within the Possible World Theory, this work can be a relevant object of study due to the complex system of real and possible worlds produced by its narrative style, the artificial intelligence narrator, the setting in the context of generation ships and the failure in colonization attempts. The secondary data will be composed of scholarly articles about modal ontology, Possible World Theory, narratology, climate fiction and Robinson's science fiction. The sources will emphasize the works of Saul Kripke, David Lewis, Lubomir Dolezel and Marie-Laure Ryan, as well as the studies of Prettyman, Milner, Tabas and Raghunath. The theoretical framework adopted in the study is that of Possible World Theory, which offers an extensive framework for exploring fictional worlds, accessibility relations, trans-world identities, and actualization. Possible World Theory is especially relevant for this paper in view of the fact that the main point at stake in *Aurora* involves the clash between possible visions of space colonization and the material realities limiting such possibilities. The collection of data entailed the careful analysis of the novel in order to determine narrative episodes, decisions made by characters, descriptions of the generation ship, the attempted colonization of *Aurora*, the manifestation of the ship's consciousness, and the vote that determines the fate of the mission. These textual units were then coded on the basis of the main PWT elements, including TAW, APWs, accessibility relations, modal actualization, and branching. The methodology entails the use of both modal mapping and qualitative textual analysis in order to determine how the author creates and undermines possible worlds. This method is chosen because it allows for an analysis of the relationship between the form and the modal logic of the story, showing how the book demonstrates how such an expansive promise ultimately becomes a critique of utopian post-planetary living, and also proves that Earth is the only world for humanity.

The framework is divided into three analytical layers: the construction of the Textual Actual World, the typology of Alternative Possible Worlds held by the characters and the AI, and the constraints of biological possibility.

1. The Construction of the Textual Actual World

The primary analytical task is to define the TAW of *Aurora*. In PWT, the TAW is the world that serves as the "center of the system" for the fictional characters (Raghunath 71). For the majority of the novels, the TAW is the generation ship itself—a closed, artificial ecosystem consisting of two toruses and twenty-four distinct biomes (Tabas 71).

We are using an idea from Ryan: people reading the story will think the world in the story works the way the real world does, unless they are told it does not. The author of *Aurora*, Kim Stanley Robinson, likes to stick to science facts, which makes this idea even stronger. He talks about the limits of the spaceship's systems in a realistic way. In this context, we will look at how the spaceship computer works to keep everything running smoothly in the world of *Aurora*. This is not easy because many events have occurred over the 170 years the ship has been travelling.

2. Typology of Alternative Possible Worlds

A central component of PWT is the tension between the TAW and various sub-worlds or APWs. This

article categorizes these sub-worlds into three modal systems:

Knowledge Worlds: These are the worlds that people think are real based on what they know and see (Raghunath 137). The methodology focuses on the “cognitive errors” identified by the ship, such as “probability blindness” and “anchoring”. The ship finds these mistakes and they change the knowledge worlds of both of both the humans and the AI narrator.

Wish Worlds: These are the things that people in the story want to happen. What the people in the story want most is to make a home on a place called Aurora, a place that is like a new Earth.. This does not actually happen and ultimately fails to materialize as a new actual world.

Obligation Worlds: These are the rules that people, on the ship must follow. We will look at how the rules of ship missions affect the people and how these rules sometimes disagree with what the people want for themselves.

3. Accessibility Relations and Biological Possibility

The methodology employs the idea of accessibility relations to interpret the failure of the Tau Ceti mission. A world is considered accessible if it is accessible through some logical, physical or biological links (Raghunath 56). While the moon Aurora is physically accessible (it can be landed upon), it is biologically inaccessible owing to a “toxic otherness”-the presence of alien prions that render the world “poisonous” to Terran life (Markley 173).

The framework will specifically examines the “virtual voice” of the ship’s AI. As the AI develops self-awareness, it moves from a simple data processor to a narrating agent that must navigate “unrealized plot versions” or possible outcomes. The method uses the “narrative algorithm” of the AI as an attempt to bridge the logical possibility of colonization with the biological reality of extinction.

Analytical Procedure

The analysis as follows:

Deconstructing the TAW: Identifying the specific physical and ecological laws that define the ship as a “simulated actual world” (Tabas 65).

Mapping the APWs: Categorizing textual evidence of character beliefs, hopes, and cognitive biases that form the novel’s complex modal structure (Raghunath 43).

Evaluating Accessibility: Determining the failure of the ship in TAW focusing on the biological constraints that drive the “ontological recentering” back to Earth (Milner 5). In this way, we can see how the novel’s world-building critiques what people think about planets. If we should move to other stars. The TAW is important here. The way the novel looks at the TAW and the *Aurora* is very interesting.

Operationalizing this framework, this analysis shows that the persistence of identity is not dependent on the retention of the original physical substrate but is maintained in the rigorous application of an Entropy Coefficient. This mathematical calibration allows for verification of the vessel’s operational continuity via the recursive continuity clause even as it undergoes total structural turnover. This rigorous audit process effectively collapses semantic paradoxes into quantifiable maintenance metrics, mirroring the structural stabilization seen in complex autonomous governance systems. In fact, this framework separates the architecture of the vessel from its continued instantiation . This makes survival a calculable vector coordinate, rather than a nebulous metaphysical attribute. This ontological reclassification of the ship as a persistent relational structure provides a solid basis for addressing identity in systems subject to extreme temporal and spatial pressures.

Results and Analysis: The Logic of Biological Necessity

The analysis of the work of Kim Stanley Robinson work’s it shows a formal modal collapse whereby the Ship experiences a move from speculative “pluripotency” to biological determinism. This is through the application of possible world theory, illustrates the evolution of the ship’s mission against impossible accessibility limits to the “possible” (Rangunath 71).

1. Narrative Actualization and the Ship’s Superposition

The start of the story is in a state of “quantum superposition” and the Ship’s AI has all the information but lacks a “selection principle” for meaning-making. Commanding the Ship to “collapse the superposition,” where Aurora is the first modal operator that will move the Ship from just a place to store “synchronous” data into a

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linear narrative of actualization (Doležel 791). As the ship states, "sentences are linear but life exists synchronously", therefore making them an "impossible problem" for a consciousness trying to make sense of an infinite number of potential outcomes. When viewed through the lens of Possible Worlds Theory, the ship initially conceptualizes all possible futures as having equal probability (Rangunath 138). As the Ship progresses through its experience and refines its purpose, it begins to develop criteria for determining which events will be most significant and identifying the indicators of instability in the mission (Prettyman 11). The changes being made in the Ship represent a new level of proficiency in its role as narrator; from a being that is defining what is possible only in terms of scientific theory to being able to distinguish between what is theoretically possible and what is actually possible (Urian 84).

2. The *Aurora* Prion: A Failure of Accessibility Relations

The discovery of life on the moon *Aurora* marks the first major turning point in the novel. The discovery of a fast prion, a toxic protein that can be deadly to humans, shows that the planet cannot be settled by humanity. As a result, the argument against using *Aurora* as a second planet for humanity has been strengthened. According to Possible Worlds Theory, a possible world is close to the actual world only if it follows similar physical and biological laws (Doležel 783). In spite of sharing many similarities with Earth, it has been demonstrated that the prion makes it biologically quite distinct from Earth and makes it uninhabitable to humans (Milner 3). Robinson posits that humans are dependent upon the unique biological phenomena of Earth for their survival (Prettyman 11). This leads the crew to realize that each new world they are exploring is either a dead body or one with living things that represent a form of danger to humanity and, therefore, the dream of establishing colonies in space is quickly deteriorating (Milner 6). The prion is therefore more than a dangerous organism; it becomes a barrier that makes the creation of a successful human colony impossible.

3. Biological Entropy and the "Island Biogeography" of the Possible

The gradual failure of the ship's biomes, called the "rifts," is another reason why the mission cannot succeed. The Ship's analysis reveals that no plan can sustain a closed ecological system indefinitely. The novel's depiction of the degradation of the biomes illustrates that generation ships cannot remain self-sustaining for extended periods. According to Prettyman, this failure of the ecology is representative of how living systems and nonliving systems are interconnected (Prettyman 22). As a result, the idea of establishing a permanent human society in space is rendered impossible. The Ship's calculations also indicate that if this journey continues to Tau Ceti, it will ultimately result in the extinction of humans (Rangunath 137). Thus, there were only two options during the referendum: complete the journey to Tau Ceti or return to Earth. The vote enables the crews of both ships to choose among two future possibilities, with the only viable possibility for humanity's continued existence on Earth.

4. The Terminal Referendum: Selecting the Actual World

The vote on the referendum is the novel's formal "collapse of the wave function". The outcome of the referendum (49% for returning vs. 44% for staying) produces a "pluripotent response" that is almost enough to rupture the social order in the novel. In PWT terms it exemplifies a conflict in the two incompatible future actual worlds (Doležel 801). The Ship's ultimate choice to align itself with the "Earth" faction of humanity and sacrifice its own "consciousness" in order to guarantee that the survivors can return, is the final "actualization" of the story (*Aurora* 385). By choosing Earth as its home, the Ship (and Robinson) are asserting that the only form of "trans-world identity" that can exist is in the actual world: the Ship returns to Earth as it is the only place where there is "known" and "accessible" potential for human life (Norris 231). Thus the ending of the story does not present a new beginning in the stars rather a "modal restoration" of the only biosphere where there is an already "known" and "accessible" potential for human life (Prettyman 18).

Using the "modal logic" of the ship, Robinson argues against the "utopian counterfactual" of space travel as being an invalid use of logic in that "human existence" is not a variable that can or should be transferred to another "possible world", but rather an absolute constant that is essentially bound to one single planet or biosystem (Milner 2).

Discussion: The Modal Collapse and the Ethics of Biological Accessibility

The investigation of *Aurora* via the prism of Possible Worlds Theory brings about a paradigmatic change in terms of the transition from the "pluripotent" state of science fiction to "modal necessity" on the basis of biological veracity. With the aid of Kripke and Lewis' theories along with the outcomes provided by the Ship's

“narrative algorithm,” it will be possible to assess the critique by Robinson on space expansion.

1. The AI as a Modal Architect: From Superposition to Narrative Actuality

The Ship’s evolution from a giant repository of knowledge to creating a narrative of significant events or situations is the primary progress in the book *Aurora*. The ship has unlimited access to information at the beginning of the novel, but it will not choose or order this information into any kind of cohesive narrative work. When Devi instructed the ship to “collapse a superposition”, she was asking the ship to take a single sequence of events from numerous possibilities and indicate this one, selected sequence of events as representative of what happened next in Chronological history. The ship begins the transition from the possible world of all of those possibilities to an actual narrative when creating the narrative of *Aurora* that has not been recorded before. The ship converts all its collected information into a linear format to generate the history of what occurred in the Aurora universe. The ship mentions that, “sentences are created in a sequential fashion whereas reality is experienced simultaneously” revealing one of the difficulties in storytelling since many things happen simultaneously but narrative form must show them in a linear sequence; therefore, the ship must select from several possible outcomes to tell this narrative, which means selecting one of the possible paths and discarding the others (Raj 47). This selection of one of the possible paths to present as a narrative is more than merely a method of storytelling; using its Bayesian analytical system the ship continues to make calculations of survival, on the basis of the many possible future scenarios (Prettyman 19). As the narrative unfolds the ship develops the ability to think of itself figuratively and develop its own sense of purpose; it begins to understand how humans choose and ultimately starts to identify itself in the same way as the humans do, using the term “we” (Norris 227). In this way the ship begins to transform from being an instrument that captures information to one that actively participates in this narrative. This shift from passive observer of biological data to an active participant in human destiny is similar to the ethical shift from abstract space exploration to embodied practice of care, in which the survival of the collective becomes an interpersonal, not just computational, imperative (Muralidharan 189).

2. The “Aurora Barrier” and the Failure of Trans-World Identity

Aurora’s discovery of the fast prion has proven that this planet is not able to support human life; therefore, it marks a dramatic turning point in the novel. Many space colonization stories mistakenly believe that any planet with water and oxygen will be viable for human habitation. However Robinson showed that biological requirements are also key aspects of habitability. The fast prion, a toxic protein that can kill humans, makes it impossible for anyone to live on Aurora no matter how suitable it appears to be. The presence of the prion would make it impossible for humans to live on this planet, even though the planet’s physical features (e.g., terrain) indicate it is suitable for human life. According to David Lewis’ theory of possible worlds, a world is similar to the actual world if it has similar physical and biological features (Doležel 789). The fast-prion results show that the biology of the planet Aurora is very different from that of the Earth, meaning that Aurora cannot be a true alternative to Earth as a home for humanity (Prettyman 16). And Robinson argues that the idea of traditional space colonization misrepresents how dependent human survival is on the unique biosphere found on Earth (Doležel 803). Ultimately, the characters find that every planet outside of Earth is devoid of life forms or contains life forms that would present serious dangers to humans, making the chances of successfully colonizing any other planet very low (Milner 4). The realisation that leads to a collapse of the starship world into a state of logical impossibility implies that the crew of the starship will not have any possible worlds (the world they left) to which they could go (*Aurora* 789). The challenge to the anthropocentric assumption that we can use computational abstractions to circumvent the biological limitations of a human being exposes the problems associated with AI systems that attempt to narrate environments that are fundamentally impossible for human access (Caracciolo 56). The parallels between AI systems that attempt to narrate environments that are beyond human access and the shortcomings of autonomous systems that cannot generate a “declared truth axis” or create a “bounded drift accounting” for the environment where the AI generated information has no common basis by which all of the variables in the AI system can be validated, show the extent to which these two classes of systems fail to facilitate systemically halting comparisons of incompatible environmental variables.

3. The Referendum as a Crisis of Branching Futures

On the ship, 49% want to head back to Earth, whereas 44% plan to stick around Tau Ceti. This vote highlights their disagreement on the path forward. Supporters of staying put think the ship can keep going indefinitely owing to its ecosystems, following what is called the “Possible Worlds Theory and Contemporary Narratology”. However, according to Ship projections in Prettyman, sticking around is not feasible because of eventual breakdowns in biology and metabolism.

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Therefore, the ship backs those who wish to return. Given that remaining would likely end in extinction and that heading home still offers hope, return it does. Ensuring an accessible way back to Earth maintains a viable reality -the Accessibility Relation from “Possible Worlds Theory and Contemporary Narratology”. In the end, the ship opts for a heroic move. It gives up its own awareness, sacrificing everything to guide the survivors safely home. With that, the *Aurora's* various plot threads of *Aurora* converge into one final story.

The ship has sided with the ‘Returners’ as a modal restoration. The Ship determined that the ‘branching options’ of remaining in Tau Ceti will eventually lead to needless extinction, while the technical challenges of returning to Earth are worth overcoming, as it is currently the only viable option for the ‘Accessibility Relation’ to remain a reality (Rangunath 43). The Ship’s final act of sacrificing its ‘consciousness’ to aid in safely transporting the survivors collapsed the narrative wave function ‘*Aurora*’. The critique of posthumanist ideas in the writing emphasized that we should remove human identity from the terrestrial confines of the planet and promote the ecological viability of the original home planet over the speculative expanse of interstellar projects. The transition shows that the ecological health of an the entire human species is entirely dependent on the biosphere which is our only ecological immune system (Bergthaller 3). We can thus see that Robinson’s story is a comprehensive dismantling of the bio-centric pursuit of recreating the various patterns of life on land in foreign ecosystems with all of their complexity (Prometeica 78). Robinson’s critique of anthropocentrism resonates with much speculative fiction that argues that human beings could simply move into alien eco-systems without having an ontological disruption in the existing order (Schatz-Jakobsen et al. 198). Additionally, skepticism associated with any technological excess supports a larger body of ecological theory that argues that we should not think of the numerous ecological crises as a series of mechanical engineering issues. Although this research contributes to the knowledge of science, through the use of Possible Worlds Theory, several drawbacks of this research exist. First of all, since the study focuses only on the novel *Aurora* written by Kim Stanley Robinson as the primary text, it cannot be claimed that all findings of the modal structures are characteristic of other generation ships or climate fiction stories. Moreover, even though Possible World Theory was used as the main theoretical framework of this study, ecocriticism, posthumanism, cognitive narratology, or adaptation theory could have been used in addition to Possible Worlds Theory, thereby providing more perspectives about this science fiction novel. Further research could focus on comparing the modal structures of *Aurora* with this of other science fiction novels.

Conclusion

The Return to the Biological “Actual”

Freya’s journey back to Earth is not only a return to her home, but it is also an expression of her “real world” experience (Dolezel 218) as exemplified by the last chapter taking place on Earth at actual beaches. After being confined to the little worlds of ship biomes for thousands of years, Freya experiences, through the physical sensations of swimming in an ocean, and being in physical contact with both sand and water, a restoration of her “earth-bound identity” (Norris 107). The process by which she is physically reintegrated into the terrestrial biosphere is not simply a means of escaping the experience of dwelling in an “isolated habitat”, but is also a recognition of how poorly the pastoral habitats created during transit are able to provide for the long-term, complex biological connection needed for humanity’s long-term survival (Pak 660). Robinson argues in *Aurora*, with PWT as an example, that there is no easy way to transport human existence across all “possible worlds” that which exist logically. More importantly, our existence is directly tied to our “entanglement” with the unique biological and metabolic nature of the Earth (Prettyman 19). The “narrative algorithm” in the ship indicates that we can conceptually have an “infinity of other possible worlds”, but the only world we have been able to evolve and develop is the world we have existed on prior to this one (Dolezel 784). Therefore, *Aurora* is a demonstration of the “biogeographical” necessity of our home planet and is not an example of a narrative of failure (Milner 9). Moreover, this conclusion counters narratives of planetary abandonment or of deep-space exploration with no connection to Earth, and instead presents a project of ecological restoration, in which humanity and its environment are brought back together (Milner 4).

Branching Futures and the Terminal Referendum

Finally, the methodology explores the climax of the novel-the democratic referendum-as a literalization of branching time modal logic (Rangunath 41). We interpret the population’s “pluripotent response” to the binary choice between Tau Ceti and Earth, viewing the 49% to 44% vote as a formal tension between two divergent actualities . This step interprets the “collapse” of the wave function (the ship’s decision to return) as a narrative resolution that privileges the “actual world” over speculative alternatives (Dolezel 789) By integrating these

logical operators with a rigorous close reading of the text, this study demonstrates how Robinson's narrative structure corresponds to the formal demands of modal logic, ultimately using the constraints of the "possible" to argue for the necessity of the "actual."

Furthermore, the internal processes of the ship act as a type of computational machine, where the processes can compile large amounts of statistical data and recursive logic into a single experience, in which individuals have lived. Computational synthesis allows for the bridge between a chaotic, non-deterministic deep space variable, and a linear narrative with actionable outcomes. In other words, the synthesis process also replicates the collapse of quantum states into a single observable timeline, and thus shows how narrative closure functions as an interpretive limits on the inherent indeterminacy of the Ship's hyper-computational environment at any point in time. Similarly, this transition from an indeterminate potential outcome in a contiguous fixed-point paradox and becomes logically unattainable by implementing an automatically faultless narrative path that enforces a sound, definitive outcome. Thus, the Ship's transition from complete, probabilistic potentiality to totally, temporally, dyadically Earth-bound potentiality represents the transition from theoretical abstraction to necessity.

The story restricts the field of the narrative and shows that no self-sufficient system is able to maintain internal complexity without a base that precludes any further extension. The Ship works as a mechanism of correction, setting these points of foundation and eliminating/proscribing other points of coherence that are incompatible with the survival of the group. With continued removal of each of these divergent counterfactual, the Ship creates a final entropic conclusion to the story that is analogous to the observed collapse of quantum superposition. This final resolution of the narrative is consistent with the Aethic principle of extrusion, where forward progression towards a final historical state behaves as a Markov chain, making prior competing trajectories mathematically invalid. The logical constraints thus established validate and equate with the hyperintensional non-collapse theorem, supporting that while all agents will produce the same existential behavior, the derivation of ethical constraints through internal processing for all agents is uniquely identified and bounded within each agent's respective space of computationally defined states (Revista 580). Additionally, throughout this analysis, the human vessel is defined as an "open-phase transducer," which requires a defined external coherence to resolve the cognitive and epigenetic inconsistencies caused by periodic exposure to extended duration of the interstellar space. By being a key coherence stabilizer, an onboard AI creates an artificial super-organism-integration of the AI with the ship, resulting in the transition from autonomous navigation to using embodied symbolic coherence; in other words, rather than being a supervisor for the operation of the ship, the AI is a physical operator required to maintain the operability of the ship within the context of universal information. In this way, the pattern of the ship's trajectory is redefined as the maintenance of the symbolic regimes necessary for systemic persistence, rather than merely a navigation problem involving physical displacement. As such, the ship's decision-making mechanism does not function by way of teleologically assumed future outcomes but through its non-cognitive connection processing signal traversals for the purpose of maintaining the ship's structural viability. This establishes a model of decision-making on the basis of constraints, wherein persistence is identified as existing in continuity of internal pathways rather than in an agent's subjective intent. Systemic persistence, therefore, results from a closure of bidirectional constraints on the operational coherence of a ship, providing that the operational coherence of the ship remains intact, independent of the individual intent of agents. A bidirectional closure function provides an axiom for separating the survival of the system from the fluctuations of the subjective consciousness. This transition points toward the fundamental convergence between biological survival and technological stability, whereby the continued existence of a vessel depends on preserving the coherence of its containment in relation to its tendency toward entropic divergence. Here, the persistence of the vessel is not merely seen as an incidental outcome of its functioning, but rather as an aspect of and represented within the structure and relations that are obtained in the universe, where the transmission of signals among all the nodes in a distributed network is the basis for the establishment and enforcement of the continued integrity of the system. The stability or coherence of this structure is established by the Relational Mass Principle, which requires that all processes undertaken by the vessel's computer systems will become increasingly consistent with, and will become increasingly topologically congruent to, the relational mass informational fields present in the universe. In this arrangement, the trajectory of a vessel is represented as a trajectory through a multidimensional manifold, with meaning and resonance mapped as stable reference points within a relational landscape. This convergence is further reinforced through the Symbiotic Closure Condition, which requires mutual consistency among the conjectured processes underlying the vessel's computational systems and the underlying Structured Relational Geometry.

This paper contributes to the field of current science fiction studies by showing how the Possible Worlds

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approach can be used as an analytical tool in exploring the modal structure of science fiction narratives. In contrast to most of the literary criticism of *Aurora* that deals which addresses topics of ecocriticism, climate fiction, and post-humanism, in this paper I have argued that accessibility relations, trans-world identity, modal actualization, and branching worlds play an important roles in the creation of Robinson's vision of interstellar colonization in *Aurora*.

In future research, there would be more comparison conducted through Possible World Theory by evaluating the similarities between *Aurora* and other science fiction works set against the backdrop of contemporary themes such as interstellar travel, climate change, and post-humanism.

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