

When Science Meets Literature: Reframing George Orwell's *Animal Farm* with Four Quantum Concepts

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Abstract

This paper pioneers the application of Quantum Narratives, a novel theoretical framework inspired by quantum mechanics, to George Orwell's *Animal Farm*. Drawing on such quantum concepts as uncertainty, entanglement, superposition, and wave-particle duality, the study reveals the underlying meanings within the text's coexisting narratives and paradoxical realities. Unlike traditional literary analyses, which often fail to capture the novella's multifaceted nature, the paper employs a meticulous close reading methodology to scrutinize the text with a precision akin to examining the subatomic world. The findings reveal that, like quantum particles, the narrative elements in *Animal Farm* exhibit indeterminacy, interconnectedness, and the coexistence of multiple realities. This approach not only deepens our understanding of the novella's timeless themes but also contributes to the growing debate on interdisciplinary methods in literary criticism. Therefore, by spanning the gap between quantum mechanics and literary analysis, the study opens new paths of investigation into complex works of literature.

Keywords: *Animal Farm*, George Orwell, Interdisciplinary Studies, Literary Criticism, Quantum Narratives.

Introduction

Orwell's *Animal Farm*, a timeless allegory of revolution and its subversion, continues to resonate with readers as a scathing critique of power structures (Ghimire 2021). Its enduring impact lies in its ability to expose the complexities of power dynamics through the seemingly simple lens of a farmyard rebellion. While existing scholarship has dissected the text from various perspectives (Fajrina 2016; Dai 2020; Xiao 2022; Rodden 2003), a fresh approach can uncover additional insights into the novella. This study proposes a novel lens: Quantum Narratives. By drawing on concepts such as uncertainty, entanglement, superposition, and wave-particle duality, we aim to bridge this gap and explain the hidden dimensions of power dynamics in the novella. Building on the rhetorical theory of narrative, Yousef

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(2023) highlights the interconnectedness of critical theories and underscores how each element within a text relates to the others. Similarly, this analysis draws from quantum physics to reveal how Orwell's characters and narrative details function as interwoven parts of a complex whole. This interdisciplinary framework allows us to better understand the complex systems of power and revolution that Orwell explores.

Orwell's mid-20th-century novella is more than a superficial tale about a rebellion in a farmyard. Under the simple farmyard setting lies a rich constellation of allegorical motifs and sociopolitical insights. Scholars such as McBeath (2014), Muico (2022), and Ghimire (2021) have argued that *Animal Farm* offers significant potential for ongoing investigation and analysis. While the existing body of literary criticism is undoubtedly rich, traditional approaches may not fully capture the text's complex nature and its enduring psychological impact. This paper proposes Quantum Narratives, an innovative framework that taps into the "world of infinite possibilities" of quantum mechanics and "meaningful symmetries between modern science and the humanities" (Oppermann 2015, 102) to investigate the complexities of power, revolution, and the erosion of ideals in the novella.

At first glance, quantum mechanics, the study of matter and energy at the atomic and subatomic levels, might seem far removed from literary analysis (David 2015). However, this study reveals surprising parallels between these seemingly disparate fields. As Bohnenkamp makes the point, "Physics and literature are intertwined and incestuous." According to him, "both posit hypothetical worlds. Both are judged at times by their degree of verisimilitude to what we regard as the real world" (Bohnenkamp 1989, 20). Therefore, by making use of the principles of quantum mechanics, we can uncover hidden meanings within Orwell's text. For instance, the principle of uncertainty reflects the characters' constant struggle with doubt and the ever-shifting realities of the farmyard. Entanglement highlights how the characters' actions trigger a chain reaction of interconnected events that bind their fates. Superposition suggests the possibility of coexisting storylines and paradoxical realities, which challenges linear interpretations of the revolution's trajectory. Finally, wave-particle duality sheds light on the complex nature of leadership and individual agency within the animal society. Therefore, this interdisciplinary approach not only enriches our understanding of the novella's timeless themes but also aligns with quantum theory's tendency to "shatter the stark Cartesian division between mind and world" and promote deeper dialogues between science and the humanities (Oppermann 2015, 95).

On the other hand, although we examine *Animal Farm* through the lens of quantum mechanics, we retain the methods of close reading that are traditionally associated with formalism and New Criticism, while highlighting the intrinsic features of the text such as structure, language, and paradoxes. As Brooks (1947) argues, literature often thrives on internal contradictions, an idea closely related to the quantum notions of duality and uncertainty explored in the paper. However, by incorporating concepts such as superposition and wave-particle duality, this analysis goes beyond traditional formalist frameworks, and proposes an innovative reading that places Orwell's novella within a scientific paradigm. This approach not only highlights Orwell's exploration of truth, revolution and power, but also brings new interpretive depth by linking literary and scientific discourses. Therefore, the paper paves the way for a new era of

scholarly inquiry, one that embraces interdisciplinary exploration and pushes the boundaries of traditional literary analysis.

2. Literature Review

Animal Farm has been analyzed through various established critical frameworks, each offering insightful perspectives. For instance, New Historicism has explored the relationship between the novella and the historical events that shaped it to demonstrate how the narrative reflects the political climate of its time (Xiao 2022). Marxist analysis has been employed to examine the work's portrayal of power dynamics and class struggle (Rodden 2003). Biographical readings have shed light on the personal experiences and political views that influenced Orwell's writing (Rodden 2003). Historical contextualization has provided a deeper understanding of the text's allegorical references to real-world events (Rodden 2003). Satirical critique has been used to uncover the militaristic themes in the story and highlight the use of animals as a metaphor for human behavior (Muico 2022).

While these critical frameworks have undeniably enriched our understanding of the novella's narrative construction, a closer examination reveals that they have limitations in fully addressing its thematic depth. These approaches often struggle to capture the text's inherent complexities and the complex nature of power dynamics within the animal society. Therefore, a more nuanced exploration is necessary to fully grasp the richness and enduring relevance of Orwell's masterpiece.

One prominent lens through which the novella has been investigated is Marxism. Scholars like Masofa (2015) and Saoudi et al. (2022) explore the novella's depiction of class conflict and oppression. Masofa examines how characters represent social classes, while Saoudi et al. examine the struggle between the upper and lower classes. Although scrutinizing the socioeconomic aspects of the story and drawing parallels to historical revolutions offer valuable insights into Orwell's critique of totalitarianism, the Marxist perspective still has limitations. Critics argue it oversimplifies the complexities of the story and reduces it to a simple binary class struggle (Siahaan 2018). Afolayan and Ibitoye (2011) contend it neglects other important elements like character development and broader themes of power and corruption. Additionally, Siegel (1986) criticizes its deterministic view of history, which may not account for the complexities of the plot and characters.

A significant portion of traditional analyses centers on the political allegory embedded in *Animal Farm*. Critics dissect Orwell's satirical portrayal of historical events, particularly the Russian Revolution of 1917. In their respective studies for instance, He (2023) and Fajrina (2016) both highlight the novella's critique of the Soviet Union. He (2023) emphasizes the role of human inferiority in the ultimate destruction of the farm, while Fajrina (2016) draws direct comparisons between the characters in the novella and the Soviet leaders. Therefore, this approach investigates political ideologies and totalitarian regimes, thus offers insights into Orwell's critique of the abuse of power and the betrayal of revolutionary ideals.

However, focusing solely on historical parallels can limit the narrative's scope. As Cobb (2018) argues, allegorical works, whether on screen or in writing, risk becoming overly reliant on specific

historical references. This can limit their ability to resonate with people across cultures and time periods. Political allegory in the novella can be further enriched by exploring its broader implications. For instance, Ismail Kadare's work (Gould 2012) demonstrates how allegory can critique the very concept of sovereignty, not just specific regimes. Therefore, while political allegory exposes the abuse of power and the perils of revolution, it is crucial to consider its potential for wider societal critiques beyond specific historical contexts.

Another prevalent traditional approach involves examining the novella within the context of Orwell's life and political convictions. The proponents of this approach explore the autobiographical elements present in the narrative. They draw connections between characters and events in the novella and Orwell's experiences fighting in the Spanish Civil War, alongside his subsequent disillusionment with socialist movements (Dickstein 2007). This disillusionment is reflected clearly in *Animal Farm*, where the pigs' betrayal of the other animals echoes Orwell's perception of the Soviet Union's abandonment of the Republican cause in Spain (Rae 2009). Therefore, by uncovering the personal motivations and ideological evolution of the author, this approach enriches our understanding of the nuances present in the novella. However, the risk lies in the potential reduction of the novella to a mere reflection of Orwell's convictions. This could lead to overlooking the broader significance embedded within the allegorical structure of the work.

Traditional analyses of Orwell's *Animal Farm* have also focused on its historical context, particularly the mid-20th-century socio-political climate, and its influence on the author's ideological stance (Turberfield 2012; Xiao 2022). While this analytical approach provides valuable insights, it may oversimplify the narrative by neglecting the novella's literary and thematic complexity (Charan 2019). In other words, Orwell's personal experiences and observations of contemporary events are crucial to understanding the genesis of the novella, but a balanced approach that integrates historical insights with literary interpretation is necessary to fully appreciate its richness and complexity (Cole 2017).

Last but not least, *Animal Farm* is recognized for its satirical elements, and traditional critical interpretations have extensively analyzed the work's satirical aspects to uncover and explain the nuanced layers of irony and humor that Orwell employs. Scholars have focused on how these elements reveal hidden weaknesses in prevailing political systems and reveal flaws in human behavior itself (Jasim and Aziz 2013, Dai 2020; Kemit and Hendar 2022). Such readings often emphasize how the novella uses humor and irony to deliver a message of social and political critique. Although examining *Animal Farm* through the lens of satire is valuable, focusing solely on this aspect risks overlooking its complex and multifaceted nature.

In a nutshell, valuable as they are, traditional literary approaches may not fully capture the complexities inherent in the novella. To address this gap, this study proposes a novel approach inspired by quantum mechanics: Quantum Narratives. This framework acknowledges the co-existence of multiple interpretations within a text (Grinbaum 2017). Just as quantum mechanics posits the possibility of particles existing in multiple states simultaneously, Quantum Narratives suggests that literary works can hold multiple valid interpretations. This approach is particularly suited to *Animal Farm*, a text rife with

When Science Meets Literature: Reframing George Orwell's *Animal Farm* with Four Quantum Concepts

paradoxes and ambiguities. Through the lens of Quantum Narratives, the story reveals its potential for multiple readings. In this way, this approach allows us to explore the coexisting possibilities within the narrative, such as the revolution's idealistic beginnings existing alongside its descent into tyranny. This juxtaposition unlocks a deeper understanding of the text's inherent complexities.

3. Theoretical Framework: Quantum Narratives

This study pioneers the application of Quantum Narratives, a theoretical framework inspired by the foundational principles of quantum mechanics, to the analysis of Orwell's *Animal Farm*. Quantum mechanics, a cornerstone of modern physics, has revolutionized our understanding of the behavior of matter and energy at atomic and subatomic levels (David 2015). By introducing groundbreaking concepts such as superposition, entanglement, wave-particle duality, and the uncertainty principle, quantum mechanics challenges the simplistic view of the universe as a predictable and linear system and reveals a far more complex reality with inherent uncertainties (Brandt and Dahmen 2012). Despite its seemingly paradoxical aspects, quantum mechanics has been widely applied and significantly contributed to our understanding of the physical world (McEvoy and Zarate 2014).

3.1 *The Principle of Uncertainty*

One cornerstone of Quantum Narratives is the principle of uncertainty. Borrowing from Heisenberg's Uncertainty Principle (1958), which dismantled the notion of classical determinism, Quantum Narratives posits that, similar to quantum particles, narrative elements can exist in a state of indeterminacy until solidified by the act of storytelling (Pospiech 2000). This inherent fluidity in plot developments, character motivations, and thematic interpretations fosters depth and complexity within narratives (Pospiech 2000). Mirroring the indeterminate state of quantum particles, this ambiguity invites readers to engage in a dynamic dialogue with the text and to navigate its complexities and unresolved elements (Gurukkal 2019).

3.2 *Entanglement*

Another critical concept in Quantum Narratives is entanglement (Vidal et al., 2003). Just as quantum mechanics posits the interconnectedness of particles regardless of spatial separation, Quantum Narratives proposes that narrative elements are strongly interconnected (Zeilinger 1998). Narrative elements, such as characters, plotlines, and themes become entangled, and each one of them influences and shapes the course of the others in unexpected ways. This interconnectedness mirrors the phenomenon where altering one entangled particle instantaneously affects its counterpart (Zeilinger 1998). Within a Quantum Narrative, developments in a single aspect of the story resonate throughout the entire narrative, thus create a cohesive and unified whole.

3.3 *Superposition*

Furthermore, Quantum Narratives draws upon the concept of superposition, the ability of particles to exist in multiple states simultaneously. Within the framework of Quantum Narratives, superposition

opens up a vast space of narrative potential, where multiple storylines coexist (Chiribella and Kristjánsson 2019; Rubino et al. 2021). Superposition disrupts traditional storytelling, allowing characters to explore divergent paths and alternate realities. This provides readers with a view into a multiverse of narrative possibilities. By embracing superposition, Quantum Narratives challenges traditional linear storytelling. It encourages both authors and readers to explore many narrative possibilities beyond a single path (Tegmark and Wheeler 2001).

3.4 Wave-Particle Duality

Finally, Quantum Narratives finds resonance with the concept of wave-particle duality (Shimony 1988; Teller 1996). Just as particles exhibit both wave-like and particle-like behavior, Quantum Narratives asserts that narratives can be flexible and multidimensional. They may oscillate between different storytelling modes and blend elements of realism, surrealism, and metafiction to create a dynamic and fluid narrative landscape (Pratt 2003). This approach goes beyond conventional boundaries to reflect the way particles defy categorization in the quantum world. Narratives within the Quantum Narratives framework embrace ambiguity and fluidity to reflect the inherent uncertainties of the quantum world. However, the lack of a universally agreed-upon interpretation of quantum physics emphasizes the complexity and ongoing exploration of these concepts (Frank 2015).

The application of Quantum Narratives to *Animal Farm* holds particular promise due to the text's inherent paradoxical nature and richness in allegorical symbolism (Abass 2021). The narrative defies straightforward categorization because it includes elements of social commentary, political satire, and cautionary fable. Quantum Narratives provides an analytical tool to navigate the simultaneous existence of multiple allegorical layers, divergent interpretations, and shifting power dynamics within the text. Viewing the novella through the lens of Quantum Narratives allows for a more nuanced interpretation of its complexities (Rodden 2003). The evolving commandments, dynamic character interactions, and portrayal of farm animals gain additional depth when analyzed through this framework. Quantum Narratives not only transcends the confines of traditional linear analyses but also facilitates a comprehensive understanding of the multifaceted layers embedded in Orwell's masterpiece (Arifriarni 2021; Muico 2022).

4. Methodology

This research breaks away from traditional literary analysis. It employs a novel approach to elucidate the complexities of Orwell's *Animal Farm*. Through the innovative lens of Quantum Narratives, we delve deeper into the text to uncover the coexistence of varied interpretations and contradictory realities.

4.1 Data Collection

The cornerstone of this analysis lies in a meticulous close reading of the novella. We approach the text with the precision of a scientist examining the subatomic world. Each sentence and scene is carefully dissected, scrutinized for its potential connection to the core concepts of uncertainty, entanglement,

When Science Meets Literature: Reframing George Orwell's *Animal Farm* with Four Quantum Concepts

superposition, and wave-particle duality in Quantum Narratives. Particular focus is placed on passages that embody ambiguity, paradox, and shifting realities.

For instance, we analyze the pigs' shifting vocabulary after the revolution. Their language exposes the contradictory narratives of freedom and control that co-exist. Similarly, we scrutinize passages that depict the animals' internal conflicts and the ever-changing nature of their world. Through this granular data collection process, we gather the textual evidence necessary to demonstrate the novella's inherent uncertainty, entangled narratives, superimposed realities, and the wave-particle duality of power dynamics.

4.2 Data Analysis

Following the comprehensive close reading, a thematic analysis is conducted. This process involves identifying recurrent patterns, themes, and motifs within the text. Here, the focus shifts to meticulously mapping how the concepts of uncertainty, entanglement, superposition, and wave-particle duality manifest within the narrative.

For example, we analyze how the animals' initial hope for equality coexists alongside their eventual subjugation under the leadership of the pigs. Further analysis explores how the concept of freedom transforms from a shared ideal to a privilege reserved for the ruling class. Thematic analysis serves as our key tool to dissect the interwoven narratives in the novella. This approach allows us to expose the deeper layers of complexity hidden within the story.

4.3 Contribution and Originality

The originality of this research lies in its pioneering application of quantum mechanics to literary criticism. By drawing parallels between quantum principles and narrative structures, this study challenges conventional methodologies and opens new avenues for exploring literary texts. This novel approach not only enriches our interpretation of *Animal Farm* but also sets a precedent for future interdisciplinary studies and demonstrates the transformative potential of combining science and literature.

5. Findings

Traditionally, *Animal Farm* is perceived as a straightforward allegory. However, this innovative analysis unlocks a hidden dimension. Through the lens of quantum mechanics, we explore unexpected parallels to four key principles: uncertainty, entanglement, superposition, and wave-particle duality. These connections provide a fresh critical lens for understanding the complexities of power dynamics, the shifting ideologies, and the very essence of humanity that Orwell portrays. We will investigate each concept in detail and use excerpts from the novella to illustrate how these scientific principles manifest in the story and shape its developments, characters, and interpretations.

5.1 The Grip of Uncertainty on *Animal Farm*

This section explores how the concept of quantum uncertainty, characterized by the inherent indeterminacy of a system's state, illuminates the pervasive ambiguity within Orwell's novella. In *Animal*

Farm, the atmosphere of uncertainty reflects the constant manipulation and ambiguity that clouds the animals' understanding of their reality. Just as "all physicists agree on the mysteriousness, invisibility, and inaccessibility of the quantum realm and have likened it to a kind of flux, fog, or buzz" (Coale 2012, 13), the power dynamics on the farm are similarly enshrouded in a fog of uncertainty, where truth is constantly reshaped to serve those in power.

In her analysis of Suzanne Collins's *The Hunger Games*, Yousef (2023, 1068) argues that "the dystopian image of fear and the postmodern atmosphere of uncertainty reflect on the rhetorical aspects of the novel and consequently enhance our reading and understanding of the text." Similarly, the uncertainty in *Animal Farm* heightens readers' awareness of the fluid and unstable political environment within the story. This pervasive uncertainty shapes not only the plot's development but also the characters' motives and the interpretations of the story's core themes.

Quantum mechanics introduces the concept of uncertainty, where the exact state of a system cannot be precisely determined until it is observed. This probabilistic nature can be likened to the unpredictable changes in the farm's rules and power structures, which reflects the fluid and unstable political environment. A prime example of this uncertainty lies in the gradual alteration of the Seven Commandments, the moral backbone of the farm. Initially, these commandments stand as steadfast pillars of Animalism, thus represent ideals of equality and justice. This conviction is clear in their rallying cry: "All animals are equal!" (Orwell 1945, 30).

However, as the pigs consolidate power, the commandments undergo subtle changes. This manipulation reflects the uncertain and dynamic nature of authority on the farm. Woolf's project of "using concepts drawn from physics to destabilize fixed models of identity is one that she shares with contemporary popular science writers" (Livingstone, 2018, p. 67), and in *Animal Farm*, Orwell similarly destabilizes notions of equality and justice by showing how easily ideals are manipulated. The cornerstone commandment, "All animals are equal," transforms into the Orwellian paradox: "All animals are equal, but some animals are more equal than others" (Orwell 1945, 126). This revision reflects the pigs' manipulation of language to legitimize their burgeoning hierarchy and subvert the revolution's foundational principles.

Napoleon's rise to power, and the gradual rewriting of history, introduces uncertainty into the animals' perception of reality. The animals cannot be sure of what is real or what has been altered through propaganda, much like the uncertainty principle, where the more you know about one property, the less you can know about another:

Napoleon, with the dogs following him, now mounted on to the raised portion of the floor where Major had previously stood to deliver his speech. He announced that from now on the Sunday-morning Meetings would come to an end. They were unnecessary, he said, and wasted time. In future, all questions relating to the working of the farm would be settled by a special committee of pigs, presided over by himself. These would meet in private and afterwards communicate their decisions to the others. The animals would still assemble on Sunday mornings to salute the

When Science Meets Literature: Reframing George Orwell's *Animal Farm*
with Four Quantum Concepts

flag, sing 'Beasts of England,' and receive their orders for the week; but there would be no more debates (Orwell 1945, 65).

In quantum mechanics, the uncertainty principle holds that certain pairs of properties—like position and momentum—cannot be precisely known at the same time. This limitation of knowledge translates to Orwell's novella, where Napoleon's manipulation of power creates an atmosphere of pervasive uncertainty, leaving the animals unable to grasp a stable reality. When "Napoleon, with the dogs following him [...] announced that from now on the Sunday-morning Meetings would come to an end", he effectively removes the animals' last avenue for transparency and open discussion. The decision to replace collective debate with closed meetings among the pigs introduces an imbalance in information, where the animals are increasingly kept in the dark about critical decisions affecting their lives.

This suppression of knowledge generates a powerful form of uncertainty, as the animals are left questioning the nature of their own reality. Like the Uncertainty Principle, where knowledge of one property obscures the other, Napoleon's control of information means that animals can only see fragments of the truth, enough to understand their orders, but never enough to understand the larger power dynamics at play. With no way to verify the truth or voice dissent, the animals are forced to accept a reality shaped entirely by Napoleon's regime, further deepening their dependence on and vulnerability to manipulation. This imposed uncertainty dismantles their grasp on the past and future, making them malleable to the pigs' agenda and trapping them in a cycle of obedience and doubt.

Orwell emphasizes the pigs' manipulation through the animals' faulty memory. Their misremembering of the Fifth Commandment about alcohol consumption, "they had thought the Fifth Commandment was 'No animal shall drink alcohol,' but there were two words that they had forgotten" (Orwell 1945, 106), exposes the pigs' effective control of information and the subsequent uncertainty clouding the animals' perceptions. This maneuver is a microcosm of the pigs' establishment of hegemony on the farm. By rewriting the commandments, they employ a combination of cooptation (securing the animals' consent) and coercion (maintaining control through force) to solidify their power (Arifriarni 2021).

The pigs' strategy in the novella aligns with the Italian Marxist theorist Antonio Gramsci's concept of hegemony. According to Gramsci (1971), the ruling class maintains dominance not only through physical coercion but also by subtly shaping the dominant ideology and worldview. This ideological control makes the ruling class's position seem natural and unquestionable. In *Animal Farm*, the pigs, as the new ruling class, demonstrate this through their manipulation of memory and information. By rewriting the commandments, the core tenets of the rebellion, and controlling the flow of information, the pigs keep the other animals disoriented and unable to challenge their authority. As Stone argues, "total war did not lead to a total state [...] In politics, there are no wholly good options – only shades of evil" (Stone 2016, 225-6). Orwell emphasizes this moral ambiguity through the pigs' actions, showing how power can corrupt even noble causes.

Uncertainty breeds distrust. Therefore, the animals become unsure of whom to believe as allegiances shift and betrayals become commonplace. Initially, the animals are united by a hope for equality and

freedom. Snowball's expulsion serves as a prime illustration of this growing fracturing. Ousted by Napoleon, who prioritizes brute force and personal gain, the animals are forced to choose sides based on fear or uncertainty about the future. As Huifang and Chenglian (2021) note, the shifting allegiances and betrayals among the animals create an atmosphere of mistrust and uncertainty on the farm. Characters like Snowball, who initially embody the spirit of revolution, are later branded as traitors by Napoleon: "Snowball was in league with Jones from the very start" (Orwell 1945, 48). This accusation, much like the act of observing a particle, sows confusion and division among the animals.

Even the most dedicated animals become shrouded in doubt due to the shifting power dynamics and arbitrary rule. Boxer, the epitome of loyalty and hard work, like a particle's position and momentum in quantum mechanics, illustrates this growing uncertainty. A hint of sadness tinges his voice as he repeats the mandated slogan, "Comrade Napoleon is always right" (Orwell 1945, 118). The forced repetition betrays a flicker of doubt, a stark contrast to his earlier unwavering faith. The pigs' arbitrary exercise of power fosters a pervasive atmosphere of mistrust. The animals, constantly anxious, are no longer able to distinguish truth from manipulation. Stripped of their autonomy, they live in a state of perpetual uncertainty, always afraid of the next betrayal that could shatter their fragile sense of security. Just like scientists deal with the inherent probabilistic nature of quantum mechanics, the animals can never be truly certain of anything.

The pervasive uncertainty ultimately leads to the erosion of individuality among the animals. Critical thinking and independent thought are discouraged and replaced by blind obedience to the pigs' pronouncements. "The electron, which takes on a specific position once observed, reflects the reduction of [an indeterminate, pluralistic state] to a singular identity" (Livingstone, 2018, p. 71). In a similar manner, the pigs' regime transforms the animals from distinct beings into a homogenous mass, aligning them with a single, dictated reality under the guise of Animalism's principles. This chilling effect, which mirrors the Heisenberg uncertainty principle in quantum mechanics, is evident in the sheep's mindless chanting of "Four legs good, two legs bad!" (Orwell 1945, 49) throughout the novella. Their unwavering support, regardless of the situation, demonstrates the pigs' success in turning the animals into a homogenous mass, easily manipulated for their own gain. Orwell illustrates the insidious nature of propaganda through the animals' vulnerability to manipulation. As Boxer reflects, consumed by self-doubt, "I do not understand it. I would not have believed that such things could happen on our farm. It must be due to some fault in ourselves" (Orwell 1945, 88). This internal struggle lays bare the tragic erosion of individuality under the pigs' oppressive regime.

By the novella's conclusion, uncertainty has become the defining characteristic of life on the farm. The animals are left perpetually questioning their reality, unable to trust their own memories or perceptions. In contrast, the pigs revel in the power this uncertainty grants them. As Orwell depicts, the farm becomes indistinguishable from its former state under Mr. Jones: "The creatures outside looked from pig to man, and from man to pig, and from pig to man again; but already it was impossible to say which was which" (Orwell 1945, 131). The haunting image of the animals gazing from man to pig and back again, illustrates how the farm's revolution has failed and how the new rulers, who are identical to

When Science Meets Literature: Reframing George Orwell's *Animal Farm* with Four Quantum Concepts

the old, have just reproduced the same repressive authority. Orwell emphasizes how the pigs' corruption has obliterated the principles of the uprising by making it "impossible to say which was which," trapping the animals in a hopeless cycle where authority stays the same, which not only highlights the cruel irony of the farm's metamorphosis, but also reveals the futility of a revolution that merely substitutes one type of oppression for another.

5.2 *Entanglement and the Erosion of Animal Farm's Ideals*

Orwell employs the concept of entanglement not just in its scientific sense but as a metaphor for the interdependent relationships that shape the characters and their fates. These entangled relationships influence power dynamics, decision-making, and the overall trajectory of the revolution. Analyzing these entanglements through a quantum mechanical lens offers a novel interpretation of the novella and elucidates the link between power, loyalty, and resistance that ultimately determines the farm's tragic destiny.

In quantum mechanics, entanglement refers to a phenomenon where particles become interconnected in such a way that the state of one particle instantaneously influences the state of another, regardless of the distance between them (Orkin 2022). This principle can be metaphorically applied to the relationships in *Animal Farm*. The animals' fates and actions are deeply interconnected, with each change in power dynamics affecting the entire community. These relationships form an interdependent system that ultimately leads to the erosion of the farm's revolutionary ideals (Relotić 2015).

One critical entanglement on the farm lies in the complex web of alliances and dependencies woven between the animals. Orwell establishes this dynamic early on, with the pigs' natural leadership stemming from their "superior knowledge," which justifies their position above the others (Orwell 1945, 44). This power structure promotes a one-sided entanglement, as illustrated by Boxer's unwavering loyalty to Napoleon. Despite mounting evidence of the pigs' corruption, Boxer clings to blind faith:

Boxer was the admiration of everybody. He had been a hard worker even in Jones's time, but now he seemed more like three horses than one; there were days when the entire work of the farm seemed to rest on his mighty shoulders. From morning to night he was pushing and pulling, always at the spot where the work was hardest. He had made an arrangement with one of the cockerels to call him three-quarters of an hour earlier in the mornings instead of half an hour. And in his spare moments, of which there were not many nowadays, he would go alone to the quarry, collect a load of broken stone, and drag it down to the windmill unassisted. His answer to every problem, every setback, was 'I will work harder!'—which he had adopted as his personal motto (Orwell 1945, 45).

Boxer's life becomes deeply entangled with the ambitions of the pigs, as they exploit his strength and dedication to build their own power. The statement, "Boxer was the admiration of everybody [...] his answer to every problem, every setback, was 'I will work harder!'", reveals how Boxer's unwavering commitment makes him a vital asset to the pigs, who rely on his work to establish and maintain their

power. His loyalty blinds him to the reality that his hard work serves the pigs' self-interest, not the collective welfare he envisions.

Boxer's entanglement with the leadership becomes a tragic bond from which he cannot escape. As he takes on an almost superhuman workload, rising earlier than other animals and working tirelessly even in his spare moments, he fails to recognize how the farm's prosperity is increasingly tied to the pigs' control. Boxer's motto, "I will work harder," symbolizes his entangled role within this power structure: every ounce of his strength fuels the pigs' rise, every setback deepens his commitment, which the pigs exploit until he is no longer useful. Just as entangled particles are bound by a relationship in which one influences the other, Boxer's fate is inextricably linked to the manipulation of the pigs, a bond that ultimately leads to his betrayal and destruction. This tragic entanglement highlights Orwell's critique of how those in power exploit unwavering loyalty and work hard to consolidate their power, even at the expense of those most loyal.

The pigs' elevated position on Manor Farm reinforces their dominance and entangles the other animals in a system of subjugation. The windmill project exemplifies this dynamic. Initially proposed as a symbol of progress for all, it becomes a tool for the pigs to solidify their power (Arifriarni 2021). The animals' resigned acceptance of their inferior roles in its construction underscores the entwined nature of power and submission within the farm's newly formed social hierarchy: "Napoleon himself, attended by his dogs and his cockerel, came down to inspect the completed work; he personally congratulated the animals on their achievement" (Orwell 1945, 98). This social structure, which the pigs craft, creates a system of dependence where individual agency is eroded. Entangled in their assigned roles, the animals become inseparable from the very system that exploits them.

Squealer, the cunning mouthpiece of the pigs, uses propaganda and manipulation to entangle the animals in a regime of deceit. Orwell portrays him as "a brilliant talker" (Orwell 1945, 35). This description emphasizes his ability to twist facts and control the narrative. The animals themselves recognize the danger he poses and admit with a hint of resignation, "he could turn black into white" (Orwell 1945, 36). This shared awareness highlights the pervasiveness of Squealer's deceit and the constant threat that entangles the animals in a distorted reality (Chen and Liu 2022). As Aspalter explains, "the forces of human entanglement, we carry in us, are formed by language, by words and the particular ways of common logic and common sense we use, our past experiences and communications, and by our social, cultural, political, and natural environments" (Aspalter 2024, 20). Squealer's manipulation of language taps into these internal forces, ensuring the animals' continued exploitation.

The contrasting narratives of Moses and Benjamin also reveal the manipulative forces at play on the farm. Moses, Mr. Jones's former raven, embodies the manipulative outsider. A "clever talker" who uses deceptive tales of Sugarcandy Mountain to maintain the status quo (Orwell 1945, 37). His presence highlights the constant challenge the animals face in discerning truth: "The pigs had an even harder struggle to counteract the lies put about by Moses, the tame raven" (Orwell 1945, 36). Benjamin the donkey, on the other hand, represents a different kind of entanglement – one of disillusionment. His cynical perspective, "Only old Benjamin professed to remember every detail of his long life and to know

When Science Meets Literature: Reframing George Orwell's *Animal Farm*
with Four Quantum Concepts

that things never had been, nor ever could be much better or much worse..." (Orwell 1945, 122), serves as a counterpoint to the manipulable hope offered by others. Entangled in his own cynicism, Benjamin offers a bleak but potentially clear-eyed view of reality.

Moreover, Clover's concern for Boxer illustrates the emotional entanglements that bind the animals. Her unwavering support for Boxer and her increasing anxiety over his well-being demonstrate how personal relationships are affected by the broader power dynamics. Clover's loyalty and care for Boxer highlight the interconnectedness of their fates and emphasize how individual actions and relationships contribute to the overall entanglement on the farm (Harefa 2015).

Divisions and conflicts within the animal community further entangle them in a system of exploitation and control. The rift between Snowball and Napoleon symbolizes the broader ideological battles that often lead to the downfall of revolutionary movements (Arifriami 2021). Initially, Snowball and Napoleon appear to work together for the common good, but as their interests diverge, their rivalry becomes more pronounced. Snowball's expulsion from the farm marks a turning point, where the entanglement of power struggles becomes evident. Napoleon's consolidation of power is a direct result of this conflict: "Nine enormous dogs wearing brass-studded collars came bounding into the barn. They dashed straight for Snowball, who sprang from his place just in time to escape their snapping jaws" (Orwell 1945, 67). This event not only solidifies Napoleon's dominance but also deepens the animals' entanglement in a regime driven by fear and coercion. Orwell demonstrates that "politics ultimately rests on the will and ability to employ force in its defence" (Stone 2016, 223).

The division between the pigs and the other animals becomes more pronounced as the pigs adopt human behaviors and privileges. Orwell's portrayal of the pigs' gradual transformation into the very oppressors they overthrew emphasizes the cyclical nature of power and corruption. The animals' growing disillusionment is encapsulated in the iconic final scene where they can no longer distinguish between pig and human: "The creatures outside looked from pig to man, and from man to pig, and from pig to man again; but already it was impossible to say which was which" (Orwell 1945, 141). This blurring of lines highlights the ultimate entanglement of the revolution's ideals with the corrupting influence of power.

The entanglement of relationships and power dynamics in *Animal Farm* ultimately leads to the erosion of the farm's founding ideals. The Seven Commandments, initially established to guide the animals towards equality and justice, are gradually altered to justify the pigs' actions. These changes reflect the entangled nature of ideology and power, where the manipulation of principles becomes a tool for maintaining control. The final commandment, "All animals are equal, but some animals are more equal than others" (Orwell 1945, 134), encapsulates the complete subversion of the revolution's original goals. Therefore, "entanglements are created by establishment, maintenance and promotion of (often dichotomic) evaluations, legitimizing arguments and rationales, and of course attempts to convince others to support rules, rulings, laws, policies, and practices" (Aspalter 2024, 24). This manipulation secures the pigs' dominance over the other animals as they entangle the farm in a web of lies and deceit.

The animals' gradual acceptance of these changes stresses their entanglement in a system that exploits their trust and labor. The pigs' ability to manipulate language and history ensures that the animals

remain complicit in their own subjugation (Arifriarni 2021). The entanglement of propaganda, power, and complicity creates a self-perpetuating cycle that erodes the farm's revolutionary ideals and entrenches the pigs' dominance.

5.3 Superposition and the Coexistence of Contradictions in Animal Farm

The concept of superposition, borrowed from quantum mechanics, provides a compelling framework to analyze the complexities of power, ideology, and revolution in Orwell's novella. In quantum mechanics, superposition describes how a particle can exist in multiple states simultaneously (Rubino et al. 2021). Similarly, Orwell employs a narrative framework that mirrors the concept of superposition in quantum mechanics. His characters, the social structures he depicts, and the narrative itself embody coexisting contradictions that ultimately culminate in the farm's tragic demise.

From the start, Old Major's speech introduces a moment of superposition for the animals. They are presented with two futures: one where they remain subjugated under human control, and another where they seize control of their own destiny. Consider the following passage:

Comrades, you have heard already about the strange dream that I had last night. But I will come to the dream later. I have something else to say first. I do not think, comrades, that I shall be with you for many months longer, and before I die, I feel it my duty to pass on to you such wisdom as I have acquired. I have had a long life, I have had much time for thought as I lay alone in my stall, and I think I may say that I understand the nature of life on this earth as well as any animal now living. It is about this that I wish to speak to you.

Now, comrades, what is the nature of this life of ours? Let us face it: our lives are miserable, laborious, and short. We are born, we are given just so much food as will keep the breath in our bodies, and those of us who are capable of it are forced to work to the last atom of our strength; and the very instant that our usefulness has come to an end we are slaughtered with hideous cruelty. No animal in England knows the meaning of happiness or leisure after he is a year old. No animal in England is free. The life of an animal is misery and slavery: that is the plain truth (Orwell 1945, 26-7).

Old Major's words, "The life of an animal is misery and slavery: that is the plain truth" explain the oppressive reality they currently inhabit and lay bare the conditions they could choose to reject. This recognition of their oppression creates a fork in the road, where the animals' future rests in a state of superposition (between continued subjugation and the hope of a liberated existence).

By describing his own life of isolation and contemplation, Old Major conveys a deep understanding of animal suffering and self-awareness, suggesting that change is possible. His dream, which he introduces as "strange" and yet to be fully explained, represents a potential alternative reality that the animals might bring into existence if they choose revolution. But until they act, the two alternatives (slavery and freedom) coexist in the animals' minds simultaneously, which reflects the concept of

When Science Meets Literature: Reframing George Orwell's *Animal Farm*
with Four Quantum Concepts

superposition. The fates of the animals are currently oscillating between two competing realities, waiting for their collective decision to collapse into one. Through Old Major's words, Orwell represents quantum superposition, placing the animals on the verge of metamorphosis, where their decisions will eventually determine which course they will choose.

Boxer, the loyal workhorse, himself embodies the essence of superposition. His tireless commitment to the rebellion's ideals, epitomized by his mantra "I will work harder," (Orwell 1945, 45) represents one state of his existence: unwavering devotion. Yet, tragically, Boxer coexists in a contradictory state, a state of blind faith that renders him oblivious to the pigs' manipulation. This internal conflict, where loyalty wars with critical thinking, becomes a microcosm of the revolution's own struggle. Boxer's tragic flaw, the paradoxical coexistence of devotion and naiveté, exposes the dangers of blind faith within a revolution (Kumar 2014). He serves as a stark reminder that unwavering dedication, without skepticism, can leave one vulnerable to exploitation.

Similarly, Mollie, the vain mare, embodies the tension between comfort and the desire for change (Dwan 2012). Content with her comfortable life under Mr. Jones, shown in her refusal to learn beyond "the six letters which spelt her own name," (Orwell 1945, 49) she initially craves a different state, evident in her excitement about the rebellion: "She [Mollie] took a place near the front and began flirting her white mane, hoping to draw attention to the red ribbons it was plaited with" (Orwell 1945, 27). This suggests a desire for a glamorous new life, different from her current situation. However, faced with the realities of revolution and collective responsibility, Mollie's divided loyalties are exposed. In stark contrast to her initial excitement, "She had remained behind in the best bedroom" (Orwell 1945, 41) during the farm's attack. This choice seemed to contradict the ideals she once embraced.

Snowball, the visionary pig, represents the complex superposition of idealism and pragmatism. He champions the rebellion's hopeful vision, exemplified by his leadership in building the windmill and his study of military strategy: "Snowball, who had studied an old book of Julius Caesar's campaigns" (Orwell 1945, 54). These actions showcase his belief in a brighter future for the farm. However, Snowball isn't a one-dimensional idealist. The harsh realities of power struggles force him to exist in a contradictory state as well. His expulsion by Napoleon, marked by the manipulative voting process ("Vote for Snowball [...] Vote for Napoleon" (Orwell 1945, 62), reveals Snowball's own pragmatic streak. The willingness to manipulate the vote, despite his championing of a brighter future, exposes the true complexity of Snowball's character. His fight for a utopia clashes with the need for real-world tactics. This struggle highlights the tension between utopian ideals and the necessity of practical considerations (Relotić 2015).

The animals' rebellion is fueled by a singular dream: equality. This core principle, enshrined in the commandment "all animals are equal" (Orwell 1945, 31), represents a utopian ideal, a world free from Mr. Jones's oppressive hierarchy (one state). However, the narrative exposes a disturbing shift – the pigs' gradual consolidation of power (another state). Their superior intellect and manipulative tactics exploit the trust of the other animals. The windmill project, initially presented by Snowball as a symbol of collective progress, becomes a tool for control: "Snowball also busied himself with organising [...] Animal Committees"(Orwell 1945, 47), which foreshadows the pigs' growing power. The blatant

violation of the Fourth Commandment, with the ban on walking on two legs despite allowing beds with sheets, exemplifies the hypocrisy at the heart of the revolution. This coexistence of contradictory states - the initial dream of equality and the pigs' seizure of power - ultimately leads to the downfall of the farm. (Hasan et al. 2023).

The narrative voice in *Animal Farm* initially appears objective, as it chronicles the rebellion's triumphs and struggles (single state) to allow readers to immerse themselves in the story and form their own interpretations. However, a closer look reveals a subtle duality (another state). While seemingly neutral, the narrator carefully selects which events to depict and which characters' perspectives to present (another state). This subtle manipulation guides the reader's attention towards specific issues, such as leadership's impact on the revolution (Omar 2021). For instance, when the animals first take over the farm, the narrative describes the initial euphoria and sense of accomplishment: "The animals were happy as they had never conceived it possible to be. Every mouthful of food was an acute positive pleasure, now that it was truly their own food, produced by themselves and for themselves, not doled out to them by a grudging master" (Orwell 1945, 45). This depiction highlights the initial success and unity of the rebellion.

However, the narrative also subtly hints at the emerging power dynamics, such as when the pigs begin to assume leadership roles: "The pigs did not actually work, but directed and supervised the others. With their superior knowledge it was natural that they should assume the leadership" (Orwell 1945, 44). This selection of events shows the gradual shift in power and the pigs' consolidation of authority. Additionally, the narrative's portrayal of Napoleon's rise to power highlights this subtle manipulation. The description of Napoleon's actions, such as his strategic expulsion of Snowball, emphasizes the pragmatic and ruthless aspects of his leadership: "He [Napoleon] said very quietly that the windmill was nonsense and that he advised nobody to vote for it, and promptly sat down again; he had spoken for barely thirty seconds, and seemed almost indifferent as to the effect he produced" (Orwell 1945, 63). This careful presentation of events guides the reader to focus on the leadership's impact on the revolution.

The narrative's duality is further evident in its use of foreshadowing and irony (Bansal and Singh 2021). Early pronouncements, like Major's dream of a society where animals are equal, plant seeds of doubt about the revolution's ability to achieve true equality. Major's speech sets the stage for the animals' rebellion and expresses a vision of equality and justice: "All men are enemies. All animals are comrades" (Orwell 1945, 30). This vision is codified into the Seven Commandments, with the core principle: "All animals are equal" (Orwell 1945, 31). However, the narrative subtly foreshadows the contradictions that will emerge.

As the narrative unfolds, the contradictions become increasingly apparent. This prompts readers to question the animals' choices and the fragile foundation of the revolution. The commandment "All animals are equal" is eventually contradicted by the pigs' ironic proclamation: "All animals are equal, but some animals are more equal than others" (Orwell 1945, 126). This alteration of the commandments reveals the betrayal of the revolution's ideals. "Cause and effect don't operate in quantum theory, but they must in the language and logic we use to try and explain it" (Coale 2012, 17). Similarly, Orwell

When Science Meets Literature: Reframing George Orwell's *Animal Farm* with Four Quantum Concepts

manipulates language to blur cause and effect, much like the pigs' manipulation of the commandments. Through this subtle distortion of reality, the commandments are gradually transformed to justify actions that directly contradict the original intentions of the revolution, obscuring the causal relationship between ideology and practice.

The narrative also employs subtle irony, like the renaming of the farm, to highlight potential flaws. Initially, the change from Manor Farm to Animal Farm signifies a break from the past and a step towards a just society (Al-Hilo and Gebreen 2021). The farm was to be called "Animal Farm" (Orwell 1945, 42). However, the farm's eventual transformation back to Manor Farm under the pigs' rule emphasizes the hollowness of this symbolic change: "The creatures outside looked from pig to man, and from man to pig, and from pig to man again; but already it was impossible to say which was which"(Orwell 1945, 131). Indeed, the final change of the pigs into humans can be explained using the concept of quantum superposition. The pigs gradually absorb the actions and features of the people they have overthrown, creating a state of superposition in which they are both animals and oppressors. This ironic twist compels readers to question the true meaning of revolution and whether symbolism alone can guarantee lasting change.

5.4 *Wave-Particle Duality and the Perversion of Revolution*

The fourth quantum lens for analyzing the novella is the concept of wave-particle duality, a cornerstone of quantum mechanics. This principle posits that a particle can exhibit both wave-like and particle-like properties simultaneously (Chowdhury et al. 2021). Similarly, Orwell crafts characters, the narrative voice, and the social structures in *Animal Farm* to exist in a state of duality, where seemingly contradictory elements coexist, thus enriches our understanding of the farm's tragic fate.

Animal Farm exemplifies wave-particle duality in its portrayal of leadership. Initially, Napoleon and Snowball represent a wave-like collective identity, as they both advocate for equality and liberation. When Napoleon introduces the idea that "all animals are equal" (Orwell 1945, 31), it promises a utopian society of shared prosperity – a wave-like characteristic. However, as they vie for power, both Napoleon and Snowball transition into particle-like figures, as they start to assert individual agency for personal gain. This shift is evident in Napoleon's mantra, "Napoleon is always right" (Orwell 1945, 66), which emphasizes individual authority over collective decision-making. Furthermore, Napoleon's manipulation of the farm's resources and his false claim that Snowball collaborated with the ousted Jones to remove him highlight this shift in leadership dynamics.

The culmination of this transition occurs when Napoleon usurps leadership and expels Snowball. Orwell describes this critical moment in the following words:

At this there was a terrible baying sound outside, and nine enormous dogs wearing brass-studded collars came bounding into the barn. They dashed straight for Snowball, who only sprang from his place just in time to escape their snapping jaws. In a moment he was out of the door and they were after him. Too amazed and

frightened to speak, all the animals crowded through the door to watch the chase
"(Orwell 1945, 64).

The expulsion of Snowball represents not only Napoleon's consolidation of authority, but also the breakdown of the cooperative values that originally distinguished the animal uprising.

This highlights Napoleon's dominance and control over the farm and marks the transformation from collective representation to individual dominance (Gurung 2024). This shift represents a transition from a wave-like, collective leadership, in which authority is somewhat dispersed among the pigs and guided by revolutionary ideals, into a particle-like, centralized force embodied solely by Napoleon. Initially, Snowball and Napoleon's leadership styles are complementary; Snowball brings creativity and vision, while Napoleon exhibits a more pragmatic and forceful approach. Together, they offer a dual view of leadership. However, by eliminating Snowball, Napoleon dismantles this dual system and establishes himself as the solitary "particle" of authority. This change underscores the complexities of power dynamics inside revolutionary movements, where the unity that drives collective action is frequently fragmented as individuals compete for power and domination. Through their journey, Orwell highlights the dangers of unchecked authority and the fragility of collective solidarity in the face of individual ambition.

Boxer, the loyal workhorse, embodies a unique form of wave-particle duality in *Animal Farm*. His unwavering dedication to Animalism, symbolized by his mantra "I will work harder!" (Orwell 1945, 45) represents the farm's collective identity in its purest form – a wave-like commitment to progress. He embodies the collective spirit and strives for the betterment of the farm. However, Boxer's blind trust in Napoleon, evident in his repeated belief that "Napoleon is always right" (Orwell 1945, 66), presents a particle-like characteristic. Boxer's unwavering loyalty to an individual leader undermines the collective ideal. This internal conflict showcases the collision between collective loyalty and individual vulnerability. Boxer's tragic downfall lies in his inability to reconcile this duality. His final lament, "I do not understand it... The solution, as I see it, is to work harder" (Orwell 1945, 88), exemplifies his unwavering commitment to the collective ideal even in the face of personal exploitation. This blind faith, a testament to his strength and vulnerability in equal measure, underscores the complexities of revolution and the dangers of unquestioning authority.

Similarly, Squealer, *Animal Farm*'s propagandist pig, embodies wave-particle duality through language manipulation. Initially, he promotes collective ideals, acting as a "brilliant talker" (Orwell 1945, 35) who justifies the pigs' actions for the "greater good" (wave-like). However, as power consolidates, Squealer's rhetoric shifts. He portrays leadership as a "deep and heavy responsibility" (Orwell 1945, 66). This change in narrative (particle-like) aims to deflect suspicion from the pigs' true motives and perpetuate their power (Alozie-Onumadu 2020). This manipulation extends to revising history, as seen in his denial of the resolution against trade (Orwell 1945, 73). Squealer's ultimate betrayal lies in the infamous quote: "All animals are equal, but some animals are more equal than others"(Orwell 1945, 126). This dismantles the collective identity of Animalism and highlights the dangers of uncritical acceptance of leadership narratives.

When Science Meets Literature: Reframing George Orwell's *Animal Farm* with Four Quantum Concepts

The narrative itself oscillates between collective solidarity and individual desires, thus reflecting the wave-particle duality. Initially united in overthrowing Mr. Jones and establishing Animalism, the animals symbolize a wave-like collective identity driven by revolutionary ideals. This unity is captured in the declaration, "all animals are equal" (Orwell 1945, 30). However, as the pigs prioritize their own interests, individual ambitions emerge, which leads to discord and manipulation by the ruling elite. Napoleon's assertion of authority, "Napoleon is always right" (Orwell 1945, 66), signals the emergence of individual dominance and the erosion of collective solidarity. The culmination of this transformation is encapsulated in the quote, "all animals are equal, but some animals are more equal than others" (Orwell 1945, 126). This shift symbolizes the fragmentation of the collective identity and the rise of individual desires among the ruling elite.

The pigs' gradual transformation from liberators to oppressors epitomizes the collision between revolutionary aspirations and authoritarian reality (Bloom 2009). Characters like Benjamin and Clover undergo wavering allegiances, which reflects the dynamic nature of their identities within the collective society. Initially supportive of the revolution, they become disillusioned in response to the pigs' tyranny. This disillusionment is portrayed in the final scene as follows: "The creatures outside looked from pig to man, and from man to pig, and from pig to man again; but already it was impossible to say which was which" (Orwell 1945, 131). This quote demonstrates the fading wave of collective identity as they witness the pigs becoming indistinguishable from the humans they once rebelled against. Benjamin's cynical remark, "none of you has ever seen a dead donkey" (Orwell 1945, 46), further illustrates their individual agency amidst the fading collective identity.

6. Discussion

The application of Quantum Narratives to Orwell's *Animal Farm* marks a significant advancement in literary criticism and reveals new dimensions of the novella's exploration of power, control, and human nature. This discussion emphasizes the importance of these findings, their broader implications, and potential avenues for future research.

6.1 Significance of Findings

6.1.1 Uncertainty and Its Alignment with Historical Parallels

The concept of uncertainty in quantum mechanics resonates with the fluid and indeterminate nature of power dynamics depicted in *Animal Farm*. This congruence drives us to a deeper understanding of how the novella reflects real-world political instability. It emphasizes the unpredictable nature of revolutionary movements and the complexities inherent in leadership transitions.

Several studies (He 2023; Fajrina 2016) situate *Animal Farm* within the historical context of the Russian Revolution and the subsequent rise of the Soviet Union. The quantum narratives approach complements and enriches these established historical analyses by foregrounding the inherent uncertainties within power dynamics. Therefore, this lens provides a more nuanced exploration of Orwell's critique of totalitarian regimes and the subversion of revolutionary ideals.

6.1.2 Entanglement and Marxist Theory

The application of entanglement promotes a deeper understanding of the complex network of interconnected events and characters within *Animal Farm*. This approach not only highlights the holistic nature of Orwell's narrative but also reveals how individual actions are deeply intertwined with broader social and political structures. For instance, the relationships between characters like Napoleon, Snowball, and the other animals reflect the interconnectedness of personal ambitions and collective movements. Such a perspective offers a more holistic approach to analyzing historical and political narratives because it recognizes the reciprocal influence of individual and collective actions.

Masofa (2015) and Saoudi et al. (2022) dissect the novella through the lens of Marxism to reveal the story's underlying themes of class struggle and oppression. However, the quantum narratives approach complements Marxist analysis by illustrating how entanglement and superposition manifest within class dynamics. While Marxist readings often emphasize a binary class conflict (Siahaan, 2018), quantum concepts suggest a more complex power dynamic where characters and events are closely linked and connected. This portrayal reflects the complex and multifaceted nature of social hierarchies.

6.1.3 Superposition and the Multifaceted Nature of Power

The concept of superposition in quantum mechanics allows us to demonstrate the coexistence of contradictory narratives within *Animal Farm*. The novella presents ideals of equality existing alongside the harsh reality of oppression. This duality challenges simplistic, one-dimensional interpretations and compels a deeper engagement with the text. Understanding this superposition is important because it encourages readers to engage with the text on multiple levels. This promotes a more nuanced understanding of the themes of revolution and tyranny.

Dickstein (2007) and Rae (2009) examine how Orwell's personal involvement with socialist movements, and the subsequent disillusionment he experienced, influenced his writing of *Animal Farm*. The quantum narratives perspective broadens this discussion by suggesting that Orwell's personal disappointment can be seen as an embodiment of a larger pattern of uncertainty and paradox inherent in revolutionary movements. This approach demonstrates the fluidity and interconnectedness of personal and political narratives. It provides a richer understanding that not only transcends mere biographical connections, but also reveals how personal experiences can reflect and be shaped by broader historical forces.

6.1.4 Wave-Particle Duality and Satire

Incorporating the quantum principle of wave-particle duality into the analysis of Orwell's *Animal Farm* reveals insights into the complex and conflicting aspects of revolutionary movements. By analogizing characters and social structures to the duality observed in quantum mechanics, this analysis reveals how satire can operate on the principles of wave-particle duality. Such analogies reflect the dual nature inherent in characters and events.

Building on existing analyses of the novella's satire (Jasim et al. 2013; Dai 2020; Kemit and Hendar 2022), this "quantum narratives" approach offers a fresh perspective. It reveals how satire can function on

When Science Meets Literature: Reframing George Orwell's *Animal Farm* with Four Quantum Concepts

multiple levels. Like wave-particle duality, it can not only target specific regimes but also expose broader human flaws reflected in the characters' and events' inherent duality.

6.1.5 *Quantum Narratives and New Historicism*

The introduction of quantum mechanics into literary analysis represents a significant interdisciplinary approach that echoes recent trends in literary criticism aimed at integrating scientific concepts (Grinbaum 2017). This innovative perspective not only deepens our understanding of *Animal Farm* but also contributes to the broader discussions about the value of interdisciplinary methods in uncovering new layers of meaning within literary texts. Furthermore, this approach aligns with the principles of New Historicism. That is, the quantum narratives approach emphasizes the fluidity and interconnectedness of historical and literary elements and demonstrates how historical events shape the narrative and how different narrative threads and historical realities within the text are interwoven.

6.2 Broader Implications

The interdisciplinary approach of Quantum Narratives demonstrates the transformative potential of integrating scientific principles into literary criticism. This method not only deepens our understanding of specific texts but also bridges the gap between the sciences and the humanities, which promotes a richer, more holistic approach to knowledge. The application of specific quantum concepts, like the ones employed in this research, can reveal new dimensions of meaning and enhance the interpretive depth in literary analysis.

6.2.1 Enriching Literary Analysis

The theoretical implications of this study are profound. By bridging the gap between literature and quantum physics, Quantum Narratives offers a novel lens for analyzing literary texts. This approach, which goes beyond surface interpretations, allows us to uncover hidden layers of meaning aligned with the principles of superposition (the coexistence of multiple states) and entanglement (instantaneous interactions between linked elements). Such an innovative perspective can open new avenues for understanding character motivations, plot complexities, and the overall thematic richness of literary works.

6.2.2 *Interdisciplinary Insights for a Holistic Education*

By integrating principles from literature and quantum physics, educators can promote a more holistic understanding of literary texts. This approach encourages students to think outside the box and forges their analytical and interpretative skills. It allows them to appreciate the complexities and nuances within literary works and develop a critical eye for hidden layers of meaning.

Furthermore, such an approach equips students for a future that values cross-disciplinary knowledge. They learn to draw connections between seemingly disparate fields and apply their learning in innovative ways. This holistic educational model cultivates astute and adaptable thinkers, capable of approaching problems and ideas from multiple perspectives.

6.3 Future Research Directions

This research demonstrates how the application of Quantitative Narratives to *Animal Farm* reveals the coexistence of multiple interpretations and contradictory realities. This enriches our understanding of power dynamics, shifting ideologies, and the complexities of human nature. Building on these insights, the following future research directions aim to expand the applicability of Quantitative Narratives and promote broader interdisciplinary approaches in literary criticism.

Moving beyond allegory and dystopia, future research can explore the application of Quantum Narratives to literary genres such as magical realism and historical fiction. Demonstrating the framework's adaptability by applying principles such as uncertainty, entanglement, superposition, and wave-particle duality to a wider range of literary works can validate and extend the valuable findings from this study.

This study draws on quantum physics to uncover new layers of meaning. However, integrating insights from other scientific disciplines such as biology, psychology, and ecology can offer complementary perspectives. Examining character development through an evolutionary lens or narrative structures through complex systems theory can lead to new interpretations, enriching literary analysis by building on the interdisciplinary foundation of the study.

Since Quantum Narratives bridges the gap between literature and physics, encouraging interdisciplinary collaborations between literary scholars and physicists could enhance the robustness of Quantum Narratives. Scholars from both disciplines should collaborate to develop and forge a common vocabulary and methodology. This would facilitate more rigorous and meaningful analyses that draw on the strengths of both fields.

7. Conclusion

This study explores Orwell's *Animal Farm* through the innovative lens of Quantum Narratives. The application of quantum concepts such as uncertainty, superposition, entanglement, and wave-particle duality exposes the contradictions inherent in power. The rebellion, initially envisioned as a clear path to freedom, becomes entangled with new forms of oppression. The characters themselves embody a superposition of revolutionary fervor and vulnerability in the face of manipulation. This approach reveals the novella not as a simplistic tale but as a narrative brimming with coexisting realities. It serves as a powerful reminder of the inherent uncertainties and complexities that lie at the heart of power, revolution, and perhaps, the human condition.

The integration of quantum mechanics into literary criticism not only enriches our understanding of the novella, but also paves the way for innovative methodologies in the field. This fresh perspective underlines the novella's enduring relevance as a timeless allegory that continues to resonate with readers across different eras and cultures. By bridging the gap between science and literature, we emphasize the transformative potential of interdisciplinary approaches and highlight how they can deepen our comprehension of classic texts. Therefore, this novel framework invites scholars to reconsider other

When Science Meets Literature: Reframing George Orwell's *Animal Farm*
with Four Quantum Concepts

literary works through similar interdisciplinary methodologies in order to expand the horizons of literary criticism and enrich our collective understanding of the multifaceted nature of literature.

عندما يلتقي العلم بالأدب: إعادة صياغة رواية (مزرعة الحيوان) لجورج أورويل بأربعة مفاهيم كمية

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الملخص

تسلط هذه الورقة الضوء على تطبيق السرديات الكمية، وهي إطار نظري جديد مستوحى من ميكانيكا الكم، على رواية (مزرعة الحيوان) لجورج أورويل بالاعتماد على مفاهيم اللايقين والتشابك والتراكب وثنائية الموج-الجسيم، ويكشف البحث عن أبعاد مستترة من المعاني داخل السرديات المتعايشة والحقائق المتناقضة في النص، وغالباً ما يفشل التحليل الأدبي التقليدي في التقاط الطابع المعقد والمتنوع لرواية (أورويل)، ويستخدم هذا البحث منهجية قراءة دقيقة لفحص النص بدقة تشبه فحص العالم تحت الذري، وتكشف النتائج أن العناصر السردية في (مزرعة الحيوان) تشبه الجسيمات الكمية في حالتها من عدم التحديد والتشابك والتعايش بين حقانق متعددة، وهذا النهج لا يثري فهمنا للمواضيع الخالدة في الرواية فقط، بل يسهم أيضاً في النقاش المتزايد حول الأساليب المتعددة التخصصات في النقد الأدبي، وذلك من خلال سد الفجوة بين ميكانيكا الكم والتحليل الأدبي، وتفتح هذه الدراسة آفاقاً جديدة لاستكشاف الأعمال الأدبية المعقدة وتفسيرها.

الكلمات المفتاحية: مزرعة الحيوان، جورج أورويل، الدراسات البيئية، النقد الأدبي، السرديات الكمية.

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When Science Meets Literature: Reframing George Orwell's *Animal Farm*
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When Science Meets Literature: Reframing George Orwell's *Animal Farm*
with Four Quantum Concepts

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