MERGING LITERATURE AND SCIENCE:
SHAKESPEARE THROUGH THE SCOPE OF QUANTUM PHYSICS AND LACAN

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The arts and the sciences have coexisted for centuries, yet there have been few instances in modern academic history in which scientists and literary scholars worked together side by side, influencing each other’s research and benefitting from their varying approaches and ideas. This work examines the beneficial effects that may result from a discourse between those two cultures in order to help promote a better understanding of the importance of interdisciplinarity. I chose quantum theory as a representative of the sciences and Lacan’s psychoanalysis as a representative of the arts to demonstrate that a shared metalinguistic coding system can provide the basis for successful communication. Therefore, the first part of this thesis explains the two theories without using jargon or mathematical formulae to make them more accessible to a broader audience. In the next part, I analyze two Shakespearean plays, *A Midsummer Night’s Dream* and *Hamlet*, through the scope of these theories, utilizing both their similarities and their differences. Working from the perspective of a literary scholar, my final claim is that literature can be used as an analogy to better understand both quantum theory and psychoanalysis, while at the same time, these two theories can help us understand and discover new meaning in literary works. This demonstrates that no discipline is superior to the other, and that bridging the communicational gap between them in order to combine multiple approaches and their different viewpoints will have beneficial results for both cultures, opening up an entire new spectrum of ideas and theories.
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INTRODUCTION

The arts and the sciences have always existed side by side, yet the fact that both have been mutually influencing and important to society and humanity seems to have been ignored for the most part, particularly by the scientists. Hans Holbein’s painting, *The Ambassadors* (1533), demonstrates exactly this discourse, or lack of such, between the two fields (fig. 1). The painting shows two men who look very much alike, one representing the royalty, and the other one representing the clergy. This overarching motif of doubling is present in every aspect of the painting, seemingly juxtaposing scholarship and religion. A slightly more subtle reference is made to the hierarchical order within scholarship, namely the arts and the sciences. The two men are framing a shelf full of material objects used to analyze and understand both the worldly and the spiritual realms. By taking a closer look at the items on this shelf, it becomes obvious that the top shelf contains exclusively scientific tools, while all the tools related to the arts, like the hymn book or the lute, are positioned on the bottom shelf – not to mention the second lute, which is flipped over and seems to be abandoned completely is lying on the floor underneath the shelf. This perfectly indicates the importance attached to science above everything else, as it had already been in the Early Modern period.

The most remarkable aspect, however, is the emergence of the anamorphic skull placed in the bottom center of the painting. It adds another sphere of doubling, in this case between the material and the immaterial world. While everything else is clearly positioned and functions within the dialectic of the painting, the skull seems to be oddly out of place and does not belong or connect to anything. It is positioned underneath everything else and far below the gaze of the two men, demonstrating the inferiority of the arts, while at the same time, adding a new sphere to the context of the painting. The fact that one can only see the skull as an actual skull when
looking at the painting from a certain angle shows that the arts introduce a different perspective that the sciences do not have, indicating that one can only see the overall picture with all of its parts by engaging in different disciplines and utilizing their different assets. There are two ways of seeing the skull, which is either by standing 17 feet below to the left of the painting or 17 feet above to the right of the painting, showing that the arts can offer new perspectives. Therefore, the same way one can choose to look at the painting from either above it or below it, the arts cannot only provide new viewpoints from different angles, but one can also choose to see the arts as inferior or superior to the sciences.

There have been few times in modern academic history when it was common for scientists and literary intellectuals to be working together side by side, influencing each other’s research and benefitting from their approaches and ideas. In The Two Cultures and the Scientific Revolution, C. P. Snow pointed out this academic problem. He observed in 1959 that “[t]he non-scientists have a rooted impression that the scientists are shallowly optimistic, unaware of man’s condition. On the other hand, the scientists believe that the literary intellectuals are totally lacking in foresight, peculiarly unconcerned with their brother men, in a deep sense anti-intellectual, anxious to restrict both art and thought to the existential moment” (5-6). While this was written almost 60 years ago, these prejudices still exist today. Even more threatening to general knowledge is the fact that the humanities now have to fight for survival in higher education.

In the capitalist 21st century, the value and worth of different forms of knowledge are measured by their perceived ability to increase economic productivity. In response to this crisis, humanists, like Stanley Fish, claim that “the value of the humanities cannot be validated by some measure external to the peculiar obsession of scholars” (1). The perception that the humanities
should have capitalist value and that they have no intrinsic value, nor do they serve society in any way, must be attended to by way of thinking about the humanities in relation to both the sciences and to capitalism. When we fail to perceive significant connections across disciplines, not only do the humanities suffer, but the societal demand on researchers to produce profitable outcome as well as the constant decline in governmental funding have forced the academic world to battle for their existence, causing many departments – except for a few, like business, which are created to fit the needs of capitalism – to fight each other.

In *Against Method*, Paul Feyerabend was determined to make two points. “[F]irst, that science can stand on its own feet and does not need any help from […] [non-scientific cultures]; and secondly, that non-scientific procedures and assumptions can also stand on their own feet and should be allowed to do so” (xviii). While this is definitely true and agrees with the conviction of most of the representatives of these cultures, one needs to consider the dynamics between the humanities and the hard sciences to acknowledge the enormous potential that can result from the collaboration and combination of different mindsets and resources. For example, by taking another look at the painting mentioned above, one can see that it was the combination of resources from both the arts and the sciences that allowed Holbein to paint the anamorphic skull. While the anamorphic object itself is considered an object of the arts, one also needs significant knowledge of scientific fields, such as geometry, in order to construct the accurate spacing and angles between the lines. Lacan quite accurately described this painting as the representation of “the vanity of arts and sciences” (*Seminar XI* 92).

In his introduction to “The Science of Literature,” Helmut Müller-Sievers points out that the English language plays a big part in the separation of science and literature:
The German notion of a “Science of Literature” [Literaturwissenschaft] – still the prevalent name of Literature Departments in German universities – has never found acceptance in Anglo-American culture. Some believe that to qualify as a “science” literary studies must submit to the protocols of imaging and quantification provided by cognitive and statistical sciences. Others think that the ideals of scientific objectivity and completeness commit interpreters to a stance of mastery over deeply ambiguous material or, worse, trap them in the ideological proscenium of a text. Still others charge that the entire project is emblematic of the plodding approach to products of the imagination that the public has come to expect from academics in general, and from German academics in particular. (1)

Snow identified the problem of the North American higher education system as “the task of producing a tiny elite […] educated in [only] one academic skill” (21). This seems to have changed today, as students from many diverse backgrounds seek academic degrees, and having a college education is becoming more common than not having one; but has it really changed in terms of the narrow focus on particular ideas that lead to disciplinary elitism? Interdisciplinary studies have become increasingly advertised at American universities. In 2013, the Yale Daily News published an article with the title “Students Turn to Interdisciplinary Majors.” In this article, the Yale College Dean Mary Miller is quoted as saying that “interdisciplinary majors – who draw from departments across the University to focus on a particular topic, like American studies or environmental studies – have become increasingly popular over the last decade” (Menton and Milstein). However, while these majors allow students to take classes within different academic fields, for the most part, they still do not cross the boundaries of different academic areas like humanities and natural or hard sciences. If they do represent interdisciplinary
thinking, they often combine closely related areas, like humanities and social sciences, or any combination of the STEM fields (science, technology, engineering or mathematics). There are only a few exceptions where these lines are crossed (see for example the History of Science Ph.D. program offered at the University of Minnesota). What was a striking movement toward interdisciplinarity became a reason for administrations to diminish differences among programs to create new fields that blended disciplines that were already closely related. The use of interdisciplinarity is an excuse for a failure to think across differences that are significant to methods of inquiry in the humanities and the hard sciences. Further, the goals are consistently aimed toward financial benefits of institutions, rather than toward the ideal of knowledge inquiry.

The combination of science and literature remains underexplored and understudied. There are a few literary and cultural studies pioneers who have published works on scientific analyses of literary works or studied the connection between scientific and literary concepts, such as Arkady Plotnitsky, Henry S. Turner, Carla Mazzio, or Jonathan Sawday. However, despite the attempts of these (and other) scholars in the humanities to engage the sciences, a very small number of scientists reciprocate interest in the dialogue across disciplinary and methodological boundaries. And, even smaller is the number of scientists who engage in research connecting their field of expertise with literature. It seems that the importance of the connection of these two fields is only realized by those who have already been in contact with it, like Dan Falk, who wrote that it was not until his interest was aroused by a paper on Shakespeare and astronomy, that he was “quickly realizing that [he] had only scratched the surface of a rich and underexplored topic” (ix). He sees the problem with this in the way science is perceived as
“being unique in having the power to actually change society, with art, music, literature, as vital as they are, merely coming along for the ride, providing an occasional diversion” (314).

This idea of the superiority of science has its origin in the 13th and 14th centuries, when philosophers and scientists, like Roger Bacon, started to make the case for physics becoming its own discipline rather than being a branch of philosophy. This was finally accomplished in the 16th and 17th centuries through the development of fundamental physical concepts by Galileo Galilei and Isaac Newton, and the split between science and other fields like philosophy and literature was finalized during the scientific revolution, introduced by Francis Bacon and his work *Novum Organum*, published in 1620. He claims that science should be based on deduction rather than induction, meaning that new theories should not evolve from already existing ones but merely rely on the observation and analysis of natural phenomena. This lead to a “clear division between the Church, which has authority on moral matters, and Science, which has authority on material phenomena” (Hebron 101), meaning that intellectual approaches such as geocentrism and heliocentrism, subjectivity and objectivity, interpretation and measurement, or language and mathematics, amongst others, were considered mutually exclusive. As a result, “the scientific and the literary gradually separated out into separate spheres of discourse” (ibid. 103) and have been moving further away from each other ever since.

Significantly, there were times when this limited view of science as a discipline above all others was not seen as dominant as it has been in the recent past. The ancient Greek philosophers, Aristotle and Plato, although not always on the same terms when it came to philosophical questions, agreed that one has to take all possible views into account rather than gathering their knowledge from a singular discipline, for philosophy “includes all science, or knowledge, attainable by man” (Hebron 100). Their theories were regarded as highly influential
throughout the medieval and renaissance period, where it was common courtesy to introduce new ideas and concepts through deduction from and referencing of already existing sources.

Therefore, in Early Modern England, for example, some believed that “art was not separated from the practices that became science but instrumental to them” (Spiller 25). This connection was particularly focused on by metaphysical poets such as John Donne and Andrew Marvell, whose poems used, explained, and evolved around concepts of new scientific discoveries, such as cosmology, astronomy, alchemy, and many others. In “The Definition of Love,” for example, Marvell defines two lovers’ courses of life through the mathematical concept of linear equations in a Euclidean plane using metaphors instead of variables: “As lines, so loves oblique may well / Themselves in every angle greet; / But ours so truly parallel, / Though infinite, can never meet” (25-28).

But while these concepts were rather obviously depicted in metaphysical poetry, there were other authors that used them in a more subtle way. In *The Man in the Moone* (1683), Francis Goodwin draws on theories of astronomy, as introduced by Johannes Kepler and Nicolaus Copernicus, in order to introduce “a new way of presenting a theoretical argument through fiction” (Aït-Touati 47). Edward Ravenscroft chose the field of medicine for his 1762 play, *The Anatomist, or the Sham Doctor*, which has at its center “an image of death and resurrection concealed behind the masque of comic burlesque, innuendo, and deviously cynical manipulation” (Sawday 46). Among other famous writers who combined literature and science are Thomas More (*Utopia* 1516), John Milton (“Paradise Lost” 1667), and Jonathan Swift (*Gulliver’s Travels* 1726).

One of the most popular writers, whose works have been the basis for a plethora of discussions and academic analyses for the past centuries, is William Shakespeare. Shakespeare’s
knowledge regarding the science of his time, though utilized sometimes more or less obviously in his plays, eventually caught the attention of some scholars who have then dedicated their research to this topic. Some of these are Howard Marchitello in “The Machine in the Text: Science and Literature in the Age of Shakespeare and Galileo,” Jonathan Gil Harris’s work, “Untimely matter in the time of Shakespeare,” and Dan Falk’s “The Science of Shakespeare: A New Look at the Playwright's Universe.” The Johns Hopkins University Press has even published an issue of the South Central Review, with the title “Shakespeare and Science.” The articles in this volume analyzed topics such as the connection of Shakespearean plays and physics, anatomy, cartography, cosmology, and many other scientific fields.

To summarize a few of these critical interventions, in “The Nature of Norms in Early Modern England: Anatomy, Cartography, King Lear,” Valerie Traub analyzes the “anatomical illustrations of the human body and representations of human figures on maps” (45) in King Lear and demonstrates how concepts of nature and norms interact in the play. She analyzes the material and ideological interaction of anatomy and cartography, concluding that the relationship between nature and norms demonstrated in King Lear reveals a genealogy of the modern concepts of norms and the normal and the terms of abstract universal humanity. Jean Feerick connects botanical imagery and human differences in "Botanical Shakespeares: The Racial Logic of Plant Life in Titus Andronicus.” She argues that the play makes use of the classifying principles of botany in order to trace the differences of race and bloodlines. Instead of just focusing on one field, William N. West in "What's the Matter with Shakespeare?: Physics, Identity, Playing," shows that Shakespeare made use of both theological and physical views and was capable of engaging with a large number of theories, “depending on which offered the most dramatic force in any situation” (Mazzio 9). He then uses the theatrical trope of one body being
in several places at the same time, or two bodies occupying one and the same place at the same
time, to show Shakespeare’s engagement with Aristotle’s physics and the reshaping of identities.

Considering the general reluctance to analyze literature through a scientific scope, a
surprising amount of research has been done on the connection of Shakespeare and science.
However, there seems to be one common denominator amongst all of them. Neither of the
academic articles nor books include any contemporary science or scientific advancements made
after the 17th century, but rather investigate how much Shakespeare knew about early modern
science, and how he utilized these concepts in his plays. When literary theory is applied to
literary works, there is often no time restriction. Newer concepts, like the philosophy of Slavoj
Zizek, can be applied to older texts, like Ovid’s *Metamorphosis*, the same way older concepts,
like Marxist theory, may be applied to contemporary texts. Why can the same not be done with
Shakespeare and contemporary science? Francis Crick wrote that “[w]hat makes people really
appreciate the connection between two fields is some new and striking result that obviously
connects them in a dramatic way” (quoted in Turner x). Instead of demonstrating how
Shakespeare used the scientific concepts known in early modern England, in this thesis I
investigate what aspects of contemporary science might be found in Shakespeare’s plays and
determine how he utilized and applied them. Since contemporary science is a very broad term,
this needs to be narrowed down to one specific field. I am most specifically invested in
understanding how Shakespeare’s work relates to quantum physics. Although the discourse of
quantum theory may not have been available as it is today, it already has its roots in classical
science and in particular in physics, so while he could not have been aware of the mathematical
formulae behind it, he seems to have been aware of the mechanics. Poetry and physics work well
together to determine how space and time, in conjunction with a view of the human subject and
material things (as well as immaterial matter), function in the universe. This cannot be limited to a time period, but opens up discourse about how language and science relate to each other in and across time.

In developing my thesis I realized that one device that Shakespeare often uses in his plays is the so called “play within a play.” This *mise-en-abyme* of representation that is a common tool within Shakespeare’s plays relates to quantum theory. The quantum world exists within our classical physical world, and the “many-worlds-theory” implies that we live in a superposition of different worlds with different outcomes of events. In his essay, “What’s the Matter With Shakespeare? Physics, Identity, Playing,” West compares the idea of an actor being “similarly doubled and divided” (105) when he is on stage – for he is still himself, while at the same time he is portraying another character – to the “debates about the nature of matter and identity within the institutions of the Church, the universities, and the intellectual culture at large” (ibid. 103) that were posed in Shakespeare’s time. By examining the idea of being both doubled and divided at the same time through the lens of contemporary theories, I realized that the quantum physical concepts of the many-worlds-theory, superposition and collapse of wave functions, and a particle’s endeavor to a universal equilibrium helps to explain Shakespeare’s doubling. Further, this is connected to psychoanalysis where Lacan’s idea of the subjection to the desire of the Other, the split self, and the myth of the mirror image, on the other reflect fragmentation and multiplicity of identity. But how do these concepts of quantum physics and Lacanian psychoanalysis fit in with the idea of a scientific analysis of Shakespeare?

The importance of academic discourse – even if only within their own field of research – is something scientists have understood for a long time. One of the most famous and most
influential discourses in quantum mechanics were the Bohr-Einstein debates\(^1\). This series of public disputes began in 1905, with Albert Einstein proposing that light does not only act as a wave, but sometimes also as a particle.\(^2\) Niels Bohr refuted this claim based on the factor of arbitrariness, which he considered unmathematical. In 1926, Max Born introduced the idea of mechanical probabilities rather than definite entities,\(^3\) which was rejected by Einstein, who wrote in one of his letters: “I, at any rate, am convinced that He \textit{God} is not playing at dice” (91). In 1935, Einstein, Boris Podolsky, and Nathan Rosen published an article on the entangled states of two systems. Five months later, Bohr published an article in the same magazine and with the same title, refuting the so called EPR paradox. Another influential but more private discourse was the one between Einstein and Heisenberg. After meeting each other at a conference in 1926, the renowned physicists began sending letters back and forth, discussing new theories and challenging each other’s ideas. Their correspondence resulted in a number of groundbreaking ideas, like Heisenberg’s uncertainty principle, and set the path for further research. Mara Beller claims that “Heisenberg’s case demonstrates how genuine novelty emerges through dialogical creativity. Dialogical creativity is not an instantaneous ‘eureka’ experience; It is rather a patiently sustained process of responsiveness and addressivity to the ideas of others, both actual and imagined” (6). If this process of creative exchange can help advance theories within one field, would it not be of even greater impact if it was performed as an interdisciplinary dialogue? By combining two disciplines with different ideas, approaches, and a different mindset, the outcome may be of much greater significance, opening doors to new ideas and concepts that one single discipline cannot provide.

\(^1\) For a detailed account of these debates read Bohr’s article “Discussions with Einstein on Epistemological Problems in Atomic Physics”.
\(^2\) This will be further explained in chapter 1 as the “double-slit experiment”
\(^3\) This is later known as the “uncertainty principle”, which will also be discussed in chapter 1
In the field of literary studies and textual analysis, it has become a common practice to apply philosophical or psychoanalytical theories to literary texts. Among the most influential theorists are Michel Foucault, Giorgio Agamben, Jacques Derrida, Sigmund Freud, and Jacques Lacan, to name but a few. Their theories help us understand literature on a different level and draw parallels to human attitudes, mannerisms, or society at large. For example, when Freud identified the origin of certain types of neuroses, which he thought to be rooted in particular stages of an infant’s psychosexual development, he referred back to Greek mythology in order to explain his theory and make it more accessible to non-psychoanalysts. He used the myth of the Greek king Oedipus, who killed his father and married his mother, as a metaphor to explain a certain developmental stage that is experienced by boys in the form of castration anxiety, and by girls in the form of penis envy. As a result of this metaphor, he coined the term Oedipus complex.

In contrast to the connection of these fields, very few advances have been made in order to create a discourse between the hard sciences and literary theory. While Freud persisted in saying that psychoanalysis is a science, without providing convincing support for his claim, Lacan was the first who attempted to bridge the gap between the hard sciences and the arts through psychoanalysis. In 1971, he introduced a new concept, by using so called mathemes. Mathemes are meant to make his ideas more accessible to the broader masses by replacing the often complicated psychoanalytic jargon with a symbolic representation, similar to formulae used in mathematics and other hard sciences. Unfortunately, this new concept was not as successful as he hoped it to be and was met with a lot of criticism, particularly from literary scholars and those who saw psychoanalysis as a literary theory. Jonathan Gil Harris for example claims that Lacan’s mathemes “are topographical diagrams that imply a complex mathematical
understanding of psychic activity” (95), when in fact all it requires is an understanding of some of the most basic mathematical concepts. This assessment shows just how wide the gap between the hard sciences and literature is and that they basically use completely different sets of languages to convey their ideas. What Lacan seemed to misunderstand is that by translating his psychoanalytic jargon into scientific jargon, he did not speak to a broader audience but merely addressed a different kind of academic elite.

Therefore, I seek to help forward a significant connection between literature, literary theory, and the hard sciences, by demonstrating that these disciplines only seem irreconcilable to most scholars, because they use different metalinguistic coding systems. Bridging this gap, these disciplines can benefit from one another, by utilizing both their similarities and their differences, which I will demonstrate in this thesis. As representatives of the two applied theories, I chose quantum theory and Lacan’s psychoanalysis, because they are both considered particularly difficult to understand and use a significant amount of jargon. In most cases, scholars who do not study one or the other, do not engage in it at all. As a common ground for the literary analysis, I chose two plays by William Shakespeare. His plays seem to combine both worlds— science and literature; on the one hand, he is so popular that his works became an important litmus test for literature, and on the other hand, as mentioned above, the Early Modern period was an important time for the scientific revolution. New scientific theories and ideas abound and significant progress was made in fields like mathematics and physics. I am examining both tragedy and comedy as a way of understanding the connection between science and literature. In chapter one, I will first introduce a selection of the quantum theoretical and psychoanalytical theories applied in this thesis. Chapter two will focus on *A Midsummer Night’s Dream*, which seems to be portraying the quantum aspects in the most obvious way, such as the two worlds, the dreaming,
the concept of doubling, and the time discrepancy. For the second play, which will be discussed in chapter three, I chose the tragedy *Hamlet*, since it seems the most obvious choice for a Lacanian approach, not only because Lacan himself has chosen to analyze it, but also because of its portrayal of the aspects of mourning, the desire of the Other, and the gaze. By applying both theories to both texts, I will demonstrate that although one certain approach seems to be the obvious choice, others can also be applied and prove to be just as beneficial.

Working from the perspective of a literary scholar, my final claim is that literature can be used as an analogy to better understand both quantum theory and psychoanalysis, while at the same time, these two theories can help us understand or discover something new in literary works. By creating a discourse of not only literature and one theory, but literature and several theories, it is possible to cover a broader spectrum of ideas and interpretations. While psychoanalysis might help us understand the human behavior and drives, quantum theory helps us understand the composition of the world we live in and our connection to it. If we want to understand how everything interacts, we need to see the bigger picture, and that cannot be accomplished by merely focusing on one single theory, but by combining multiple different approaches and their different viewpoints.

Very few scholars have attempted to create a discourse between the “two cultures”, the sciences and the humanities, and even fewer have succeeded in creating one that demonstrates a meaningful connection between two or more of their disciplines. In *Shakespeare’s Double Helix*, Henry S. Turner analyses *A Midsummer Night’s Dream* from both a linguistic, and a scientific perspective. Unfortunately, instead of combining the two approaches and creating one continuous argument, the book consists of two completely different essays, which although related in some way, make two completely different claims and arguments. The structure of the
book is supposed to mirror the form of a DNA double helix, with the linguistic essay printed on the left pages, and the scientific essay printed on the right pages. The missing parts in his analogy, are the base pairs that combine the two strands of a double helix, meaning the connection of argument between the two essays.

The pioneer in providing a common ground for the two cultures is the literary scholar with a background in mathematics, Arkady Plotnitsky. For his publication, *The Knowable and the Unknowable*, he started creating a discourse between the sciences and the humanities the moment he started his research, for he communicated with and gathered information from representatives of both academic fields. His main focus is the dialectic of classical and nonclassical thinking and the importance of intellectual discussion. Plotnitsky explains that nonclassical thinking includes even that which is not known to us, and although nonclassical theories are aware that their investigated objects are beyond our knowledge or conception, they also acknowledge that the unknowable affects the knowable. He defines the unknowable “as that which is placed by such theories beyond the limit of any analysis, knowledge, or conception, while, again, having shaping effects on what can be known” (xiii). In opposition to this, classical theories are only concerned with the knowable, while “[t]he irreducibly unknowable, if allowed, is placed strictly outside their limits, rather than is seen, as it would be in nonclassical theories, as a constitutive part of knowledge” (xiv). In his book, Plotnitsky compares aspects of nonclassical theories, such as quantum mechanics, complementarity, and Lacan’s mathemes to classical theories like mathematics, mechanics, and physics, among others, to stress the point that ideas need to be exchanged across the boundaries of classical and nonclassical thinking and the two cultures of science and humanities. Plotnitsky finally concludes that getting these different disciplines to interact with each other “may enable us to open more effective channels of
communication and even ethical relationships between our two cultures” (xiii). Contrary to Plotnitsky’s more general approach of comparing different scientific and humanist fields and ideas as a whole, I decided to use a narrower approach. I will focus on a more limited selection of theoretical concepts of both quantum theory and Lacan’s psychoanalysis and then apply those directly to the two literary texts in order explore their relationship and establish a connection between all three disciplines, demonstrating how they can benefit from and utilize one another. I will first explain the scientific and psychoanalytic concepts used in this thesis in a way that they are easily accessible to both scientific and non-scientific readers. This means that quite opposite to Lacan’s approach with his mathemes, I will use neither mathematic formulae, nor psychoanalytical jargon in the following literary analysis, but “plain” linguistic metaphors in an attempt to break down the language barriers between the sciences and the humanities, as well as the academic and non-academic audience.
CHAPTER 1 - UNDERSTANDING QUANTUM THEORY AND LACAN

The first step to understanding the concepts of quantum physics is to understand the difference between quantum physics and classical physics. The most common explanation is that quantum physics function on a microscopic level, dealing with the smallest particles possible, like photons, while classical physics function on a macroscopic level, dealing with more tangible elements. In layman’s terms, this explanation might be correct, although it fails to grasp the complexity of the subject. Therefore, I will first of all amplify the main differences between these two fields and explain some of the most important quantum physical terms and concepts.

As mentioned in the introduction, classical physics was developed as its own individual field in the 16th and 17th centuries. Since then, classical physics has been based on the interweaving of experiment and theory in order to achieve empirical data collection. It requires a “precise treatment that predicts the evolution of the world through mathematical equations [following a] deterministic character” (Bès 1). Determinism is “the notion that all processes in the world, and in our minds, are algorithmic and our choices inevitable and predetermined, with perhaps a dash of randomness” (Hameroff 118). This is often opposed to the concept of free will. Quantum physics is a much younger discipline and is said to have been discovered at the end of 1900, by Max Planck and his formula “for the energy distribution of electromagnetic black body radiation” (Müller-Kirsten 1). Similar to the black hole in space, a black body has the quality of absorbing all incident radiation.

This concept of the black body already indicates the first major difference to classical physics and also the first problem that quantum physics has to address. The most common form
of a black body, is a black box, which has to be perfectly black on the inside, therefore allowing no observation of the internal structure. Elements can be observed entering the box and exiting it again in a changed state, without any knowledge of how this change occurred. A black box is an example for a quantum system, which is a small portion of the universe, selected by the researcher to study and analyze particle movements and their effects, both within that system and everywhere but that system. In order for a black body to completely absorb light or any kind of radiation, it needs to be a closed and sealed entity without any outer interference. As soon as a measurement apparatus is used to collect data, the interference changes the state of the investigated objects. When the observer opens the black box, light will enter and alter the state of the box since it is not a perfectly black body anymore; in further consequence, the particles inside the box are subject to change as well. This is one of the basic problems quantum physicists have to work around in order to collect data without compromising it. In classical physics, measurements do not influence the outcome of the experiment. For example, by measuring the speed of a car at a certain point of acceleration, the interaction of the measurement apparatus (speedometer) and the object system (car in motion), do not influence each other and do not change the state of either one of them. As opposed to this, “the investigated phenomena [in quantum physics] are so small that it becomes unavoidable to not change their properties during measurement. The observer is never a passively reporting entity, but always a reality-changing interfering entity” (Brüntrup 36). This problem is called the quantum measurement problem and deals with the question, how and why a wave function collapse occurs. The physicist and mathematician Eugene Wigner proposed a solution for this by explaining that the moment a conscious observation is made, it enters into the observers consciousness and changes their evaluation of probabilities for future impressions linked to the experiment. This understanding
can be used to modify the two dynamical laws of the standard-Dirac collapse formulation: “[I]f no conscious mind apprehends its state, the system S evolves in a deterministic linear way [and] if a conscious mind apprehends its state, the system S randomly, instantaneously, and nonlinearly jumps to an eigenstate of the observable being measured” (Barrett 67). Two terms that need further explanation before we move on are “wave function” and “eigenstate.”

In the 1920s, Clinton Davisson conducted experiments to research the nature of matter and its motion. He used electrons and shot them at crystal surfaces in order to analyze the pattern in which they would rebound. His observations showed that the electrons were not scattered randomly but “came out in an organized pattern. Particularly after his experiments, it became clear that these patterns were exactly like wave diffraction” (Davies and Betts 5). At this early stage, the experiment was only conducted with electrons, but later research showed that this wave-like pattern applies to all particles like protons, neutrons, mesons and whole atom molecules (ibid. 5). Einstein took this new observation one step further and explained that every elementary particle can be attributed both the properties of a particle and that of a wave. The only problem is that these two types cannot be observed at the same time because they exclude each other. This does not mean that they are contradictory, because they can in fact coexist, but they are simply complementary, since “[p]ure particle behavior requires localization of the particle, while clear wave behavior appears only when the particle has a definite momentum” (Bes 19). The problem here is again that of measurement and observation. In order to single out one of the two aspects, the observer has to modify the experiment in a way that it becomes impossible to also observe the other aspect. This phenomenon is called “particle-wave dualism” and is part of the “uncertainty principle” (Müller-Kirsten 13-14).
The uncertainty principle states that two complementary pairs of observables, as for instance coordinate and momentum operators, can never both be precisely measured (Bes 18). In case of a particle, its two characteristics are place – meaning its definite location along the coordinate axes – and momentum – meaning its motion, which can either be moving or at rest. Depending on which of the two characteristics is precisely measured and defined by the observer, the object will either appear as a particle or as a wave.

As an example, one could picture the beam of a flash light. By holding it steady, pointing at one spot at the wall, and not moving it, the beam will appear as a circle. This circle may represent the properties of a particle because we know its exact location but nothing about its momentum. But when the beam is quickly being swayed back and forth from one end of the wall to the other, it looks like a continuous jet of light, spreading all the way across the wall. This jet of light may represent the properties of a wave because we know its momentum but cannot measure a specific location.

From the uncertainty principle can be concluded that while one of the complementary variables can be exactly measured, the other one can only be assumed according to its probabilities, which fall within the scope of statistics. The accuracy of a predicted probability is directly proportional to the number of samples used in an experiment. The more data is collected and analyzed in an experiment, the more precise is the resulting probability distribution, which requires a statistical ensemble of the quantum system in question. In this case, a statistical ensemble is the experimenter’s assumption of a large number of identical virtual copies of the analyzed system. They all represent possible locations that the real system might be in (Müller-Kirsten 31). In other words, if a scientist performs one and the same classical experiment several times, they should always get the same result. If the results vary, they know that there is a flaw in
the experiment which they have to fix. A quantum experiment, however, may be repeated under
the same macroscopic conditions while the microscopic conditions cannot be controlled, leading
to a range of different outcomes that then constitute the statistic ensemble of the state of the
microscopic system. The result is a wave packet, which is a superposition of plane waves, all
with a slight change in momentum, meaning similar but not the same wave vectors (ibid. 131).
The next step is to describe this quantum state as an isolated system with all its particles and
probabilities, which can be done through a wave function. The wave function contains all the
information about every particle in this system, rather than having a separate wave function for
every particle.

Wave functions are elements of a vector space, and a set of those form a function space,
which in quantum physics is a Hilbert space. A vector is an abstract mathematical concept rooted
in linear algebra. They are usually visualized as arrows and contain two parts, direction and
magnitude. Vectors can be combined through addition and subtraction, or they can be multiplied
and divided by scalars, which are real numbers. A collection of vectors forms a vector space,
which in calculus and vector algebra are two- or three-dimensional spaces (Tiller 4-10). If the
vectors in a certain space represent functions, then it is also called a function space, and in the
case of superposition of wave functions, it can have an infinite number of dimensions and is
called Hilbert space. “A Hilbert space is a [vector] space together with an inner product that
endows the space with the structure of a complete metric space” (Alabiso and Weiss 1), meaning
a space in which the distance between every element is defined. The inner product of two vectors
is calculated by the multiplication of the lengths of the vectors and the cosine of the angle
between them (ibid. 63). This means that an inner product space, or Hilbert space, is a complete
metric space with the additional property of possessing the structure of an inner product,
allowing length and angle of the space to be measured, and while a metric space can only be defined through real numbers, a Hilbert space allows for complex values and dimensions of denumerable infinity. In terms of quantum physics, a “Hilbert space [can be defined] as the space of states of a physical system” (Müller-Kirsten 41).

In order to fully understand this, it is necessary to elaborate on the concept of a quantum state. According to quantum physics as opposed to classical physics, an elementary particle lacks definite physical properties and is defined only by probabilities of being in various states, which can either be a pure state or a mixed state (Müller-Kirsten 81). A pure state is represented by a single state vector in the Hilbert space, while a mixed state is a probabilistic combination of pure states, represented through a density matrix (ibid. 77). “A state vector […] is an abstract entity that carries information about the results of possible measurements. It replaces classical concepts of position and momentum in the description of physical systems” (Bes 9). Superposition is the addition of two state vectors, which will create another state vector in the same Hilbert space and therefore another pure state. Every pure state has an expectation value, and the sum of the values for each of the pure states is the expectation value of the mixed state. This can be computed as the trace of the product of the mixed state’s density matrix, which holds all the information of the above mentioned statistical ensemble. In short, a state vector or the superposition of state vectors describe a pure state and therefore the density matrix of a pure state has the property 1, which means that the probability for the determination of observables in this state is 100%. Statistical ensembles of pure states, meaning different state vectors, combined in a density matrix determine a mixed state. The property of this density matrix has a value between 1 and 0 since the probability for the determination of observables in a mixed state is always less than 100%.
This finally brings us to the point of understanding how a wave function collapse occurs and what eigenstates are. Pure states and mixed states are both expressed through a wave function, which is a combination of all possible states and their probabilities (in quantum physics called superposition), which are called eigenstates. As soon as the observable is measured, the pure or mixed state is resolved into an eigenstate (“eigen” is German for innate or natural). The resulting value is called eigenvalue. It is no longer a probability but a definite number measured in an experiment. This reduction from probabilities to certainties is called wave function collapse because “the wave package collapses into one determinate result” (Brüntrup 37).

These quantum physical concepts are very abstract and hard to grasp since they cannot be pictured or tested. While in classical physics, ideas and hypotheses can be tested through experiments, this is not always possible in quantum physics, and even if it is possible, the interference of the observer will influence the outcome of the experiment. Therefore, so-called “Gedankenexperimente” (German for thought experiments) are used in quantum physics in order to test a principle by exploring its potential consequences. The two most famous and also most important ones that aid understanding the basic quantum physical concepts are the “double-slit experiment”\(^4\) and “Schrödinger's cat.”\(^5\) I will now briefly introduce both of them to support the above explained theories.

The double-slit experiment, first introduced by Werner Heisenberg is meant to explain the wave function collapse phenomenon. In preparation for this experiment, the action of ordinary particles needs to be evaluated. By shooting small objects like marbles at a screen with one slit, it can be observed that a pattern forms on the back wall where the marbles went through

\(^4\) For a more scientific explanation see chapter 1.3 “Particle-Wave Dualism” (p. 12-13) in Müller-Kirsten’s *Introduction to Quantum Mechanics* for a more scientific account of the experiment.

\(^5\) For Schrödinger’s own account of this experiment see page 6 in his article "Die Gegenwärtige Situation in Der Quantenmechanik."
the slit, replicating its form and position. Adding a second slit to the screen and repeating the experiment will result in two linear patterns at the back wall.

The next step is looking at waves. By sending them towards the screen with one slit, they will radiate out in a semi-circular pattern, striking the back wall with the most intensity directly behind the slit. This area of intensity is similar to the line made by the marbles. But this pattern changes by adding the second slit to the screen. Two smaller waves emerge behind the screen, but when they expand, they inevitably hit each other. When the top of one wave hits the bottom of another wave, they cancel each other out, leaving an interference pattern on the back wall. While the highest intensity is in places where the two tops meet, there is no intensity where the waves cancelled each other out. This intensity pattern forms many bands on the back wall, as if there were many slits in the screen. The aim of these experiments was to establish the difference between particles and waves hitting a screen with two slits.

The final step is to bring this experiment on a quantum level. Electrons resemble the form of marbles in a microscopic size. By firing a stream of electrons through the slit, the same band that was observed in the marble experiment appears on the back wall. By firing electrons through two slits, one would expect to get the previously observed pattern of two bands on the back wall. Contrary to what is expected though, the pattern on the back wall is an interference pattern. So, how is it possible that microscopic bits of matter are fired through the slits, but the pattern that appears is that of a wave?

The most plausible answer seemed to be that after the electrons had passed through the slits, they were bouncing off each other, creating the interference pattern, which should be prevented by sending the electrons through one at a time. However, after an hour of doing that, the pattern at the back wall was still that of a wave. From a mathematical and logical point of
view, this is impossible. All at once the particle goes through both slits, it goes through none of
the slits, it goes through only one of the slits, and it goes through just the other slit. This
demonstrates a superposition of possibilities. They concluded on a physical level that the
electron starts as a particle, becomes a wave of potentials, goes through both slits and interferes
with itself to hit the wall like a particle.

In order to finally solve this problem, a measuring device was set up to observe one of the
two slits and see whether the electron was flying through it or not. But as soon as the observation
aspect was added, the electrons started to behave like marbles, going through either one slit or
the other and producing the pattern with two bands instead of the interference pattern. This
collapse of the wave function was induced by the interference of the measuring device, which
interacted with the electron and altered the result of the experiment because “the investigated
phenomena are so small that it becomes unavoidable to not change their properties during
measurement” (Brüntrup 36). The finding of this experiment led Heisenberg to propose another
version of his uncertainty principle. The original one defined the relationship between two
observables, like momentum and position, and the new one defines the relationship between
observable and measurement apparatus: “It is impossible to design an apparatus to determine
which hole the electron passes through, that will not at the same time disturb the electrons
enough to destroy the interference pattern” (Feynman et. al. 1-9).

Another interpretation of this experiment is the “many-worlds interpretation,” which is
even better highlighted by the second experiment, which was originated by Erwin Schrödinger in
1935. The Schrödinger's cat experiment was intended to explain the theory of quantum
superposition in regards to the Copenhagen interpretation, which says that the superposition of a
quantum system will only collapse when the system reacts with or is observed by the external world and is forced to collapse into an eigenstate.

Through his experiment, Schrödinger explained how to theoretically create a superposition in a macro system, with the superposed elements being an alive cat and a dead cat. His experiment goes as follows:

A cat is locked up in a steel chamber with nothing but a device placed in a way that is unreachable for the cat. This device is a Geiger counter with a very small amount of radioactive substance in it. This amount is so small that one of the atoms might decay within an hour, but it might as well not. The chances are 50% to 50%. If the atom should decay, it will start a chain reaction, causing the counter tube to discharge, which then releases a hammer, which shatters a small flask, which contains hydrocyanic acid, which if released will kill the cat instantly. Therefore, without interfering, one will not know whether the cat is alive or dead after the hour has passed. The wave function of the system within the chamber would be a mixed state of both a dead and an alive cat.

The idea was to transform the indeterminacy of a microscopic cosmos into a macroscopic one which will allow for the change to be observed. In this case the observable indeterminacy was that of an existing superposition of states and the time when it collapses to either one or the other state. If the cat survives, it will only remember being alive, while if the cat dies it will not remember anything. So this raises the question whether the cat can even function as an observer, and how an external observer can be utilized without changing the outcome of the experiment.

While this is obviously only a brief account of the very basics of quantum theory, it is enough to understand the basics needed for this thesis. In order to complete the account of theoretical background, I will now also summarize Lacan’s concepts of psychoanalysis, with a
particular focus on the three stages, the Real, the Imaginary, and the Symbolic, as well as the desire of the Other.

As Jacques Lacan explicates in “The Mirror Stage,” every human being experiences three developmental stages: the Real, the Imaginary (Mirror stage), and the Symbolic Order. In his speech “The mirror stage as formative of the function of the I as revealed in psychoanalytic experience,” Lacan explains the process going on within a child’s mind that is set in motion through the realization of a connection between image and reflected environment, triggered through the gaze in a mirror (Ecrits 1-7). This moment occurs when an infant sees himself/herself in the mirror and realizes for the first time that it is their own reflection gazing back at them, which is “prior to any social interactions” (Lynch 209). At this point, the child experiences a split, a fragmentation of their identity. Up to this moment of realization, within the stage of the Real, the child thought that it was one with the mother, when it suddenly realizes that it is its own entity and has its own identity, the I. The infant recognizes his/her own subjectivity in relation to their surroundings, including their mother.

Lacan refers to this first encounter with the mirror as “Aha-Erlebnis, [which is] the expression of situational apperception” (Ecrits 1). This moment of identification and the concomitant transformation within the subject is termed “imago.” This term is borrowed from the field of entomology, where it refers to the perfect and final stage of an insect, after it has undergone metamorphosis. As opposed to this, in Lacan’s “little myth” of the Mirror Stage, it is also the perfect but first stage of the I, the first image of one’s own identity, which has not yet been influenced by any other outer factors. Although this stage of the imago has already caused a first fragmentation of the self, we can never regain this uncorrupted I in later stages of life, since it “is precipitated in a primordial form, before it is objectified in the dialectic of identification.
with the other” (Ecrits 2). The first reflection is only one that is not yet determined by outer influences. Lacan refers to this first mirror-image as Gestalt, which is the German word for form. This Gestalt “symbolizes the mental permanence of the I, at the same time as it prefigures its alienating destination” (Ecrits 3). We take this Gestalt for our true self while in reality it is merely a distortion of our self. Therefore, this first encounter with the mirror is the beginning of our alienation from our self that can never be reversed. From this moment on, the I moves like an asymptote, forever trying to get back to that first, perfect stage without ever being able to reach it again.

This alienation continues, caused by the subsequent mirrors a person encounters throughout their life, which will reflect their self back to them. These are not mirrors in the literal sense, but can be outer influences such as society, national identity, or the Other. All these mirrors supply different reflections and lead to an ever further modification and fragmentation of the self.

In terms of visual identification, Lacan does not disregard Freud’s concepts but has a slightly different approach and introduces new ideas. Both Freud and Lacan are convinced of the primacy of the phallus. According to Freud, everything is rooted in a child’s realization of the lack of the mother’s phallus. This realization causes castration anxiety, which is the reason for several diagnoses, like paranoia, the development of a fetish, or psychosis. In Freudian theory, everything leads back to castration anxiety. The point where the theorists’ ideas diverge is the moment when the child realizes that he/she is not one entity with the mother. For Freud, this first phase is followed by the child’s identification with the father as their role model, which to him is the reason why women are often attracted to men resembling their father, while Lacan differentiates between homeomorphic and heteromorphic identification. Homeomorphic
identification is the identification with one’s own body. By drawing parallels to Freud’s idea of attraction, this indicates that both men and women seek partners that visually resemble themselves. Heteromorphic identification is “an identification with a different body” (Ecrits 4). Lacan reaches towards entomology again and uses the example of mimicry to explain the human desire to fit in. All the figurative mirrors that reflect our self back at us leave an imprint of their own impression of our current self and how it rather should be. For example, if the mirror is another person’s gaze, the reflection of our self will be influenced by the other person’s ideals, moralities and how they view our self. Their judgment will leave a mark. “From the moment that this gaze appears, the subject tries to adapt himself to it, he becomes that punctiform object, that point of vanishing being with which the subject confuses his own failure” (Seminar XI 83). In case of society as the mirror, these influences are even more numerous and diverse and trigger a person’s desire to constantly adapt and evolve in order to master their surroundings. However, Lacan comes to the recognition of “the effect in man of an organic insufficiency in his natural reality” (Ecrits 4) and that human knowledge is determined in a so called “little reality,” which means that we are haunted by a permanent sense of imperfection while yet relentlessly striving for perfection.

In addition to homeomorphic and heteromorphic identification, Lacan also uses the terms Innenwelt und Umwelt, which are German for inner world and outer world. The Innenwelt, the I, is dependent on the interaction with the Umwelt, the environment and surroundings. He explains this with the example of the cortex, which is part of the cerebrum and functions as an “intra-organic mirror” (Ecrits 5). The cortex is the part of the brain that harbors sensory-, motor- and association areas and is responsible for the meaningful perceptual experience of the world. In order for the brain to produce output, it needs a point of reference, an outer influence that it can
process. In terms of the Mirror Stage this means that the I only comes into being through the association with an outer image.

The third and last stage is the symbolic order, which is triggered as soon as an individual is introduced to language. The entry into the linguistic world of signifiers and signified objects introduces the desire of the Other. It is important to mention that the Other does not have to be related to otherness but that it is the Symbolic Order as such. John P. Muller equates the Other with Freud’s concept of the unconscious. Both are structured like a language and “like language itself [are] other than what is given to conscious awareness, it is a form of thought that takes place on ‘another scene,’ Ein anderer Schauplatz” (149). This means that in linguistic terminology, the Other can be compared to the pure content of the message, the level of objectiveness, beyond any intention of the speakers. In Lacanian terms, the Other, in the Symbolic Order, is connected to desire, while the self, in the Imaginary stage, is connected to identification. So by saying that one is acting on the desire of the big Other, this can certainly refer to the desire of other people, but it can also be related to cultural rules, socio economic factors and every other part of the Symbolic order, since “[m]an’s desire is the desire of the Other” (Seminar XI 235).

In addition to the aforementioned castration anxiety, Lacan also identifies other “side effects,” which can be caused by the transition from one stage to the next. One of them is the Oedipus complex, which is caused by the transition from the Real to the Imaginary. Separation anxiety, caused by the split from the mother and the recognition of one’s own self, often results in an urge of the individual to be one with the mother again, which they think is only achievable through sex with her. Through the combination of the Imaginary and the Symbolic Order, some individuals may fail to distinguish between self and other and therefore between identity and
desire, which, according to Lacan, is the reason for people being attracted to the same gender as their own.⁶

These summaries of quantum theory and Lacan’s psychoanalysis only focus on a portion of the two fields, simply because a more detailed account would go far beyond the scope of this thesis. The theoretical background provided here will be the basis for the following analyses of *A Midsummer Night’s Dream* and *Hamlet*, and I will only refer to terms and concepts already explained in this chapter. The next two chapters aim at showing a connection between science, psychoanalysis, and literature. In particular, a connection that is not dominated by one superior discipline "teaching" the others, but by a mutual discourse that proves to be equally beneficial for all three academic fields.

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⁶ One of the points of criticism in regards to Lacan’s theory is his focus on the mother’s lack of a phallus and the concomitant castration anxiety. Admittedly, Lacan does not refer everything back to the phallus as Freud does, but he still sees it as an important factor in the equation. The question is why he fails to recognize that not having a phallus must not automatically be equated with a lack? Lacan completely disregards the idea that one can experience the Real, the Imaginary and the Symbolic Order without any traces of castration anxiety or the notion of a lack related to the phallus.

Another blind spot in Lacan’s theory of the Mirror Stage is the age span of 6-18 months, which he provides for the time frame in which a child first recognizes the connection between image and reflected environment. Lacan never offers an explanation for the numbers he provides. A possible explanation might be rooted in the findings of the so called “lipstick-test”. For this test, a lipstick is used to draw a red dot on a child’s nose. They are then put in front of a mirror in order to see how they react. The study revealed that children usually recognize themselves in the mirror between the ages of 13 and 24 months (Webb). This point is reached when the child stops trying to wipe the lipstick off the mirror and touches their own nose instead. Although the two age spans do not correspond perfectly, the lipstick study could be used to provide evidence for Lacan’s claim.
CHAPTER 2 - QUANTUM DREAMING: AN ANALYSIS OF A MIDSUMMER NIGHT’S DREAM

By thinking about Shakespeare’s plays through a quantum theoretical lens, it becomes clear that A Midsummer Night’s Dream displays the most obvious characteristics that support a reading of literature and drama in the context of physics. The play illustrates Shakespeare’s use of quantum theory. The plot is set in two different worlds, the classical world of the humans and the magical world of the fairies. By taking a closer look at these two spheres, it becomes obvious that they are juxtaposed in a similar way as our classical physical world and the quantum world. The classical world, the one that we live in, is defined by determinacy, by cause and effect, as opposed to the probabilistic character of the quantum.

In A Midsummer Night’s Dream the world of the humans is governed by the royal law, which means that every action will result in a particular consequence. Therefore, every cause has a predetermined effect. In Hermia’s case, she is given two options that are unchangeably bound to two outcomes, determined by the sovereign power:

EGEUS. I beg the ancient privilege of Athens,
As she is mine, I may dispose of her:
Which shall be either to this gentleman
Or to her death, according to our law
Immediately provided in that case. (1.1.41-45)

This law leaves nothing to chance and is therefore like an experiment with an already predicted outcome. It is like choosing between two glass doors. Since one can see what lies behind both doors, the outcome of the experiment is already determined and the result known at the moment the decision is made. The final act of walking through the glass door is then merely symbolic.
This changes, however, as the lovers wander into the woods, leaving the world of the formal court and the sovereign state, and entering the world of the fairies. Chaos takes over and no outcome can be precisely predicted until it actually happens. This part of the play can serve as a useful analogy for a quantum theoretical experiment, helping us visualize and understand the different components and how they collaborate. In Shakespeare’s scenario, Oberon signifies the scientist conducting an experiment set in the quantum world. His sovereignty is put into motion by his jealously regarding Titania, and the “laws” of the fairy world are not based on the same sort of social contracts that seem to exist in the court. Yet, Oberon and Titania parallel Theseus and Hippolyta in that they are powerful figures who make their own laws as they progress in their actions. At the beginning, Oberon is merely driven by envy and entirely focused on getting revenge on Titania for what he perceives to be her infidelity to him. When the four humans enter the woods and cross his path, Oberon gets distracted and in the spirit of a true scientist, seizes the opportunity to toy with them.

Now this point of the four lovers entering the fairy/quantum world is crucial for the argument of this thesis, because the following analysis can be conducted on the basis of three different theories, interpreted from three different perspectives, and used to help understand additional aspects of all three disciplines. For the sake of a continuing argument, let us begin with the quantum perspective in order to see how *A Midsummer Night’s Dream* functions like a thought experiment to explain different states of particles. As mentioned in the previous chapter, every particle can be in a pure state or in a mixed state, which is a superposition of all possible eigenstates. Upon measurement of the observable, a wave function collapse occurs in which the pure or mixed state is resolved into one single eigenstate, turning one of the probabilities into an actual, measured value, termed eigenvalue. When we now apply this to the four lovers, we have
to think back to the laws of the royal world. Since everything is determined through cause and effect and we know the outcome before we even have to conduct the experiment, the factor of probability is eliminated and we have definite values instead. This means that when we treat the four lovers as particles they enter the fairy world in their determined eigenstates with their eigenvalues because their course has already been predicted through the royal law. However, since in Shakespeare’s plays, “the course of true love never did run smooth” (1.1.134), just like the function of a wave, the law cast upon them loses its effect once they enter the new world of chaos. From this point on, nothing is predetermined anymore and the four lovers/particles fall back into a pure state, every one of them with their own set of probabilities. As soon as two or more particles collide, they interact with each other and cause a series of superpositions of the different states through addition and multiplication of their state vectors. These vectors are represented in the play through the emotions and feelings of the lovers toward each other, which constantly change due to Puck’s mishandling of the love potion. In a scientific setting, the love potion would be equal to a measurement apparatus, and Puck is the involuntary influence an observer has on the quantum world, simply by entering it. He adds the unpredictable factor of quantum indeterminacy. Whenever one of the lover’s emotions changes, it leads either to a superposition of states or a reduction to a previous state, based on the influence on the other lovers. Meaning, when Demetrius falls in love with Helena and her feelings towards him are mutual, their wave functions collide and they are raised to a mixed state. If, however, Helena does not respond to his love, their functions will not collide and he simply evolves to a different pure state, that of a man being crossed in love. Once that spell is lifted, he is reduced back to his previous state. The final superpositions of wave functions are those of Lysander and Helena, and Demetrius and Hermia. The two couples are now in mixed states and share their combined sets
of probabilities. Upon entering back into the real world, the factor of probability vanishes again, and when the new pairings are accepted by the royals, their wave functions with all their probabilities collapse and they are now reduced to two new eigenstates with definite eigenvalues, one being the couple Hermia and Demetrius, and the other one the couple Helena and Lysander. In other terms, the four lovers who started out in the fairy world as individual particles, each with their own set of probabilities, paired up in sets of twos, combining both their probabilities until they finally reach a state of equilibrium, represented by a couple, united in love, turning their probabilities in definite values. The mutual attraction of quantum particles and their constant attempt to change and adapt to their surroundings until they find their perfect partner can be explained by the four lovers’ journey through the fairy world and their many unlucky constellations, until they found the right partner to spend the rest of their lives with.

The second option of analysis uses quantum theory in order to add a new perspective to the play, in particular regarding the dynamics of the four lovers and the role of the observer. The hierarchy in *A Midsummer Night’s Dream* seems clear. Oberon has sovereignty over the woods and over Theseus, and Theseus has sovereignty over the law, but the four lovers seem to have no sovereignty over anything. The characters are empty and therefore interchangeable. But by viewing them as these floating particles, we can draw a parallel between the play as such and a quantum experiment. Within the confinements of the play, Puck functions as the observer of the particles, although he is not the only one. Every play has an audience and the audience as a whole functions as another observer that also influences the particles. Both the play and the quantum experiment start with a predetermined set of probabilities, which can turn into different certainties, depending on the influence of the observer. So for example, in the double slit experiment, the measurement can be either a particle, a wave, both, or neither. This means that
this particular experiment does not have an endless set of probabilities, it has exactly four. Therefore, the influence of the scientist conducting the experiment can turn either of these four probabilities into a certain value, an eigenvalue. The same applies to stage productions of plays. The reaction of the audience has a certain influence on the performers, the particles floating around on stage. Obviously, one needs to acknowledge that there is a limit to the scope of possible outcomes of the play. The influence of the audience will not change the plot, but depending on how they react to certain aspects of the actors’ performances, they may choose to represent their character differently in the following scene, for instance by adding a more comical or a tragic note to their performance. By drawing a parallel between the stage performance of a play and the execution of a quantum experiment, the influence of the scientist as an observer, can here be used as a metaphor for the audience and shows that they are not merely passive observers but have an active influence on certain micro aspects of the play. On the one hand, this metaphor is a vivid way of thinking about the flexibility that becomes activated in every performance, reminding us of its uniqueness, and one the other hand, it helps explain these dynamics of theatrical performances to scientists and other non-literature scholars.

Finally, these two concepts can be connected to Lacan’s psychoanalysis and will show that a discourse between all three fields, quantum theory, psychoanalysis, and literature, offers new perspectives and a means of communication between specialists of different fields as well as non-academics. Everything in our environment is connected, and we need to learn how to equally connect our different ideas, approaches, and worldviews in order to see how everything comes together and maximize our combined knowledge and understanding of the world. Lacan’s concept of the gaze and the desire of the Other offers a different explanation for the phenomenon that the audience can influence the performance of the actors, that particles are attracted to each
other and attempt to combine their probabilities in an attempt to strive for equilibrium, or that the four lovers in *A Midsummer Night's Dream* desperately try to find a partner. Lacan explains that from the moment we enter the discourse with the Other, we are subjected to the desire of the Other. This means that we start noticing how things, people, concepts, ideologies, and everything else interacts in our environment, how they react to us, how they perceive us, how we perceive them, and how we want to be perceived by them. All these are combined by Lacan under the term Other. From this moment on, and this can be before we are even introduced to language, a human being can never again stop noticing the Other. As a result of our inherent desire to fit in and be in conformity with our surroundings, we will constantly change and adapt, just like the actors adapt to the reaction of the audience, a set of probabilities collapses into one definite value, or particles strive for equilibrium.

Circling back, another moment of the play that shows significant traces of quantum theory occurs when the four lovers wake up in their own world after their shared dream. According to the law of quantum *decoherence*, a certain state can never be precisely restored to its initial state. There is a constant exchange of information between particles, systems, and the environment, which means that changing one energetic state automatically induces change in its surroundings. Even if, through the expenditure of energy, a state is given all its properties back and therefore returns to its original state, the entire environment can never be restored, leaving the “new” original state in a changed environment (Bes 170-171). For *A Midsummer Night’s Dream*, this means that once Puck’s mistake has been undone and Lysander’s state is reduced back to his initial state of loving Hermia, a change in environment needs to occur as well, which happens when the four lovers are sent back to their original world. In the same way a state cannot be returned to its original without affecting the environment, a state can also not be
moved back to its original environment without this motion causing some sort of change in its properties. This change is present in Demetrius, who left the human world being in love with Hermia, but reenters it being in love with Helena.

While this explains the correlation between the two different worlds, the elements of dream and the magical potion seem to be purely artistic choices made by the author to create a more interesting storyline. But even these seemingly random factors add to the entire concept of a quantum world within a classical physical world. This concept of two worlds is mirrored in the passage where Helena laments about the flaws of love, saying that “Love looks not with the eyes, but with the mind; / And therefore is wing’d Cupid painted blind” (1.2.234-235). The same way true love cannot be detected through the mere eye, the quantum world is also hidden in a microscopic plane. Both are difficult to detect, and although she first claims that love sees with the mind, Helena changes this statement, acknowledging that love is rather driven by impulse: “Nor hath Love’s mind of any judgement taste; / Wings, and no eyes, figure unheedy haste: / And therefore is Love said to be a child, / Because in choice he is so oft beguil’d” (1.2.236-239). This does not only align with the quantum world, which exists beyond the spheres of our logic, but also with Lacan’s claim that love equals the square root of negative one. Since we have no definition for square roots of negative numbers in the realm of the rational numbers, it can only be defined within the range of irrational numbers. Therefore, Lacan claims that love is irrational and defies any idea of logic known to men, meaning it can also not be depicted visually, which brings the argument back to the claim that love cannot be perceived by the mere eye.

Stuart Hameroff claims that “[c]onsciousness seems related to the boundary between quantum and material world” (100), and at the same time, consciousness is defined by the distinction between dreaming and being awake. When we fall asleep, our unconscious awakens
and helps us process the residues of our daily life. According to Sigmund Freud, a dream is not random, “senseless, [or] absurd, [but instead] a psychic phenomenon of full value” (111). Upon awakening, the dreamer might not see any connection between the dream and their lived experiences, because the dream is not a direct copy of the way their conscious mind has perceived this experience. It is rather an abstract recollection that requires skilled interpretation and a high level of attention to detail in order to connect the content of the dream to the respective real life experience, for it is “a highly complicated intellectual activity” (111). It almost seems like the process of dreaming takes us into another world, which, just like the quantum world, does not abide by the rules of our conscious logic and renders it impossible to determine specific factors such as time and space. Neither the dream nor the quantum can be directly experienced by the conscious mind, but both can be analyzed and interpreted from the outside. Brüntrup explains that “[t]he problem with quantum mechanics is […] not simply the interference of the observer with the observed objects but that the very nature of the quantum realm seems bizarre and incomprehensible to us” (37), seen “as the behavior of particles in this state seems to defy the laws of logic.” (36) In this case, a parallel can be drawn between the conscious, awake, and the material world on one side, and the unconscious, dreaming, and the quantum world on the other side. In *A Midsummer Night’s Dream*, the transition between conscious and unconscious occurs when the four lovers fall asleep, thus entering the dream/quantum world. By adding the supernatural element of the love potion, Shakespeare provides his audience with an access point to this seemingly illogical part of the play. The audience is familiar with the concept of magic, knowing that it is a fictional creation that cannot exist within the confines of logic in our world, which can therefore bridge the gap between the world that we know and the seemingly peculiar laws of the dream/quantum.
One question that many have pondered over is the discrepancy of time in the play. While “[t]he dramatic action ought to cover five days; only three are accounted for” (Paolucci 317). At the beginning of the play, Theseus announces that it will only be four more days until their wedding, and Hippolyta concurs: “Four days will quickly steep themselves in night; / Four nights will quickly dream away the time” (1.1.7-8). Considering that the day of the wedding is the last day of the play and that this first day has to be added to the count, the play is supposed to span over a five-day period.

During the first day of the play, a meeting between the four lovers, Hermia, Lysander and Demetrius, and the royal sovereignty, Theseus and Hippolyta, takes place in Athens. Addressing the problematic love triangle, Hermia is given two equally unsatisfactory options to choose from. As a result, all four lovers run off into the woods, where the day ends with them falling asleep. The magical dream sequence happens on the second day, which contains most of the play’s action including the royal humans as well as the fairy King and Queen and the group of laborers. This day also ends with the four royal lovers falling asleep in the woods. The third and last day begins with the four humans waking up in a field, being discovered by Egeus, Theseus and Hippolyta, and ends with all three couples getting married. In order to find out the actual number of days that occur in the play, it is important to know which of the characters experienced which time period. The only people who experience a five-day time frame are the courtly royals. For everyone else, the plot seems to be stretched out over only three days. The important factor that distinguishes the temporal differences that affect the two groups is that of place. It seems like everyone who spent the third day in the quantum world experienced only one day, while those who spent it in the classical world are of the impression that three days had passed. However, neither of the two answers is correct nor incorrect. By again imagining the characters as particles
in a quantum state, the time discrepancy is simply a result of Heisenberg’s uncertainty principle, which states that two complementary variables, in this case time and space, can never be measured with the same amount of accuracy. The more precisely you determine the value of one variable, the less precise becomes the value of the other one. In *A Midsummer Night’s Dream*, the value of time is determined as one day only in connection with the correlating space variable of the fairy world. A second measurement that uses the classical world of Athens as its space variable results in a time variable with the value of three days. This means that neither of the two time units is wrong, but that the temporal determination simply depends on the viewpoint of the observer and that these distinctions are uncertain.

Closely related to the uncertainty principle is the idea of quantum indeterminacy or the measurement problem (as mentioned in the previous chapter in correlation with the experiment of Schroedinger’s cat, as well as briefly noted above in correlation with Puck). In *A Midsummer Night’s Dream*, Puck represents the connection of the quantum world and the classical world. He is the element of chaos that makes it so complicated for the analytical and deterministic mind to understand the quantum world and to predict the outcome of experiments conducted in the quantum sphere. In a classical physical experiment, the scientist can directly interact with the material because it is visible to them and does not acquire any aids that bridge the gap between the scientist’s world and the quantum world, which makes the experiment more determinable. In a quantum experiment, however, the scientist needs to rely on these devices to bridge said gap, which add another factor of uncertainty, represented by Puck. Oberon thinks his instructions are clear and there is only one way to follow them:

Oberon. Take though some of it, and seek through this grove:

A sweet Athenian lady is in love
With a disdainful youth: anoint his eyes;
But do it when the next thing he espies
May be the lady: thou shalt know the man
By the Athenian garments he hath on. (2.2.253-258)

However, he is not aware that he cannot see everything that happens in the quantum world, so he fails to recognize the fact that not only two but four humans have entered the forest. Oberon’s sovereignty is limited, uncertain, and indeterminate. These added variables make the difference between determinant and probability. Since Puck now has two couples to choose from, this leaves him with a probability of only 50% to choose the male Athenian Oberon wanted him to choose, and another 50% to choose the correct female Athenian. By means of statistical ensembles, his chances of choosing both the correct man and the correct woman are only 25%.

The probability distribution of 50% is also not chosen by random. In A Midsummer Night’s Dream, the numbers two and three seem to be in constant opposition with each other. While two is regarded as desirable, the number three as an odd number stands for imbalance and disunity, which is demonstrated by the various love triangles that only cause chaos and heartache: “Lo, she is one of this confederacy! / Now I perceive they have conjoin’d all three / To fashion this false sport in spite of me” (3.2.192-194). Contrary to that, the number two is valued both in the human world as well as in the fairy world.

A brief digression to Early Modern numerology will be helpful here to provide some background on the meaning of the number three, which was then seen as the number of courtly love and the holy trinity. In case of the holy trinity, the explanation found in The Bible goes against any logical mathematical explanation. On the one hand, God seems to unite three personae into one, God the son, God the father, and God the Holy Ghost. On the other hand, The
Bible states that there is only one true God. According to science, there are only two possibilities to solve this equation. Either God is split into three parts which means: \[ \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1 \], or God is not truly one but truly three: \[ 1 + 1 + 1 = 3 \]. Neither of these equations is able to explain the relation of God and the holy trinity, which means that the divine world does not obey to the scientific rules of our three-dimensional world. In case of the concept of courtly love, the number three stands for the triangular relationship of a person with their lover and their spouse.

Especially in regards to noble marriages, love was usually not a determining factor, but rather the possibility of raising the family’s societal status and their wealth. As a result, one had to commit adultery if they wanted to be with their true loved one, and so the concept of courtly love was introduced. It was somewhat of a loophole for the couples so that they could get married according to their families’ arrangement and still experience love without breaking the law since courtly love was accepted, or at least tolerated by the royal courts. This made the triangular relationship legal but left it still morally questionable. Considering these Early Modern affiliations with the number three and Shakespeare’s emphasis on its negative connotation, one could assume that he was positioning himself on the side of science and morale, rather than religion and courtly law.

The entire world of the humans in *A Midsummer Night’s Dream*, is determined by cause and effect, right and wrong, and either and or. In terms of the law, everything is easily divided into two opposites, meaning either obeying or defying the law. Egeus, therefore, gives his daughter two options: “As she is mine, I may dispose of her: / Which shall be either to this gentleman / Or to her death, according to our law” (1.1.42-44). Adding a third option would mean a legal gray area, which would only complicate things, so Theseus gives Hermia two
options, which are “[e]ither to die the death, or to abjure / For ever the society of men” (1.1.65-66).

In the fairy world, the third factor is always the one causing trouble by disrupting the harmonic binary of the lovers. For Oberon and Titania, it is first the Indian child that is a thorn in the fairy king’s flesh, and when he tries to reconcile the love relationship with his fairy queen, it is Bottom, who functions as the disruptive third element. The same applies to the four lovers, who stumble from one love triangle constellation to the next. This odd connection of three and the concomitant singling out of the fourth person leaves them in a constant state of confusion and dissatisfaction, which hints at the issue of courtly love and its concept of someone being married to one person yet loving another one. The only solution for this would be a married couple with both partners finding their courtly lover in another married couple, turning the odd number three into the even number four, and thus eliminating the problem of singling out one person. For Shakespeare, however, this was also an unacceptable solution, since he would not finish his play until all characters were allowed to marry not according to status but based on who they really love. He therefore eliminated the need for courtly love entirely.

The only character that seems to find the chaos caused by the addition of a third element satisfactory is Puck: “[t]hen will two at once woo one; / That must needs be sport alone; / And those things do best please me / That befall preposterously” (3.2.118-121). Very fittingly for him being the reason of all this chaos, Puck also seems to be the only one who is not in search of a partner, but who is simply content in his role as knavish sprite. The rest of the characters strive for a unified duality. The sole purpose of Oberon’s doings is to achieve a clear pairing into twos for both him and the humans. This wish is finally satisfied when the four lovers awaken from
their strange excursion to the fairy world, and Hermia notices: “Methinks I see these things with parted eye, / When every thing seems double” (4.1.190-191).

The only occasion when the number three is deemed desirable is when it appears together with the number two, which is firstly stated by Theseus, who announces the big wedding celebration: “Away with us to Athens! Three and three / We’ll hold a feast in great solemnity” (4.1.185-186). And later also by Oberon: “So shall all the couples three / Ever true in loving be; / And the blots of Nature’s hand / Shall not in their issue stand” (5.1.396-399). In this case, it is not actually the number three but the number six that both of them are discussing, for it is the result of two multiplied with three. Every multiple of two can be split up into pairs without leaving one singular item standing alone. Therefore, any even number is accepted in the world of *A Midsummer Night’s Dream*, because if broken down into its parts, it still satisfies the need for duality. Even the last possible division (of the number two) does not result in leaving one single item behind, while the others all remain paired up, but a pair of individual elements, which is then again a form of duality.

But how does this focus on the number two relate to quantum mechanics? As mentioned in chapter one, an elementary particle lacks definite physical properties and is defined only by probabilities of being in various eigenstates, the sum of which is a so called pure state. When two particles interact, they are not defined by their own probabilities anymore but by the combination of their individual probabilities, which can be calculated by the product of their state vectors. Through this superposition, the states of the particles will change until they reach equilibrium and they stop changing. Once this point is reached, the mixed state of the two particles is its own new pure state. A metaphor for this phenomenon can be found in the following passage, where
Helena reminisces about how she and Hermia used to be united as one, before love’s rivalry and the opposite sex split them apart:

HELENA. We, Hermia, like two artificial gods,
Have with our needles created both one flower,
Both on one sampler, sitting on one cushion,
Both warbling of one song, both in one key,
As if our hands, our sides, voices and minds,
Had been incorporate. So we grow together,
Like to a double cherry, seeming parted,
But yet an union in partition;
Two lovely berries moulded on one stem;
So, with two seeming bodies, but one heart;
Two of the first, like coats in heraldry,
Due but to one and crowned with one crest. (3.2.203-214)

At First glance it seems like Hermia is not talking about two things coming together, but about her and Helena breaking apart; however, this passage needs to be seen as part of an extended metaphor in which friendship mirrors the concept of superposition. The friendship between two people can either evolve, break apart, or not be viable to begin with, the same way particles and their states can. Two particles can superpose and combine their two states to one new mixed state until they form a new pure state, which then continues superposing with other states, as in a friendship between two people that keeps evolving and adapting to new life situations and new
people around them. Instead of evolving and reaching new states together after they superposed, particles can also be reduced back to their initial states, which is what happens to Helena and Hermia when their friendship breaks apart over their love rivalry. The third possibility is for two particles to just not interact at all, just like two people whose character traits are irreconcilable or who are prevented from getting along by outer influences and can therefore never be friends.

To elaborate a little further, an example from the classical world would be the combination of liquids. If two immiscible liquids, like water and oil, are poured together in one vessel, they will simply not mix and therefore not combine their states to a shared one. If two miscible liquids with different temperatures, different densities, and different heat capacities are poured together, they will first be in a mixed state, for different areas of this new concoction will show different quantities of either of the three units. After a while, the process of superposition is completed and there will be one uniform quantity in every place of the entire vessel. At this point, the two previous liquids cease to exist by losing all their individual properties and turning into one new liquid with a shared set of properties and a new pure state is created. From this point on there are two different developmental options. The mixture of liquids might be reduced back to its previous state through some sort of outer influence, like water and ethanol when they are heated to a temperature above the boiling point of ethanol but below the boiling point of water. The ethanol will turn from its liquid form into gas form and rise up into the air until it reaches a point of temperature that turns it back into its liquid form. This leaves both liquids in its initial states, noted though with a change in place, since as mentioned above, no particle can be reduced back to its original state without it causing a change in environment. The other option is a continuous superposition. By pouring milk into coffee, the two liquids will mix and develop a new combined state. This new particle then correlates with another particle; for example, if
someone drinks the mixture, it will then mix with whatever liquids are already in the stomach of this person, turning it into one new type of liquid. When it leaves the body, it will mix with the next liquid it encounters, because eventually every combination of particles strives for the state of equilibrium, leaving their previous probabilities behind and creating a new set of shared probabilities. This can be visualized like an inverted tree diagram, starting from the broad bottom with all singular particles, and then working its way up in potencies of two, continuously combining two adjacent particles on every level, until there is only one singular particle left at the top, which would then embody the final universal equilibrium.

As mentioned above, in *A Midsummer Night’s Dream*, the humans can be seen as particles, which are forced to interact with each other, although not according to chance but according to the way Oberon sees fit. This happens in a hierarchical order, starting within the human circle. The court has sovereignty over the four lovers and attempts to match them up according to Egeus’ wishes over his daughter. However, they are overruled by the sovereignty of the fairy king, who has his own agenda and stirs the lovers in different directions. He first starts by pairing up two of the lovers, who will lose their individual probabilities and form a new set of shared probabilities, that of a couple in love. Once this is achieved, the newly formed particles interact with each other (Hermia and Lysander, Helena and Demetrius) to once more reach a state of equilibrium, as do the two sovereign couples (Hippolyta and Theseus, Oberon and Titania) in terms of common consent of the pairings. In the end, as Oberon reconciles with Titania, and the three human couples have accepted one another, a final state of equilibrium, at least concerning the eight characters, is achieved through the shared factors of love, happiness, and acceptance. None of the original particles exist in their pure state anymore but have formed a combined new state, which can now be described by their combined probabilities or rather by
one shared set of probabilities. This is also happening in potencies of two, with every new level representing a new state of shared agreement:

\[ 2^0 = 1 \rightarrow \text{every individual for themselves} \]

\[ 2^1 = 2 \rightarrow \text{combination of two lovers turning into a couple} \]

\[ 2^2 = 4 \rightarrow \text{the two human couples and the two sovereign couples reaching a state of consent over the situation} \]

\[ 2^3 = 8 \rightarrow \text{all four couples are united as part of the shared “love universe” created by Oberon} \]

The next step is to now relate these quantum theoretical aspects to the psychoanalytic concepts of Lacan, mentioned in the first chapter. To begin with, we have to take another look at the German word “eigen”, as in eigenstate. While it does mean innate or natural, it can also be translated as self. So let us now compare the Lacanian self, or I, with the quantum physical eigenstate. By entering the mirror stage, the I is in its pure and uninfluenced form because it had not yet had contact with the outer world. From that moment on, every contact with its surroundings and outer influences will cause a fragmentation in the I, further modifying and alienating it from its original state. We can understand quantum particles by way of similar framework, where a particle starts out with its own eigenstate and eigenvalue, depending on its position. In its strive to connect with other particles, and through the superposition of states, the particle will lose its initial properties by combining into mixed states and eventually forming new pure states. The common denominator here is that neither the I nor the state can be restored to its origin. From the first moment of existence, both attempt to master their surroundings by constantly adapting and evolving, but in the same way the I will never be able to reach this perfect stage, the particle will never reach a state of universal equilibrium. This metaphor connects our classical world and inherent human characteristics to the quantum world and shows
that both share this basic principle that confines them to the limitations within their environment. By drawing this connection, the quantum realm does not seem as abstract and illogical anymore as it may appear prima facie, providing yet again a means of communicating ideas between different disciplines, by making them understandable to a broader audience.

In *A Midsummer Night’s Dream*, the lovers are constantly subjected to the desire and the gaze of the Other, which leave a permanent mark on them, for they will continuously try to adapt themselves to the Other’s gaze, which causes a continuous fragmentation of their selves. This means that while from a quantum physical point of view, their probabilities are combined to shared states in potencies of two, the lovers’ selves fragment into pieces, also in potencies of two. By applying both concepts to the analysis of *A Midsummer Night’s Dream*, the lovers’ strive for adaptation and unity can be viewed through different lenses and translated into different codes, giving it a wider range of accessibility. It also shows that while some theories might seem very different at first glance – like quantum superposition and Lacan’s concept of the fragmentation of self, with one combining things while the other one is breaking them apart – they actually share great similarities. This new insight was achieved by including literature and creating a discourse that combines all three disciplines.

Another three-part parallel that has already been hinted at above is the connection between conscious, awake, and the material world on one side, and the unconscious, dreaming, and the quantum world on the other side. As mentioned in chapter one, the unconscious as defined by Freud is structured like a language and constructed by signifiers, relating it to Lacan’s Symbolic Order, which is connected to desire and the discourse of the Other. Similar to the quantum world, desire is situated outside our lawful world and does not follow the rules of our known logic. It is rather arbitrary, subject to unlawful drives, and can often not be understood.
One can never fully determine the influence the Other will have on the subject or in which way it will cause the self to develop; therefore, it is more like a set of probabilities than a definite quantity. This probabilistic structure draws the connection between the quantum world and Lacan’s Symbolic Order, supplying once more a two-way metaphor.

The importance of the number two for Lacan has already been explained with the constant strive for unity and subjection to the gaze of the Other. Not only does the self split into twos, but the connection between subject and Other is also twofold. The disturbing third factor is, however, present in the Oedipal triangularity. Upon transitioning from the Real to the Imaginary, the infant longs for a reunification with the mother, which is usually disrupted through the presence of the third factor, the father, which is positioned between the child and the mother. Therefore, the number three can be seen as a sign of disunity and undesirability in both quantum theory and Lacan’s concepts of psychoanalysis.

This analysis shows that quantum theory cannot only be applied to the analysis of *A Midsummer Night’s Dream*, but it can also be connected with Lacanian concepts, and both theories share a common interpretational denominator. Because this analysis is dominated by quantum theoretical concepts and uses them as a basis for the study of the Shakespearean text, the next chapter will start with a Lacanian analysis and focus more on his concepts before connecting them to quantum theory. This shall demonstrate that both theories weigh equally and that they can be used interchangeably for the analysis of literary texts.
CHAPTER 3 - THE OTHER HAMLET: DELIVERING THE MESSAGE OF PHYSICS IN THE CONTEXT OF SHAKESPEAREAN CRITICISM

William Shakespeare’s Hamlet has been analyzed using a number of different critical and methodological approaches, but in order to fully understand the complexity of both Hamlet’s and Ophelia’s desperate struggles, a consideration of the underlying psychological circumstances is imperative; this requires an analysis of the lovers’ struggles through the three Lacanian stages, the Real, the Imaginary, and the Symbolic, as well as the constant subjection to the gaze of the Other. While this topological system of Lacanian concepts is present in numerous literary works, only a few demonstrate them as a determining factor in the tragic development of the characters’ story, and an epitome of this is Hamlet. According to Lacan, the play “reveals a most vivid dramatic sense of this topology, and this is the source of its exceptional power of captivation” (Desire 11). Both Hamlet and Ophelia are constant subjects to the desire of the Other, which slowly destroys them on a psychological and finally on a physical level. The unexplained absence of Ophelia’s mother leaves her with only male role models. She has absolutely no agency and is a mere puppet of the desire of the Other, to which she is subjected to throughout the play until her untimely death. In Hamlet’s case, his acting on the desire of Other is similar to that of Ophelia with the difference that he seems to have more agency. While it is true that he is “merely the reverse side of a message that is not even his own” (Lacan Desire 11), in the case of his father’s desire for him to revenge his death, Hamlet is not forced to do something that goes entirely against his will. He loved his father, and punishing his murderer aligns with his own desire for revenge. Although he seems to have more agency than Ophelia, his actions are still
driven by the desires of the Other with the difference that they coincide to at least some extent with his own.

In this following analysis, I will first look at Ophelia and Hamlet from a Lacanian perspective, and then I will add the quantum physical aspects. There are of course more characters in this play that are worth looking at, especially in regards to psychoanalysis, but in order to focus on the connection between Lacan and quantum theory, the precise love and missed encounter between Ophelia and Hamlet offers the most clear example of the elements at stake in my argument.

The first stage appearance of Ophelia is together with her brother Laertes. Before he leaves the country, Laertes intends to warn her that engaging with Hamlet is a mistake for he, as the Prince of Denmark, has obligations towards his country that will always come before her. He wants his sister to stay away from Hamlet: “Fear it, Ophelia, fear it, my dear sister / And keep you in the rear of your affection / Out of the shot and danger of desire” (1.3.37-39). Ophelia does not agree with her brother for she loves Hamlet and sees no danger in him, but she keeps this to herself and tells him that she “shall th' effect of this good lesson keep / As watchman to [her] heart” (1.3.49-50). She is torn between the conflicting emotions of her own desire and the wish to obey her brother’s desire, but the desire of the Other overpowers her own.

However, even more prominent is the influence of the desire of her father, Polonius. He goes to great lengths in order to tell his daughter how bad of an influence Hamlet is and that she needs to stop seeing him right away: “I would not, in plain terms, from this time forth / Have you so slander any moment leisure / As to give words or talk with the Lord Hamlet. / Look to't, I charge you. Come your ways” (1.3.141-141). Ophelia has a loving and devoted relationship to her father. She does not simply obey him because it is what is expected of her, but she really
cares for him and wants to please him. Therefore, she painfully agrees to “obey [her] Lord” (1.3.145), which leaves her devastated for she truly loves Hamlet and so has to choose between the two men in her life she loves most.

When she does as she was bidden and ignores Hamlet and his letters, he does not react calmly to her repulsion. He goes to see her in her closet and acts like a mad man, grabbing her and frightening her, “as if he had been loosed out of hell” (2.1.93). Driven by fear and despair, Ophelia seeks out her father to tell him about Hamlet’s mad behavior. Now that she can see the result, she realizes that she has made a mistake by doing as Polonius asked. Desperately crying, she tells her father that it was his instruction that lead to this situation and caused Hamlet’s mad reaction. Witnessing the oppression cast upon his daughter by the desire of the Other and realizing that he misjudged Hamlet, Polonius decides to take Ophelia to the king to tell him about the incident and Hamlet’s state of mind in order to find a solution for this situation.

After they have told Claudius what happened, he decides to spy on Hamlet in order to find out about his true state of mind. Polonius and Claudius decide to use Ophelia as a lure to get Hamlet to speak from his heart. Now she is surrounded by three different people and driven by three different desires that all lead to the same plan. Gertrude, Hamlet’s mother, wants to find out what is wrong with her son, presumably in order to help him. Although she has a desire in this case, she is not the driving force in the scheme but merely obeys to the wishes of her husband Claudius. Polonius wants to undo the effects of his misjudging Hamlet in order to help his daughter, while Claudius wants to spy on his nephew out of purely selfish reasons. Although it is Polonius who tells Ophelia what part to play in the scheme, the driving force in this is Claudius. Therefore, she might act upon her father’s wishes, but the dominant desire of the Other that she is enslaved to is the desire of Claudius. Ophelia dislikes the plan of being the lure for the others
to spy on Hamlet, but the pressure of three different desires, all focused on her, leave her incapable of acting according to her own wishes for she is enslaved, once again, to the desire of the Other. Throughout the play, Ophelia has no agency whatsoever. She is objected to the desires of the Other and especially “identified with her father’s desires, [even] to the extent that she has none truly her own” (Muller 157). Throughout the play she is surrounded by people who make decisions for her and tell her how to behave and what to do, such as Laertes, Polonius, and Hamlet – their relationship in particular will be discussed later in this chapter – but one by another they leave her. First Laertes leaves the country, then Hamlet gets mad and turns away from her as a reaction to her behavior, dictated by her father, and finally, her last and most valued confidant, her father Polonius, dies by the hand of her former lover. After this she is left without any signifier of the phallus, and Muller adds that:

Assuming both the foreclosure of the Name-of-the-Father (based in part on the father’s own inconsistent relation to the law) as well as the absence of the phallic signifier that would normally be set in motion in the process of mourning the death of her father, his death doubly evokes a void, a hole in the symbolic order for her, an absence of these correlative signifiers which then unleashes the imaginary reshaping of the signifier-signified relationship and provokes the appearance of the phallus as real. (158)

This loss of every connection to the phallus, followed by the complete focus on it, is permanent in Ophelia’s last scenes. During her mad rampage she mentions it explicitly: “Young men will do ’t, if they come to ’t; / By Cock, they are to blame. / Quoth she “Before you tumbled me, / You promised me to wed” (4.5.60-63), as well as implicitly through some of the flowers she lists.
When Gertrude describes the place where Ophelia’s body was found, she “explicitly includes ‘dead men’s fingers’. The plant in question is the *Orchis mascula*, which is related to the mandrake and hence to the phallic element” (*Desire* 23). This shows that the obsession with the phallus stays with Ophelia until her very end, when “the phallic flower surrounds [her] corpse as its grave marker” (159).

The first desire Hamlet has to act upon is that of his father for revenge. Since Hamlet is devastated by his mother’s decision to marry his late father’s brother and furious when he finds out that it was not a natural death but that he was murdered by Claudius, Hamlet himself wants nothing more than revenge, which he promises: “[s]o, uncle, there you are. Now to my word: / It is ‘Adieu, adieu, remember me.’ / I have sworn’t” (1.5.110-112). While the desire of both seems equally weighted, Hamlet is the one who has his stakes in it and who has to actually commit the murder, which he is reminded off by the ghost when he fails to perform:

> GHOST. Do not forget. This visitation
> Is but to whet thy almost blunted purpose.
> But look, amazement on thy mother sits.
> O, step between her and her fighting soul.
> Conceit in weakest bodies strongest works.
> Speak to her, Hamlet. (3.4.111-116)

This scene is an example of the pressure put on Hamlet by his father’s reminders and attempts to guilt his son into following his orders. It demonstrates that although the desire is mutual, it is Claudius’ ghost who is pulling the strings, urging Hamlet to finally take actions.
Unfortunately, others’ desires interfere with his own on his vengeful path. Hamlet loves Ophelia, but her father Polonius wants her to stay away from him. Therefore, Hamlet is indirectly influenced by Polonius’ desire. During their exchange, Ophelia seems to be torn between sadness and fear of the raging Hamlet, while the prince seems to be subjected to a myriad of emotions, all pouring down on him at the same time. In his devastation about losing the love of his life to her father, after he has already lost his father to death and his mother to his uncle, he realizes that he has been played by Polonius and Claudius and tells Ophelia what he thinks about her father: “[l]et the doors be shut upon him, that he may / play the fool nowhere but in’s own house. Farewell” (3.1.133-134). He feels betrayed by everyone for “God hath given [them] one face, and [they] make [them]- / selves another” (3.1.145-146). Although he realizes that it is not Ophelia’s free will that drives her decisions, he is still furious and does not know how to deal with this new insight. He exclaims that he never actually loved her but at the same time curses her in case she would ever marry another man:

HAMLET. If thou dost marry, I'll give thee this plague

for thy dowry: be thou as chaste as ice, as pure as
snow, thou shalt not escape calumny. Get thee to a
nunnery, farewell. Or if thou wilt needs marry,
marry a fool, for wise men know well enough what
monsters you make of them. To a nunnery, go, and
quickly too. Farewell. (3.1.136-142)

When he finally gets the chance to avenge his father’s death, he encounters Claudius while he is praying. Hamlet is about to strike him with the sword, when it suddenly dawns on him:
HAMLET. But in our circumstance and course of thought

'Tis heavy with him. And am I then revenged
To take him in the purging of his soul,
When he is fit and seasoned for his passage?
No.
Up sword, and know thou a more horrid hent. (3.3.83-88)

He realizes that he cannot kill his uncle midst prayer for he might find salvation and therefore his father would not be avenged properly. He sheathes his sword and leaves because “[n]ot for a moment does he think that his time has come. Whatever may happen later, this is not the hour of the Other, and he suspends his action. Whatever Hamlet may do, he will do it only at the hour of the Other” (Lacan Desire 18). It seems like Hamlet is caught in a vicious circle of contradictory desires that are all connected in a way that if he takes action to satisfy one, he would destroy all chances of satisfying another. As a result, he is unable to act throughout most of the play, leaving him with nothing but his thoughts and a constant feeling of incompleteness and non-fulfillment.

At the end, when he enters the battle with Laertes, he does so, once more, under the desire of the Other, for Claudius is sure that he has nothing to lose, with Laertes being a better fighter than Hamlet. Lacan claims here that although when Hamlet is mortally wounded it is finally his hour, the tragedy still “attains completion at the hour of the Other” (Desire 19), when Hamlet wounds his enemy. However, by looking a few moments further, right before Hamlet is dying, it is his desire to keep Horatio alive that prevents his friend from drinking the poison so that he can deliver Hamlet’s message. Therefore, when Hamlet is in his last breaths, it is finally his hour. He is the Other for Horatio and dictates his desire onto his friend.
Another Lacanian concept that is constantly present and interwoven most interestingly in *Hamlet* is that of the mirror stage and the gaze of the other. In the scene where Hamlet performs his famous soliloquy – “to be or not to be…” – he thinks he is alone in the room, talking to himself, and merely reflecting upon his life and everything that has happened. During all that time when he is weighing his options, trying to decide whether it is worth living or not, Claudius and Polonius are only feet away from him, hiding behind a tapestry and listening to every word he says. While Hamlet thinks he is making this decision based on his own conscience, figuratively speaking by consulting his own mirror image and having his own desire reflected back at him, the truth is hidden behind the tapestry. Although Hamlet is not aware of this, Claudius and Polonius are the ones pulling the strings, influencing the most crucial parts in his life, like the death of Hamlet’s father, the love of his mother, and the affection of his beloved Ophelia. This scene connects the transition from the mirror stage to the Symbolic and the binary of self-reflection and the subjection to the desire of the Other. In his 1996 film adaptation, Keneth Branagh decides to visualize this Lacanian image and positions Hamlet in front of a mirror, talking to his own reflection gazing back at him, while the truth, the actual gaze that is influencing him, in form of Claudius and Polonius, is hidden right behind that mirror.

In addition to this hidden gaze, there is also the gaze defined by the dichotomy and interdependence between Ophelia and Hamlet and the question of how their desires and gazes determine one another. Hamlet and Ophelia function as a mirror for each other. At first both look at each other with the eyes of true love. Hamlet’s love is reflected back to him through Ophelia as well as the other way round, which he expresses in his letter to her: “Doubt thou the stars are fire, / Doubt that the sun doth move, / Doubt truth to be a liar, / But never doubt I love” (2.2.124-127). Later, when their love has already been tempered with, their reflection upon each other and
therefore their gazes also change. When they meet again in the “To be or not to be” scene, their exchange is full of anger, disappointment and, most of all, bitterness on Hamlet’s side, which is reflected back to him through Ophelia, who is devastated and desperate, but also afraid of Hamlet and his strange behavior.

In Ophelia’s last scene, she seems to have lost any sense of self. She was defined by the gaze of the men around her, which are all gone now, leaving her behind with no one else to turn to. By losing all the men that have determined her throughout her life and have functioned as her signifier, Ophelia has nothing left. Her entire personality and living was built upon the desire of the Other. By losing them, she is so estranged from her self that she does not even recognize herself and the people around her anymore. The loss of her self leaves her like an empty shell, descending to madness and finally even losing any desire to live.

In *Hamlet*, the quantum physical references are much less obvious and numerous than in *A Midsummer Night’s Dream*. Yet, by taking a closer look, it becomes obvious that quantum theory is everywhere and, just like psychoanalysis, aids to define every level of our existence.

First of all, although not as prominent, there are also two worlds in *Hamlet*. In “The Science of Shakespeare”, Falk has already made the point that *Hamlet* takes place in two worlds, between which the prince seems trapped throughout the entire play:

In act I we find him ‘crawling between earth and heaven’ (1.2.129); when his uncle asks him about his dark mood, he claims to have been, on the contrary, ‘too much in the sun’ (1.2.67). Several acts later, we find him peering down at Ophelia’s freshly dug grave while invoking the planets above; he notes that Laertes’ grief ‘conjures the wand’ring stars’ (5.1.249). And lest we imagine the stars are moving across the sky peaceably, the ghost has warned Hamlet that his tale will ‘make thy two eyes like stars
start from their spheres’ (1.5.17). The prince will soon be complaining that the world
–‘this goodly frame the earth’ – is, for him, ‘a sterile promontory’ (2.2.298-99). (146)
While Falk is addressing the science of cosmology and refers here to the two worlds as heaven
and earth, I propose another interpretation, where the existence of one world determines the
actions within the other. The first world is the usual one, the classical world that we know. The
second one is the world of the ghost of Hamlet’s father, a kind of limbo between death and alive,
where he is “[d]oomed for a certain term to walk the night, / And for the day confined to fast in
fires, / Till the foul crimes done in [his] days of nature / Are burnt and purged away” (1.5.10-13).
This world again represents the illogical concepts that cannot be explained with the knowledge
we have in our world. Contrary to A Midsummer Night’s Dream, it does not rely on magic, but
according to the ghost, on something that no living human could understand:

Ghost. But that I am forbid
To tell the secrets of my prison house,
I could a tale unfold whose lightest word
Would harrow up thy soul, freeze thy young blood,
Make thy two eyes, like stars, start from their
spheres,
Thy knotted and combinèd locks to part,
And each particular hair to stand an end,
Like quills upon the fearful porpentine.
But this eternal blazon must not be
To ears of flesh and blood. List, list, O list! (1.5.13-23)
From this moment on, when Hamlet is introduced to the knowledge of this second world, it defines his further actions and seems to constantly be around him. When he is talking to his mother about her adultery and the evil nature of her new husband, the brother and murderer of her old husband, the ghost reappears to remind Hamlet of his task: “Do not forget. This visitation / Is but to whet thy almost blunted purpose” (3.4.111-112). Although Hamlet can see and hear him, his mother cannot. She is finally convinced that Hamlet has gone mad for he sees things that do not exist, at least in her world, and so she tells him:” This is the very coinage of your brain. / This bodiless creation ecstasy / Is very cunning in” (3.4.138-140). This draws a parallel to the quantum world, showing that without understanding, one cannot see. The quantum world is invisible to our eyes because it is merely too small to detect; therefore, a scientist needs some sort of instrument to make observations in the quantum world. In Hamlet’s case, the difference between him and his mother are his strong emotions. The instrument that makes him see the ghost are his devastation about his father’s death, the feeling of both loss and betrayal, and his longing for revenge.

As with the characters in *A Midsummer Night’s Dream*, the desire of the Other and the constant attempt of Hamlet and Ophelia to adapt to their surroundings is similar to that of a particle trying to reach equilibrium. Both Hamlet’s and Ophelia’s entire existence is defined by the enslavement of this desire and no matter how hard they try, they will never be able to either free themselves or fulfill the demands of the desire of the Other. Ophelia’s every decision is determined by someone else and this goes as far as she completely loses her self in the end. While Hamlet does not completely descend into madness, he is also torn by the different desires that are pulling him in different directions and cannot find a way to please all of them. The end is the same for both of them: they die in the vain attempt of mastering the demands of the Other.
This process is basically the same that a particle goes through when trying to reach a state of equilibrium with its surroundings. At first it will just have to give up parts of itself by combining with a neighboring particle, and that new state will then have properties of both previous particles. But with every new connective attempt, the traces of the original particle will become smaller and smaller, until it is lost in its surroundings, the same way Ophelia and Hamlet were lost in the desire of the Other, and will finally cease to exist without ever having reached the state of universal equilibrium.

Hamlet and Ophelia are not merely connected by the fact that they are objected to the desire of the Other, but rather by the impact of their individual decisions on the other, regardless of the special proximity of the two. While in Shakespearean times it would not have been thought of to attribute that much influence on a man to a woman, it is obvious that they are connected through a deep bond of love and that Ophelia’s decisions, actions, and in the end her death, have an impact on Hamlet and trigger different reactions, as well as the other way round. The way their gazes towards each other change is determined by actions that happened either while they were conversing, or while they were apart from each other. But regardless of the special proximity, they still have an impact and cause a change in the other person. First, it is Ophelia’s letter that causes Hamlet to go mad, then it is his reaction that makes her realize what she has done to the man she loves and her despair drives her to her father and the king. Their encounter in the nunnery scene leaves Hamlet angry and Ophelia frightened, yet they cannot stay away from each other. Finally, Hamlet’s leaving is one of the circumstances that cause Ophelia’s suicide, and when he finds out about it, Hamlet finally realizes what this means to him and how deeply attached to Ophelia he was: “I loved Ophelia. Forty thousand brothers / Could not with all their quantity of love / Make up my sum. What wilt thou do for her” (5.1.271-273)? In quantum
theory, this phenomenon is called quantum entanglement, which is “a profound, non-classical
correlation between two (or more) quantum systems. The members of entangled systems do not
have their own individual quantum states. Only the total system is in a well defined state” (Bes
154). This means that if two particles are entangled and some form of measurement is performed
on one particle, which will change the original property of this particle, such a change also
occurs in the other particle. This happens regardless of the two particles, which can be of any
arbitrary amount (Bes 153-154). This seems paradoxical for these particles do not need to
directly communicate with each other, which is the same with Hamlet and Ophelia; therefore, the
two lovers are in an entangled state, influencing each other even if they are miles apart.

This analysis of Hamlet shows that quantum theory cannot only be applied to selected
literary works, but also to those that are “rarely examined from the point of view of science”
(Falk 146). Just because the scientific aspect is not blatantly obvious, it does not mean that it is
not there. And while quantum theory and psychoanalysis cannot always be applied to the same
passage or aspect of a literary work, they have still a lot of common ground and can therefore
learn and benefit from each other by utilizing both their similarities and their differences.
CONCLUSION

Over the past several decades, a growing number of scholars have dedicated their research to the discourse between the sciences and the humanities. While this is ideally a beneficial process for both fields, the ever-growing influence of capitalism adds a new side of possible detrimental effects of interdisciplinarity, which need to be taken into consideration. Carla Mazzio expresses one of these concerns quite accurately: “Since the cultural and economical capital of the sciences continues to flourish while the humanities remain in the balance, there is always the risk, as a title such as Shakespeare & Science might suggest, of making even that mainstay literary study a bit more ‘dwarfish’ (to quote Macbeth) in the process of wrapping itself in another ‘giant’s rob’” (12). This, however, should not stop us from attempting to connect the two cultures but merely remind us to proceed with caution, making sure we represent neither culture as superior nor inferior to the other, but rather as equal interlocutors.

As demonstrated in chapter one, the first step in establishing a common ground between different academic fields needs to be an equal understanding of their respective theories and concepts. Such an understanding cannot be achieved by expressing one type of jargon with the words of another, as Lacan attempted through the introduction of his mathemes, but rather by establishing a common metalinguistic code that is understandable throughout the disciplines and among both academics and non-academics. Once this is accomplished, the final gateway to a mutual understanding and exchange of ideas is the metaphor. It is important to clarify that metaphors cannot only be utilized as stylistic devices in poetry or prose, but as Mark Johnson examined: “A metaphor is not merely a linguistic expression (a form of words) used for artistic or rhetorical purposes; instead, it is a process of human understanding by which we achieve
meaningful experience that we can make sense of. A metaphor, in this "experiential" sense, is a process by which we understand and structure one domain of experience in terms of another domain of a different kind” (15). The same way quantum theory uses thought experiments to make the quantum world more tangible and less abstract, we can use metaphors to explain a seemingly incomprehensible idea by drawing on a concept known to the respective audience.

This type of metaphorical discourse is implemented in the second chapter through the analysis of A Midsummer Night’s Dream. The entire play can be seen as a metaphor for a quantum physical experiment with the human and the fairy world mirroring the classical physical and the nonclassical quantum world, and more parallels can be found throughout the play. The plot centering on the four lovers in the woods is a thought experiment explaining the movement and interaction of quantum particles to non-scientists, and the juxtaposition of a stage performance and a quantum experiment, in particular the connection between scientist and experiment and the connection between actors and audience, functions as a reminder of the uniqueness of every stage performance, as well as a metaphor to explain the dynamics of theatrical performances to scientists and non-literature scholars. This interaction between quantum theory and A Midsummer Night’s Dream refutes Spillers claim that “[f]rom a modern perspective, science may not seem to be able to tell us much about Shakespeare or Shakespeare about science” (24). As demonstrated, scholars of both sides can utilize the respective other field to not only communicate their ideas to a new audience, but also to get a different viewpoint on their own theories, allowing for an entire new level of discourse.

More importantly yet, the next section of this chapter demonstrated that this discourse is not restricted to two interlocutors, but can be further expanded, by connecting quantum theory, literature, and psychoanalysis in a three-way discourse. The way the actors react to their
audiences’ feedback and the reduction of probabilities into one determinate value are also metaphors for Lacan’s psychoanalytical concept of the desire of the Other and the concomitant inherent aspiration to fit in and adapt to one's surroundings. Not only does this analogy offer ways of communication and mutual understanding between different academic fields, it also shows that the constant desire to connect to the environment in order to find some sort of equilibrated state is a common denominator that connects all three theories.

While the second chapter started the analysis from a scientific perspective, the third one approaches it from the reverse side, beginning the analysis from a psychoanalytical perspective, and then adding the scientific approach. Upon closer investigation, it becomes clear that *Hamlet* also combines two worlds, just in a more subtle way than *A Midsummer Night’s Dream*. The same applies to the two main characters, Hamlet and Ophelia. Their constant and very obvious enslavement to the desire of the Other is apparent throughout the play, which can again also be referred to as particles striving for equilibrium. Their harmful relationship and connection to each other is a metaphor for quantum entanglement, which adds a new level of understanding to the interpretation of the play and can once more be used to explain the underlying scientific concept through the play or the other way round. This aimed to demonstrate that although a certain concept is not quite as obviously depicted, it does not mean that it is not present, just like the quantum world, which is not visible to the unaided eye, yet it defines and pervades every level of our existence.

Finally, this thesis is meant to be a small building block in support of the long path to merging the two cultures. My aim is to forward the connection between hard sciences, literary theory and literature, by demonstrating that once the barriers of different languages are bridged, and mutual appreciation and respect is established among the representatives of the different
fields, interdisciplinary discourse will open an entire new world of possibilities and progress.

The author and motivational speaker Zig Zigler said that “[i]n many ways, effective communication begins with mutual respect, communication that inspires, encourages others to do their best.” This concept of communicational motivation and inspiration is one that finally needs to be understood and adapted by the representatives of both the sciences and the humanities, for as demonstrated, the beneficial effect is balanced and no one discipline can claim superiority over the other. By allowing the sciences and the humanities to mutually learn from one another and teach one another, a new discourse is created that introduces an entire new realm of possibilities and progress.
WORKS CITED


Ziglar, Zig. "Leaders Are Communicators." Presentation Pointers - A Message From Zig Ziglar.

APPENDIX