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A Study on the Interaction between Human Consciousness and Artificial Intelligence in Refik Anadol's Quantum Memories: The Creation of Quantum Memories by the Many Worlds Interpretation of Quantum Physics

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Abstract

This study aims to understand the quantum superposition and observer effect in the Copenhagen interpretation and to explore the interaction between human consciousness and artificial intelligence (AI) involved in the creation of quantum memories by applying the many worlds interpretation of quantum physics to Refik Anadol's *Quantum Memories*. According to the Copenhagen interpretation, the act of observation itself determines the state of an object. Furthermore, from the perspective of the many worlds interpretation of quantum physics, when we observe and interact with something, we create a new being or universe. Anadol said that his project was inspired by the many worlds interpretation of quantum physics. The intersection between human consciousness, AI, and the aesthetics of probability that can be experienced through his work presents a new form of memory from a quantum physics perspective.

Keywords Copenhagen Interpretation, Quantum Superposition, Observer Effect, Human Consciousness, Artificial Intelligence (AI), Many Worlds Interpretation, Refik Anadol, Quantum Memories

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Introduction

In the natural sciences, determinism and probability have long been at odds. Determinism holds that all phenomena in the universe are determined by initial conditions and cannot deviate from them. Newtonian mechanics is at the heart of this, according to which the path of any particle can be calculated exactly by knowing its position and velocity at any given time. Everything in the universe is a collection of particles. If we had all the information about their current positions and velocities, we could trace their entire history, from the distant past to the eternal future. Obtaining such a large amount of information can be difficult, but it is important to note that it is possible in principle. In other words, if Newtonian mechanics is indeed correct, then the fate of real beings is already determined at a distant moment in time. Time simply unfolds everything in order, with no possibility for anyone to deviate from their path.

With the advent of quantum physics in the 20th century, this determinism was dealt a serious blow. According to the “indeterminacy principle” of quantum physics, we cannot know a particle’s position and velocity “simultaneously” and “exactly” because trying to know the position exactly leads to velocity ambiguity, and trying to know the velocity exactly leads to position ambiguity. Therefore, even if we know the current position of a particle, it is essentially impossible to predict exactly where it will be at the next moment. As a result, there is no such thing as a “path” or “trajectory” as envisioned by Newtonian mechanics, and the notion of fate and destiny becomes moot.

A similar debate has been raging outside of the natural sciences. It is the so-called “do humans have free will” question. The affirmation of free will is almost essential for those who want to allow humans moral freedom and hold them accountable for it. In fact, every country’s penal system is essentially based on the idea that “with freedom comes responsibility”. It is clear that in practice, at least some degree of free will is recognised. Christian predestination, on the other hand, posits a divine will behind human behaviour. In psychoanalysis, the seemingly free behaviour of adults is actually the result of subconscious forces formed in childhood, and extreme believers in the power of DNA say that the life of every living thing is nothing more than the temporal unfolding of genetic information.

Interestingly, both views have strong arguments and are still in conflict. Of course, there have long been attempts to reconcile them somehow into a unified scheme. One important current event is implicit in another principle of quantum physics. According to this, the realisation of a phenomenon can only be predicted probabilistically. But the probabilities follow a strict deterministic equation. In other words, everything in the world is essentially chance, but its probability is inevitable. This leads to the many-worlds interpretation of quantum physics. This paper focuses on Refik Anadol's *Quantum Memories* to explore the close interaction between human consciousness and artificial intelligence (AI) in the universe.

Magic of the Atomic World

History of the Atomic Model

In the 5th century BC, the ancient Greek philosopher Democritus argued for atomism, the idea that all matter is made up of smaller things that cannot be broken down any further. At the time, however, it could not be demonstrated, so it remained a philosophical discussion among philosophers. In the Middle Ages, atomism sank below the surface. It was the English chemist and physicist John Dalton who brought atomicism back to the forefront. In 1803, Dalton used atomism to explain why the law of conservation of mass and the law of constant proportions hold. According to his atomic theory, atoms are the smallest elementary particles of an element that have properties that cannot be further broken down (Kwak, 2016, pp. 39-46).

At a time when some scientists were denying the existence of atoms, scientists studying them were looking for smaller things. Joseph John Thomson discovered the electron in 1897 while studying cathode rays. Ordinary gases and liquids are not electrically charged, meaning that electrically, atoms are neutral. However, the electrons Thomson discovered were negatively charged, so he wondered if there was a positive charge somewhere in the atom that would cancel out the negative charge. Thomson came up with a model of an atom in which there were a uniform distribution of electrons with a charge equal to the total amount of positive charge (Kwak, 2016, pp. 115-118).

Thomson's protégé, Ernest Rutherford, began experimenting with gold foil in 1909 to probe the internal structure of the atom. He created a 1/20000 cm gold foil and fired alpha particles (stable particles made up of two protons and two neutrons) from radioactive elements at the foil at speeds of about 16,000 km per second. If Thomson's model of the atom is correct, firing alpha particles at the gold foil should be like throwing a baseball at a stack of ping-pong balls. Almost all of the alpha particles went straight through the gold foil, as expected, but some bounced off at large angles, and some bounced forward altogether. Rutherford realised that something very small and hard inside the nearly empty atom was causing the alpha particles to bounce. Thomson named this solid core the nucleus. He proposed a new model of the atom in which electrons orbit around the nucleus (Kwak, 2016, pp. 119-123).

However, according to the Rutherford model, electrons in circular motion undergo accelerated motion, where their velocity changes because they keep changing direction. And according to classical electromagnetism, accelerating electrons emit electromagnetic waves and lose energy. In this way, the electrons would eventually collide with the nucleus of the atom, and the atom itself would disintegrate. In reality, however, atoms are very stable. Furthermore, since electromagnetic waves are emitted continuously, they should show a continuous distribution in the spectrum, but in reality, a discontinuous line spectrum appears. The Rutherford model could not account for these two problems. In 1913, Niels Bohr provided an answer. Bohr observed the discontinuous line spectrum of a hydrogen atom and modelled it by applying quantum theory: electrons move in a circular motion in constant orbits, and each orbit is not continuous, but rather spaced apart. The Bohr model thus describes the structure of an atom as discontinuous electron circular orbits around a small, positively charged nucleus, much like the solar system (Kwak, 2016, pp. 124-147).

However, the Bohr model could only predict the line spectrum of hydrogen. It did not work for multi-electron atoms. Worse, as spectral graphics technology improved, additional spectra of hydrogen were discovered that the Bohr model could not account for. Louis de Broglie's concept of matter waves changed the way of thinking. de Broglie realised that just as light is both a wave and a particle, matter could be both a particle and a wave (Kwak, 2016, pp. 148-158). Later, the idea that moving objects could be represented by waves stimulated Erwin Schrödinger, leading to Schrödinger’s wave equation, a quantum mechanical reinterpretation of the classical energy equation “E = T + V (E=energy, T=kinetic energy, V=potential energy)”. This interpretation led to the uncertainty principle, the fateful conclusion of treating matter as a wave (Kwak, 2016, pp. 182-202).

According to Werner Heisenberg, to observe something is to detect the light, or photons, that bounce off of it. When you want to observe the position of an electron, you can do so by shining a light on it and capturing the photons that bounce off. To get better resolution on the position of the electron, the light needs to have a shorter wavelength. Here's the problem. Light with a short wavelength has a lot of energy, which greatly affects the motion of the electron you are observing. This results in a large change in the momentum of the electron.

Momentum is classically given by the product of an object's mass and its velocity. Any attempt to increase the accuracy of the position of the electron will result in a significant change in its momentum. In other words, the smaller the uncertainty in the position of the electron, the larger the uncertainty in its momentum. These two uncertainties are inversely proportional to each other, so that the product of the two uncertainties can never be less than a value on the order of Planck's constant. As a result, Heisenberg abandoned orbits. The position of an electron is indeterminate, meaning that it can be in several places at any given time. If we observe it directly, we know where it is, but if we do not, it can be anywhere. Electrons are scattered around like clouds. The fact that electrons have both particle and wave properties, and that their location cannot be precisely calculated, has led to a model called orbitals. An orbital is a probability function of electrons around an atomic nucleus, i.e., a cloud-like model of the probability distribution of electron presence (Kwak, 2016, pp. 211-219).

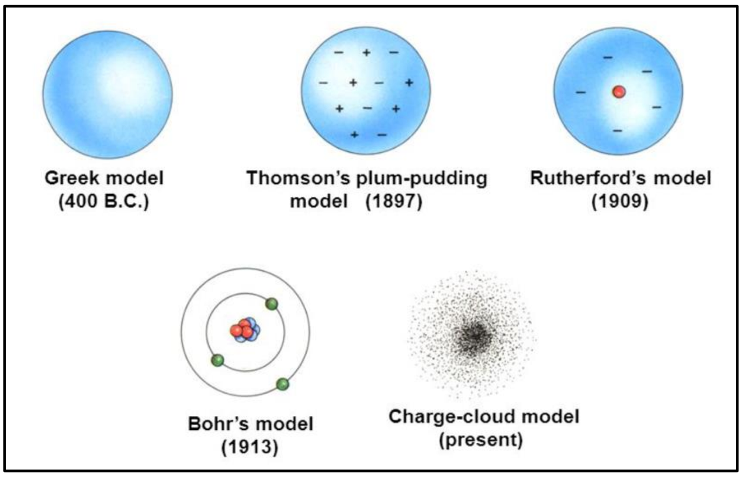

Figure 1. Models of the Atom (Dorin, Demmin, and Gabel, 1990).

Copenhagen Interpretation

The way we describe the motion of particles underwent a major shift in the 20th century. Before that, mechanics described particles as occupying a point in space and changing over time with laws of motion. This view, which originated with Newton, dominated physics for more than 200 years, but it was unable to explain the microscopic physical phenomena observed since the early 20th century. Thus, new theories were proposed that shook the existing physical framework to its core. In 1926, Schrödinger treated electrons as waves, expressing their energy states as a wave function (psi, Ψ). Schrödinger actively utilised the Planck constant (h) and de Broglie's concept of matter waves, and identified the various physical quantities of particles as quantities with spaced values, in contrast to classical physics. Whereas the classical wave equation could not adequately describe the behaviour of particles in the microscopic world, the Schrödinger wave equation mathematically described the wave nature of particles in the microscopic world perfectly. However, it did not reveal the exact meaning of the wave function Ψ (Kaku, 2006, pp. 244-245).

In 1928, Max Born discovered the meaning of the wave function Ψ. The wave function Ψ was a function that represented the probability of finding an electron at a given location. Strictly speaking, the square of the absolute value of the wave function is the probability density function of the particle being at a particular location. This means that we cannot know the location of an electron with 100% accuracy, we can only calculate the probability of it being there through the wave function Ψ (Kaku, 2006, p. 245). Based on this, Bohr and Heisenberg made the following assumption to resolve the gap between the probability of a wave and its commonsense existence. "If the wave function is observed by an outside observer, it collapses to a single value." In other words, the wave function as the probability of an electron being found is simplified to a single value by the act of observation. By this logic, the act of observation determines the state of the electron.

Finally, Bohr, Heisenberg, and Born derive the following interpretation in Copenhagen.

a. All energy is made up of discrete bundles called quanta.
b. Matter is represented by point particles, but the probability of finding a particle is given by a wave. And these waves satisfy Schrödinger's wave equation.
c. Before an observation is made, the object exists "simultaneously" in all possible states. To determine which of these states it is in, an observation must be made, and the act of observation collapses the wave function so that only one state is obtained as a result of the observation. Only after the observation is made does the object become a solid entity (Kaku, 2006, pp. 246-247).

The Copenhagen interpretation was too bizarre from the point of view of classical physics. In classical physics, the state of an electron is already determined and the act of confirming it is an observation, but in the world of quantum physics, the act of observation itself determines the state of the object. The moment we look at an electron, its wave function collapses, and from that moment on, the electron has a definite character, i.e., it is no longer necessary to describe it in terms of a wave function after the observation has taken place. The Copenhagen interpretation divides the universe into macroscopic and microscopic worlds, with the macroscopic world, which includes our daily lives, dominated by Newtonian classical physics, and the microscopic world dominated by quantum physics.

Inherent in classical physics is the basic assumption that the object of observation and the experimental apparatus that observes it are completely independent, and that all observations can in principle be of any precision. When we see something, our eyes receive the light reflected by the object, and the object we see is assumed to be there. We do not think of an object as moving from one location to another because it is reflecting light. The nature of the object and the act of observation are completely independent. However, the microscopic world is different. In the microscopic world, we have to treat light as particles with momentum. This means that a photon can touch something very small and cause a disturbance in its position. In the microscopic world, the act of observation becomes a variable. Therefore, Heisenberg said that no matter how advanced science becomes, it is impossible to accurately measure the position and momentum of a single electron at the same time. This is called the uncertainty principle.

Probabilistic Existence

Quantum Superposition

In 1927, Clinton Davisson and Lester Germer conducted an experiment in which they fired an electron gun at a nickel crystal (Juffmann, Mairhofer, Nimmrichter, Asenbaum, Kuhn, Tsukernik, Mayor, Cheshnovsky, and Arndt, 2017). The method was the same as Thomas Young's double-slit experiment to prove the wave nature of light. The difference is that instead of monochromatic light, they fired an electron gun. At the time, electrons were recognised as particles, so we expected to see a pattern like the one on the left in Figure 2. However, the experiment produced an interference pattern of waves, as shown on the right in Figure 2. The fact that electrons are matter waves cannot be explained by Newtonian mechanics and electromagnetism.

According to the Copenhagen interpretation, the electron double-slit experiment is interpreted as follows, “The electron simultaneously exists in all probabilistically possible positions before it is observed, and is determined to be in one position at the moment of observation”. This phenomenon is called quantum superposition. But what does it mean to have multiple states superposed on each other before being observed, and then to be determined to be one at the moment of observation? The probability of a particle's state is obtained from its wave function.

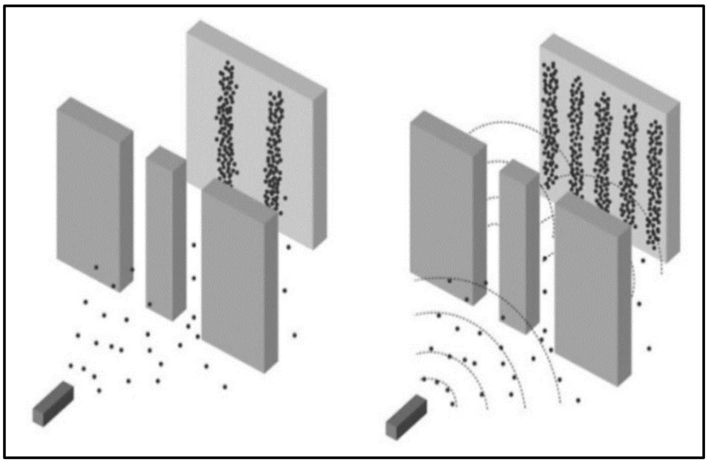

Figure 2. Quantum interference experiment with electrons (Oh, Son and Han, 2017).

The left side of Figure 3 is a visualisation of the wave function (more precisely, the square of the absolute value of the wave function) that represents the probability of an unobserved electron being at a particular location. As you can see, the probability is highest in the middle and decreases in the edge. However, as soon as an observation is made, the probability of being in a different location converges to zero and the wave function collapses, as shown on the right side of Figure 3 (Baggott, 2023).

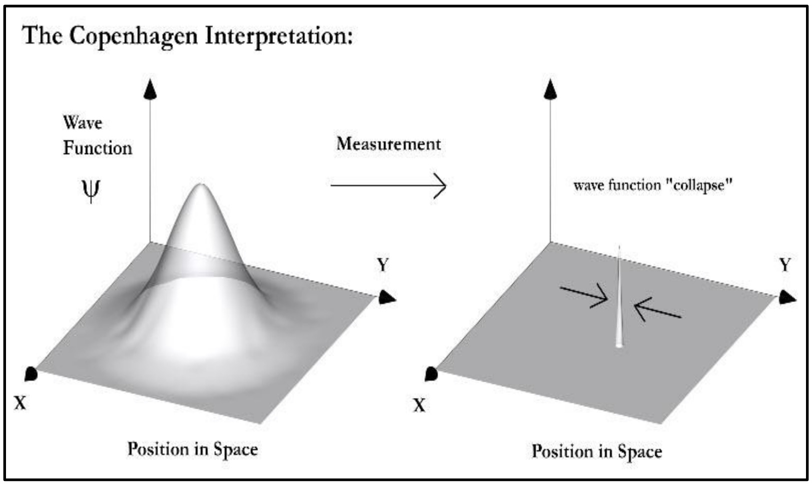

Figure 3. The Copenhagen Interpretation: Wave Function Collapse (World Science Association, 2020).

To summarise, quantum superposition refers to a state in which all possible states of quantum matter are probabilistically superposed before it is observed. Unobserved electrons behave like waves that interfere with each other because they have a superposition of probabilities of being here and there, and once they are observed, they are no longer probable to be anywhere else and are determined to be in one location. It is like when someone buys an instant lotto ticket and before they scratch it, there is a superposition of winning and non-winning states, but the moment someone scratch it, it decides to be one. Quantum superposition is a very basic principle of quantum physics and plays an important role in explaining how quantum computers work.

Creation of the Existence By The Observer

In the double-slit experiment in Figure 2, electrons become particles when observed and waves when not observed. This phenomenon is called the 'observer effect'. In the microscopic world, matter and energy become interchangeable at any time due to observation. As shown in Figure 3, an electron lies in a stochastic superposition before it is measured, but when it is measured, its wave function collapses simultaneously: the observation determines that the electron is no longer a superposition, but a single state. The idea that the nature of matter could be changed by observation was revolutionary. Einstein and Schrödinger found this quantum superposition distasteful and opposed the introduction of probability into physics.

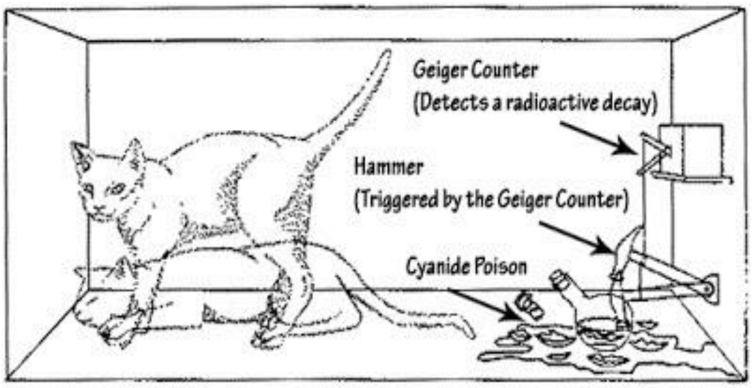

Figure 4. Schrödinger's cat thought experiment (Gribbin, 2011)

In 1935, Schrödinger proposed the cat thought experiment to criticise the introduction of probability. As shown in Figure 4, a cat is locked in a box. Inside the box is a bottle containing a poisonous gas. Its lid is closed. A hammer is set near the bottle, which is connected to a Geiger counter, and a piece of uranium is placed near the counter. Since the radioactive decay of a uranium atom is a purely quantum event, there is no way to predict in advance when it will decay. For now, let's assume that there is a 50% chance that a uranium atom will decay within one second. A uranium atom decay triggers the Geiger counter, which in turn releases the ring holding the hammer and allows it to hit the bottle. The poisonous gas in the bottle will then escape, and the cat will die (Baggott, 2023, pp. 243-246).

Under these conditions, according to the Copenhagen interpretation, we have no idea whether the cat is alive or dead before we open the lid of the box. The cat is in a strange state of “50% dead and 50% alive”. If we then open the lid and observe the inside of the box, the wave function representing the cat's state collapses into one. In other words, the moment you open the lid of the box, you will see only a live (or dead) cat. Schrödinger could not accept this nonsense. Einstein went a step further and said “God does not play dice with universe”, criticising quantum physics based on the Copenhagen interpretation (Baggott, 2023, pp. 247-248)

However, Bohr responded, "Einstein, stop telling God what to do". Since then, several experiments have demonstrated Bohr over Einstein, and the Copenhagen interpretation has become the mainstream of quantum physics (Baggott, 2023, pp. 249-250). However, it is still unclear why quantum superposition and the observer effect occur. Hugh Everett III’s many-worlds interpretation offers an alternative. Everett solved Schrödinger’s cat thought experiment in a circuitous way. It resolves the paradox of quantum physics by introducing the hypothesis that a dead cat and a living cat exist simultaneously in different universes. According to Everett’s many-worlds interpretation, the collapse of wave function is not real. Instead, the universe is constantly splitting apart, with quantum bifurcations forming whenever a random observation is made. If Everett’s claim were true, our bodies would exist in different states in different universes even at this very moment (Kaku, 2006, pp. 270-272). In this way, our observation and interaction with something creates a new existence or universe, whether it is the collapse of the wave function that determines one existence or the unfolding of another universe without the collapse of the wave function.

Birth Of A New Consciousness

Refik Anadol’s Quantum Memories

Quantum Memories (2020) was commissioned by the National Gallery of Victoria (NGV) to Refik Anadol. It was displayed on the largest LED screen of any NGV work to date, and was the most technically and conceptually ambitious project to date (NGV, 2020).

Figure 5. *Quantum Memories* in the National Gallery of Victoria (Anadol, 2020)

It utilised a dataset of over 200 million nature-related images from the internet. The dataset was processed using quantum computing software developed by the Google AI Quantum research team. Quantum computing is a new form of computing that utilises the unusual physics of the subatomic world, such as quantum superposition. As shown in Figure 5, the resulting real-time image reveals another dimension of the natural world, as well as a radical visualisation of nature's digitised memories.

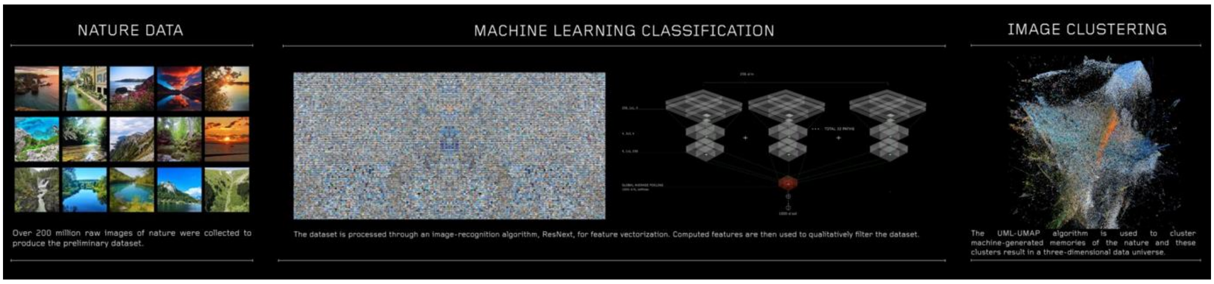

Figure 6. Data Narratives of *Quantum Memories* (Anadol, 2020)

The dataset of *Quantum Memories* is created by combining the following three processes: (1) collecting nature-related images, (2) classifying the data through machine learning algorithms, and (3) clustering the images. It can be organised into the data narrative shown in Figure 6. (1) Over 200 million images of nature are collected to create a preliminary dataset. (2) The dataset is processed using an image-recognition algorithm called ResNext for feature vectorisation. The computed features are then used to filter the dataset. (3) A clustering algorithm, UML-UMAP, is used to cluster the machine-generated memories of nature, and these clusters create a three-dimensional data universe (Anadol, 2020).

Then, quantum computing software developed by the Google AI Quantum research team can speculate alternative modalities within the most sophisticated computers and create new quantum noise-generated datasets as building blocks of these modalities. In addition, the 3D visual piece is accompanied by an audio experience based on data generated by quantum noise, providing an immersive experience. Furthermore, tapping into the random fluctuations of quantum noise as a unique realm of prediction and possibility, *Quantum Memories* provides an interactive aesthetic experience by tracking the audience's movements in real time and simulating how their observer positions become entangled with the visible outcomes of the ever-changing artwork (Anadol, 2020).

As a result, *Quantum Memories* is an epic scale investigation of the intersection between human consciousness, AI, and the aesthetics of probability, based on the Google AI Quantum Supremacy experiment. The work’s striking visuals and accompanying audio are composed in collaboration with AI-powered generative algorithms. Using the data flowing around us as its primary source material and the neural networks of the quantum mind as its collaborators, Anadol paints with a thinking brush to revive our digitised memories of the natural realm. The complexity of collective memory expressed through this work allows the audience to imagine the enormous potential for the future of quantum computerised minds and art.

Combination Of Human Consciousness And AI

Anadol (2020) said the project is inspired by the many-worlds interpretation of quantum physics. As such, it utilises publicly available data from Google AI's cutting-edge quantum computing research and machine learning algorithms to explore the possibility of parallel worlds by processing nearly 200 million nature images. At its center is Quantum Supremacy, which uses a programmable superconducting processor.

Quantum Supremacy works with two main datasets: the GAN dataset and the Noise dataset. First, the GAN dataset consists of GAN inference, latent space browser, and many-world interactions, as shown in Figure 7. GAN, which stands for Generative Adversarial Network, first appeared in 2014 by Ian Goodfellow et al. (2014). GAN is a generative model that pairs a generator that produces fictitious data with a discriminator that can determine its authenticity, allowing them to learn competitively (Anadol, 2020). In Quantum Supremacy, the GAN trains on the given dataset and generates artificial images until it is able to produce an image with a resolution of 1024x1024. Then, AI finds latent spaces in data processing, recognising previously unseen connections between clusters of data. It further visualises the probabilistic nature of physical phenomena and their interactions. In this way, new images of artificial nature are created (Anadol, 2020).

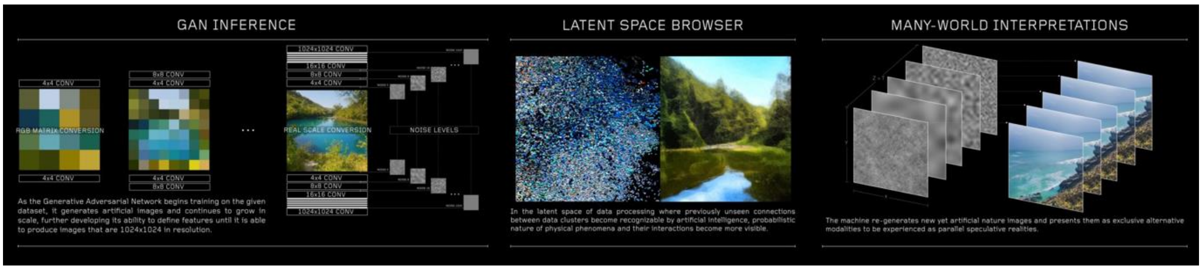

Figure 7. GAN Data Sculpture of *Quantum Memories* (Anadol, 2020)

Next, to speculate a parallel nature that is invisible to the human eye, Quantum Supremacy allows the randomness triggered by quantum noise to interact with the new data. As shown in Figure 8, quantum noise is created from the data universe of real landscape images and the audience's movement through publicly available quantum algorithms. The data is then recreated by using the same noise as a generative resource. This utilises the random fluctuations of quantum noise as a realm of aesthetic possibility (Anadol, 2020).

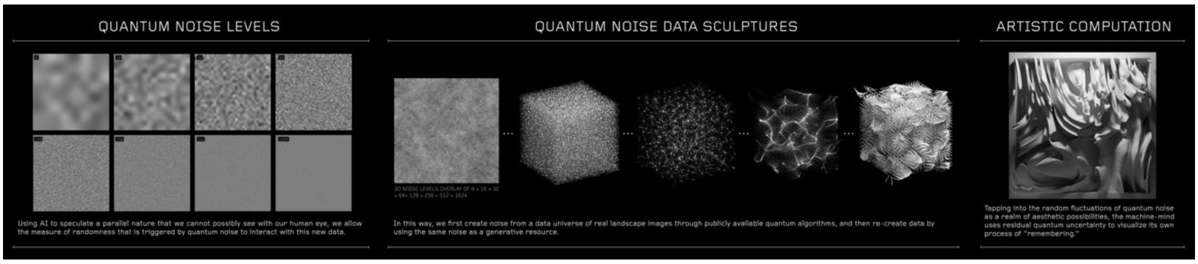

Figure 8. Noise Data Sculpture of *Quantum Memories* (Anadol, 2020)

Therefore, *Quantum Memories* utilises AI to find previously unseen connections between data clusters, presents them to the audience as probabilistic images of nature, and generates the audience’s observation and movement as quantum noise. The quantum noise is then recycled as a generative resource. In other words, *Quantum Memories* creates new probabilistic images of nature from over 200 million images of nature, and stores the audience’s observation and movement in the form of quantum noise again, constantly creating new images. This means that *Quantum Memories* connects AI and human consciousness to create a new form of memory and generates a new image of memory every moment. In this way, Quantum Supremacy, which combines GAN and quantum noise, becomes an Everywhen machine in that it uses residual quantum uncertainty to visualise its own process of remembering.

Contingent Encounter of the Copernican Principle And the Anthropic Principle

During the transition from the superstitious Middle Ages to modern quantum mechanics, science has undergone several revolutionary changes that have dramatically altered our place in the universe. The question of defining the role of humans scientifically has been pitted against Copernican and anthropic principles.

The Copernican principle argues that human beings have no special place in the cosmic scheme of things. Just as Copernicus' heliocentrism relegated the Earth from the centre of the universe to an insignificant planet on the periphery, the Copernican principle says we are just a speck of dust in the universe. The anthropic principle, on the other hand, argues that life arose because of a series of miraculous events in the universe. For life to arise and multiply, many conditions must be incredibly aligned, and we are blessed to live in such a blessed environment. As such, the Copernican and anthropic principles, while holding opposing views, provide important clues to understanding our role in the universe. While the Copernican principle focuses on the vastness of the universe and our smallness, the anthropic principle focuses on the rarity of life and consciousness in the universe (Kaku, 2006).

However, in order to identify the role of humans in the Copernican and anthropic principles, we need to look at the universe from a broader perspective, namely a quantum physics perspective. "The universe requires life's consciousness for its own existence," said Eugene Paul Wigner (The Information Philosopher, n.d.). This means that everything that exists in the universe is determined by the presence or absence of observation, i.e., interaction with consciousness. Wigner went so far as to claim that the laws of quantum physics cannot be expressed in a coherent logic without introducing the consciousness of the observer (Crease and Mann, 1986). After Wigner's interpretation emerged, the universe became less of a giant machine and more of a giant consciousness, and it became the point where Copernican and anthropic principles met.

Quantum Memories represents our world from a quantum physics perspective, that is, at the intersection of Copernican and anthropic principles. As we have seen, the generative process of images in *Quantum Memories* requires a new consciousness that combines human consciousness and AI. It creates new probabilistic images of nature from more than 200 million images of nature and stores the audience's observation and movement in the form of quantum noise to create new images constantly. In this process, images that are classified, clustered, and probabilistically existing through AI are defined as new images by the audience who look at them and react to them. In particular, Quantum Supremacy, which contains GAN and quantum noise, acts as a machine-mind and uses residual quantum uncertainty to visualise its own process of remembering. It creates quantum memories at the intersection of Copernican and anthropic principles.

Conclusion

In ancient Korean literature, there is a phrase that goes something like this: 天地無日月空殼, 日月無知人虛影. This phrase means, “The universe is an empty shell without the sun and moon, and the sun and moon are empty shadows without anyone to recognise them”. It means that humans are the ones who recognise the sun and moon in the universe and make their value visible. In other words, no matter how big and wide the universe is, it is only when humans consciously look at it that it becomes real.

Interestingly, this passage in ancient Korean literature aligns with how prominent quantum physicists have described quantum superposition and the observer effect. Wigner called the human act of observation, “Genesis by observation”, and John Wheeler expressed that “we live in a participatory universe” (Kaku, 2006, p. 524). This is because matter in the microscopic world exists in outer space as wave energy, and at the moment it is observed by an observer, it is manifested in the real world as particles. Fred Alan Wolf (1996) called the observer effect that produces this phenomenon “God's trick”, interpreting all quanta in the universe as invisible vibrations waiting to take the form of matter (particles).

When we see something, it means that some of the light bounces off the object and reaches our eyes. The light is then refracted through the crystalline lens, where it forms an image of the object on the retina and is turned into electrical signals to reach the brain. In the end, we see light bouncing off objects. In fact, seeing becomes very confusing. When we enter the world of tiny particles like atoms, seeing means seeing indeterminate objects rather than determinate objects, because very small particles can be thrown off their trajectories by the light (or photons) themselves.

In this way, seeing is essentially a process of light traveling, and humans may be creating their own truths through the observation. We, living on a little blue dot called Earth, are actually the ones sustaining the universe. And now another form of consciousness, a combination of AI and human consciousness, is observing the universe. It has become a quantum physics perspective at the intersection of Copernican and anthropic principles, and shows that the world of "Everywhen" can actually exist. *Quantum Memories* was a work that implicitly shows what the world of "Everywhen" is. The intersection between human consciousness, artificial intelligence, and the aesthetics of probability, which can be experienced through the work, has become quantum memories and is approaching our future.

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