

Alain Lioret

Time Beings :Quantum Beings for Art Exploration and Creation



Abstract:

Time Beings are a population of creator artificial beings. They take various forms of elementary corpuscles, according to various types of artwork (pixel, frame, vertex, note, word). They operate on the basis of quantum properties and can travel in space-time works of art. Their purpose is artistic exploration and/or creation. Relying specifically on computation of superposition states with Qubits and rules of Quantum Cellular Automata, Time Beings open new ways for artistic creation. They offer an innovative method for Artistic Time Travel, with scaling in the image space, film space, object space, score space and paper space.

Time traveling in space is one of the great fantasies of humanity. Inconceivable according to the principles of classical physics, this theme is back strongly, thanks to quantum mechanics.

However, this remains a great utopia for the world-scale physics of our universe. How about in the art world? It is known that quantum principles apply only at very small scales at the atomic level. However, art can explore ways that are often unreachable for scientists.

The work presented here, based on the concept of Time Beings as artificial creators, tries to translate the principles of quantum mechanics and Time Travel into the realm of artwork. Projection from our real space on a canvas painting, a sculpture, poetry or film, opens new perspectives for very interesting artwork explorations, and also methods of creation.

Topic: Artificial Life

Authors:

Alain Lioret

Université Paris VIII, Arts et Technologies de l'Image

www.alainlioret.fr

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www.generativeart.com



Quantum Exploration of the film « Back to the Future ».

Contact:

alainlioret@gmail.com

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Quantum Beings for Art Exploration and Creation

Alain Lioret.

Arts et Technologies de l'Image. Université Paris VIII

www.alainlioret.fr

e-mail: alainlioret@gmail.com

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Introduction

Time traveling in space is one of the great fantasies of humanity. Inconceivable according to the principles of classical physics, this theme is back strongly, thanks to quantum mechanics. [1].

However, this remains a great utopia for the world-scale physics of our universe. How about in the art world? It is known that quantum principles apply only at very small scales at the atomic level. However, art can explore ways that are often unreachable for scientists.

The work presented here, based on the concept of Time Beings as artificial creators, tries to translate the principles of quantum mechanics and Time Travel into the realm of artwork. Projection from our real space on a canvas painting, a sculpture, poetry or film, opens new perspectives for very interesting artwork explorations, and also methods of creation.

Theories of Quantum Mechanics

In the early 20th century, in the field of the infinitely small, Max Planck invented the Quanta Theory including the famous length (10^{-35} m) and time (10^{-43} seconds) constants, which remain barriers. Since then, Quantum Mechanics has become very popular.

In the scientific community, we have seen the famous theoretical battle between Einstein and Niels Bohr about the uncertainty principle enunciated by Heisenberg [2], and many other in-depth discussions about disturbing statements of this Quantum Theory, which go against general relativity. The paradox of Schrödinger's Cat is at

the center of these issues. [3].

The principles of Quantum Mechanics have had a great influence on art since the beginning of the 20th century, and they have inspired many artists and writers.

Context: Art, Time Travel and Quantum Mechanics

Time Travel and Quantum Mechanics have been used in many pieces of art in the past artistic history. Here are some major examples:

The theme of time travel appeared very early in literature. Before publishing his famous novel, *The Time Machine*, in 1895 (adapted for the movie screen for the first time by George Pal in 1960), HG Wells published *The Chronic Argonauts*, in 1888, and Mark Twain published his satire *A Connecticut Yankee in King Arthur's Court*, in 1889 (Adapted for the screen in 1921). Since then, many other authors have used the theme of time travel.

Time travel and wormholes as quantum alternatives have often inspired artists, including filmmakers. Among the most famous works, we can mention: *Planet of the Apes* (by Franklin J. Schaffner in 1968), the *Back to the Future* trilogy (Robert Zemeckis, 1985-1990), *Star Trek IV: The Voyage Home* (1986, by Leonard Nimoy) and more recently, *Men in Black 3* (2012).

Here we cannot make a list of all the artists who are interested in the theme of time, nor those whose artistic pieces have links with physics. The excellent book by Leonard Shlain, "Art & Physics" [4] gives a good comprehensive overview of this field.

We note the admirable work of Claude Monet, and his temporal versions of Rouen Cathedral, but also his extensive research in the quest for other dimensions.

Cubists, such as Picasso, produced paintings where one can see all facets of an object at the same time, in the same artistic space. Also, Marcel Duchamp used to say:

"I was thinking of art in a broader perspective. We were discussing altogether fourth dimension and Euclidean geometry. These were amateurs' points of view ... But, despite all our mistakes, these new ideas freed us from the conventional language – from our coffee shop platitudes."[4].



Figure 1: Marcel Duchamp. *Nude Descending a Staircase, No. 2* (1912). Oil on canvas. 57 7/8" x 35 1/8". Philadelphia Museum of Art.

The work of the Italian Futurists, such as the *Nude Descending a Staircase* by Duchamp and the Surrealists (including for example *Figure Pandyamique* by Wolfgang Paalen, one of the major surrealist quantum works) was also strongly influenced by quantum mechanics [5].

Meanwhile, the search for a fourth dimension in art was superbly analyzed in the works of Linda Dalrymple Henderson [6] (a great specialist about study of the cultural history of the “fourth dimension”) and Tony Robbin [7] (a pioneer in the computer visualization of four dimensional geometry) in particular.

Artists such as Julian Voss-Andreae, who implemented Quantum Theory in the field of sculpture [9], Lynden Stone [10] author of quantum installations, and Servant-Ermes, a French painter, based much of their art on quantum theory.

Quantum physics has also inspired many scientists to create artistic images. These artists include Eric J. Heller, who made beautiful pictures based on quantum theory and wrote many papers [8] (well known for his work on time dependent quantum mechanics, and also for producing digital art based on the results of his numerical calculations).

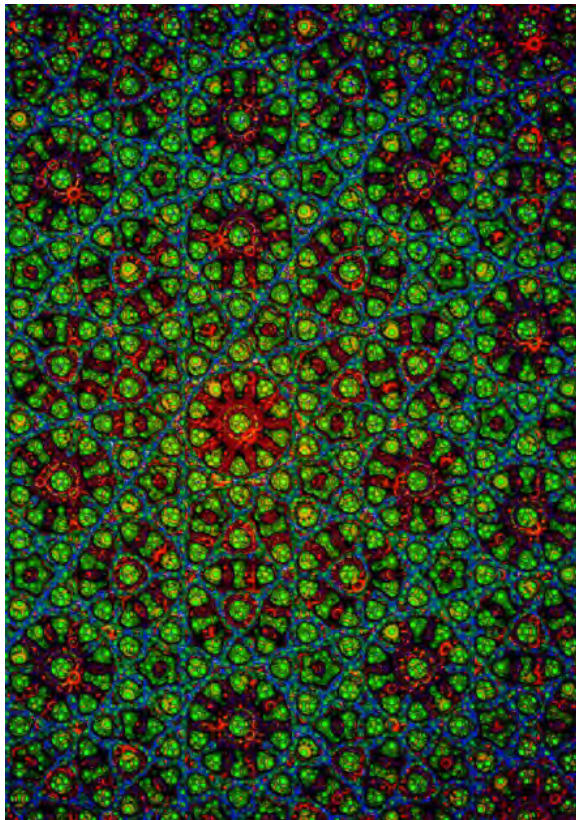


Figure 2: Quasi Quasi. © Eric J. Heller.

Finally, the Quantum Aesthetics Group, established in 2000 by Gregorio Morales, set up quantum principles as guides to creation. [11] One of the major artists of the group, the Spanish painter Xaverio, is known for his quantum art, including the series *Petrales*. While this group, which is mainly composed of authors, used quantum principles as metaphors in their creations, Morales and his friends are at the heart of deep thinking. The artwork done here with Time Beings is obviously closer to their theory.

Tools for Time Travel

The quantum theory is an important tool to enable travel in what is often called the fourth dimension, which is Time. It is especially an important part of the functioning of wormholes [1], which can help build bridges in space-time.

Moreover, in his manifesto for the quantum aesthetic, Gregorio Morales [12] gives an interesting list of quantum principles that can be applied to art. Among these, we have selected the following list:

- The Principle of Complementarity: a corpuscle is sometimes a wave, sometimes a particle.
- The Principle of Uncertainty: It is not possible to determine the position and the momentum of a particle through a single measurement.
- The Schrödinger Paradox: The observer modifies the experiment with his observations.
- Non Separability / Entanglement: As Francis Thompson said: "One cannot uproot a flower without disturbing the stars"...
- Acausality: Any event is not necessarily the result of another event.
- Complexity: Trends in the composition of complex structures.
- Ubiquity: Particles may be in many places at once.

Artificial Beings for Artistic Creation

The association between Artificial Life and Art has been for thirty years a good field of experimentation for a number of artists, including an excellent overview of this kind of art, given by Mitchell Whitelaw in his book *MetaCreation* [13] (a very good survey of artists adapting the techniques of a-life science to create a-life art).

As far as I am concerned, I have been working with artificial beings for 10 years. My first experiments were carried out between 2002 and 2005 with Plant Beings (morphogenesis based on L-Systems and Cellular Automata), Light Beings (for photosynthesis), and Painting Beings (self-organized artificial pigments for painting) [14].

Also present in the artwork of Cinema Beings, introduced in 2012 [15][16], Time Beings have proved to be an excellent path to novel techniques for creative practice.

Time Beings as an Artistic Exploration Tool

Time Beings can take different forms. These artificial beings will thus be classified into different types, depending on the type of artwork they will put into action. Each category corresponds to a minimal entity (a corpuscle or atom). For music, this entity is the note (3D space), while it is the word for Literature and Poetry, the pixel (2D space) for painting and photography (digital), the vertex (3D space) for sculpture and architecture, and the frame (4D space) for Film and Video, etc.



Figure 3: Exploration of the film 'Le Ballet Mécanique' (Fernand Leger, 1924) by Time Beings.

To understand what Time Beings are, let us give some examples of major artistic explorations that may be feasible by Time Beings:

In a 2D space, the basic element is the pixel. It is located on a plan (which is the image plane) and its position determines the distance in number of pixels relative to its neighbors: for example the pixel with coordinates (x_1, y_1) at $(0,0)$, has a distance value of 10 from the pixel (x_2, y_2) at $(10,0)$, using the classic formula:

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

These distance values can also be used as a time travel scale. While you look at an artwork, the journey time is real. If you move closer to see the details of a certain part, it takes a certain time to explore other areas of the work (see figure 4).

Here, Time Beings can be compared with virtual eyes, navigating on the picture space.

Thus, Time Beings have a "wormhole" function included in their system, which allows them travelling almost instantly through the space-time distance between two pixels located at the ends of the wormhole (like a virtual camera going from one pixel of a picture, directly to another one). The notion of scaling in space-time is crucial here: it is what defines the course of the work, with more or less detail.

The above description relates to a finished artistic work. But Time Beings are also able to explore a more interesting space-time which connects to the time used to make the artwork. For this, we must of course have several images, taken at different times during the artist's work in progress (for example, photographs of a painting, during its evolution). In this case, "Virtual Wormholes" work not only in the 2D space of the image, but also in multi-dimensional spaces and time series images. Thus, the exploration of a work can begin from a pixel of the final picture; go on to a pixel of a previous image from the process of creation, move back to a later one, etc.



Figure 4: *Exploration of Mona Lisa (Leonardo Da Vinci) by Time Beings. (With Quantum Cellular Automata Patterns)*

The exploration of film artworks is even more interesting. Time Beings consider a film as a 3D volume, composed of frames. They use virtual wormholes to travel through the time and space of the film, and thus view the movie in completely new ways.

As for still images, the course of Time Beings can travel in different versions of a film, from simple animated storyboards to final film, through various intermediate stages (animatics, rushes, etc.).

Just imagine you have a virtual camera, viewing one frame of your film, then going directly to another one, and so on. Thus, you can explore a movie, with strange way, and discover new interpolations between different frames.

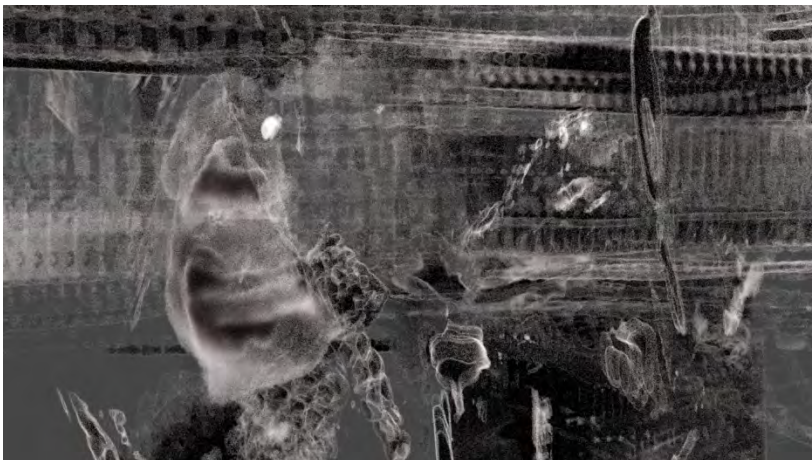


Figure 5: *Quantum Exploration of the film « Back to the Future ».*

Another aspect of Time Beings allows them to explore 3D geometry, based on the vertices coordinates, which are the main components of digital volume creations. In this case, the travel in time space is inside the 3D space of the sculpture or architecture (digital or scanned), from one vertex to another. We use the same formula as above, but with three dimensions:

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Note here that the more advanced methods for traveling in a creation's space can be employed using the rules of Quantum Cellular Automata [19] (a special kind of cellular automata, using quantum computation), which themselves are based on the principles of superposition of states, allowed by the use of Qubits [17] (a special kind

of bit, that can be 0, 1, or a superposition of both.), replacing the use of normal bits for digital creation.

Thus, the virtual camera (Time Beings) can travel from one vertex to another one, using cellular automata rules, instead of the “wormholes method”, described previously. For example, the vertex with coordinates xyz equal to (5,8,1) can be followed by (5,9,1) or/and by (5,8,2). If the superposition state is chosen (“and” mode), the system use compositing rules to make the picture (“add” mode as in Photoshop software).

Time Beings are also present in musical pieces of art. Here, the musical note becomes the elementary corpuscle, and time travel in the artwork occurs in the 2D score’s space. For example, Time Beings can read a score, not linearly, but from one note to another one, using cellular automata or virtual wormholes.

Similarly, the exploration of textual works is done with words, allowing Time Beings to create suites of poetic words, in the same way as described above.

Here is a small table illustrating some of the exploration experiences that are possible with Time Beings:

Experimentations	Painting/ Photography	Cinema	Sculpture/ Architecture	Music	Poetry
Corpuscle	<i>Pixel</i>	<i>Frame</i>	<i>Vertex</i>	<i>Note</i>	<i>Word</i>
Space	<i>Picture (2D)</i>	<i>Volume of all frames (3D)</i>	<i>Object (3D)</i>	<i>Score (2D)</i>	<i>Book (3D) or paper (2D)</i>
Time Travel with Wormhole	Start with pixel 1, zoom into a detail, space-time travel to pixel 2 by Time Being.	Start with frame 1, Time Being travels in the volumetric space-time of the film to the frame 2.	Start with vertex 1. Time Being travels to the Vertex 2.	Start with note 1, the sound is played, and then Time Being travels to note 2 (played).	Start with word 1. Time Being travels to word 2 (read).
Schrödinger Cats, Quantum Superposition	Several versions of an image available. Beings travel within pictures with quantum superposition states (Qubits calculations). (Example: Monet, Rouen Cathedral).	Several versions of the film available (animatics, final film, etc.). Time Beings travel in different versions and frames using calculations of quantum superposition with Qubits.	Several versions of the 3D object available. Beings travel between shapes (vector calculation of displacements and superposition of states with Qubits calculations).	Several versions of music available. Quantum superposition states for music.	Several variants of a text. Time Being travels by quantum superposition between existing versions.
Quantum Cellular Automata. (QCA) Using Hadamard Gates and Pauli Gates.	Using QCA rules for navigating in a picture.	Using QCA rules for navigating between frames of a movie.	Using QCA rules for navigating in the geometry of an object.	Using QCA rules for playing music.	Using QCA rules for reading a text.

Time Beings as a Creation Tool

Another very important aspect of Time Beings is that they can also be used for artistic creation. The operations here are very similar to the exploration ones and use the same basic tools (Qubits, Quantum Cellular Automata, Virtual Wormhole, etc.). In order for Time Beings to be able to create, a minimum starting axiom is required: a pixel, a frame, a vertex, a note, a word, etc. Time Beings are autonomous beings that include self-organization parameters for creation, and work with various quantum rules, as listed above.

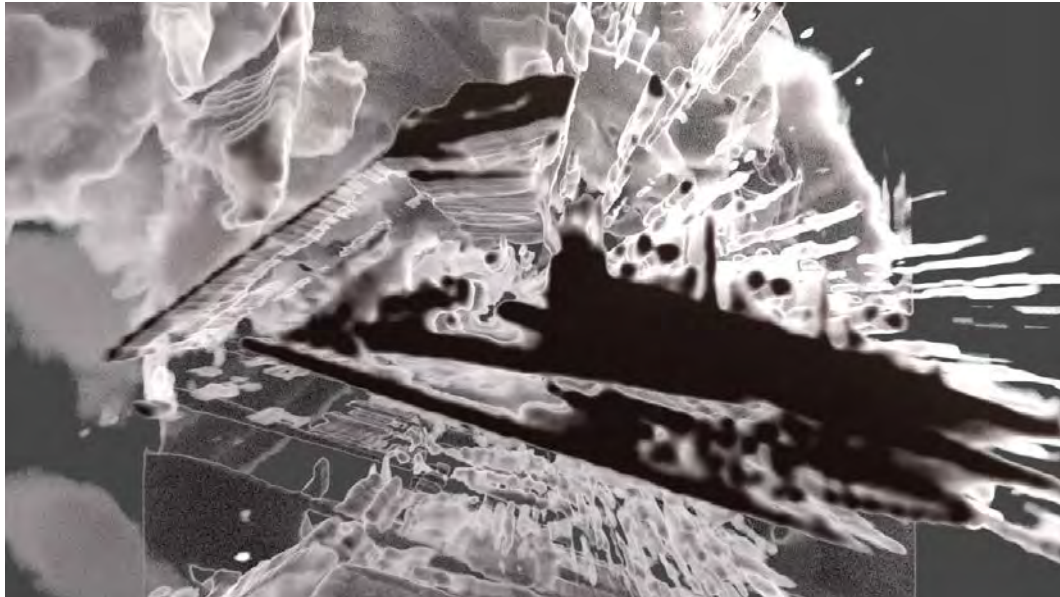


Figure 6: Cinema Quantum Creation, by Time Beings

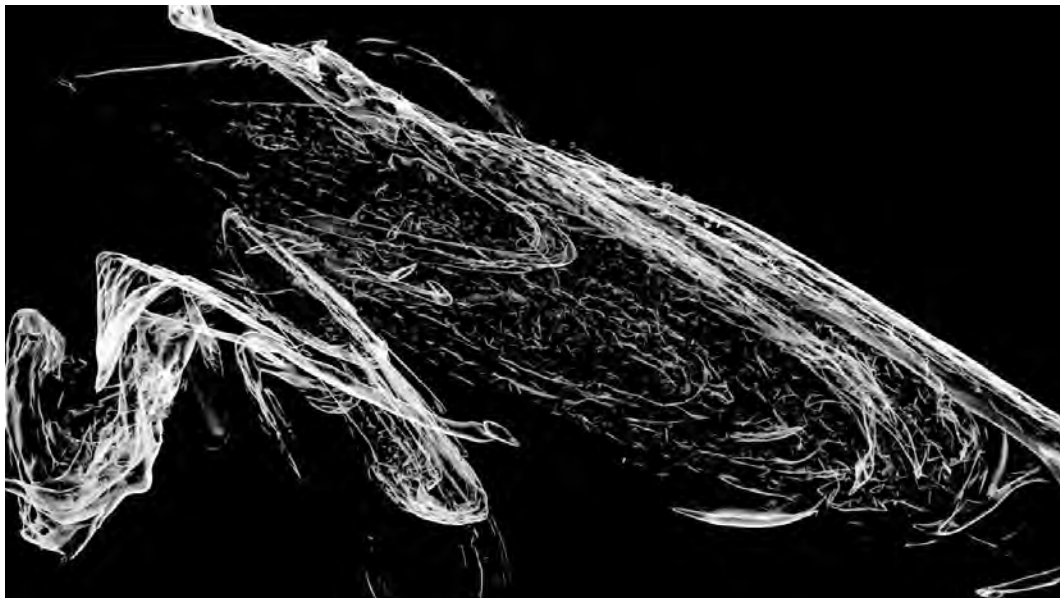


Figure 7: Digital Sculpture Creation, by Quantum Time Beings.

Most important Quantum Art Exploration and Creation Methods

Each art form has its elementary particle/atom (various kinds of Time Being) and uses various methods.

Art	Painting/Photography	Cinema	Sculpture/Architecture	Music	Poetry
Particle/Atom	Pixel	Frame	Vertex	Note	Word
Wormholes	From pixel to pixel	From frame to frame	From vertex to vertex	From note to note	From word to word
Uncertainty Principle	Pixel coordinates or color	Frame number or color histogram	Vertex position or color	Note pitch or duration	Word position or length
Complementarity / Duality	Particle (pixel, frame, vertex, note, word) transformed by a Wave Function(*)				
Schrödinger Superposition	Qubit values for parameters calculations (0,1 or superposition of both)				
Entanglement	Particles are linked (shared state / parameters)				
Schrödinger Paradox	The observer modifies the artwork (for example pixel color, frame contrast, vertex position, note pitch, word position)				
Ubiquity	One particle in two different places at the same time (parameters copied)				

(*) *Wave Function* : See definition at http://en.wikipedia.org/wiki/Wave_function (SymPy implementation)

About Techniques for Time Beings

To give a very simple example: a red pixel will be translated in the picture's space-time, according to two superposed states (by Qubit calculation), and thus will take two positions and two new colors in the image (for example, one blue and one green). These two new pixels themselves will then be transposed by the same process. Thus, a quantum image is created! Similarly, the creation of films, 3D objects, music, and poetry will use the same processes, possibly using other items (from all musical notes, words from a dictionary, etc.).

It seems important to use simulation tools to implement quantum Time Beings. In fact, why not take advantage of the possible use of Qubit superposition of states [17], instead of the traditional bits; giving only deterministic values (0 or 1)?

Without going into a technical description which would be too long to develop here, we can just say that the world of Time Beings is developed in Python language, based primarily on the SymPy module of Quantum Mechanics [18] and the concept of Qubits, allowing the superposition of the two states (linear combination of 0 and 1).

Much of the movement of Time Beings artworks is based on Quantum Cellular Automata, as described initially by Jonathan Grattage [19].

Future Work and Conclusion

The concept of Time Beings thus opens up new ways of artistic exploration and creation. However, although we are not interested here in observing the exact scientific formulations, many algorithms from quantum computation can be used to achieve more new experiences. The range of possibilities for creating and exploring Time Beings is wide, and largely undiscovered.

Heidegger, in his major work "Being and Time" [20] says about his Dasein concept (Heidegger uses the expression Dasein to refer to the experience of "being" that is peculiar to human beings):

"Dasein is its past, its mode of being, which comes every time from the future."

So, it will be very interesting to study the concept of Time Beings regarding the Dasein theory.

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