To be and not to be
A guide to the process of human quantification

Title/Statement: To be and not to be

Scientific insight: Quantum Mechanics

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"I think I can safely say that nobody understands quantum mechanics."

– Richard Feynman

The Scientific Insight

It was a cloudy September afternoon that our team decided to have our initial project meeting. All three of us brought our own personal interests and insights to be explored. The ideas that kept coming up (or immediately stood out) involved quantum physics and the uncertainty principle, so we decided and further study upon these subjects. For several meetings we tried to discuss the actual theory behind quantum mechanics and really tried to understand it, as we felt that would be important for the quality of our translation. However, upon realising that this subject is something that takes years to really fully grasp, we experienced a lively level of frustration. How can a theory that is supposed to help us understand be so ungraspable? In the end, this frustration actually inspired us to explore a more general representative approach to the subject: we tried to move away from directly trying to explain aspects of the theory (this was also suggested during the first plenary feedback session). Instead, we took a more engagement-oriented approach.

The main reasons why we chose to go with the subject of quantum mechanics over others is because we find it to have a strong relation with the given theme of certainty and because it is elusive to the visitors giving us an opportunity to use an artistic approach. The fundamental uncertainty that is woven into the theory of quantum physics, present in the Schrodinger's cat experiment, quantum entanglement, the double slit experiment and the uncertainty principle, relate to the theme well and gave us a good basis to work with. The elusive character of quantum mechanics also gave us an opportunity to move away from explaining the hard math behind the theory and instead give an opportunity to create a piece that can be interpreted from a more personal perspective.

The Importance of our Insight

The theory of quantum physics is interesting to translate into an experience because of its mystified public understanding. We think that a visitor will have heard of the theory but won't have a clear understanding of its finer details. This gives us an opportunity to play with their expectations. To be more precise, what we like about this theory in the light of this project, is that it cannot be experienced or perceived directly, leaving a lot of room for artistic interpretation.

Quantum theory deals with the world of the very small, let's say everything as small or smaller than an atom. The effects that this theory describes are very real but have little to none impact for us large humans. Our macro world is still accurately governed by Newton's classical mechanics. The distinction and paradoxical co-existence of these two theories is what gives us something to play with in the work.

Furthermore, for us there is something powerful in the fact that quantum theory is inherently ungraspable to humans. Its effects are often counterintuitive and seem to defy common sense. From the double slit experiment, for example, science infers that light has characteristics of both particles and waves. Or, the famous Schrodinger's Cat thought experiment seems to imply that animals can be both dead and alive at the same time. We think it could very interesting to try to give the visitor of the exhibition some sense of these paradoxical notions.

The Statement

The statement for the project is: "To be and not to be."

First of all, the statement is an obvious reference to the famous quote by William Shakespeare "To be or not to be" and therefore creates an immediate sense of familiarity. This quote is so famous that deconstructing it and applying it in a completely different context would spark an interest in exploring the piece further[1]. The statement is short, to the point and perfectly describes the nature of the narrative in our opinion. It offers a clear opening into the theory and its confusing nature but does not go too deep into it, leaving a lot of room for interpretation.

The statement refers to one of the aspects of quantum theory that covers the notion of the position of particles in space and time. More specifically, the statement refers to the paradox of being in parallel states at the same point in time. There are a lot of aspects of the theory that illustrate this paradox, such as entanglement and the observer effect. Entanglement, for instance, fuzzes the notion of particles being in a specific point in space by linking them in a way that seems to violate the speed limit of the universe (the speed of light).

"To be and not to be" crosses the bridge between the specific paradox of parallel states in quantum theory and the opportunity of using the artistic concept of parallel states in general, in the human world. These parallel states can be referring to states of many kinds, as is illustrated in our project description in the exhibition flyer, but our translation refers in particular to the parallel states in time and space: To be and not to be in a certain point in space at a certain moment in time.

The Translation

With this project we want to visualise something that we cannot explain (due to lack of understanding of the concepts) or experience ourselves (since it is physically impossible). Our aim is to let the visitor of the exhibition experience the weird concepts of space in time in quantum mechanics themselves.

[1] The reference to Shakespeare serves only as an attention grabber. It will not be further explored in the work.

One of the main inspirations for the translation comes from studying the double slit experiment (fig. 1) that demonstrates that light can have characteristics of both waves and particles. The setup of the experiment and what it conveys helped us draw parallels with a visualisation technique called slit scanning. The parallels between the experiment and the technique are plentiful. The literal similarity of the slits present in both the experiment and the technique is the most obvious one. More important is the concept of space. In the experiment, a stream of light passes through two slits, revealing a (initially) confusing interference pattern, which can be interpreted as a distortion of space, as the zero-dimensional stream of light is being smeared out over a one-dimensional line. In slit scanning, the distortion of space is more apparent: a 'normal' camera image is being heavily transformed into a quasi-recognisable image.

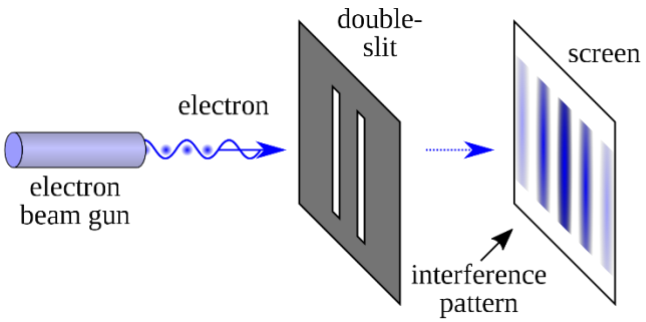

Fig 1. The double slit experiment

Slit scanning also offers us the option of visualising a distortion of time: the slit that is being used to build up the image is being displayed over time, one column or row of pixels at a time. This means that (parts of) the picture that are being taken are visible when the moment the picture was taken has already passed. This idea ties into the concept of quantum entanglement, in which the notion of time is very different from our usual experience.

The Installation

The statement "To be and not to be" comes from the idea of being in parallel states at the same time. With the installation, we want to convey this idea in a playful way. The slit scanning technique, apart from the strong connections with space and time distortion, is perfect for the playful aspect of this work. However, we want to give the audience a more powerful experience. Therefore we came up with a more literal approach to the notion of being in multiple states at once with the use of multiple slit scanned images that are being generated at the same time, at different points in space.

For the exhibition, we agreed on a multi-screen setup. A visitor steps into a circular space surrounded by screens. The screens display slit scanned feeds of the visitor, generated from videos that are recorded by the built-in webcams. All of the recordings are taken real-time, and immediately processed and displayed. In addition, we place a circular text message on the floor, in the form of a sticker. The content of the message has yet to be agreed on, but it will contain a reference to the theory. The purpose of this message is to give the audience a nudge into the frame of mind we want them to adopt. Without any reference to quantum theory, we fear that the larger narrative will be lost, leaving only a playful experience that is nice in itself, but not as powerful as we intend.

The Experience

When the visitor looks at a screen, their image is distorted, hard to recognize and clearly outside of their everyday experience. More specifically, the images are distorted in both spatial and temporal dimensions. Compare watching a screen in our installation with looking at yourself in a mirror. In a mirror, space and time are preserved perfectly: if you move, the mirrored image moves in the same

way, at the same time. On the screens, your movement is displayed with a temporal delay inherent to the slit scanning technique, and does not mirror your movement spatially.

So the screens all offer a time and space distortion. The multi-screen setup, however, adds another powerful dimension to this idea. The different screens show images that follow the same basic ideas of distortion (slit scanning), so there is nothing fundamentally different between them. However, it is important to note, one cannot look at all the screens at the same time, and the webcams do not record the same image at any given moment. If the visitor turns around (or even turns their head) to take a look at what another screen is showing, the temporal distortion guarantees an image that cannot be experienced in everyday life. For instance, if the visitor turns around, the visitor sees him-/herself from the back first (because that is what the webcam has been recording up to the moment of turning), before the image changes to their front (instead, of course, if the visitor has moved away already). The temporal distortion is thus amplified. In addition, the fact that the screens are literally in different physical places, so that the visitor is visible in different places at the same time, adds another layer to the spatial distortion.