Ghostbox

An interactive audio-visual experience

Diploma Thesis
(schriftlicher Teil der künstlerischen Diplomarbeit)

Çağdaş Çeçen

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1. Contents

2. Short Description

Ghostbox is a work in the medium of audio-visual experience within a constructed environment. It is an attempt to investigate the "Observer Effect" in the real world. The action takes place in a dark space filled with ten constantly-powered, audio-modulated, red laser modules.

While the lasers are physically identical, the audio information they carry differs. This creates an entangled, amorphous audiovisual scape, lending it a patterned structure. Although the structure appears uniform, it reveals its synthesized nature upon interaction.

Visitors wearing light-sensitive devices on both fists explore the layers of the soundscape through their body movements, as they interact with the linear-patterned space of laser beams. The devices on their wrists receive the modulated laser rays, transmitting the information to speakers, and making the rays audible inside the space.

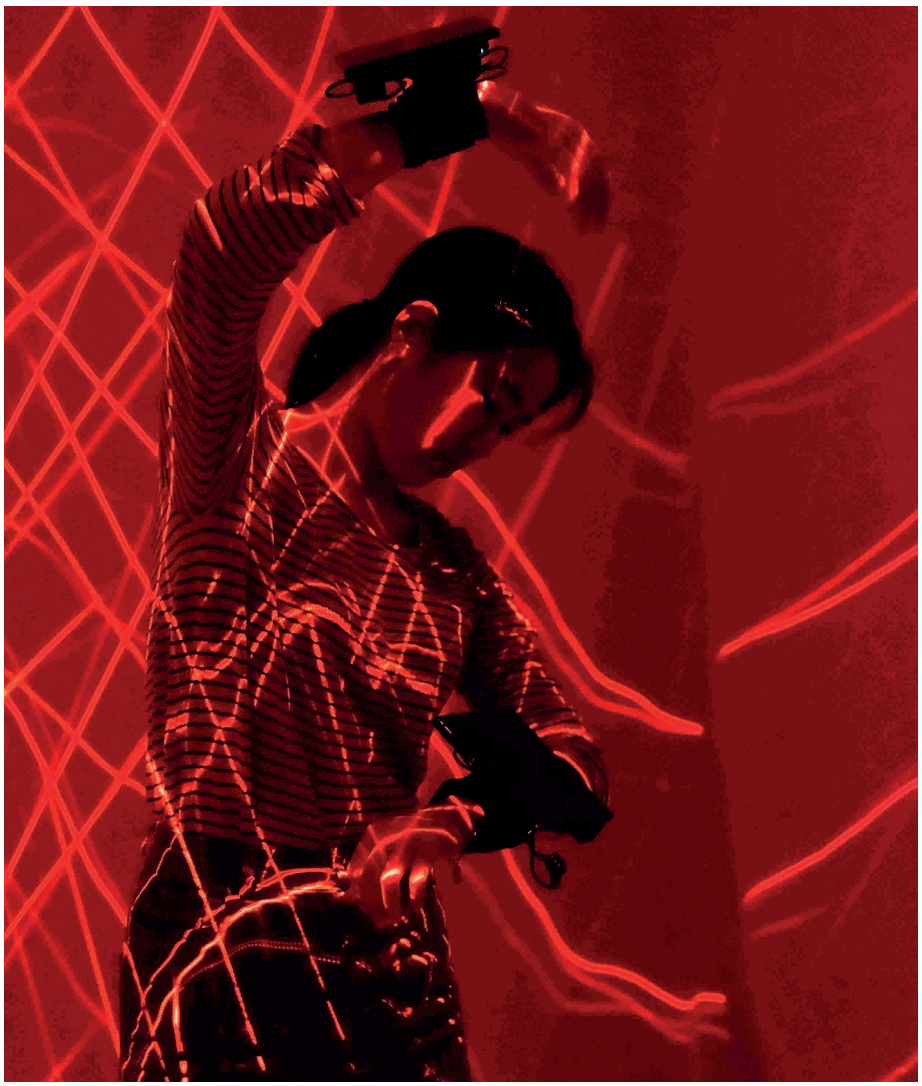


image 1

3. Discussion

What is light? (Actually)

Light makes everything visible, right? However, it also turns the universe into a visual time-travel machine. We look to the sky every night and see the past of the universe. Some of those shiny dots are long gone, so we are looking at ghosts.

Years ago, co-founder of the field of string theory, Michio Kaku, spoke very provocatively against deterministic approaches to nature and free will.

"Newtonian Determinism says that the universe is a clock, a gigantic clock that's wound up in the beginning of time and has been ticking ever since according to Newton's laws of motion. So what you're going to eat 10 years from now on January 1st has already been fixed. It's already known using Newton's laws of motion. Einstein believed in that. Einstein was a determinist.

Does that mean that a murderer, this horrible mass murderer isn't really guilty of his works because he was already preordained billions of years ago? Einstein said well yeah, in some sense that's true that even mass murderers were predetermined, but he said, they should still be placed in jail.

Then Heisenberg comes along and proposes the Heisenberg Uncertainty Principle and says: "Nonsense. There is uncertainty. You don't know where the electron is. It could be here, here or many places simultaneously."
This of course Einstein hated because he said God doesn't play dice with the universe. Well hey, get used to it. Einstein was wrong. God does play dice. Every time we look at an electron it moves. There is uncertainty with regards to the position of the electron.

So what does that mean for free will? It means in some sense we do have some kind of free will. No one can determine your future events given your past history. There is always the wildcard. There is always the possibility of uncertainty in whatever we do."

Then he adds:

"When I look at myself in a mirror, I say to myself what I'm looking at is not really me. It looks like me, but it's not really me at all. It's not me today now. It's me a billionth of a second ago because it takes a billionth of a second for light to go from me to the mirror and back."[1]

The accuracy of this statement is highly debatable; however, it is a very good point to start asking questions.

What happens if we modulate a photon with audio data and force it to decide to be either a wave or a particle, exactly like in "*Ghostbox*"? Can we find the same photon somewhere else in the space again at the same time ? Let's imagine that we found the same photon in the space somewhere else at the same time. Is the data it carried in its first position, the same data it carries now? How can we be sure?

1) Michio, Kaku"Why Physics Ends the Free Will Debate" Youtube, uploaded by Big Think, 20 May 2011
https://www.youtube.com/watch?v=Jint5kjoy6I

4. Background

The unpredictability of human behavior is exciting and scary at the same time, as each person is unique, with different opinions and choices. Not every person reacts or responds in the same way when they are put in a similar situation. Yet much time has been devoted to studying the probabilities and causes of human behavior. This work is an invitation to step back and look at who or what shapes our ideas, definitions, and very acceptance of the concept of predictable behaviors.

What has been considered predictable and what has been considered unpredictable? Is it our evolution, our morals, or just our cultures? Who knows?

What we do know is that the true nature of human behavior-- and consciousness-- still remains mysterious and sometimes quite abstract. Even without speculating about psychology or social sciences we can certainly say that human decision-making is non-binary. Words like “maybe” or “possible” do not only refer to a lack of input or information about a situation, they also bring us to the never-ending debate about “free will”, which is used to refer to a conscious mind. I am choosing to step to the side, away from the ontological debate about the existence of free will, since I believe the battle between determinism and indeterminism is a question of subjectivity. Rather, I am stepping towards a very basic idea behind this debate: If free will for a conscious subject does exists, then it must contain uncertainty but guess what, a “true uncertainty” is not only unique to a conscious subject.

This concept of “true uncertainty” is also one of the big topics in the natural sciences. The infamous double-slit experiment has opened the Pandora’s box, and since then our understanding has evolved rapidly, with scientists realising that quantum particles show some decision-making characteristics and even warp their existential characteristics in certain situations. This quantum capriciousness is closely related to quantum superposition, as well.

Theoretical physicist Richard Feynman describes uncertainty thusly: “It has not yet become obvious to me that there’s no real problem. I cannot define the real problem; therefore, I suspect there’s no real problem, but I’m not sure there’s no real problem”[2]. Some physicists partially define the problem by considering that quantum particles have their own consciousness, though of course this is just a metaphorical speculation to an existing phenomenon.

How do such particles behave? To use another metaphor, if we know that we are being observed, does it change or modify our decisions at all? Well, maybe. A speculative experiment during the 1920’s showed an interesting development in behavior when factory workers were knowingly being observed by someone. It is called the Observer effect, or Hawthorne effect, and is usually described as a “problem”, since it makes it harder, or even impossible, for a researcher to make general conclusions. This effect was later well-known as the “observer bias”, which basically states that when subjects know they are being observed, it may cause them to act abnormally, which could change the outcome of the experiment. However, in physics, this effect is even more exciting, as it is truly one of the most confusing events in the universe. In physics, we can see that an unobserved quantum system remains in a state called “superposition”, and whenever we try to measure or observe it, or let’s say, even attempt to be a part of that system, we cause a behavioral change. In other words, a quantum system can only be itself if we leave it alone. This characteristic is at once familiar and, by definition, totally mysterious.

2) Richard P. Feynman, “The Character of Physical Law” (Cambridge : MIT Press, 1965), p.129

5. Installation

My main goal for “Ghostbox” was to turn the whole space into an explorable audio-visual scape that visitors can explore at their will with minimal instructions, allowing them to become “observers”, rather than “obedient”. “*Ghostbox*” is a dream-like, quantum world not just aesthetically but in multiple ways: uncertain and entangled.

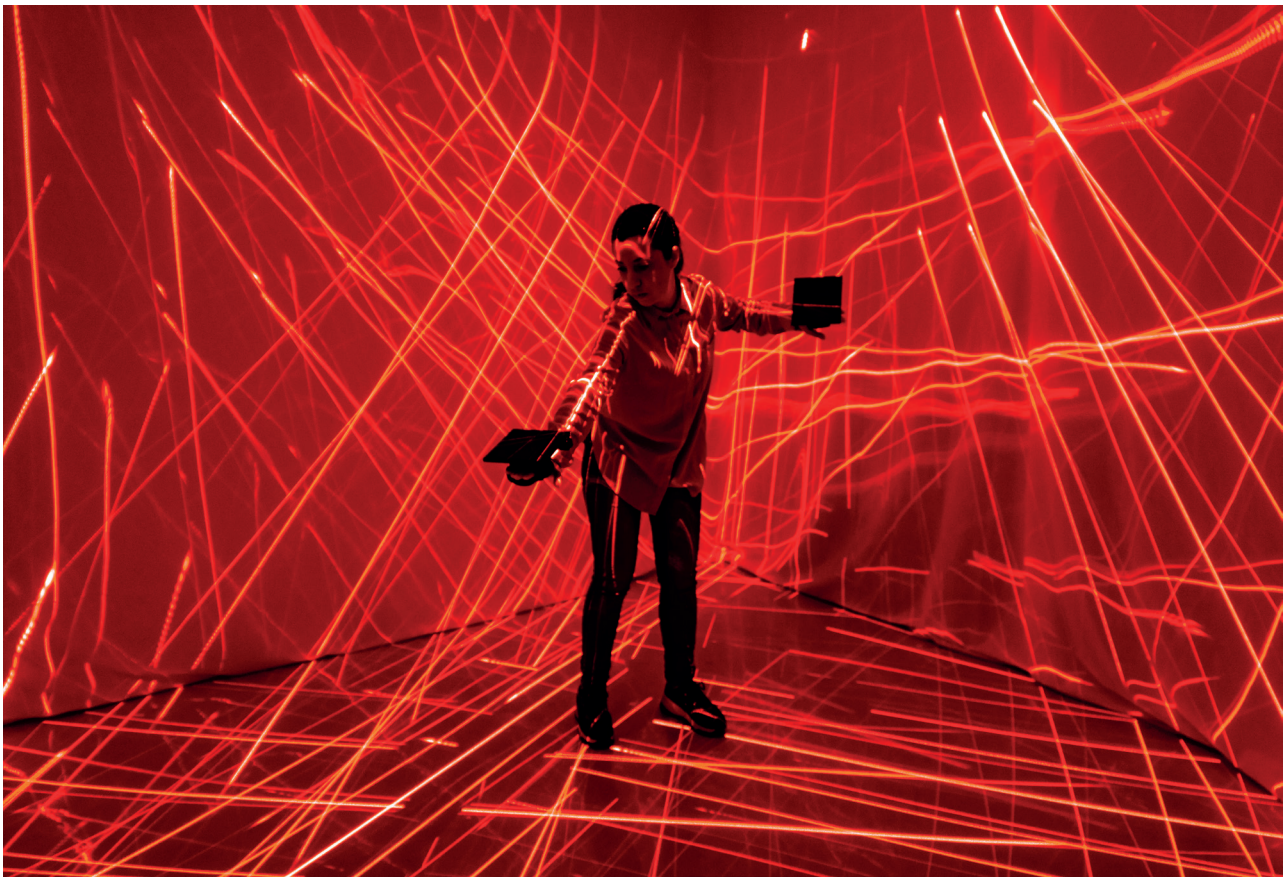


image 2

5.1 Frontstage

There are 10 identical laser modules hanging from the ceiling (image 3) with square shaped enclosures that have a diffraction grating in front of them. 2 wireless receiver apparatuses (image 4) are placeds a plinth, and visitors may hold them in their hands or strap them around their wrists, to facilitate interaction with the audio containing diffracted lasers. There are 4 speakers encompassing the space and their input source is split between both receivers to create a stereo sound. The distribution of the lasers in the space and the design of the receivers are also inspired by the observer effect principle, which will be discussed in more detail later.

image 3

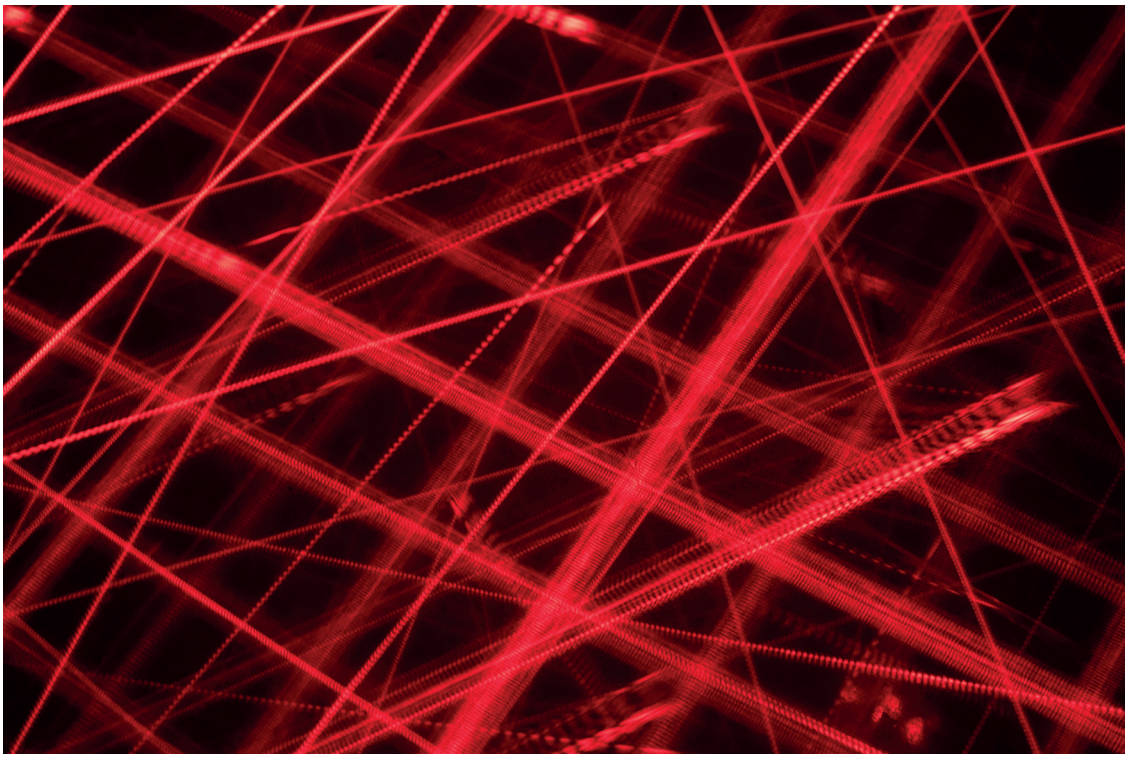


image 4

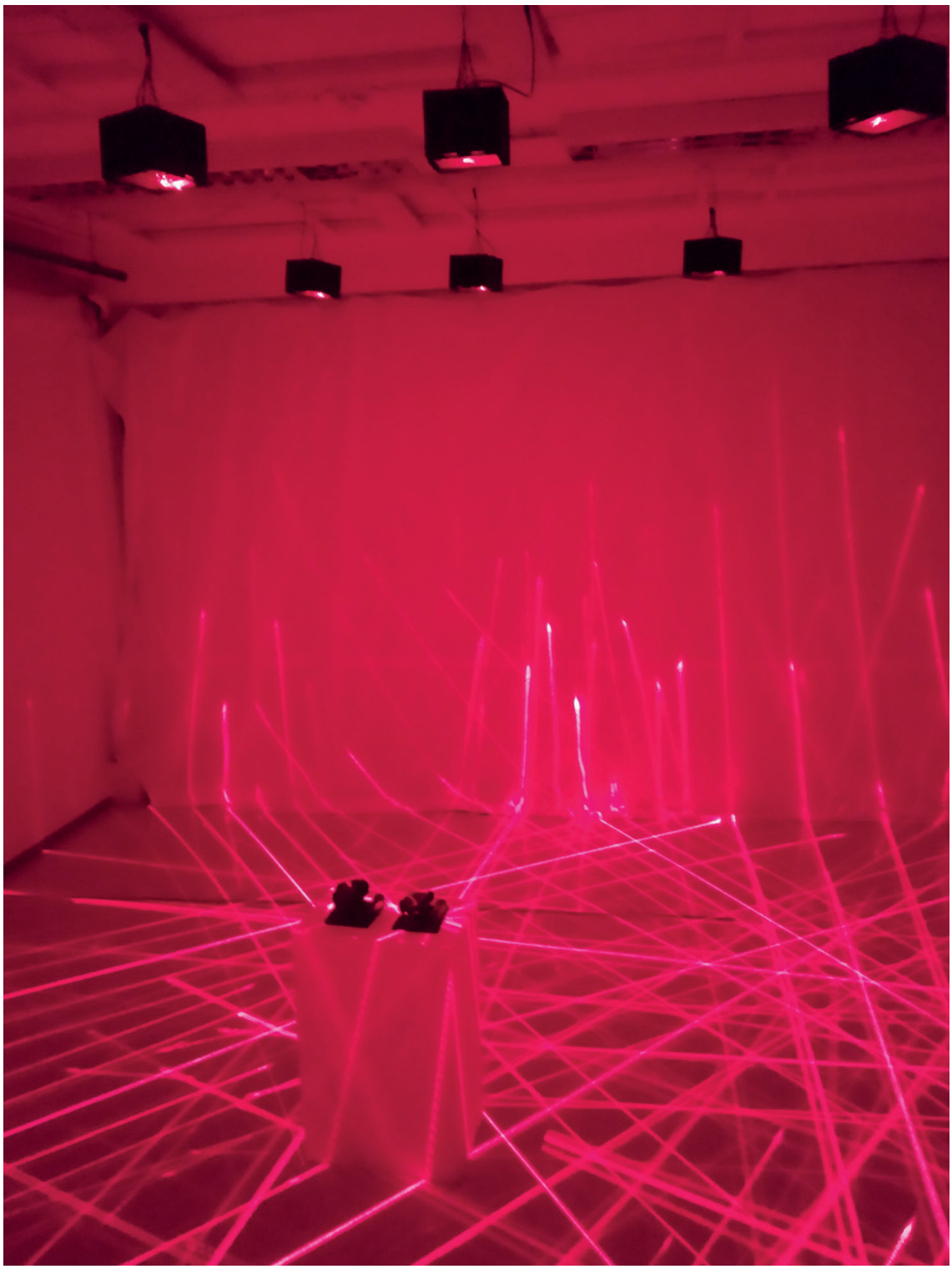


image 5

5.2 Backstage

Mini computer runs Ableton DAW that distributes 10 different analogue audio channels through an USB audio interface to a custom designed PCB(image 6, image 8). The PCB's job is to power up the lasers, as well as to filter analogue audio, amplify it and then mix it with the power source of the laser(image 7). Basically, the entire audio modulation of the laser modules happens at this stage. This process is called Li-Fi or "Light Fidelity" in popular culture.

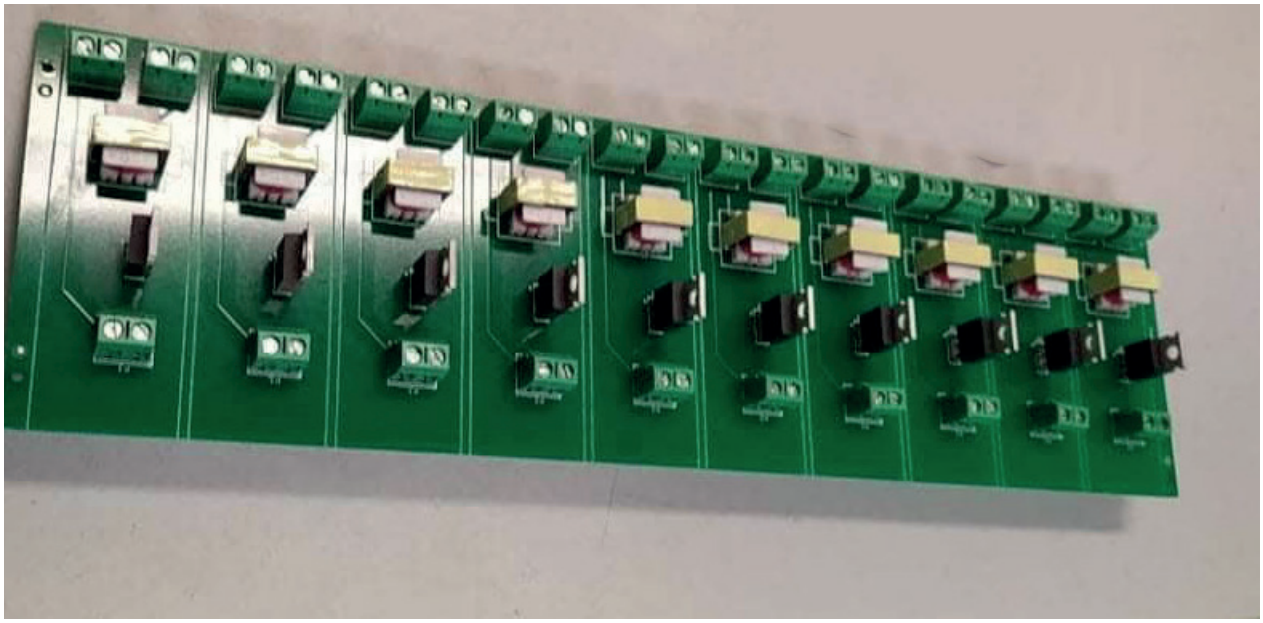


image 6

5.3 Sound

Almost all the sounds in the space are very physical and rhythmic. The audio pieces are selected from daily sounds we hear, such as noise of a big industrial fan and a loud cuckoo clock. They play in a loop at DAW, while their playing speed, frequency, loop start and end times are randomly changing with time, in a relation with the abstract and dream-like nature of the installation. The sounds are spread out unequally in the space through laser patterns.

5.4 Laser diffraction and entanglement

The use of lasers was perfect for the creation of entangled patterns in the space. Although every light source has similar characteristics due to the wave-particle duality, they mostly are non-monochromatic and when they diffract, we see different colors as result. Lasers, however, are capable of creating a monocolor space that appears as a whole piece. They are also excellent for carrying data, as we know well from fibre optic cables.

To be able to reproduce the double-slit phenomenon on a very large scale inside the space was a big challenge since it's usually reproduced for scientific purposes on a single axis, on a tiny scale. After a lot of research, I finally achieved the aesthetics I wanted with 650nm red cross line lasers and a special, very thin 13500 lines/inch double-axis diffraction grating film. Now I had the aesthetics I want, and an immersive quantum system which engages with the fundamental nature of photons. The question is : Decide how you want to exist in the space. Are you particle or wave, now?

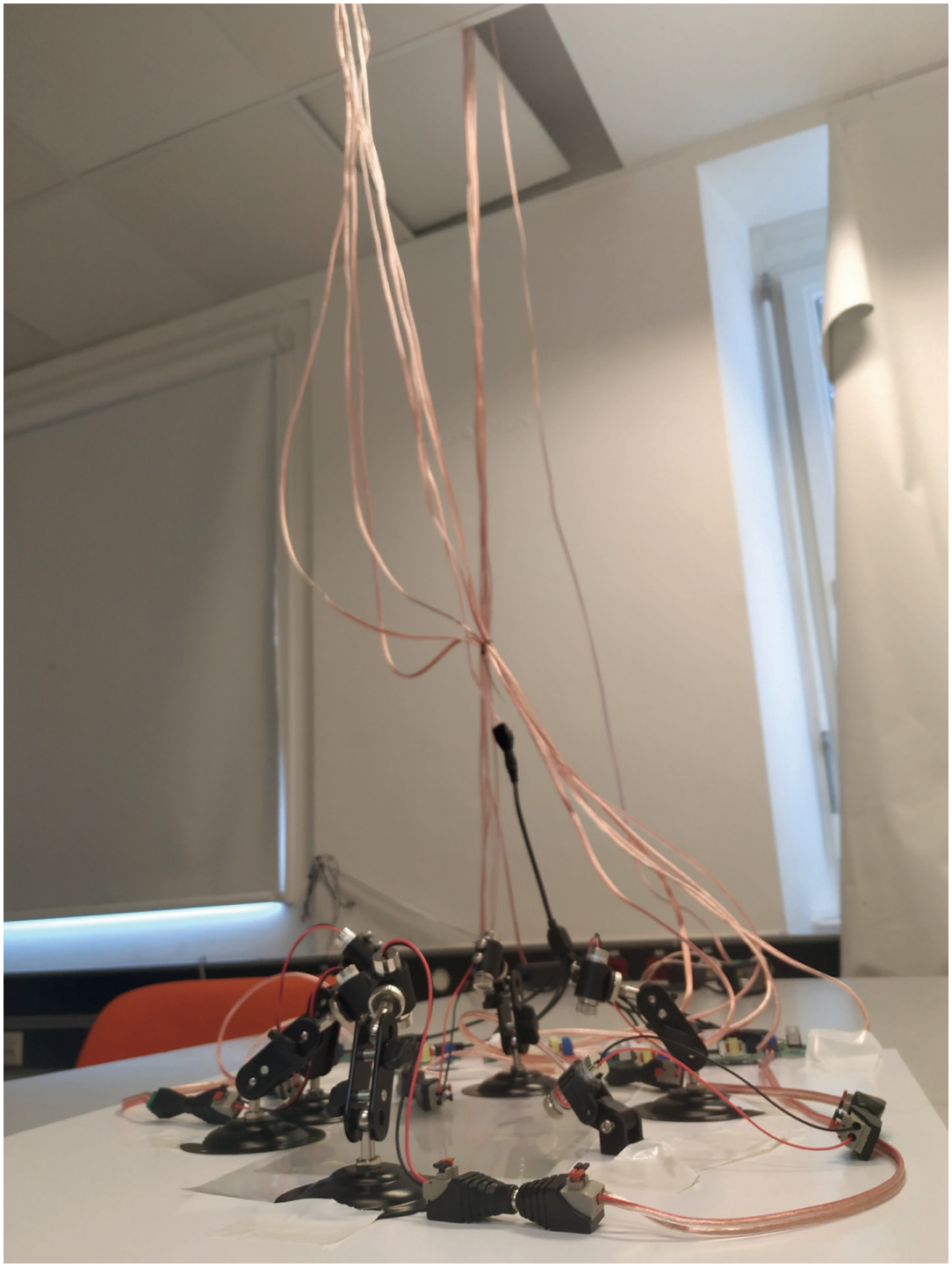


image 7

image 8

5.5 Apparatus

I am quite interested in photoelectric and photovoltaic effects. These concepts are often misunderstood because they are seen just as a source to produce clean energy, but they are actually great sensors for transforming modulated light sources into sound, as well. My apparatus uses a large solar cell in front, so that when a visitor uses the surface to interrupt and reflect the laser pattern, they capture the audio-modulated lasers and transform them into sound again. The transformed audio is amplified and sent to the speakers wirelessly. This gives visitors the freedom to observe and decide how they wish to explore the space.

Only conscious subjects are defined as “observers” in the real world, but a quantum observer doesn’t have to be a conscious one to create the Hawthorne paradox. This gave me the idea to give control of an unconscious quantum observer (the apparatus) to a conscious subject (the visitor) to replicate the paradox in both realities.

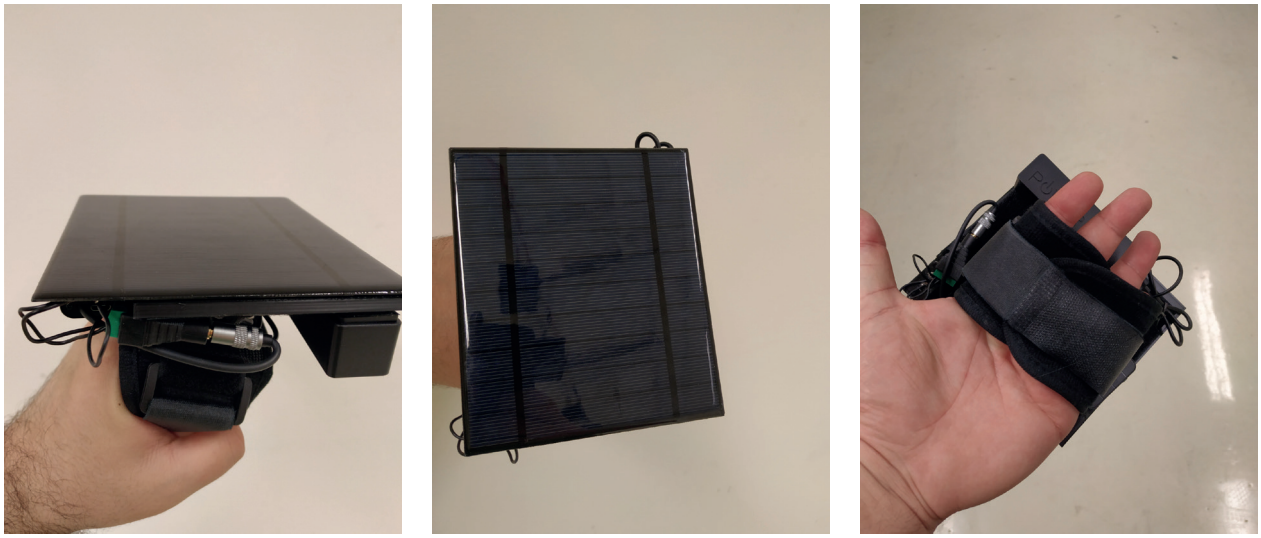
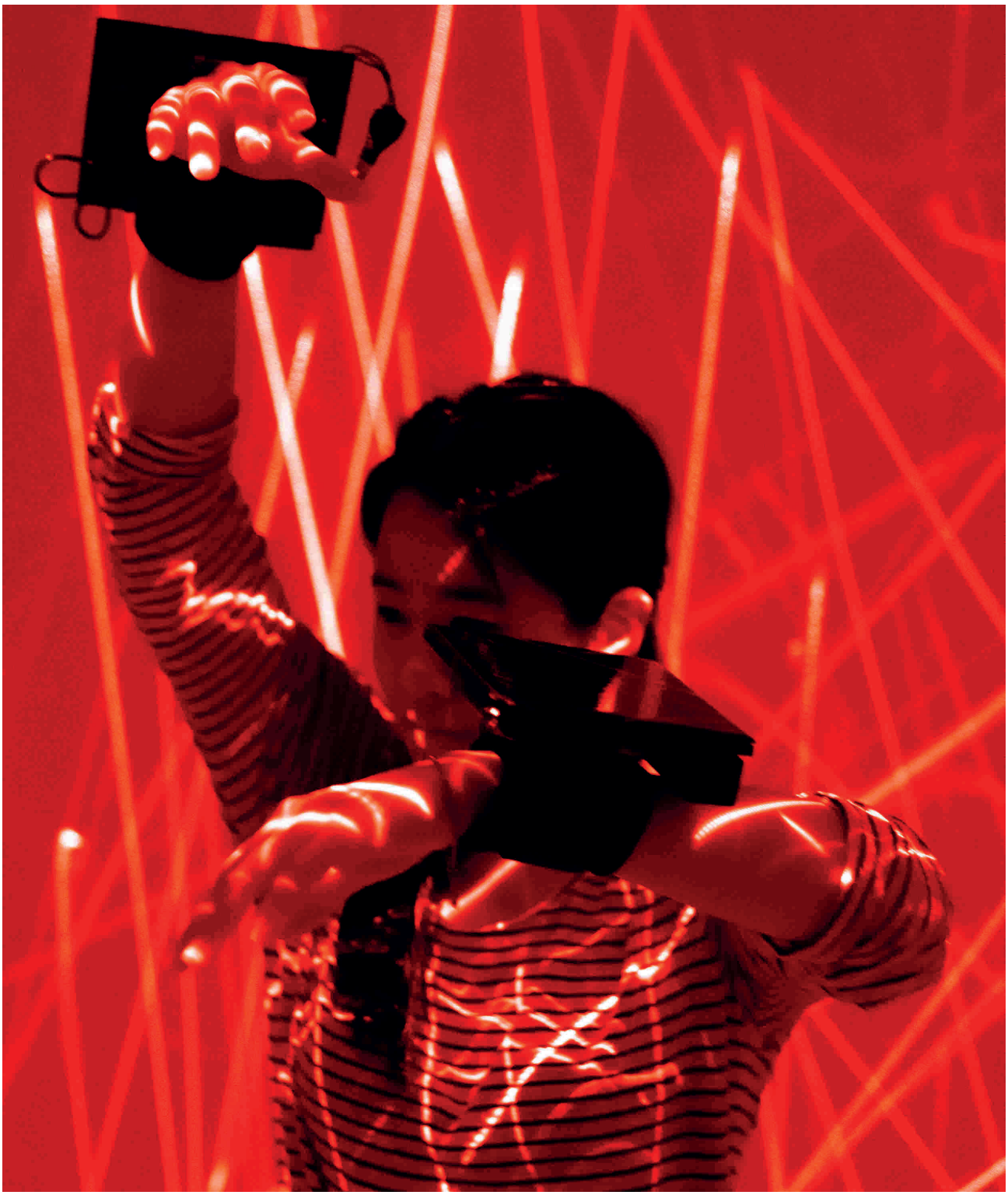


image 9

image 10



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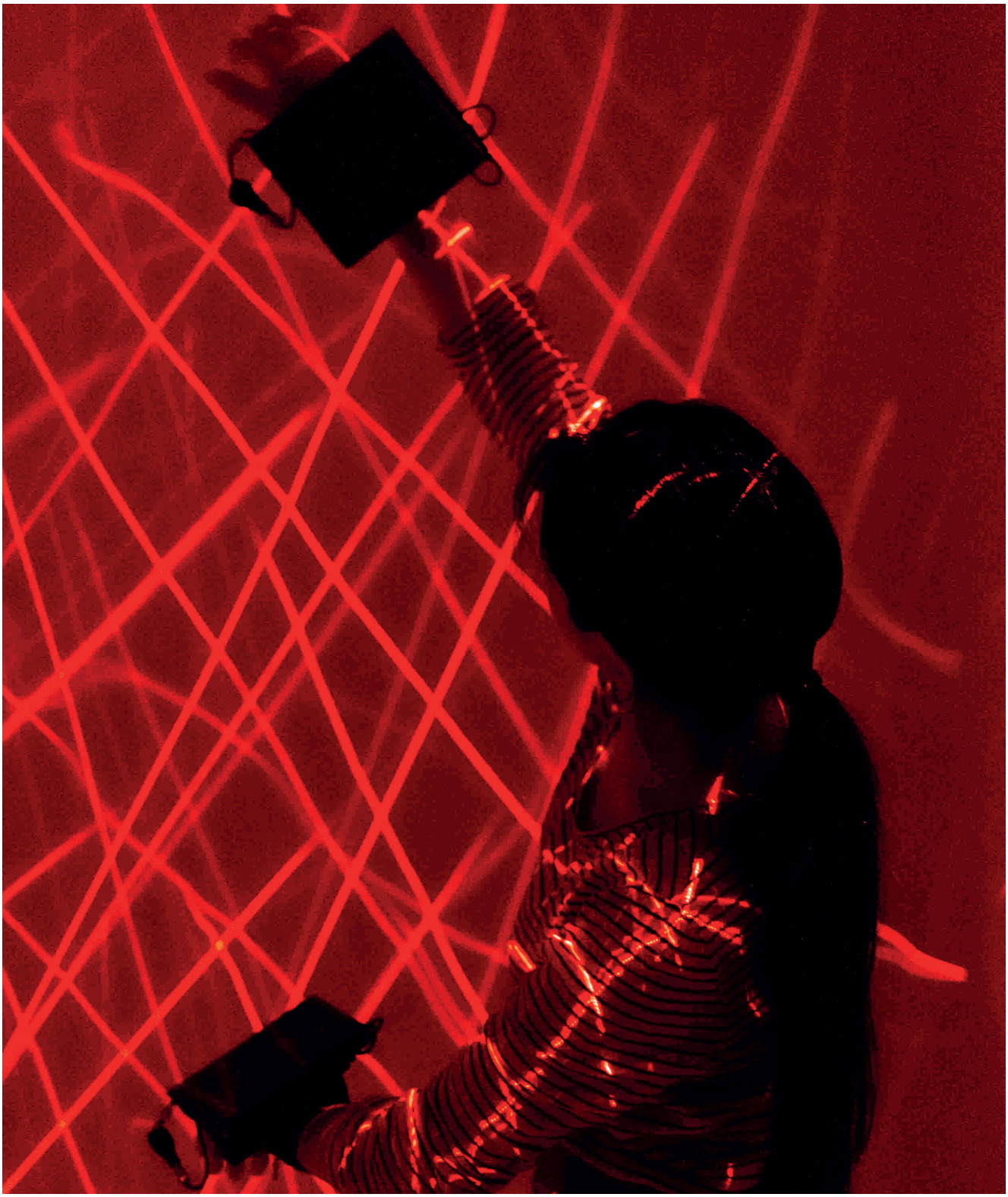

image 12

6. Previous Work

5.5
"Follow the White Noise"

"*5.5*" is an audio installation which translates artificial light into sound(image,13,14,15). That process is made possible through the use of a wearable apparatus which contains solar panels in which the light penetrates and starts the process of the sound revelation. The headgear-shaped apparatus acts like an artificial sensory organ. Small solar cells in the front of the device are covering a wide-angle area for incoming light rays that helps listeners to be able to find out where the source of the sound is. Earlier versions of the device had overhead headphones(image 15), but in later versions it has been replaced with a smaller over-ear reference heaphones(image 14) to be able to distinguish sound signatures better.

Visible lights contain a wide variety of electromagnetic wavelengths, and when they are created in an artificial way (light bulbs, television, fire, lightning etc.) their wavelengths have a unique sound signature. However, our sensory organs are not capable of detecting those sounds signatures. Therefore, we can only sense the color and the heat. But what about the sound?

"5.5" was an invitation to a synesthetic experience about your surroundings and the cacophony of light. Instructions were simple: "Follow the white noise".

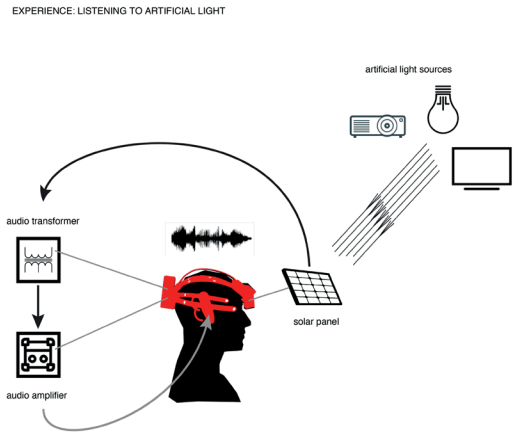

image 13

image 14

image 15

7. Artistic Reference

Christina Kubisch and *"Electromagnetic Induction"*

Christina Kubisch is one of the artists who actively relies on science in her artistic research, and who exposes the synesthetic behaviour of invisible nature. In her works she composes with electromagnetic waves (image 16) Progression of the soundscape in relation to movement, and the freedom this gives to listeners, were quite inspiring aspects of these works.

image 16

8.Bibliography

1 . Michio, Kaku“Why Physics Ends the Free Will Debate” Youtube, uploaded by Big Think, 20 May 2011
https://www.youtube.com/watch?v=Jint5kjoy6I

2. Richard P. Feynman, “The Character of Physical Law” (Cambridge : MIT Press, 1965)

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Img. 1 : Ghostbox, 2021, Cecen

Img. 2 : Ghostbox, 2021, Cecen

Img. 3 : Ghostbox, 2021, Cecen

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Img. 5 : Ghostbox, 2021, Cecen

Img. 6 : Ghostbox, 2021, Cecen

Img. 7 : Ghostbox, 2021, Cecen

Img. 8 : Ghostbox, 2021, Cecen

Img. 9 : Ghostbox, 2021, Cecen

Img. 10 : Ghostbox, 2021, Cecen

Img. 12 : Ghostbox, 2021, Cecen

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Img. 14 : 5.5, 2019, Zimmerman
http://www.cagdascecen.com/page3.html

Img. 15 : 5.5, 2019, Fernandes
http://www.cagdascecen.com/page3.html

Img. 16 : Dichte Wolken, Dortmund, 2011, Kubisch
http://www.christinakubisch.de/en/works/installations/2

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