

# **THE QUINTESSENCE**

## **An artistic exploration of the visual imaginary of outer space**

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## Abstract

This PhD by practice aims to explore the visual imaginary of outer space and the construction of contemporary astrophysical knowledge from sky observation, in order to answer the main research question: How do images of space tell a story? I will mainly consider contemporary representations of outer space, i.e. Hubble telescope images produced since the early 1990s. I will analyze photographs of outer space events and objects produced and circulated in the last thirty years and distributed by NASA through public websites and specific publications. Shorter sections of the dissertation will be dedicated to the contextual analysis of archival images of space, in order to show the variations and different approaches produced in the past from the activity of looking at the universe and wondering about its origins. The research's outcomes are artworks in multimedia forms, namely experimental films, photographs, site-specific installations, audio recordings and an artist's book.

Through crossovers and original methodologies of enquiry, visual representations of the universe are approached as complex narratives constructed through the combined agency of technological apparatus and human intervention. Moving forward from the traditional representation of the scientific world as a fixed domain of knowledge, this artistic-based research presents the domain of astrophysics as an evolving system, which evades the fixity of truth-encompassing statements.

Archival research on visual representations of outer space provides a contextual frame of reference, complemented by a series of theoretical discussions pinpointing the research. Audio-visual documentation generates a sensorial representation of highly secluded scientific laboratories usually not accessible to the general public, thus providing a first-hand impression that would not otherwise be accessible. A series of audio interviews conducted with scientists - specifically astrophysicists, cosmologists and engineers - provides an intimate portrait of astrophysicists' unique background knowledge, ideas and creative intuitions, moving beyond the traditional academic representation of scientists as individuals possessing an unquestionable knowledge of the universe. Focusing around key topics such as the nature of scientific progress and our role as humans investigating outer space, the interviews provide a unique commentary on the act of looking at the stars.

The research tests how and to what effect artistic practice can generate new and original insights on the modalities through which astrophysics represents and narrates itself. The related artworks act as a series of experiments looking at subjects (outer space visual representations, research labs), agents (scientists, technological apparatus) and contexts (theoretical frameworks of reference) and demonstrate the tension between the visible and the invisible shaping the present development of cognitive-visual knowledge about outer space.

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Link to watch the film *The Quintessence*

<https://vimeo.com/489547471>

password: quintess2020



*“Does the harmony which human intelligence thinks it discovers in Nature exist apart from such intelligence? Assuredly no. A reality completely independent of the spirit that conceives it, sees it or feels it, is an impossibility.”*

Henri Poincaré, *The Value of Science*<sup>1</sup>

<sup>1</sup> Henri Poincaré, *The Value of Science*, New York NY, Random House, 2001, p. 54.



Mars surface by Viking 1 Orbiter. Credits: NASA/JPL/USGS.



Bootes, Coma, Berenices et Mons Maenalus Constellations, from Johannes Hevelius, *Firmamentum Sobiescianum, sive Uranographia*, Gdansk, 1690.

# RESEARCH INTRODUCTION

## Stargazing

My research began at night, the first time I saw the milky rift of stars scattering through the sky. Since that moment, every time I look at the dark vault extending above the Earth, is like the first time. All my observations blend into timeless pictures of that edge on view of our galaxy. My mind floods with a sea of images and I start wondering about the universe.

Ever since I was a child, I was astonished to think that every phenomena existing in outer space reaches us through light travelling from incommensurable distances. While I was looking at the night sky, millions of light-years away things were happening. Planets were rotating around their stars and galaxies formed in the darkest regions of empty space.

What is the universe? Is it the expanse between things? Is it an emptiness, a vacant stage for our dramas? Is it a material substance? A vessel for our experiences? What is real and what is invented in what we know about the universe? Isn't it real enough even if it exists only in the configuration of our thoughts?

Thousands of years ago ancient astronomers viewed the sun and the heavenly bodies as celestial gods. They carved tablets into visual tales of the living sun and its companions, stars and planets. Now we view the universe through the scientific gaze and we have different explanations for what we see in the sky. But aren't these narratives as well?

They say the universe is infinite, it hosts an infinite number of events, an infinite number of planets, maybe an infinite number of sentient beings on those planets. Surely there must be a planet so very nearly like the Earth as to be indistinguishable from it. I admire this infinity. It makes me want to pierce its surface and fall through to its core.

The universe is space. A three-dimensional space we live in and the time we watch pass on our clocks. It is our north and south, our east and west, our up and down, our past and our future. Space is a physical dimension waved through gravitational attraction. The stars, the sun and the weight of our own body all are brought into unison because they all have gravitational attraction in common. Mass, like an electric charge, creates a field around it in the form of a curved space. Therefore space is a structure, warped in response to the presence of matter and energy, like paper curling in a flame.

Apples fall on the Earth by breaking loose from the pull of the tree, following the path of least resistance along an invisibly curved space, until the surface of the planet interrupts their fall and forces them to stay still. Planets orbit the sun by following an elliptical path defined by their natural curve. Any body and any mass takes the path of least resistance along a curved space. We all fall freely without a pull, along this natural, invisible, curve.

This is the space and time we are bound to. We cannot jump off it, or live outside of it. This is our universe, the vast extent of our curved space-time. People always ask: what's outside the universe? The answer is nothing. There is no meaning to the question where or when, if there is no space or time. The Big Bang is the creation of time itself. There is no sense to the question: how long was it before the Big Bang happened? Time began with the Big Bang. There is no sense to the question: where did the Big Bang happen? It happened everywhere. The Earth is at the centre in a sense, every galaxy is at the centre. The centre is everywhere and is becoming more diffuse as the universe continues to expand and cool.

The universe is inhabited by giant clusters of galaxies, each galaxy a conglomerate of a billion or a trillion stars. The milky way, our galaxy, has an unfathomably dense core of millions of stars. We stand on a small planet inside a huge cosmos. But we're alive and we're sentient. Many centuries ago we began to observe the sky and wonder about its secrets. We built instruments to look into the depth of the unknown, we sent telescopes orbiting around the Earth and we captured the signal of the cosmic background radiation, bearing information about time before organic life.

Due to technical constraints, we cannot see infinitely far out into space. We can only see as far as light has travelled since the beginning of the universe. While we try to determine the nature of our ultimate end, we slowly decipher our common beginnings. Gravity, matter and energy are all different expressions of the same thing. We're all intrinsically made of the same substance. The fabric of the universe is just a coherent weave from the same threads that make our bodies. Our bodies are mostly water. Water is mostly empty space. So, by extension, we are space, we are the universe.<sup>2</sup>

## **Introduction to practice-based research**

This PhD by practice aims to explore the visual imaginary of outer space and the construction of contemporary astrophysical knowledge from sky observation, in order to answer the main research question: How do images of space tell a story? I will mainly consider contemporary representations of outer space, i.e. Hubble telescope images

<sup>2</sup> This text is an extract from a performative talk presented for the first time at Harvard University, Faculty of Astrophysics, in autumn 2019. The text takes inspirations and some quoted passages from Janna Levin's *How the Universe Got Its Spots: Diary of a Finite Time in a Finite Space*, Princeton NJ, Princeton University Press, 2002.

produced since the early 1990s. I will analyze photographs of outer space events and objects produced and circulated in the last thirty years and distributed by NASA through public websites and specific publications. Shorter sections of the dissertation will be dedicated to the contextual analysis of archival images of space, in order to show the variations and different approaches produced in the past from the activity of looking at the universe and wondering about its origins. The research's outcomes are artworks in multimedia forms, namely experimental films, photographs, site-specific installations, audio recordings and an artist's book.

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## **Research title**

The research title *The Quintessence: an artistic exploration of the visual imaginary of outer space* was chosen for its ability to evoke multiple and interrelated meanings. Ac-

According to the Oxford dictionary, the “quintessence” can be defined as

1: the most important part (of something)

2: the perfect example (of something)

The first definition makes reference to the role of the universe as the wider frame of reference which contextualizes the existence of the Earth, the planet on which we live along with many other species.

The second definition relates to the multiple artworks produced throughout the research, conceived as practice-based visual and auditory analyses of the contemporary visual imaginary of outer space. In this sense, they act as exemplary statements on how to develop new ways to approach images of the universe, and the narratives they embed.

Additionally, the title generates a poetic reflection on the classical meaning of the word “quintessence”. In ancient and medieval astronomy, it was believed the universe was formed by four elements: air, water, fire and earth. A fifth, ethereal and invisible element, kept everything together, filling the region of space above the Earth. It was called the quintessence (in latin *quinta essentia*, or fifth element). For many centuries, this concept was evoked to explain natural phenomena such as the propagation of light and gravity.

Since modern scientific experiments found no evidence for the presence of such a medium, this idea was progressively abandoned at the end of the 19th century. However, the contemporary speculations on dark matter postulate the presence of a powerful yet invisible force keeping the universe together. The title thus acts as a poetic statement of intent. It highlights the research’s goal to analyse the key elements giving shape to visual representations of outer space and at the same time it makes reference to a powerful yet invisible force prompting humanity to explore the mysteries of the universe.

## Research questions

“We are all in the gutter, but some of us are looking at the stars” Oscar Wilde famously stated.<sup>3</sup> The gutter is, of course, a metaphor for our daily struggles and the obstacles we find on our path. Looking into the distance of space becomes an action that can uplift our souls and make us feel part of something greater. Astrophysics is the observational science *par excellence*. Since scientists cannot physically touch stars and galaxies, observation and visualization are essential features for the development of human knowledge about the universe.

<sup>3</sup> *Lady Windermere's Fan* (1892), in Oscar Wilde, *The Importance of Being Earnest and Other Plays*, London, Penguin, 2000, p. 47.

But how is it possible to know what is happening in the most distant regions of outer space? Throughout history, looking at the sky has meant, first and foremost, speculating about its nature, wondering about its origins and its future evolution. As a consequence, visual representations of the universe have always mirrored specific cultural, social and even political contexts. In the present research, contemporary images of space are approached considering their specific cultural, social and political context. I will analyze how they are produced within highly advanced scientific research centres financed by private and public bodies mainly focused on research on dark matter and exoplanets. Subsequently, they are published and circulated within western and eastern globalized cultures.

This approach is quite different from the modalities through which ancient cultures studied the heavens as a way to better understand earthly events. They transformed the random pattern of stars into shapes of humans, animals and gods. They used constellations to walk across lands and navigate through seas. In the Middle Ages, the sky was conceived as a series of transparent spheres rotating around the Earth, believed to be at the center of the universe. During the Renaissance, Galileo's and Newton's scientific revolutions provided a new understanding of the physical laws of the universe and opened the way to contemporary quantum theories and riddles about dark energy.

Nowadays visual representations of the sky have become the key referents for the formulation of hypotheses about the physical, material dynamics of outer space. We are all familiar with the Hubble telescope's shiny and colourful images of stars and galaxies. They are the perfect example of highly advanced observational tools employed by contemporary astrophysicists to look at the most distant regions of the visible universe. But how exactly are these images created? And what do they tell about our own specific way to observe the universe? This practice-based research tries to answer these questions. Through multiple artworks, exhibitions and a written dissertation, the research asks: How do images of space tell a story? To address this central question, the investigation is organized around three core aspects:

- 1) to collect space representations produced in different times and by different cultures;
- 2) to understand how contemporary images of space are created through the direct visits to astrophysical research centres and laboratories;
- 3) to develop multiple artworks that critically analyse the aesthetic and content related features inherent to the visual imaginary of outer space.

These key concerns can be expressed as other research sub-questions, such as: How do we capture images of the universe? How much is technology shaping what we know about outer space? What is the role of individual background knowledge and biases in the interpretation of data coming from interstellar distances?



## Introduction to context and frameworks of reference

This PhD by practice is situated in the wider context of contemporary artistic research engaging with the scientific domain through a critical and provocative approach. Contemporary artists such as María Ignacia Edwards, Katie Paterson, Steve McQueen, Fiona Crisp and Rosa Barba, among others, have been exploring the role of scientific research in unveiling the mysteries of the universe.<sup>4</sup> *The Quintessence* moves forward from these examples in order to focus specifically on the visual imaginary of outer space and the research labs where this imaginary is shaped, at a time when astrophysical observation is experiencing a technological hypergrowth. In the last three decades, scientists brought powerful telescopes in orbit around the Earth and sent probes to other celestial bodies - such as the Moon and Mars - in order to take extremely detailed images of the most distant regions of the visible universe.

As non-scientists, we can admire photographs of stars and galaxies and look with amazement at detailed digital images of planets and asteroids produced by space agencies such as NASA (National Aeronautics and Space Administration, USA) and ESO (European Organisation for Astronomical Research in the Southern Hemisphere, also known as European Southern Observatory). However, we are unaware of what actually happens when the powerful sensor of an orbiting telescope takes a picture of a distant quasar, or how a tiny mechanical gear installed on a radio station in Hawaii can shape the image of a supernova explosion.

The raw data captured from space are never distributed to the press or published online in their original format. On the contrary, they are strongly edited and visually manipulated to become more appealing for the eye of the general public. Transformed into the shiny and glossy images we are used to, they become a popularized rendition of highly complex visualization processes performed behind the closed doors of secluded astrophysical research centres. The aim of this practice-based research is to analyse and deconstruct the visual imaginary of outer space, in order to propose a critical scrutiny of pictures of and from the universe.

My research doesn't aim to generate a judgment of value on space representations, but rather to suggest new modalities to approach them through a deeper understanding of how astrophysics represents - and therefore narrates - itself. This will be done by producing a shift of attention from mere looking to apprehending via direct experience of scientific research spaces and encounters with cosmologists and engineers.

4 Carolina Castro Jorquera, "María Edwards: La levedad del Espíritu y la Materia", *Artishock*, retrieved at <https://artishockrevista.com/2015/01/12/maria-edwards-la-levedad-del-espiritu-la-materia/> on 26/06/2018; Brian Dillon, "Katie Paterson, the cosmicomical artist", *The Guardian*, retrieved at <https://www.theguardian.com/artanddesign/2012/apr/06/katie-paterson-cosmicomical-artist> on 17/07/2018; Beth Williamson, "Steve McQueen", *Studio International*, retrieved at <https://www.studiointernational.com/index.php/steve-mcqueen-review-tate-modern-london> on 18/07/2018; ArtsCatalyst, "Fiona Crisp", Arts Catalyst, retrieved at <https://www.artscatalyst.org/artist/fiona-crisp> on 01/08/2018; Douglas Heingartner, "Rosa Barba", *Frieze*, retrieved at <https://www.frieze.com/article/rosa-barba> on 09/02/2019.

## Overview of key theoretical references

The research draws on a wide range of references from different domains of knowledge, such as contemporary art and film practices, visual studies and philosophy of science. The principal sources informing the investigation have been employed as creativity triggers rather than being analysed through a traditional academic approach. They are briefly identified here by discipline.

### Visual studies

While the scientific visual imaginary has been rarely discussed within the discipline, some exceptions have been identified and studied for the present research. A significant theoretical reference has been represented by Elizabeth Kessler's *Picturing the cosmos: Hubble Space Telescope images and the astronomical sublime*, a thorough analysis of the aesthetic and content-related features embedded in the contemporary visual imaginary of outer space. Another relevant text for the research was Joanna Żylińska's *Nonhuman Photography*, for its exploration of the contemporary production of photographic images largely exerted by and for non-human agents.

This is the case of the totality of images of outer space produced remotely by advanced cameras placed on ground-based telescopes or orbiting probes. These texts have helped me to approach present-day images of space with a critical eye and to de-structure their aesthetic and content related features in order to discover how they are generated, manipulated and distributed to the general public.

### Postmodernism and philosophy of science

Questioning the cognitive and visual processes at work in the astrophysical domain touches upon the wider question of scientific knowledge formation. In this regard, the present research was inspired by the theories of philosophers of science Gaston Bachelard (*The Formation of the Scientific Mind*), Karl Popper (*The Logic of Scientific Discovery*), Thomas Kuhn (*The Structure of Scientific Revolutions*), and postmodernists Bruno Latour (*Laboratory Life: The Construction of Scientific Facts*), Ian Hacking (*The Self-Vindication of the Laboratory Sciences*), Paul Feyerabend (*Against Method*), Peter Galison and Lorraine Daston (*Objectivity*), Donna Haraway (*Situated Knowledge*) and Cristina Grasseni (*Skilled vision*).

Moving from different perspectives, these intellectuals consider the formation of scientific knowledge not as an isolated process but as an activity closely related to a number of interconnected features such as the role of subjectivity, cultural backgrounds, biases and technological constraints. These ideas and theories have been key in the development of the present practice-based research conceived as an artistic exploration of the astrophysical domain through an inquisitive and unorthodox approach.

## **Additional theoretical references**

The research has been structured making reference to recent studies exploring the concept of artistic practice as research, with particular reference to the theories proposed by Barbara Lüneburg (*TransCoding: From 'Highbrow Art' to Participatory Culture*) and Bradley C. Haseman (*A manifesto for performative research*). The methodology described by Sarah Pink (*Doing Visual Ethnography*) and Lucien Castaing-Taylor (*Iconophobia*) has been taken as a reference for the development of experimental films focused on the production of audio-visual documentation aimed at generating a visual and sensorial approach to the scientific labs.

The development of audio interviews employed as sonic installations in selected exhibitions and offscreen commentaries in multiple films was inspired by studies on oral narratives and soundscapes by Michel Chion (*Audio-Vision: Sound on Screen*) and Isobel Anderson (*Voice, Narrative, Place: Listening to Stories*).

## **Practice-based references**

The artworks developed throughout the research - experimental films, site-specific installation, photographs, artist's book - have been inspired by a number of different artistic practices. The experimental film *The Quintessence* was influenced by the cinematographic language of filmmakers Chris Marker, Werner Herzog, Trinh T. Minh-Ha, Andrés Duque and Wang Bing. A number of shorter, experimental films presented as multiscreen installations in several exhibitions were inspired by the work of contemporary video-artists Rosa Barba, Simon Starling, Fiona Crisp and Steve McQueen.

The photographic series documenting research centres and laboratory spaces moves forward from the work of Lewis Baltz, Guido Guidi and Wolfgang Tillmans. The artist's book was inspired by Haris Empaminonda's *Chapter I-XXX*. The site-specific installations took inspiration from the multimedia installations by Katie Paterson and María Ignacia Edwards. While these practitioners draw from different aesthetic approaches,

their practice is focused on the deconstruction of specific spaces or narratives. With my research, I moved forward from their example in order to produce something different, i.e. deconstruct images of the universe as narratives which mirror human dreams and expectations. This specific domain, i.e. visual representation of space and the narratives they generate, has not been approached and deconstructed by any other contemporary artist. In this regard a highly original feature of the research is the visits I conducted personally to over thirty laboratories and astrophysical university faculties, the vast majority of these centres are not accessible to the general public and have never been documented before on camera.

## **Methodology**

Through art practice approached as a rigorous investigation, the research tackles problems and questions arising from the very nature of astrophysics representation, i.e. what does it mean for humans to look at the universe and reproduce it in visual form. The aim is to untangle a complex web of relations, agencies and theories informing the present imaginary of outer space.

The multidisciplinary approach to artistic-based research entailed the construction of a strong theoretical frame of reference. This grid was necessary to guide the development of different artworks and to provide a deeper understanding of the conceptual motivations and aesthetic choices that informed the practice-based work.

At the initial research stage, selected readings helped me to pinpoint key concepts on the nature of scientific visual-cognitive patterns of knowledge formation. At this stage, a broad survey of past and present representations of outer space was conducted through online and physical open source libraries and archives. Subsequently I visited several astrophysics research centres and observatories in Europe and the USA, producing extensive audio-visual documentation. A collaborative interaction with cosmologists and engineers led to the development of multiple audio interviews.

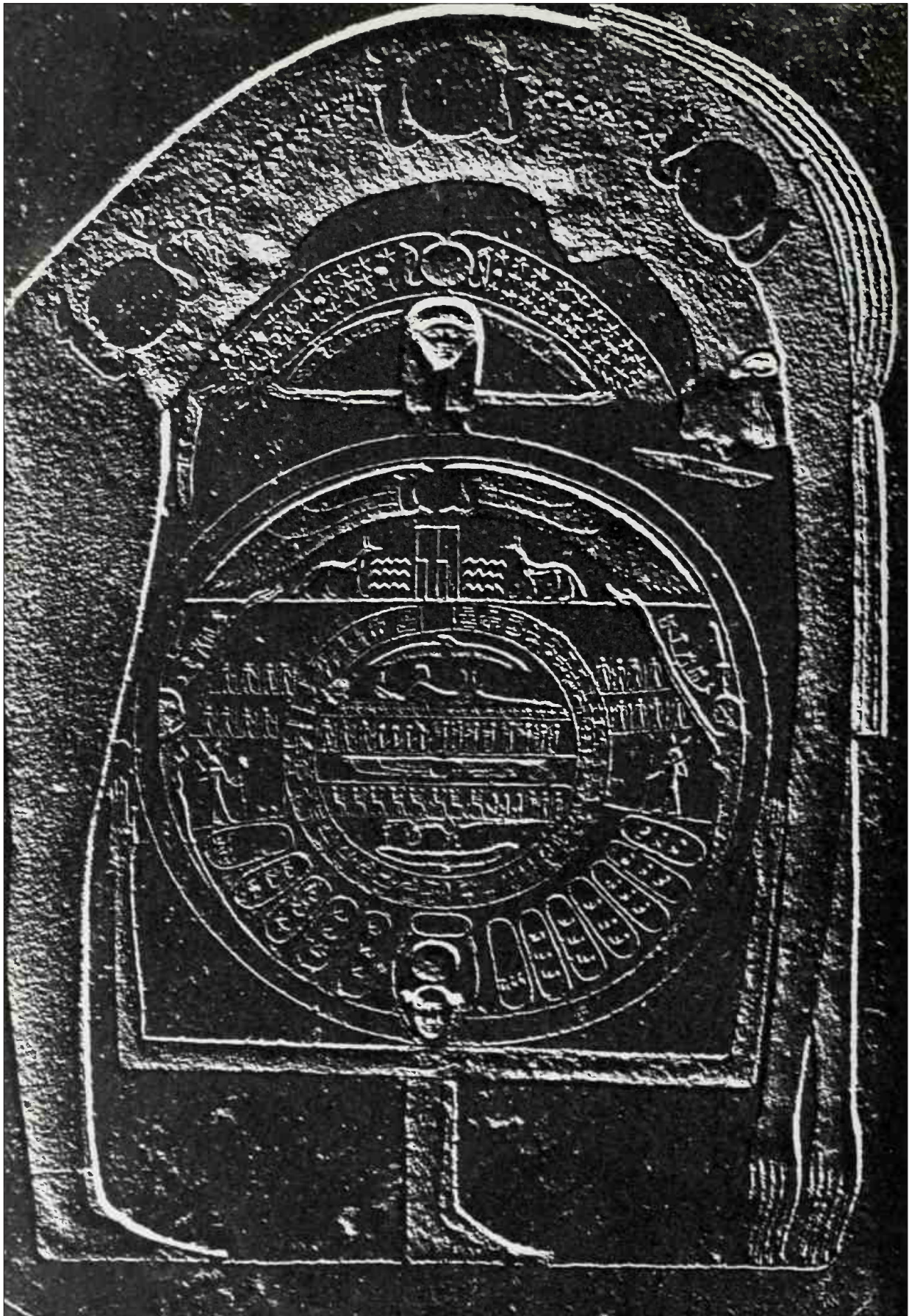
The choice of conducting only interviews with scientists (astrophysicists, cosmologists and engineers) - rather than with academics or researchers working or studying representations of the universe - was motivated by two reasons. Firstly, to consider other visual domains related to space - for example, images from science fiction imaginative worlds - would have broadened too much the spectrum of research. Secondly, I wanted to consider the most objective and scientific representations of the universe – i.e. Hubble telescope's images - and deconstruct them, in order to discover at their core the individual and subjective features they embed.

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Plate b26816 of Large Magellanic Cloud taken on December 18, 1900 from Arequipa, Peru, with the 8 inch Bache Doublet, Voigtlander, reworked by Alvan Clark. Credits: Harvard College Observatory (USA).



Egyptian carving on stone, 5th century BC, showing Nut, goddess of the sky, arched over the Earth, from Fred Hoyle, *Astronomy: a History of Man's Investigation of the Universe*, Rathbone Books, London, 1962, p. 80.

Aquarius

$\alpha$  Peg.

30 Degrees

$\gamma$  Peg.

VENUS

35.6 Cm. Goerz

Iso-Inst. Plate

Street Lights

HALLEY MAY 13, 1910

Halley's Comet photographed in 1910. Credits: NASA.





Selknam's Hain Ceremony, Tierra Del Fuego. Photo by Martin Gusinde, 1923. Credits: Martin Gusinde / Anthropos Institute / Atelier EXB.



NASA  
S-65-63873



Full Moon over the Earth, Gemini 7, December 1965. Credits: NASA.



The Great Comet of 1577 over Prague, in Peter Codicillus of Tulechova, *About a terrible and marvelous comet as appeared the Tuesday after St. Martin's Day (1577-11-12)*. Credits: Zentralbibliothek Zürich (CH).



One of the oldest photograph of the Moon, taken by John Adams Whipple, February, 1852. Credits: Harvard College Observatory.

The material collected through the visits to multiple research centers and the interviews with scientists has been subsequently employed in multiple artworks presented as site-specific exhibitions and video installations. Drawing from Jacques Rancière, my intention was to disrupt the normalized “distribution of the sensible” at play within the astrophysical domain in order to uncover specific narratives underlying present day images of universal phenomena.<sup>5</sup> The resulting artworks excavate beneath the scientific gaze to discover at its core individual trained visions, technological constraints as well as philosophical, ethical and cultural implications shaping the act of looking at the sky.

The artistic gaze on the scientific world operates at the edge between the known and the unknown, a metaphorical stage connecting the here and now of our human condition to wider temporal and spatial scales. The domain of astrophysics emerges as an evolving system which evades the fixity of truth-encompassing statements. Thinking about the universe and its visual representations thus becomes a phenomenological opportunity to experience our role of human observers within a wider context.

5 Jacques Rancière, *The Politics of Aesthetics. The distribution of the Sensible*, Continuum International Publishing Group, New York, NY, 2010, p.12. See also Scott Durham, Dilip Parameshwar Gaonkar, Jacques Rancière, *Distributions of the sensible: Rancière between aesthetics and politics*, Evanston IL, Northwestern University Press, 2019.

# CHAPTER I

## RESEARCH SUBJECT AND PRACTICE-BASED METHODOLOGY

The following chapter will present a contextual analysis of the visual imaginary of outer space and of how representations of the universe have been approached through artistic practice in order to answer the main research question: “How do images of space tell a story?”.

The chapter will be divided into three sections. In the first section, I will describe the aesthetic and content-related features of old and modern visual imaginaries of outer space. I will consider how different cultural and religious beliefs, as well as different technological apparatuses, gave rise throughout the centuries to different ideas and theories about the universe, and, as a consequence, to different representations of outer space.

In the second section, I will consider a series of studies and essays on the characteristics of practice-based artistic research and its innovative potential. Selected extracts will highlight the role of original and un-orthodox research methodologies in order to propose new approaches to specific domains of knowledge. Subsequently I will connect these reflections to my own artistic practice, providing in-depth considerations on the conceptual intentions put into play through the development of artworks in multimedia form.

The third section of the chapter will present an overview of the different artworks developed throughout the PhD: artist’s book, experimental films, photographic series and site-specific installations. Describing the aesthetic and conceptual features of each artwork, I will provide a wider analysis of how artistic research can produce original outcomes, especially when applied to the study of the scientific domain, usually described or represented from a neutral or supposedly objective perspective. By so doing, I will posit that artistic research can lead to new insights, generating original knowledge that can - and must - be spread to a wide range of public, such as scientific communities, academics, artists and the general public.

## Visual imaginaries of space

*“Gazing out into the night sky or deep down into the structure of matter, with telescope or microscope in hand, Man reconfirms his ability to negotiate immense differences in scale in the blink of an eye. Designed specifically for our visual apparatus, telescopes and microscopes are the stuff of mirrors, reflecting what is out there. Nothing is too vast or too minute. Though a mere speck, a blip on the radar screen of all that is, Man is the center around which the world turns. Man is the sun, the nucleus, the fulcrum, the unifying force, the glue that holds it all together. Man is an individual apart from the rest.”*

Karen Barad, *Meeting the Universe Halfway*<sup>6</sup>

It has often been said that astronomy is the oldest of the sciences. Since the beginning of human history, mankind looked at the sky and wondered about the universe. Throughout the centuries, different civilizations produced diverse visual representations of objects and events observed in the heavens: from ancient cave paintings to Egyptian stone reliefs, from Renaissance star atlases to astrophotographic glass plates, up to the most recent high-resolution digital photographs of distant regions of the visible universe.

The visualization of sky phenomena has evolved along with the legends, myths and theories devised to explain the structure, laws and origins of the universe. At the initial research stage, I analysed the aesthetic and content related features of sky representations produced over the centuries, visiting physical and online astronomical libraries and browsing through astronomy books, star atlases, encyclopedia and scientific publications. Every image found at this stage has been scanned, digitized and stored in a dedicated hard-drive. The collection constitutes a unique visual repository of outer space representations produced by different cultures in different times.

This visual flux of images reveals the main difference between past and present representations of sky phenomena: ancient drawings produced through direct eye observation have been replaced in the last century by photographs of outer space. With the aid of the photographic medium, scientists began to keep a record of the positions of objects in the sky with a new level of precision. From the first daguerreotype of the Moon taken in 1840,<sup>7</sup> to the early photomaps of the northern and southern sky hemispheres,<sup>8</sup> never

<sup>6</sup> Karen Barad, *Meeting the Universe Halfway*, Durham NC, Duke University Press, 2007, p. 134.

<sup>7</sup> The daguerreotype is attributed to Dr. John William Draper. Jason Major “This is the oldest surviving photo of the moon”, *Lights in the dark*, retrieved at <https://lightsinthedark.com/2016/03/23/this-is-the-oldest-surviving-photo-of-the-moon/>, on 02/08/2020.

<sup>8</sup> Seth Fletcher, *Einstein’s shadow: a black hole, a band of astronomers, and the quest to see the unseeable*, New York NY, Harper Collins, 2018.

before in human history had the sky been observed and represented in such detail. As critic Knorr Cetina observed:

“For a long time, astronomers were restricted to observation, even though since Galileo it was observation aided by a telescope. Now for more than a century, astronomers have also used an imaging technology, the photographic plate, with the help of which photons of light emitted by stellar bodies can be captured and analyzed. Astronomy therefore appears to have been transformed from a science which surveys natural phenomena into a science which processes images of phenomena”.<sup>9</sup>

During the 20<sup>th</sup> century, the technical capacity of astrophysical photography has advanced so much that nowadays scientists are able to capture the light coming from stars, galaxies and other space phenomena located billions of light years away from Earth. The most famous contemporary images of space are the Hubble telescope’s photographs. Designed by NASA and launched into orbit around the Earth in 1990, the Hubble high-precision camera has produced hundreds of space images that can be easily found in books, astronomical publications and online archives, on the websites of national space agencies (NASA, ESO, ISRO, CNES, CNSA, etc.) as well as on photo sharing platforms like Flickr, Pinterest and Instagram.

They have become so emblematic that they are taken as visual references for the development of millions of space images captured by thousands of professionals and amateur astronomers around the world. In *Picturing the cosmos* Elizabeth Kessler considers how the Hubble telescope’s dramatic and colourful images of distant stars and galaxies have come to define a specific imaginary of outer space, generating a new clarity of vision about the universe much in the same way as Galileo’s telescope did in the 17th century.<sup>10</sup>

Contemporary images of outer space depict planets and stars, galaxies and nebulae with a striking combination of bright colours and eerily aloes generating dramatic visual effects. I was always struck by how these pictures differ from our own experience of the sky. When we look at the starry vault at night with the naked eye, we see hundreds of tiny bright lights surrounded by vast areas of dark space. By contrast, Hubble photographs depict colour-saturated stars and planets, comets and nebulae. Yet interestingly, they are hard to decipher for someone who is not a professional astrophysicist.<sup>11</sup> Describing

9 Karin Knorr Cetina, “The Couch, the Cathedral, and the Laboratory: On the Relationship between Experiment and Laboratory in Science”, in Andrew Pickering (ed.), *Science as Practice and Culture*, Chicago IL, The University of Chicago Press, p. 117.

10 Elizabeth A. Kessler, *Picturing the cosmos: Hubble Space Telescope images and the astronomical sublime*, Minneapolis MN, University of Minnesota Press, 2012, p. 4.

11 Don Ihde, *Instrumental realism: the interface between philosophy of science and philosophy of technology*, Bloomington IN, Indiana University Press, 1991, p. 34. See also Don Ihde, *Postphenomenology and technoscience: the Peking University lectures*, Albany NY, SUNY Press, 2009.

the famous Hubble photograph of the Eagle Nebula, Kessler observes:

“The closer one looks, the more difficult it becomes to classify what is pictured. Because of its wispy outline and top-heavy proportions, it appears that the form must be composed of something airy, something gaseous and insubstantial; however, its elongated profile resembles none of the clouds seen above the earth, and its blackness surpasses that of even the most threatening storm. Its colour and assertive vertical orientation instead suggest a gravity-defying geological formation carved into a twisting pillar by unknown forces and silhouetted against a bright sky. The object almost oscillates before the viewer: cloud and landscape, familiar and alien”.<sup>12</sup>

While these images defy our comprehension, they provide us with the direct testimony of events located at the border to the visible universe. But what exactly does the raw data coming from the universe look like? How do scientists transform them into images? Where do these colours come from? In order to answer these questions, the present artistic-based research employs several methods of investigation that could be defined as interzonal. Not clearly labelled, they stand in between what are considered as more “orthodox” methodologies and can be best described as fluid modalities of analysis.

## Practices of artistic research

The demands and preoccupations of the project determined an un-systematic approach, what German philosopher Theodor Adorno would have described as an “unmethodical method”,<sup>13</sup> mixing theoretical analysis and practice-based strategies that would have otherwise seem incompatible.<sup>14</sup> To clarify my approach to the subject of enquiry, I will present some readings of practice-based researches that I find particularly in line with my methodology.<sup>15</sup> My artistic practice has been informed by two lines of action:

- 1) the collection of pre-existing visual material (archival photographs and videos) and their elaboration in artworks in multimedia forms, comprising site-specific

<sup>12</sup> Elizabeth Kessler, *ibid.*, p.1.

<sup>13</sup> Quoted in Lane R. Kauffmann, “The Skewed Path: Essaying as Un-Methodical Method”, *Diogenes*, 36 (143), pp. 66-92. See also Brian O’Connor, *The Adorno Reader*, Oxford, Blackwell, 2000.

<sup>14</sup> Bradley C. Haseman, *ibid.*, p. 100.

<sup>15</sup> There seems to be not a single or fixed point of origin from where this type of research originated. According to researchers Maggi Savin-Baden and Claire Howell Major, art-based research practices stem from an educational event held at Stanford University in 1993. In Maggi Savin-Baden, Claire Howell Major, *Qualitative research: the essential guide to theory and practice*, London, Routledge, 2013, p. 4, note 3.



- installations, experimental films, video projections and an artist's book;
- 2) The original production of audio-visual documentation through field work and its elaboration in the form of experimental films, audio recordings, photographs and site-specific installations.

The research preoccupations and methodological approach make reference to what Hal Foster has described as the 'ethnographic turn' experienced by the art scene in the last decades.<sup>16</sup> As ethnography is often considered the science of alterity *par excellence*, my practice stands as an original artistic-ethnographic exploration of the little-known domain of astrophysics.

Due to the physical impossibility of visiting multiple countries outside Europe and the USA, the research had to be limited to the study of images of space produced within western cultures and societies. In this sense, the research material stems from a western point of view. The same applies to some ethnographic material employed in the different artworks produced throughout the PhD - I'm referring in particular to some images of the Selkham tribe produced by western colonizers in the late 19th century. While this westernized look is very much present in the research, my approach is to consider every image of space as a different narrative about the universe, developed from a unique perspective. Through my artworks I aim to deconstruct a privileged, westernized point of view on outer space, and to look beyond the traditional way of looking at images of the universe in order to discover at their core a multiplicities of points of view and perspectives.

I approach the domain of astrophysics as a visual ethnographer, in the sense of looking at an "unknown other", in this case a western subject, i.e. the scientific domain of astrophysics, formed by thousands of scientists working behind closed doors. In the thesis, I make multiple reference to the multiplicity of gazes that I bring together through different artworks, in order to shed light on the different and varied narratives generated by the act of looking at interstellar distances.

Additionally, through the collection of archival material, audio-visual documentation of research spaces and direct interaction with scientists, I take the role of an ethnographer, producing in-depth research and presenting the findings through a wide range of material - photographs, audio and video recordings, research notes - in the form of different artworks. I invite the viewers to become co-researchers and study for themselves the

<sup>16</sup> Originated as a rebellion against official art institutions that generated and promoted exclusive artistic definitions and forms, this trend called for a critically-driven art practice that would operate as a site of cultural and political transformation beyond art institutions or academic artistic recognition. Hal Foster, *The return of the real*, Cambridge MA, MIT Press, 1996. For descriptions of anthropologists and artists borrowing from each other's disciplines, see Alex Coles, *Site-Specificity: The Ethnographic Turn*, vol. 4, London, Black Dog Publishing, 2000; Caitlin DeSilvey, "Art and Archive: Memory-work on a Montana Homestead", *Journal of Historical Geography*, 33, 2007, pp. 878-900; Kathryn Ramey, "Productive Dissonance and Sensuous Image-Making: Visual Anthropology and Experimental Film", in Marcus Banks, Jay Ruby (eds.), *Made to be Seen: Perspectives on the History of Visual Anthropology*, Chicago IL, University of Chicago Press, 2011.



*The Quintessence*, Artist's notebook. Credits: Pamela Breda.

research's findings: they have, so to speak, to connect the dots, engaging at a deeper level with the discussed topic.<sup>17</sup> By so doing, the research overcomes the traditional, one-sided academic representation of the scientific domain. As Barbara Lüneburg observes, artistic practice as research creates a new space for groundbreaking outcomes, crossing disciplines, fixed domains and forms of knowledge:

“To this category belongs knowledge based on and gained through artistic practice, as well as the knowledge that manifests itself through the results of artistic practice for which experience with the artwork is essential. Artistic research strives for alternative possibilities to communicate these forms of knowledge. The essential difference between artistic and scientific research is that in artistic research, the goals and methods for acquiring

17 Claire Bishop, “History Depletes Itself. Claire Bishop on Danh Vo at the Danish Pavilion and Punta Della Dogana”, *Artforum*, 54, September 2015, pp. 324–330, retrieved at [www.artforum.com/print/201507/claire-bishop-54492](http://www.artforum.com/print/201507/claire-bishop-54492) on 14/07/2019; Christoph Chwatal, “Notes on Claire Bishop's lecture: “Information Overload: Research Based Art and the Politics of Spectatorship”, Kunsthalle Wien, retrieved at <http://kunsthallewien.at/#!/BLOG/2019/01/NOTES-CLAIRE-BISHOPS-LECTURE> on 06/09/2018.

knowledge are infused with the posing of questions that stem from the structured and reflective direct involvement of the artist in the process of creating the work and the artwork itself".<sup>18</sup>

Following this description, my research proposes an original approach on the domain of astrophysics, moving forward from the traditional modalities of communicating science to and for the general public. These normally involve publications in specialized magazines or press conferences, often employing a highly technical language not easily accessible or comprehensible. My project fills this gap through a visual and sensorial approach to the astrophysics domain. In this regard, the research partakes of multiple features described by Maggi Savin-Baden and Claire Howell Major as being key in artist-based research:

"1. Arts-based inquiry: where the artistic process is used as research by artists, researchers and participants in order to understand the art itself or a phenomenon through the artistic process.

2. Arts-informed inquiry that is of two types:

a. Where art is used to represent the findings of a study;

b. Where art is used to represent a response to the findings of an issue or situation studied;

3. Arts-informing inquiry: where art is used in order to evoke a response from an audience (in the broadest sense) made to a situation or issue: the response may or may not be captured".<sup>19</sup>

The artworks I've produced throughout the research share several of these features. As arts-based inquiries, they aim to generate new insights into the investigated domain. The goal is to produce a new understanding of the imaginary of outer space for the insiders (the scientists) as well as for the outsiders (academics, artists, the general public), leading to original debates on cognitive and visual dynamics at play within the astrophysical domain.<sup>20</sup> At the same time, they aim to evoke a response in the public in the form of a new critical approach to images of space as means to reflect on wider cultural and social cognitive modalities of apprehending the universe at large through human expectations, dreams and fears.

18 Barbara Lüneburg, *TransCoding: From 'Highbrow Art' to Participatory Culture*, Bielefeld, Transcript, 2018, p. 131.

19 Maggi Savin-Baden, Claire Howell Major, *ibid.*, p. 299.

20 Kat Jungnickel, Larissa Hjorth, "Methodological entanglements in the field: methods, transitions and transmissions", *Visual Studies*, 2014, Vol. 29, 2, pp. 138-147, retrieved at <http://dx.doi.org/10.1080/1472586X.2014.887263> on 10/04/2019.

Another significant reference for my practice-based methodology was Bradley C. Haseman's *A Manifesto for Performative Research*. The text proposes a performative paradigm for the creative arts, suggesting that the distinctive research strategies, interpretative methods and outcomes arising out of artistic-based research point towards a new research paradigm.<sup>21</sup>

This approach is highly resonant with the one applied by scientists trying to establish new knowledge about outer space through original strategies of enquiry. By applying the performative research approach to my project, I create a literal and metaphorical reference to the scientific topic I am exploring, while testing a new methodology of field-research. According to Haseman, the main difference between quantitative and qualitative research lies in the modalities through which research findings are expressed. In particular, qualitative research employs a wide range of methods to communicate its findings, often incorporating the perspectives of both researchers and participants. Many practice-led researchers begin a project

“led by what is best described as ‘an enthusiasm of practice’: something which is exciting, something which may be unruly, or indeed something which may be just becoming possible as new technology or networks allow (but of which they cannot be certain). Practice-led researchers construct experiential starting points from which practice follows. They tend to ‘dive in’, to commence practising to see what emerges”.<sup>22</sup>

Such an explorative approach was essential for my project. Prompted by a real enthusiasm for visual representations of the universe, through artistic-based enquiry I described and at the same time questioned the imaginary of outer space in a poetic and evocative way. As scientists struggle to make new discoveries about the universe, through artistic practice I've tried to discover something new about their research.

## **Analysis of artworks produced during the first and second research years**

During the first and second research years I have produced a number of artworks in multimedia forms: each of them focuses on a specific topic related to the wider research frame of reference. They can be considered as preliminary steps for the development of

<sup>21</sup> Bradley C. Haseman, “A manifesto for performative research”, *Media International Australia Incorporating Culture and Policy: quarterly journal of media research and resources*, 2006, pp. 98-106.

<sup>22</sup> Bradley C. Haseman, *ibid.*, pp. 100-101.

the feature-length film *The Quintessence* conducted during the final research year. In the following subchapters I will describe each artwork in chronological order of production, considering their aesthetic features and how they critically approach the main research questions.

## ***The Quintessence* - Artist's Book**

As previously stated, during the initial research stage I collected a vast number of representations of space from online and offline open source libraries and archives. Very useful references in this regard have been the internet archives:

[www.archive.org](http://www.archive.org),

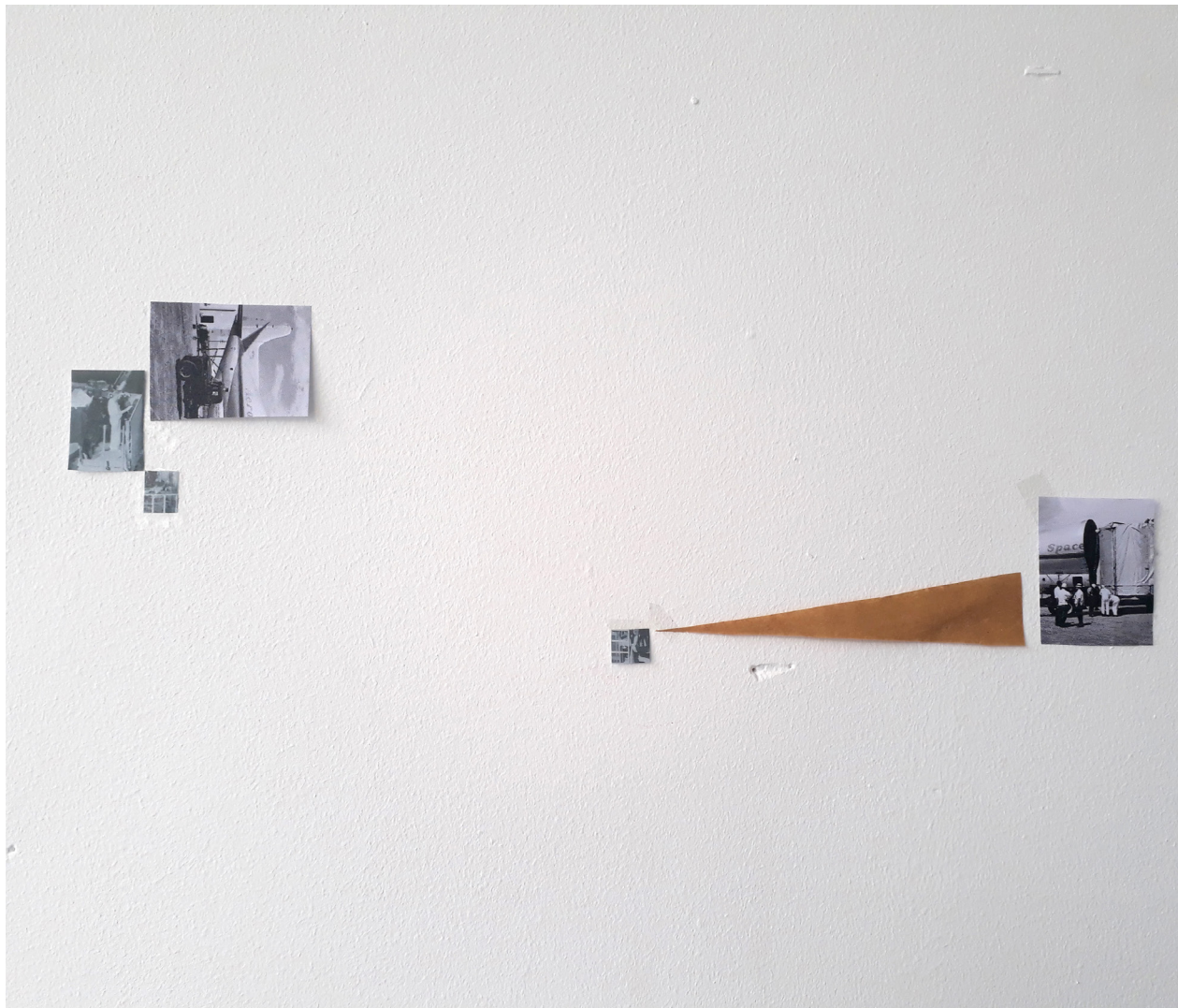
[www.imagesonline.bl.uk](http://www.imagesonline.bl.uk),

[www.observatoiredeparis.psl.eu/bibliotheque](http://www.observatoiredeparis.psl.eu/bibliotheque).

Each collected image has been scanned, digitized, inkjet printed and placed in three dedicated notebooks. With time, the collection grew consistently and I decided to showcase it through a specifically-designed artist's book. The publication stands as an artwork in its own right, as well as an introduction to the research key questions: it accompanies and complements the multiple artworks produced throughout the PhD. Bringing together images of the universe created in different times and by different cultures, the artist's book generates an original critical approach to how humanity has conceived and represented outer space through the centuries. I will provide the description of three images included in the publication to clarify this point.

The first is an ancient Egyptian stone relief representing Nut, goddess of the sky and all heavenly bodies, also known as a positive entity protecting the dead in the afterlife (page 66, picture 34). The Egyptians believed that during the day, the sun would cross the sky's body and at dusk Nut would swallow it until dawn, when it was reborn: the myth thus explained the alternation of day and night.

In the image, we can see the goddess represented as a physical embodiment of the sky, forming an arch with her body while bending over the Earth. This is a powerful example of how ancient cultures perceived the universe as a scenario shaped by the actions of gods and deities residing in the Heavens above the Earth. The second image is the photograph of a Selk'nam tribesman taken in the 1890s (page 88, picture 40). Also known as the Onawo (or Ona people), the Selk'nam were indigenous inhabitants of the Pata-



*Away from Here*, site-specific installation detail, Cité Internationale des Arts, Paris. Credits: Pamela Breda.

gonian region of southern Argentina and Chile. Mainly located in the Tierra del Fuego islands, for centuries they travelled by sea among this vast archipelago using the stars to orientate themselves. To this day ethnographers have no idea of how they came to possess such advanced astronomical knowledge. One of the last native groups in South America to be encountered by Western colonizers, they were practically exterminated by the newcomers in the late 19th century.<sup>23</sup>

In the photograph I choose to include in the book, a Selk'nam man is seen in ritual disguise, his body covered by a line of white dots representing stars and constellations. The image shows the strong connection between sky observations and the daily life and rituals of ancient populations: the Selk'nam literally embodied the universe on their own

<sup>23</sup> Martin Gusinde (1886-1969), a German priest and ethnologist, documented this native people and their practices through a series of photographs, the only remaining testimony of this culture. Xavier Barral, Martin Gusinde, Christine Barthe, Marisol Palma, Anne Chapman, Dominique Legoupil, *The lost tribes of Tierra del Fuego: Selk'nam, Yamana, Kewésqar*, London, Thames and Hudson, 2015. See also Marisol Palma, *Bild, Materialität, Rezeption: Fotografien von Martin Gusinde aus Feuerland (1919-1924)*, München, Peter Land, 2008.

bodies. The third image is a photograph titled “eXtreme Deep Field” taken by the Hubble telescope and published by NASA in 2012 (pages 104-105, picture 60). It documents a small region of space in the constellation Fornax containing an estimated 10,000 galaxies. Obtained by combining hundreds of photographs and observations made over a ten-year timespan, the picture represents the most recent technical advancements in optical instrumentations used to observe the universe.

In the artist's book, these three images are presented in combination with many others, generating a critical analysis of how the visual imaginary of outer space has changed over time. While ancient Egyptians and Selk'nam read the universe through religious myths, contemporary astrophysicists study outer space through the scientific gaze. Different modalities of looking at the universe lead to different cultural and social perspectives on the same object of enquiry. By combining these images, the publication stresses how human understandings of outer space have never been fixed but are always subjected to changes of cultural, social and technological scenarios.

The main inspiration for the book is Haris Epaminonda's *Chapters I-XXX*, a catalogue that accompanies a series of experimental 16mm films shot by the author in Cyprus.<sup>24</sup> The text presents a wide range of material such as found photographs, pages from vintage ethnographic publications and stills from archival footage.

Much in the same way, in my artist's book I employ de-contextualized archival material from different sources, giving it a new meaning. The images I have taken as examples - the Egyptian relief, the photograph of the Selk'nam tribe and the Hubble photograph - have a strong connection among each other. They all represent the same subject, i.e. the starry sky, but in very different ways.

Their combination suggests how different ideas and interpretations about the dynamics of the universe can influence its visual depictions. While each individual image stands as a single statement, together they acquire enhanced meaning, creating a system of variations and non-linear narratives that highlights the human relationship with outer space throughout the centuries.

## ***Away from Here* - Site-specific installation**

*Away from here* is a site-specific installation presented at the Cité Internationale des Arts (Paris), showcasing a selection of images collected throughout the research. In the main gallery space - a huge room surmounted by a smaller exhibition area - I presented a series of collages formed by groups of photographs of stars, galaxies, telescopes,

<sup>24</sup> Haris Epaminonda, Marco Walser, *Chapters I-XXX*, Zürich, Elektrosmog with Kunsthau Zürich, 2014.

technical equipment and scientific experiments. The collages were placed directly on the wall of the gallery space. Additionally, five 70x100 cm framed collages from a series titled *Heavenly Bodies* were located on the upper level of the gallery along with four 70x120 cm photographic collages on lightboxes, titled *Into the Night*. The pictures - taken in different times and locations - were combined in groups of two, three or more - generating concise yet powerful visual statements about the evolution of technological apparatus used to observe the universe.

For example, a photograph taken in the 1960s documenting the construction of a big radio telescope in South America was placed side by side with a picture from the mid 2000s showing a control room full of computer screens elaborating data coming from space. These images were taken 40 years apart, a timespan during which astrophysics research underwent a huge development: scientific theories unimaginable when the first image was taken were broadly accepted when the second photo was produced.

The collages present multiple combinations of original Hubble photographs with their final edited version. This aesthetic choice reveals the original features of the raw files produced by the famous orbiting telescope. Photographs of distant galaxies, supernovae explosions and cluster of stars are originally black and white, since b/w sensors provide higher-quality pictures than coloured ones. In addition, the original images are often covered by vertical bright lines, the traces of high energy rays crashing into the telescope sensor. These visual glitches are erased during post-production, when the images are “cleansed” of imperfections, strongly contrasted and edited with highly saturated colours to highlight the presence of certain gases and chemical elements in specific areas of space.

This information is usually transmitted on light frequencies beyond the visible range - such as ultraviolet or x-rays - therefore it is impossible for us to see these colours with our naked eye. The empty space generated on the walls of the exhibition room amongst the images is a metaphorical reference to this gap in visual information: in some areas of space, nothing can be seen with the naked eye.

Another image - presenting a number of scientists around a computer screen - depicts the optical discovery of the pulsar, a rotating neutron star emitting beams of electromagnetic radiation that can occasionally be observed from Earth. This astronomical object had long been posited by astrophysicists before its first actual observation in 1967. Such a discovery was based on a complex interaction between what scientists knew and the tools they used to detect a specific signal. The image thus stands as a visual example of how human agency and technology are strongly intertwined in the process of space observation and analysis.<sup>25</sup>

25 Harold Garfinkel, “The work of a discovering science construed with materials from the optically discovered pulsar”,





*Into the Night*, lightbox, 70x120 cm. Credits: Pamela Breda.

The collages were combined with blank pieces of brown paper creating a visual thread between them. At the same time, these visual inserts make reference to brown archival folders once used to store documents and scientific data in dedicated research centres. Recalling outdated archival practices, they stress once again the role of technology and material apparatus in shaping the development of astrophysical knowledge. The installation was inspired by the work of the Chilean artist María Ignacia Edwards, who combines art and mathematics to create delicate, three-dimensional sculptures composed by hundreds of thin wooden rods representing metaphorical universes. These sculptural objects are often suspended from the ceiling of the exhibition space, arranged to rotate on their own axis and to be perfectly balanced among each other. As in Edwards' work, my installation brings together different visual elements which form a wider composition.

The collages act as a mirror of the interconnections between different elements playing a role in astrophysical research as parts of a bigger network made of humans and machines. They recall the complex calculations performed by scientists studying the universe and at the same time evoke the interrelation of all celestial bodies.

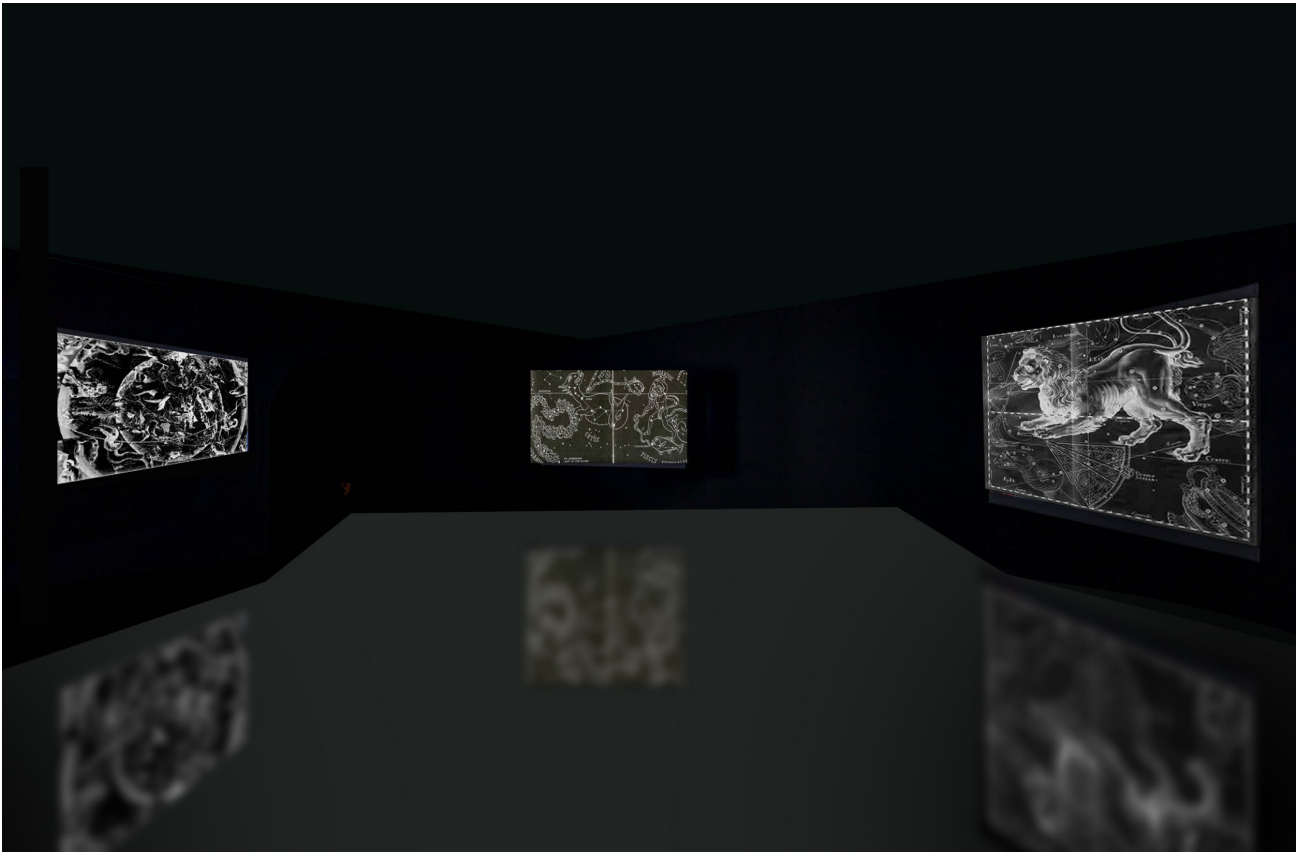
### ***Into the Night - Photographs on lightboxes***

*Into the Night* is a series of four photographic collages mounted on lightboxes (70x120 cm each) showcased at the exhibition *Away from Here*. The collages were created from scanned glassplates discovered at Harvard Astrophotographic Collection (Harvard University, USA). These images were printed on photographic paper and subsequently re-scanned through a process of de-contextualization. The resulting prints have been superimposed with reproductions of constellations and star spectra, in order to generate unique images.

Such a methodological approach highlights the multilayered nature of astrophysical knowledge. What we know about outer space is built on a series of observations and theories developed throughout the centuries by different human cultures. Very much as in an archeological excavation, these collages combine multiple representations of outer space as historical strata sedimented through time. Ancient legends about universal events ceded to Renaissance astronomy, which in turn led to the Enlightenment era of scientific discoveries and, more recently, to quantum mechanics and advanced theories on dark matter. Inspired by Man Ray's rayographs, these images are constructed as a scientific experiment, wherein different chemical elements come together in order to generate new compounds and materials.<sup>26</sup>

*Philosophy of the Social Sciences*, 2, 1981, pp. 131-158.

<sup>26</sup> Man Ray, *Man Ray: photographs, paintings, objects*, New York NY, Norton, 1997.



*Everything is Illuminated*, multiscreen installation, render. Credits: Pamela Breda.

The combination of visual layers superimposed on top of each other generates a new visual space which acts as a charged surface. Universal light travelling through space is re-activated by artificial, man-made light. Photons originated from nuclear reactions and captured on old photographic glassplates and ancient drawings of constellations are combined with photographs of stars and galaxies. All of these different images are brought to life by the lightboxes' artificial tungsten bulbs whose chemical components were also created in the dense and hot core of stars. As a neverending circle, starlight generates new light, which spreads images of outer space back to the universe where they came from.

### ***Everything is Illuminated* - Site-specific video installation**

*Everything is Illuminated* is a site-specific, environmental installation that can be adapted to varying exhibition contexts. Eight different screens occupy a huge gallery space. They present simultaneously ancient and modern images of constellations flickering rapidly one after the other accompanied by the sound of old slide projectors. The images are taken from several star atlases and encyclopedia of constellations, from Al-Sufi's *Book*



*The Beyond*, two screen installation, Foundation Arthur Cravan (Milan, IT). Credits: Pamela Breda.

*of the Constellations of the Fixed Stars* (ca. 964), to *Firmamentum Sobiescianum, sive Uranographia* by Johannes Hevelius (Gdańsk, 1690) and *Urania's Mirror* by Jehoshaphat Aspin (London, 1825).<sup>27</sup> Produced both in western and eastern cultures, these images show how in the past the act of looking at outer space was highly intuitive. No technical apparatus could help humanity to observe the near as well as the distant universe.

Through mere naked eye observations, mankind conceived astronomical objects as transfigurations of gods and goddesses, animals and fantastic beasts. Heavenly phenomena were perceived as strongly connected to life on Earth: from human biology to the weather, every event taking place on our planet was reflected in the stars.

The installation aims to re-activate such an intuitive and unmediated approach to outer space through old representations of the universe. No voiceover or offscreen commentary accompanies the projections. The emphasis lies entirely on the visual elements presented through the screens' surface, which acts as a threshold wherein the distant universe become closer, almost touchable. Light travelling through space permeates the art gallery, generating a powerful overflow that surrounds the public. Through multiplication, the magnified details of stars and constellations assume an almost physical presence.

<sup>27</sup> Patrick Moore, Robin Rees, *Patrick Moore's Data Book of Astronomy*, Cambridge, Cambridge University Press, 2011.

The viewers are literally engulfed by the light changing and moving through the screens. The work reflects on a very common experience we can all refer to: gazing at the stars at night, looking at the Moon and Venus at dawn, or simply watching the blue dome above our heads. Walking around the installation space, the viewers can quickly glance at the different screens, as they might do when looking at the starry sky. This work was inspired by Steve McQueen's video installation *Once upon a time* (2002), a sequence of 116 35mm colour slides transferred to digital.<sup>28</sup> The slides reproduce a series of photographs sent into space with NASA's Voyager space probe in 1977.

The images, accompanied by greeting voices and music from all over the world, were included in a disk placed on board the space probe, with the intention to show to a hypothetical alien civilization what life on Earth is like. *Once Upon a Time* explores the construction and representation of knowledge about the world and how we, as a species, decided to represent ourselves to the wider universe. My work moves from McQueen's video in order to shift the focus of attention on how the human species has been representing stars and constellations throughout the centuries, and how these visual imaginaries tell us a lot about how we envision outer space and how we make sense of it through images.

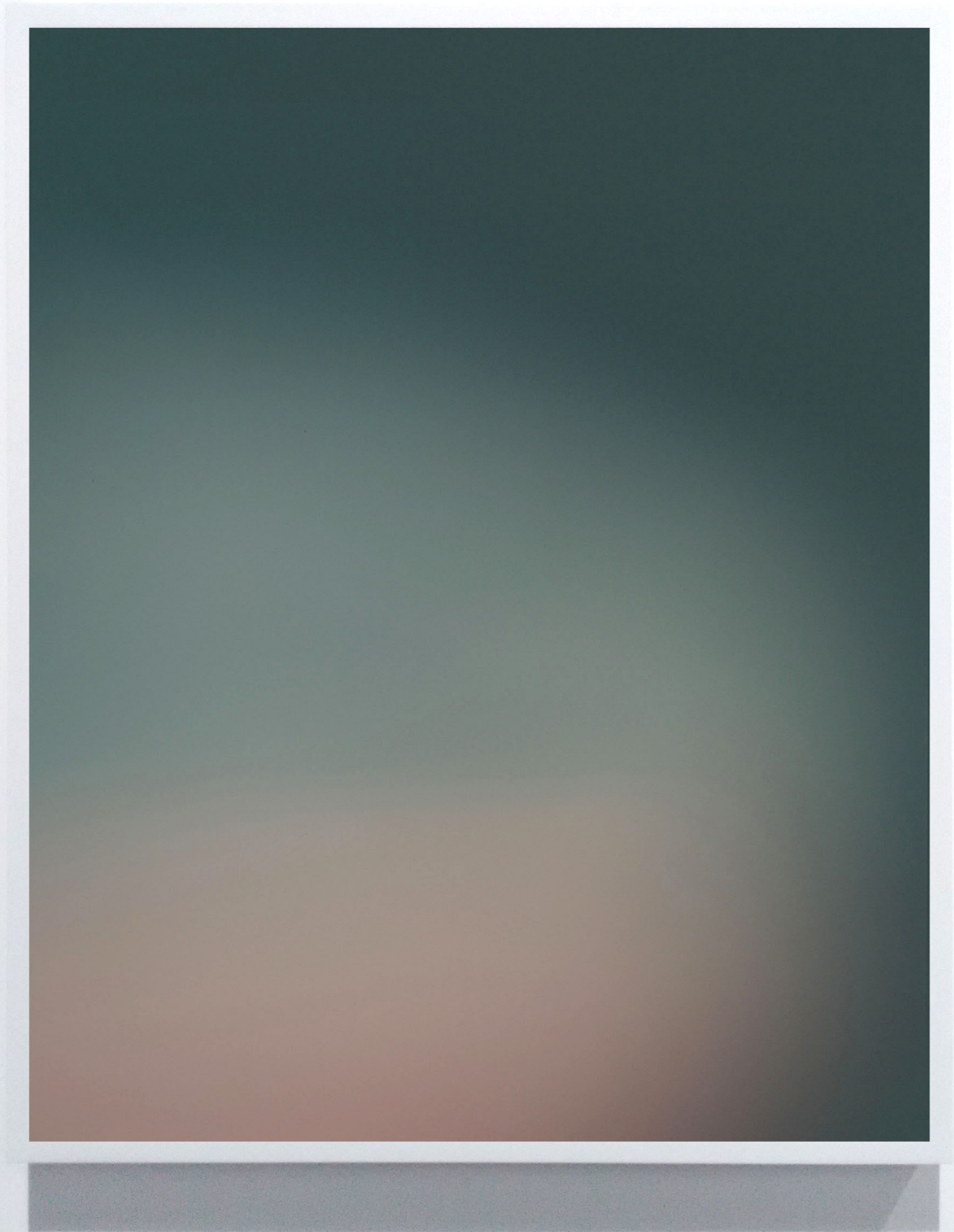
### ***The Beyond* - Two channel video installation**

*The Beyond* is a double screen installation conceived as an environmental projection. It was presented for the first time at the exhibition 'Sound creations inspired by the Universe' (16-17 December 2018), held at Fondazione Arthur Cravan, (Milan, IT) and supported by ProHelvetia-SRKS/FSRC. Running simultaneously, the two screens present rare 1950s and 1960s archival footage of astronauts training for space missions.

The sequences are accompanied by audio extracts from an interview conducted with Prof. Edward Kontar (Glasgow University) reflecting on the practical, philosophical and ethical implications of space exploration. Through montage, images of astronauts training are combined with shots of technical apparatus, calibrating instruments and outdoors test locations, generating a reciprocal exchange between inside and outside, inner and outer landscapes.

The use of archival footage recalls old sci-fi movies and evokes compelling narratives about the human efforts to explore outer space. As Walter Benjamin had predicted, "nothing brings the promise encoded at the birth of a technological form to light as ef-

28 Camelia Gupta, "Sitting Comfortably? Steve McQueen Tells The Story Of Humanity", *Culture 24*, retrieved at <https://www.culture24.org.uk/science-and-nature/art24227> on 12/10/2018.



*To the Wonder*, lambda print, 50x70 cm. Credits: Pamela Breda.

fectively as the fall into obsolescence of its final stages of development”.<sup>29</sup> Old film reels act as a powerful metaphor of how technology evolves and changes with time: while the archival images were born from a documentary purpose, their presentation in the exhibition space gives them a new meaning. The video installation was inspired by Giulia Grossmann’s films shot at scientific research centres such as ESA and CERN, since their cinematographic style blurs the boundaries between documentary and fiction.<sup>30</sup>

Another key reference was Rosa Barba’s videoworks, exploring the materiality of the filmic support and the intersection between documentary and fictional narrative. Her installation *The Color Out of Space* (2015) analyses the interconnections between our world and the nature of the universe, incorporating images of stars and planets projected through a sculpture made of coloured glass panels.

The piece is completed by voiceovers of scientists and artists discussing topics such as space and time, the limit of our knowledge and the unknown borders of the universe. I took this installation as a point of reference to elaborate a visual discourse on the human efforts to study the universe. The 20<sup>th</sup> century race to conquer outer space emerges as a powerful narrative shaped by cultural, social and political frameworks.

## ***To the Wonder* - Photographs and experimental film**

This artwork is formed by ten framed photographs and an experimental short film constructed around the role of errors in space exploration. The title *To the Wonder* evokes the double meaning of wondering as questioning and being amazed by the unknown limits of the universe.

The photographs produced for this piece are found archival images from Apollo official photographic records. Most notorious among other space exploration programs, Apollo was conducted by NASA between 1961 and 1972 with the ambitious goal of bringing humans to the Moon, a mission that culminated in the famous 1969 moon landing performed by astronauts Neil Armstrong, Buzz Aldrin and Michael Collins.

NASA recently made public a number of photographs taken by the astronauts during the missions on the image-sharing platform Flickr/The Commons. Among the pictures of amazing moon landscapes, details of the space rocket interior and breathtaking vistas of Earth seen from space, NASA published some pictures presenting errors or glitches such as hues, haloes and dots. Drawn by the elusive and mysterious character of

29 Quoted in Rosalind Krauss, *A Voyage on the North Sea - Art in the Age of the Post-Medium Condition*, London, Thames and Hudson, 1999, p. 45.

30 Charlotte Salvatico, “Giulia Grossman, Redefining the Scientific Fiction(s)”, *Labocine*, retrieved at <https://www.labocine.com/spotlights/redefining-the-scientific-fictions> on 03/03/2020.

these images, I decided to select, print and exhibit some of them in a gallery space. From a conceptual point of view, rather than being successful records of space exploration, these photographs stand as metaphors of how errors can become triggers for new approaches to scientific research. While the advancement of science is necessarily constructed on failures and wrong turns, this topic is rather taboo within the scientific domain. Monetary investments and academic prestige make it difficult for scientists and engineers to publicly announce such failures.<sup>31</sup> Whenever scientific mistakes are made, they are not widely announced or circulated among the general public.

Through my artistic intervention I wanted to subvert this trend, constructing an art piece on errors as essential elements for the development of scientific knowledge about the universe. The photographic series is accompanied by a silent experimental film presenting archival footage of multiple American and Soviet failed unmanned rocket-launches. In each shot, the camera follows the rockets crossing the sky towards the upper layer of the atmosphere until something goes abruptly wrong and the rockets explode, shattering debris in mid air. There is no clear information about the location or date of the documented explosions, however from certain aesthetic qualities of the shots we can infer they were recorded between the 1950s and 1990s.

The archival footage used for this piece has not been widely circulated in the mainstream media and was discovered through a detailed online research, after multiple and unsuccessful attempts to contact NASA enquiring about its film archive. No voiceover describes the film material or tells a story, leaving the viewers to find their own interpretation of the images they are looking at. The footage's elusive and hidden nature can lead viewers to reflect about trials and mistakes and how these are pivotal in shaping the monumental human effort to bring mankind a little closer to the stars.

An artistic inspiration for this artwork has been Bruce Conner's *Crossroads* (1976), a short film made from archival footage documenting the 1946 Baker nuclear test at Bikini atoll carried out by the US Department of Defence. Conner's film highlights the destructive power of one of the most dangerous weapons developed in the history of humanity, but at the same time creates a powerful visual statement characterized by an eerily aesthetic beauty.

Following the same principle, *To the Wonder* presents explosions and destructions as metaphors of persistent human efforts to explore outer space. Through montage, mistakes are approached as triggers for the advancement of scientific research, generating new ideas and new knowledge.

31 Mario Livio, *Brilliant blunders: from Darwin to Einstein: colossal mistakes by great scientists that changed our understanding of life and the universe*, New York, NY, Simon and Schuster, 2014.



During the film premiere at the Cité Internationale Des Arts (Paris) on the 26<sup>th</sup> of August 2018, the viewers were rather impressed and approached me to enquiry whether the scenes were documenting real events or were retrieved from some science-fiction movie. This feedback indicates how the general public is often not aware of the many errors and mistakes involved in space exploratory missions, strengthening the artwork's inherent goal to generate a new approach to the topic. After its premiere, the film has been screened at Videoproject Film Festival (Angers and Nantes, France) and Odaaqq Film Festival (online screening).

### ***The Infinite* - experimental film**

*The Infinite* is an experimental short film presented as a site-specific environmental video installation at the collective show *Envisioning Other Worlds*, showcased at Row Labs, Bow Arts (London, UK) in February 2019. The piece is constructed as a slow 3D animated zoom out from the Earth to the most distant regions of the visible universe. Generated by a spatial localization software, the video was retrieved from youtube.com and subsequently re-edited. The images are accompanied by the voice of Prof. Richard Ellis (University College London, UK) considering deep philosophical questions underlying contemporary astrophysics research. While the camera explores the huge distances of interstellar space, Prof. Ellis analyses how we, as humans, interact with the concept of an expanding universe in which everything, from small particles to gigantic planets, is progressively detaching from everything else. The combination of video and audio suggests how contemporary practices of space observation emerge as scientific endeavours shaped by the intertwined agency of humans and technology. The choice of presenting a digital reconstruction of a possible voyage from Earth to the distant borders of outer space stresses the highly elaborated nature of cognitive-visual processes at play within contemporary astrophysics.

This work was inspired by Katie Paterson's practice, evolving around the cosmos perceived as a universal frame of reference wherein human life unfolds. In her piece *The Dying Star Letter* (2012), the artist presents a series of letters she sent to several astrophysicists and researchers to inform them of the death of specific stars recorded by powerful detecting instruments.<sup>32</sup> The work stands as a poetic, elegiac homage to the tiny specks of light we see in the night sky, lost in the vastness of outer space. In my work, the point of view is flipped, since planet Earth becomes a tiny speck of light in the midst of an infinite and overwhelming cosmos. What shall we make of our position as observers into the huge vistas of the universe?

32 Neha Choksi, "On Starlight and Celestial Darkness: Human Vision and Cosmic Revision, as Seen in the Recent Works of Zoe Leonard and Katie Paterson", *X-TRA*, retrieved at <https://www.x-traonline.org/article/on-starlight-and-celestial-darkness-human-vision-and-cosmic-revision-as-seen-in-the-recent-works-of-zoe-leonard-and-katie-paterson> on 31/06/2019.



*Beneath the Sea*, film still. Credits: Pamela Breda.

## ***Beneath the Sea* - Experimental film**

*Beneath the Sea* is an experimental documentary film shot at Boulby Underground Laboratories located near the small town of Saltburn-by-the-Sea, in North Yorkshire (UK). It was presented as a cinematographic installation during an open studio event at Boghosian Foundation (Bruxells, BE) in the summer of 2020. Lying 3500 feet under the Earth's surface, the laboratories occupy some of the underground tunnels originally excavated in the 1960s as part of a potash mine. The laboratories host a series of advanced scientific researches on outer space, including experiments on Dark Matter, the study of organisms that can survive in a salt-rich environment - supposedly to be found on planets outside the solar system - and Mars Rover tests.

This location has been chosen because at this depth there is no interference from natural background radiation that could cause instrument malfunction. Access to the laboratory is highly restricted due to security reasons and a lot of negotiation was necessary to obtain permission to film inside the facility. The opening scenes present the North Yorkshire landscape located some hundred meters away from the underground laboratories. Images of sea, cliffs and beaches evoke a peaceful and undisturbed nature. However, as the film progresses, the scenario changes rapidly as the camera jumps into a dark elevator leading to the underground labs.



*The Future*, installation view, Boghossian Foundation (BE). Credits: Pamela Breda.

The viewers slowly discover how the mine's galleries have been transformed into highly advanced scientific research spaces. Views of corridors and rock passages are combined with close-ups of engineers and technicians at work. The audio track highlights the sounds of machines and tools used in multiple scientific experiments, mingling with the voices of scientists: no offscreen commentary explains what we are looking at. The narrative is constructed exclusively using site-specific environmental sound recordings. The closing scenes present the same idyllic landscape shown at the beginning.

Through montage, the laboratory emerges as an enclosed area, a capsule located beyond conventional time and space. While people are walking on the beach and enjoying the seascape, in the depth of the earth scientists are conducting experiments on dark matter and studying the secret dynamics of the universe. This work was inspired by Simon Faithful's visual explorations of spaces evoking past events and onirical visions of a possible future, as in his film *Stromness* (2005) documenting an abandoned whaling station located on the island of South Georgia, in the lower Atlantic ocean. The camera depicts an eerily, almost out-of-this-world scenario, evoking landscapes that resemble those imagined by scientists and artists alike on other planets.

This aesthetic approach parallels my own visual rendition of the mysterious spaces of Boulby Laboratories producing a striking sensation of witnessing the specific time and space of the underground facilities while being projected into the interstellar distances of outer space.

## ***The Future* - Experimental film**

While the artworks previously described are focused on past and present developments of astrophysical representation and exploration of outer space, *The Future* is an experimental film constructed on the possible future evolutions of this scientific domain.

Shot in the summer of 2018 at Meudon Observatoire (Paris), the film is structured as a fictional meditation on a possible future when artificial intelligence softwares will have full control of sky observation, data collection and analysis. As a consequence, human-led astrophysical labs will be abandoned. While the slow-panning camera wanders around silent rooms hosting telescopes, mechanical tools and optical instruments, an anonymous voice describes how the millennial tradition of sky observation has evolved through the centuries and why it was always important for mankind to wonder about the mysteries of the universe.

The film explores how the present technological apparatus used to study the universe could develop in the future and how this could in turn affect our approach to the most important ethical and philosophical questions related to the exploration of outer space. The camera movements are extremely slow, evoking the long, durational processes involved in sky observation and the huge temporal scales at which universal phenomena unfold.

The visual focus on observational tools and mechanical instruments suggests how contemporary astrophysicists act as ancient alchemists, capturing the light coming from distant stars and transforming it into a different matter, giving it new form and meaning. Looking at the images unfold on the screen, dreams and fears about the future of space exploration mingle in unexpected ways.<sup>33</sup> This artwork has been inspired by Fiona Crisp's multimedia work *Material Sight*, a series of videos and photographs documenting world-leading scientific research facilities for the study of universal phenomena. Taking science back to a material level, Crisp's work resonates with my own visual documentation of scientific laboratories where knowledge is formed beyond the limit of perception, originating extreme theoretical hypotheses about possible multiple universes and puzzling quantum worlds.

33 Alyssa Grossman, "Memory Objects, Memory Dialogues: Common-Sense Experiments in Visual Anthropology", in Arnd Schneider, Caterina Pasqualino (eds.), *Experimental Film and Anthropology*, London, Bloomsbury Academic, 2014, pp. 131-146.

## Chapter conclusion

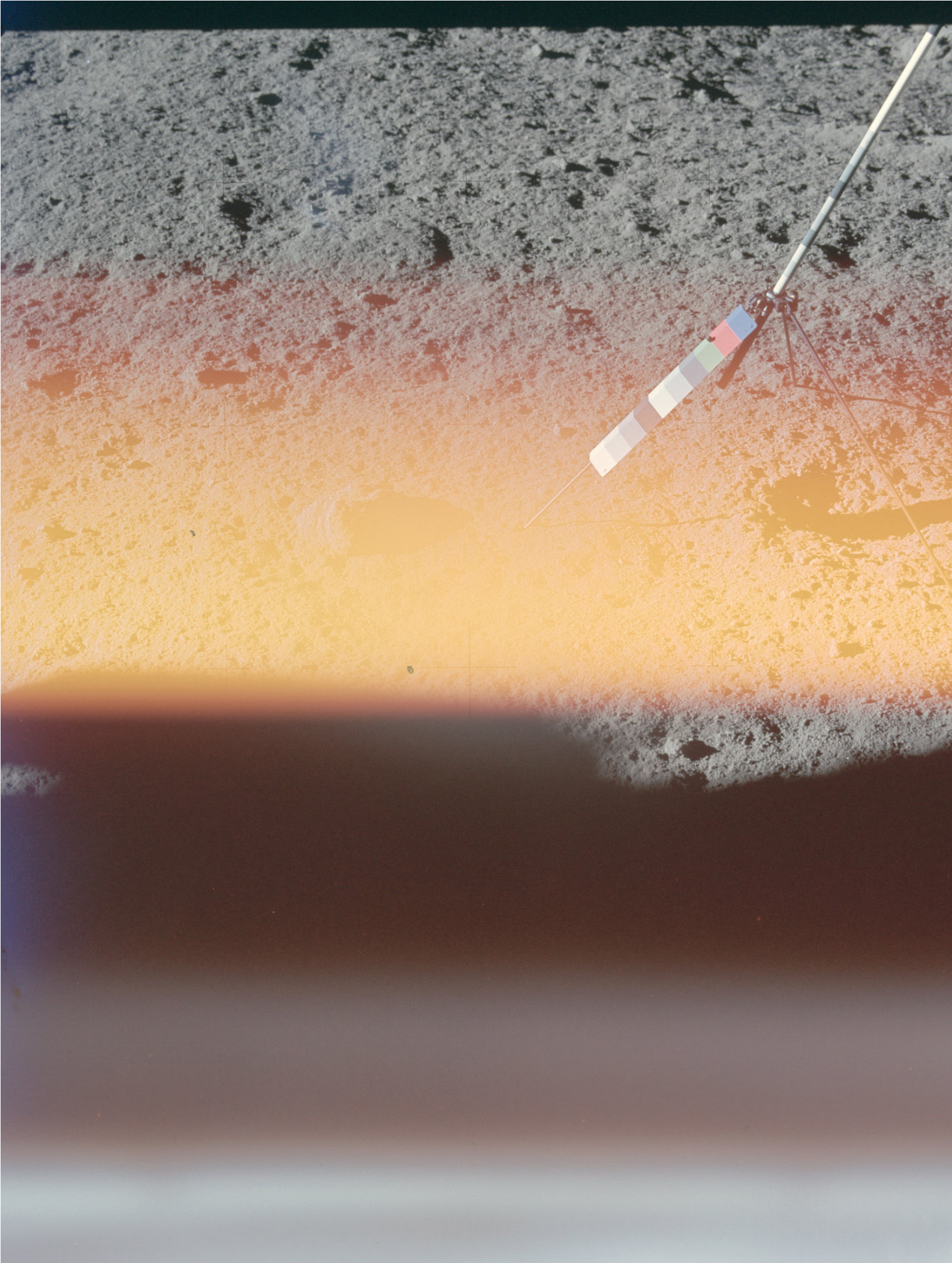
The artworks developed during the first and second research years explore from a critical perspective how the universe has been represented in the past and how it could be studied in the future. Focusing on the interconnected agency of scientists and technological apparatus, artistic practice analyses the cognitive and optical dynamics involved in the observation and representation of outer space. The resulting visual imaginary emerges as a complex field shaped by broader cultural contexts and material constraints.

Site-specific installations, experimental films, photographs, collages and an artist's book serve to question the aesthetic and conceptual features inherent to the act of looking and visualizing events and phenomena located beyond Earth. They scrutinize the subject of enquiry - the analysis of visibility in scientific representation - leading to further reflections on the idea of vision originated by light travelling through the universe. Representations of distant planets, stars and galaxies emerge as fluid documents that act both as scientific records and as mirrors of our everchanging understanding of outer space.

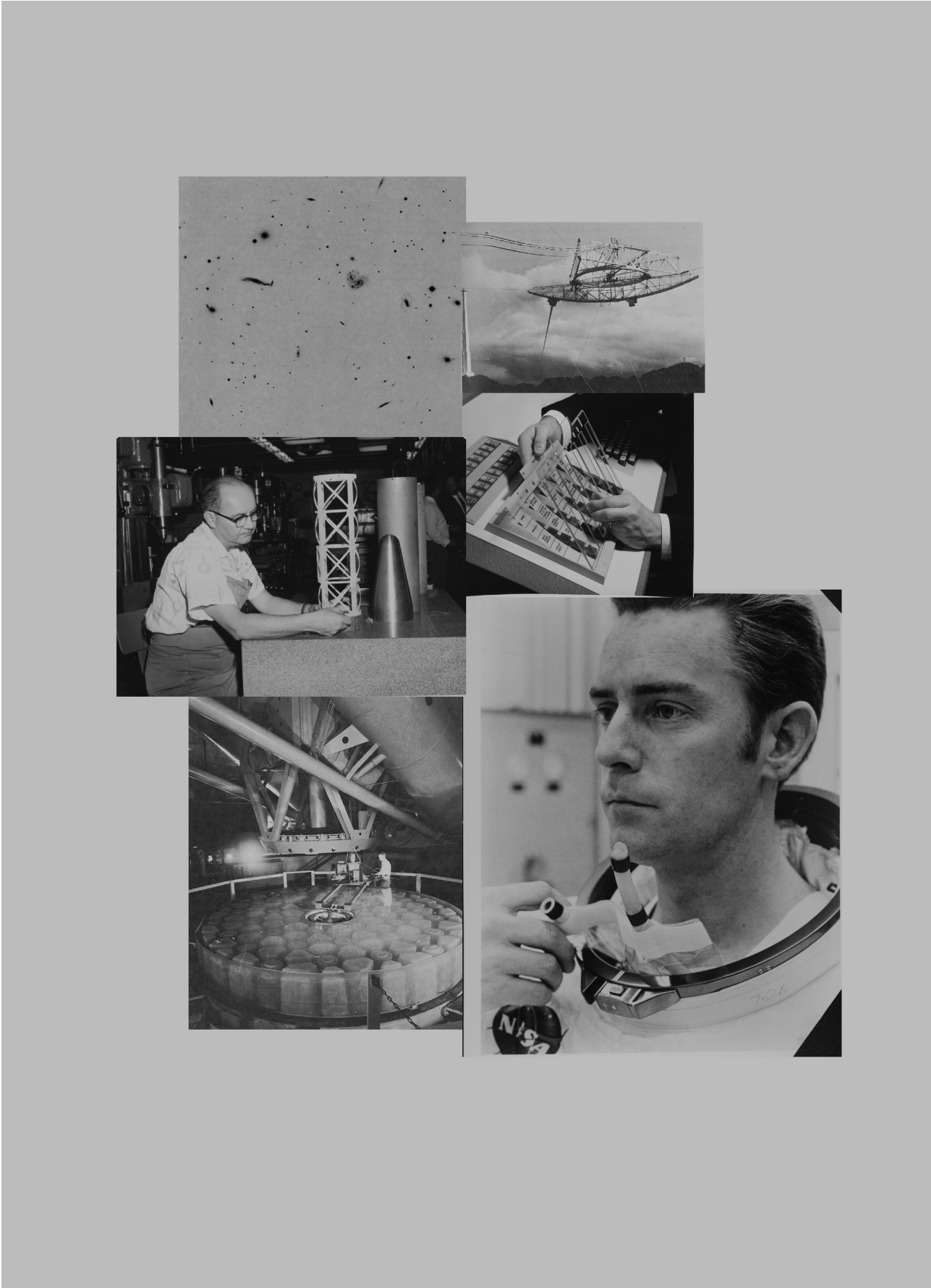
Throughout human history, different cultural, religious and, more recently, scientific beliefs, lead to different modalities of thinking and visualizing outer space. Audio interviews and site-specific sound recordings highlight the narrative features embedded in contemporary astrophysical research.

The scientists' voices add new meaning to the images recorded on video or through photographs and the act of looking - and representing - the universe emerges as a constantly evolving activity shaped by human imaginative capability. The multiple artworks presented in the gallery space (films, photographs, audio) generate a conflation of gazes through the activation of universal light on screen and photo surfaces. The visual imaginary of outer space emerges as a complex narrative that can be re-shaped and re-constructed multiple times. Distant galaxies and black holes, shooting stars and frozen planets are transfixed through artistic media.

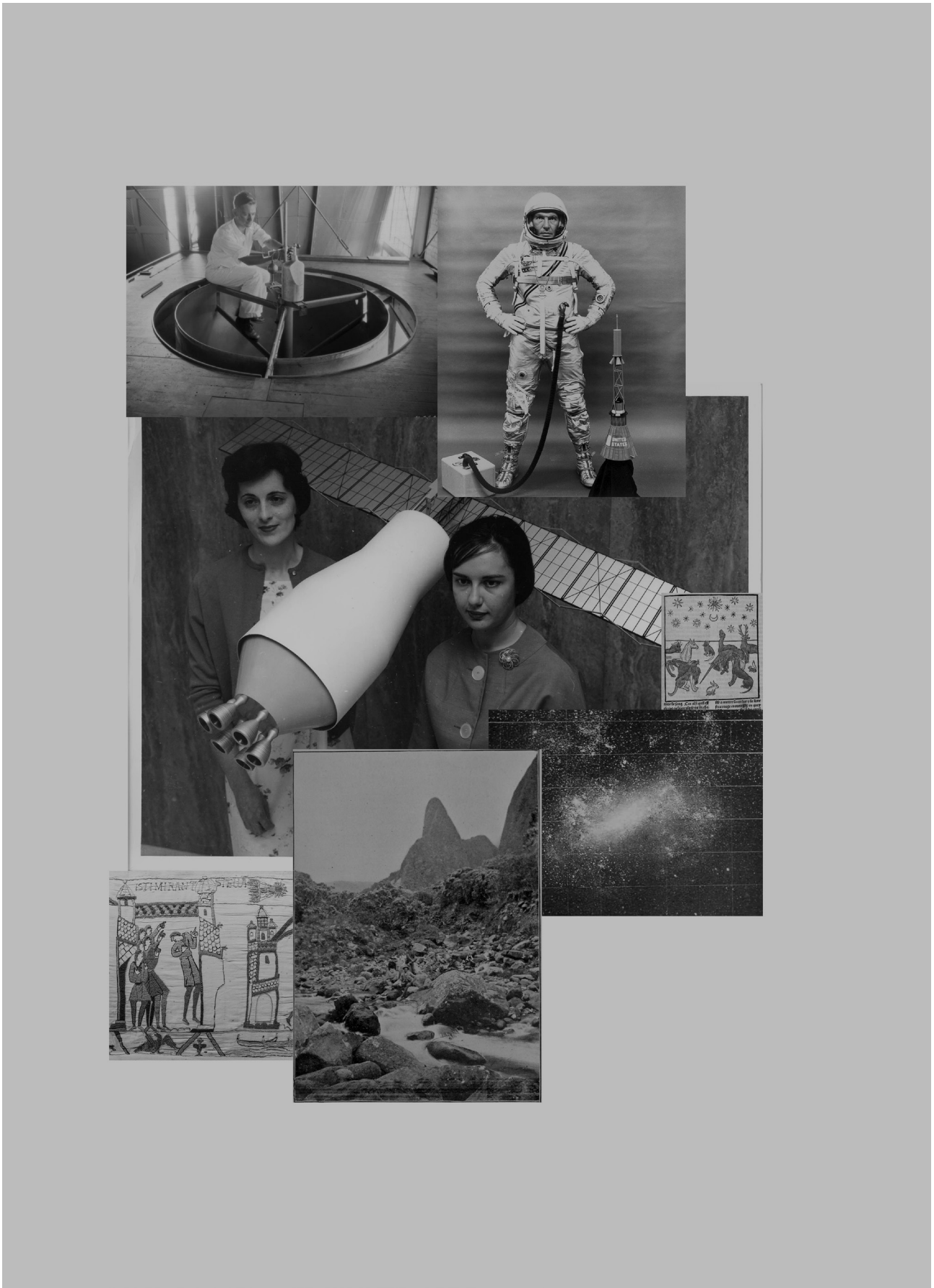
The viewers are brought directly in contact with the visible traces of universal phenomena through a sensorial experience where images and sounds collide. Such an encounter can trigger deep philosophical questions about our role as humans observing the universe, trying to find meaning in events and phenomena that shape life at the cosmic scale.



*To the Wonder*, lambda print, 50x70 cm. Credits: NASA.



To the Wonder, collage, 50x70 cm. Credits: Pamela Breda.



*To the Wonder*, collage, 50x70 cm. Credits: Pamela Breda.





*To the Wonder*, collage, 50x70 cm. Credits: Pamela Breda.

## CHAPTER II

### METHODOLOGICAL APPROACH CASE STUDY: FIELD TRIP TO PARIS OBSERVATORY

This chapter will describe the results of a site-specific visit carried out at Paris Observatory, the first of a series of research trips carried out to advanced institutions for the study of outer space. This visit enabled me to test some modalities of field-research (visual documentation through photographs and films, audio recordings of interviews with selected scientists) that I have applied in subsequent visits to other research centres.

I will consider how indoor and outdoor locations were documented, with a particular interest for the multiple observational domes built onsite, the different mechanical workshops and the optical and observational technical tools located in the different labs. Visual documentation of scientific research spaces has been used as a set of tools to generate a sensorial approach to astrophysical labs, something that would have not been achieved through more orthodox research methodologies.

The sample of two interviews conducted with astrophysicists will be analysed in detail, in order to explore the potential of audio recordings to shed light on scientists' approaches to research. The narrative features emerging through the act of speaking and listening will be considered as means to provide a more nuanced understanding of the contemporary practices of space observation, informed by creative ideas, dreams and doubts.

In addition, the chapter will present some reflections generated by my participation at the conference "The History of Space Exploration" and by my visit to the film archive Lightcone. Due to the highly advanced and multifaceted nature of the facilities hosted at Paris Observatory, the research visit led to a series of reflections that turned out to be key for the development of the subsequent research stages. Part of the audio-visual material produced during the visit has been elaborated in the feature length-film *The Quintessence* that will be described in full detail in the following chapter.

## Visit to Paris Observatory. Approach to Site-Specific Research

In January 2018 I conducted my first research trip to a highly-advanced two-site research centre for the study of outer space, namely Paris Astronomical Observatory, located respectively in Paris and Meudon (a town in the suburbs of the French capital). The visit was supported by KSA research funds and was organized in collaboration with Mr. Piercarlo Bonifacio, director of GEPI laboratory (Laboratoire d'Etude des Galaxies, des Etoiles de la Physique à l'Instrumentation).

Paris Observatory is one of the biggest research centres of its kind in Europe. It incorporates different institutes and laboratories for the study of outer space, such as the previously mentioned GEPI, LUTH (Laboratoire Univers et Théories), IMCCE (Institut de mécanique céleste et de calcul des éphémérides) and LESIA (Laboratoire d'Etudes Spatiales et d'Instrumentation en Astrophysique).

On the train taking me to Paris, I read Johanna Żylińska's *Nonhuman Photography*, a sharp analysis of how technologically mediated visions are shaping our present understanding of the world at large. In particular Żylińska explores three types of photographs massively produced today: photographs not of the human (for example, depopulated expansive landscapes), not by the human (such as contemporary high-tech images produced by traffic control cameras, Google Street View, etc.) and not for the human (from QR codes to other algorithmic modes of machine communication).

I was particularly interested in her analysis of photographs produced not by humans but rather by technological apparatus. This is the case of the highly-advanced cameras placed on telescopes located on Earth or in space, taking pictures of planets and comets situated in our solar system as well as galaxy clusters and supernova explosions located at the edges of the visible universe. As Żylińska points out, these photographs represent a very specific type of image, the result of a complex network wherein human actors play alongside a number of "machinic agents".<sup>34</sup> As she observes:

"Photography allows us to apprehend time as duration precisely by making incisions in its flow: it gives us a concept of the flow, while also enacting incisions in it. We could suggest that photography becomes a supplement to process philosophy in that it foregrounds moments when things stabilize, when they become things. Even though these moments of stabilization and isolation are temporary and impermanent - no matter whether they are enacted on a mirror-like surface of metallic silver, paper covered with silver halide, or a CCD sensor - they scale down the 'deep time' of nonhuman history to the human measure of duration and perception, while also reconnecting us to a temporal flow of

34 Joanna Żylińska, *Nonhuman Photography*, Cambridge MA, MIT Press, 2017, p. 14.

matter and energy".<sup>35</sup>

These lines mirror the artistic approach I developed throughout the research: pictures of the universe are explored as surfaces wherein time, energy and space come together, converging and melting within a unique object that captures them for eternity. In fact, when I think of a photograph of a distant star or galaxy, I perceive it as a visual metaphor, the final moment when the light travelling millions or billions of light years through the universe has found its own stabilization. By landing on the surface of a digital sensor placed on the telescope, it becomes something fixed. A memory, as well as a trace. While reading this passage of Żylińska's book approaching the Parisian outskirts, I decided to look for such a trace and to track back its origin to the very beginning.

### **Arrival and first impressions: Eiffel's dome**

The next day, a rather stormy and grey Monday morning, I reached Meudon to visit the observatory's main facilities. I was immediately struck by the location and the number of buildings on site: a series of domes and technical laboratories scattered in a big park surrounding what remains of a grand palace once owned by the King of France. The building was destroyed by fire several times over the centuries and partly abandoned. In 1876 it was taken over by the French astronomer Jules Janssen in order to implement the city observatory with new facilities.

At my arrival I was welcomed by Prof. Bonifacio. After the initial introductions, I grabbed my microphone and asked for permission to record our conversation, permission which was kindly granted. I immediately asked some questions about the inherent observatory nature of astrophysics and the imaginative and creative features embedded in the act of looking at the sky. Together we considered how this science studies the light coming from stars and galaxies located billions of light years away, almost generating a sort of excavation - like in archeological findings - of its remote origins.

Prof. Bonifacio explained how compared to other natural sciences, astrophysics is the only one that cannot physically handle the object of its research. Stars and galaxies are too distant from Earth to even imagine this type of interaction. Astrophysicists have to look for clues and causal relations in the data they collect.

<sup>35</sup> Joanna Żylińska, *ibid.*, p. 95.

Through a long process of analysis and comparison, they formulate theories based on these data. Prof. Bonifacio stressed how astrophysicists can be observational or theoretical. The former collect data from telescopes - these can be photographs of stars, planets, galaxies and other space objects, as well as x rays, star spectra, etc. - the latter formulate theories about space phenomena or events that can match the collected data.

To observe the universe, scientists use different types of high-precision cameras placed on telescopes built on mountain peaks mostly located in the southern hemisphere, due to the low level of light pollution found in that area of the globe. Additionally cameras are placed on satellites and rovers - such as Curiosity on Mars and Yutu on the Moon - and in space, such as the Hubble Telescope, the Nuclear Spectroscopic Telescope Array NuSTAR (both operated by NASA) and Gaia (operated by ESA).

Prof. Bonifacio observed how from the early 1990s analogue glassplates have been replaced by digital sky surveys that enable astrophysicists to capture high-resolution images of stars, galaxies and many other space phenomena. Along with other data such as radio signals and spectrographs, these images are used by scientists to elaborate physical models of the universe.

The dialogue with Prof. Bonifacio was extremely clarifying. It helped me to understand the highly complex and multifaceted nature of the processes involved in astrophysical observation and data analysis. In order to describe this complexity, I decided to collect a vast amount of visual and audio recordings that would act as research notes and raw material to be further elaborated through multimedia artworks.

## **Approach to visual documentation**

During my visit to Paris Observatory, I recorded seven hours of footage and three hours of interviews. Additionally, I took over 400 photographs. I had an almost compulsory need to document and record everything I was encountering. The goal of the audio-visual documentation was dual:

- (1) to explore the materiality of laboratories, technical machines and optical tools used to observe the universe;
- (2) to generate an individual, one-to-one dialogue with scientists in order to understand their own personal points of view on contemporary research projects into outer space and how these are translated into visual form.

In this paragraph I will present some reflections on the visual documentation produced during the visit. Filming was conducted in different indoor and outdoor locations. My attention was immediately captured by the many domes constructed at the Observatory throughout the decades. The first was built in 1876 on top of the ruins of the old castle. Designed by Alexandre Gustave Eiffel, it was the biggest observational dome in Europe at the time. Transfixed by the camera's gaze, the dome resting over the ruins of what was once a 17th century courtly palace stands as a metaphor of the constant and enduring human desire to discover the space beyond our own planet, using every material at hand.

Closed since the late 1990s, when a powerful storm ruined part of the roof and damaged the overall structure, the building represents a historical memory of what astronomy looked like more than a century ago. The image of the dome surrounded by a vast park was used in one of the first scene of the film *The Quintessence*. Providing the viewers with a spatial frame of reference, it also introduces the quiet and almost surreal atmosphere of the observatory located in such a bucolic setting.

Many other domes were built on site in the following decades, especially between the 1930s and 1970s. The most recent ones date from 2017 and are mainly used by the local university students for basic sky observations, since the Parisian night sky is nowadays too light-polluted for advanced scientific observations.

The camera documents the different domes scattered through the park as traces of different timeframes of space observation, each characterized by different technological instruments that lead to different ways to look at the universe. This feature is further highlighted through a series of photographs documenting optical tools such as prisms and lenses hosted in the observatory labs. Inspired by the photo essays on contemporary sites of technology produced by Lewis Baltz and Armin Linke,<sup>36</sup> my photographs document technical instruments and advanced machines used to observe outer space. Surrounded by industrial waste, dirty sheets of paper, cloths and bolts, these machines stand as symbols of how space observation is an activity deeply connected to a material and tangible reality.

The photographs generate a visual discourse on how astrophysicists, as with ancient alchemists, can transform the light coming from the universe into a different type of matter, i.e. mathematical information and digital data. Documenting details, such as the shape of electrical cables connected to a telescope or the arrangement of iron fibres bringing energy to a supercomputer, highlights the practical utility of the technology used in scientific research.

36 Armin Linke, *Transient*, Milan, Skira, 2003; Susanne Figner, *Lewis Baltz, Fotograf*, Cologne, Walther König, 2012.

At the same time, this visual approach stresses how every small component of machines and instruments becomes an essential part within a much bigger and complex process of data collection, elaboration and transformation. The images thus evoke specific dynamics at play within contemporary astrophysics, wherein large teams of people are acting simultaneously in different countries to bring forward international space exploration programmes.

The recordings of audio tracks and soundscapes is also key in this regard. Inside the scientific lab huge machines, optical scanners and powerful computers are constantly performing tasks and calibrations. The audio recordings produced on site give access to a sensorial experience: machinery noises, scientists' voices and silences alternate with each other, creating an underlying natural score which accompanies the moving images.

## Interviews with scientists

At Paris Observatory I developed a series of interviews with scientists that I subsequently reiterated during my visits to other research centres. The interviews were mainly produced in the form of audio recordings and occasionally they were also recorded on video. The idea was to collect a series of individual accounts on how astrophysical research is conducted from specific theoretical frames of reference, individual background knowledge and biases.

The interviews' first goal was to question from an artistic perspective cognitive processes at play within the formation of scientific knowledge and their translation into visual form. The interviews' second goal was to test what art historian Martin Kemp calls "structural intuitions", modalities to engage in perceptual and cognitive mechanisms to bring order to the observed reality that each individual possesses.<sup>37</sup>

Kemp observes how in science, much as in the arts, research and ideas originate at a very intuitive level, taking inspiration from the famous quote by Albert Einstein according to which "All great achievements of science must start from intuitive knowledge".<sup>38</sup> My audio interviews aimed to test this theory on the ground, in order to explore how personal intuitions mingle with scientific knowledge in the development of scientific hypotheses about outer space phenomena.

<sup>37</sup> Martin Kemp, *Structural intuitions: seeing shapes in art and science*, Charlottesville VA, University of Virginia Press, 2016, p. 34. In the book Kemp examines forms and processes as different as the geometry of Platonic solids, the dynamics of growth in nature and the patterns of fluids in motion.

<sup>38</sup> Alice Calaprice, *The Ultimate Quotable Einstein*, Princeton NJ, Princeton University Press and The Hebrew University of Jerusalem, 2000, p. 287.

The scientists' voices offer a deeper and more subjective insight than any academic paper or official report, excavating the inner dynamics of their own practices and methodologies. They provide clarifying information on how the raw data coming from space are captured, studied and edited through a series of transformations whose outcomes are the shiny and colorful images of space to which we are habituated. Generating connections between different ideas and concepts, the scientists' voices open vast metaphorical vistas over the gigantic distances of interstellar space.

### **Conference: *The history of space exploration***

While in Paris, I had the opportunity to explore the second venue of the Observatory, a 17th century building located in the centre of the city. Financed by King Louis XIV, it's the oldest observatory in the world still operating. The main historical building is constructed around a spectacular hall literally cut in half by the meridian line that runs across the French capital.

The observatory hosts optical laboratories for the design and construction of instruments and clear-room facilities used to conduct tests and experiments in a non-polluted environment, necessary to avoid the contamination of the material under examination. Access to these rooms is highly restricted to the observatory's personnel. However, thanks to exceptional circumstances, I was able to visit and document one of these spaces.

I had to wear a special white coat, gloves and hair cover, and my camera and tripod had to be sterilized. Once inside, I documented the experiments taking place in the lab, witnessing the test of a special sensor that would be placed on a powerful telescope located in Chile in order to take deep pictures of the visible universe. On my last day in Paris I attended the conference *The History of Space Exploration* held by Prof. Thérèse Encrenaz at LESIA Laboratory. The presentation provided a comprehensive survey of the key historical moments of space exploration in the second half of the 20th century.

From the orbital launch of the Soviet Sputnik mission in 1957 to the first successful human spaceflight of Russian cosmonaut Yuri Gagarin, to the historic landing on the moon performed by the Apollo 11 crew on 20 July 1969, in the 20<sup>th</sup> century humanity witnessed for the first time the shift from astronomical observation to the actual exploration of outer space. However, this achievement was not conquered without trials, errors and failures. In fact, the history of space exploration has always been marked by errors and mistakes in observing the sky, analysing and interpreting data, and - more recently - planning and carrying out space exploratory missions. The reflections and ideas generated by this conference led to the development of *To the Wonder*, a series of artworks focused on the visual representation of mistakes and errors in 20<sup>th</sup> century space exploration.



## Research at film archive Lightcone

While in Paris, I undertook research about the possible existence of old footage recorded at the Parisian observatory. I visited the Cinémathèque Française, but I discovered no film (or any other visual recording) related to space observation. On the suggestion of one of the Cinémathèque's curators, I wrote to the French Television Archive to have some information about their collections, receiving a rather blank reply about the possible existence of such material that would be, in any case, protected by copyright laws. Subsequently I visited Lightcone, an experimental film centre located in the northern part of the city.

Exploring their film collection, I discovered some works on scientific topics that proved to be very inspirational for my own research. In particular I was struck by Giulia Grossmann's film *Matter Factory* (2018), a double screen installation following the daily routines performed by industrial machines inside huge hangars at CERN (European Organization for Nuclear Research, Geneva, Switzerland). Much in the same way, through my visual documentation of astrophysical research centres, I put a strong emphasis on technical apparatus and machines used to study the universe as material tools that lead us to reflect on the human struggle to unveil the mysteries of outer space.

During my visit at Lightcone I discovered the work of Armenian director and film theorist Artavazd Pelechyan. His films - focused on the exploration of historical moments in the history of the 20<sup>th</sup> century space race - are especially interesting due to the combination of archival footage with dramatic soundtracks that generate epic visual contemporary works about human efforts to explore the universe. Finally, I was impressed by the short film *Intermittences non Reculées - Etienne-Jules Marey* (1978), by Jean-Michel Bouhours.<sup>39</sup>

The film presents the transposition of some of Marey's earliest series of chronophotographies into moving image sequences. While the photographs were originated by a scientific necessity - the study of human and animal locomotion - the fast-paced editing highlights their aesthetic qualities resembling early avant-garde films. In the same way, the archival footage I employed in *To the Wonder* documenting pivotal stages in mid 20<sup>th</sup> century space exploration, was born out of pure scientific documentary purposes.

However, through de-contextualization, the footage reveals unusual details about the dynamics at play in the scientific domain, generating a reflection on the technology used to observe, visualise and explore outer space.

<sup>39</sup> Lightcone, *Intermittences non Reculées - Etienne-Jules Marey*, retrieved at <https://lightcone.org/en/film-168-intermittences-non-regulees-de-etienne-jules-marey> on 20/09/2019.

## Chapter conclusion

The site-specific research visit conducted to Paris Observatory was extremely successful. Direct access to multiple sites enabled me to document - through audio, videos and photographs - the different activities involved in contemporary practices of space observation and exploration. Built in different decades from the late 19<sup>th</sup> to the early 21<sup>st</sup> century, highly-advanced telescopes, mechanical workshops and laboratories are approached as traces of how astrophysics has evolved throughout the decades. The optical tools and precision machines used by engineers and scientists alike are represented as conceptual sculptural pieces, embedding in their material features dreams, desires and expectations about the mysteries of the universe.

During the research visit I conducted a series of one-to-one interviews with cosmologists and astrophysicists, in order to test their own ideas and personal approaches to specific topics such as the reliability of scientific data, the level of practical and material constraints within which they operate, and the role of individual background knowledge and biases in the elaboration of data coming from the universe.

The audio-visual documentation produced during the research trip to Paris established a direct visual, spatial and temporal relationship with the world of astrophysics. Filming on location and recording live interviews enabled me to develop an active exploration of the relationship between spaces of research, technological apparatus, scientists at work and the visual imaginary they create through observations and theorization.

The conference *The history of space exploration* shed light on the many mistakes and wrong turns taken in pursuit of bold scientific missions aimed at physically exploring outer space through manned expeditions. The reflections triggered by the conference became the main inspiration to develop a series of artworks on the role of errors in contemporary space observation and exploration. Equally inspirational was the visit to Lightcone film archive. The opportunity to discover a number of films approaching the domain of science in original and unexpected ways led me to test new modalities of editing and cinematographic style in a range of experimental films produced throughout my research.



Telescope at Eiffel's Dome, Paris Observatoire. Credits: Pamela Breda.



Engineer at work, Mechanical Lab, Paris Observatoire. Credits: Pamela Breda.



Calibrating Machine, Mechanical Lab, Paris Observatoire. Credits: Pamela Breda.



## CHAPTER III

### THE QUINTESSENCE - FILM ANALYSIS

This chapter will present an in-depth analysis of the experimental film *The Quintessence*. The scientific research centres will be presented as spaces of fact construction, as metaphorical stages where the observation of outer space is shaped by technological gazes and individual points of view. I will consider how practices of space observation and visualization have been approached and documented through the analysis of selected scenes.

I will explore how specific cinematographic approaches and film montage make reference to the concept of situated knowledge and skilled vision, the conceptual motivation for particular aesthetic choices - such as employing a fixed camera, archival footage and studio shoots - in order to generate original discourses on contemporary narratives of space observation and exploration. I will consider the film's interdisciplinary nature and its connections with multiple cinematographic traditions, from cinema verité to observational cinema and ethnographic film practice, making reference to specific films and theoretical debates that inspired and informed my own artistic approach to the research's subject.

Considering Elizabeth Kessler's book *Picturing the cosmos*, I will propose to move past the visual imaginary provided by the shiny and colourful Hubble space images. My artistic proposition is that the contemporary sublime of astrophysical research can - and must - be found beyond these glossy photographs, in the documentation of old and new images of outer space, laboratory spaces and scientists in action. By closely looking at spaces and practices of research, the film generates a broader discussion on what it means to look at the universe from a human-centred perspective.

Finally I will analyse how the filmic screen surface re-activated in the gallery space can give new life and meaning to the light of distant stars and galaxies located at sidereal distances from Earth.



*The Quintessence*, film still. Credits: Pamela Breda.

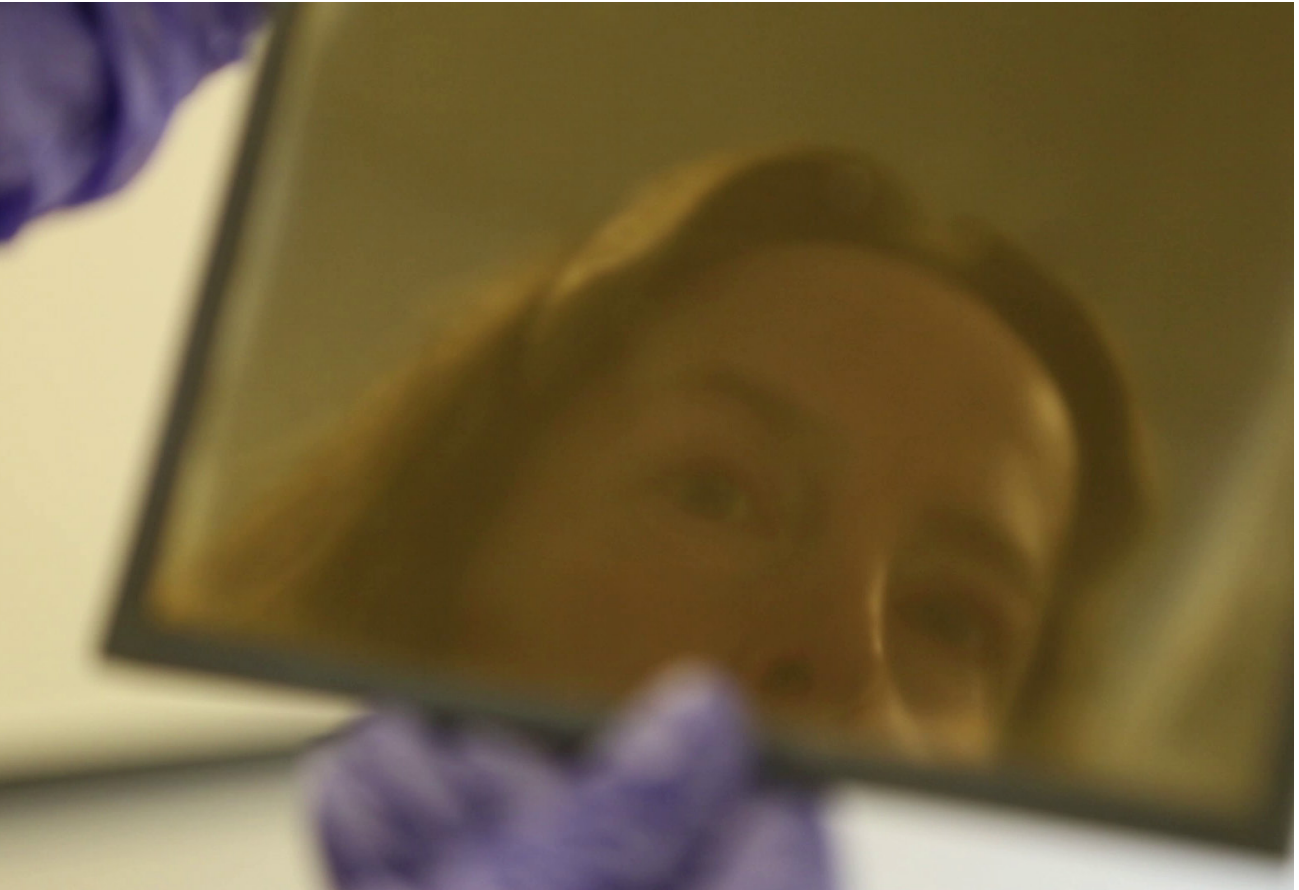
## ***The Quintessence* - Film introduction**

*The Quintessence* is an experimental film developed through visits to different research centres and astrophysics faculties located in Europe and the USA, in particular:

Bath University (UK), Boulby Underground Laboratories (UK), Bruxelles Planetarium (Belgium), Cortina Observatory (Italy), Durham University (UK), Edinburgh Astronomical Observatory (UK), Flatiron Institute (USA), Glasgow University (UK), Gornergrat Observatory - Bern University (Switzerland), Harvard Center for Astrophysics - Smithsonian Institute (USA), Hertfordshire University (UK), Imperial College (UK), Manchester University (UK), Max Planck Institute (Germany), MIT - Massachusetts Institute of Technology (USA), Nottingham University (UK), Jodrell Bank Observatory (UK), Oxford University - Bodleian Library (UK), Padua Observatory (Italy), Paris Observatory (France), Sheffield University (UK), St Andrews University (UK), Stazione Radioastronomica di Medicina (Italy), Surrey University (UK), Royal Astronomical Society (UK), University College London (UK), Wien Astronomical Observatory (Austria).

In addition, studio filming was developed to document multiple representations of the universe retrieved from different sources and printed on paper.





*The Quintessence*, film still. Credits: Pamela Breda.

Audio interviews conducted with scientists were edited and incorporated into the film as offscreen voiceovers. The film is structured as a series of interconnected chapters documenting different sites of research while bringing together the individual points of view of different astrophysicists, cosmologists and engineers. Multiple stories about the universe crisscross, generating a unique commentary on the combined role of technological and human agencies in the development of the contemporary visual imaginary of outer space.

### **Scene analysis: glassplates and images of space**

The film's opening scene documents a series of old and new representations of the universe printed on white sheets of paper placed one after the other on a white table. This visual introduction sets the focus on the main research question: "How do images of space tell a story?".



*The Quintessence*, film still. Credits: Pamela Breda.

The combination of old drawings of constellations, early 19th century photographs of shooting stars and contemporary digital images of distant galaxies creates a focus on how different technological apparatus used to observe outer space lead to the development of different representations of universal phenomena.

In the film, three separate scenes document scientists handling glassplates, i.e. glass photographs used throughout the 20th century to record sky events and objects. For many decades, these were the most advanced tools to observe and study outer space. With the introduction of digital photography in the mid 1980s, they quickly became outdated technology and were transferred to library and archival deposits, piled in boxes or hidden inside remote storage facilities.

At the initial research stage, I encountered glassplates' reproductions in astronomical books and online platforms. Subsequently, I visited and documented on camera some of the biggest glassplates collections in the world, in particular Greenwich Observatory's collection - held at an external facility of Oxford Bodleian Library in Swindon (UK) - the Royal Astronomical Society's collection (UK) and Harvard University Astrophotographic Collection (USA).

In one of the scenes, curator Sian Prosser (Royal Astronomical Society) retrieves glassplates from sealed boxes and places them on luminous tables. They emerge on screen as complex, delicate and beautiful objects: to the expert eye of the scientists, their faint dots representing stars, comets or constellations provide specific information about space events. However, to my artistic eye they are characterized by peculiar aesthetic qualities that move beyond the mere function of scientific records.

The camera explores the plates' details such as faded hues and haloes, cracks and other signs of temporal damage. Transposed on screen, these aesthetic features recall those of abstract paintings or avant-garde experimental photographs and films. I am thinking in particular of Man Ray's rayographs and of the experimental films by Al Razu-tis and Bruce Baillie, structured on impressionistic fusions of images through overlaps, transitions and dissolves.<sup>40</sup>

In these artworks, hues and haloes are often produced by the chemical elements de-caying over a period of several decades. In the same way, light coming from distant stars and galaxies is captured on the glassplates' surfaces and slowly transformed by the agency of time. Temporality modifies the photographic surface through an interven-tion that is almost cinematographic, as in the films by Peter Delpout and Bill Morrison. Delpout's *Lyrical Nitrate* (1991) is constructed with found footage from early Dutch films, edited to create a non-narrative storyline that emphasises their filmic quality rather than their narrative storylines.<sup>41</sup>

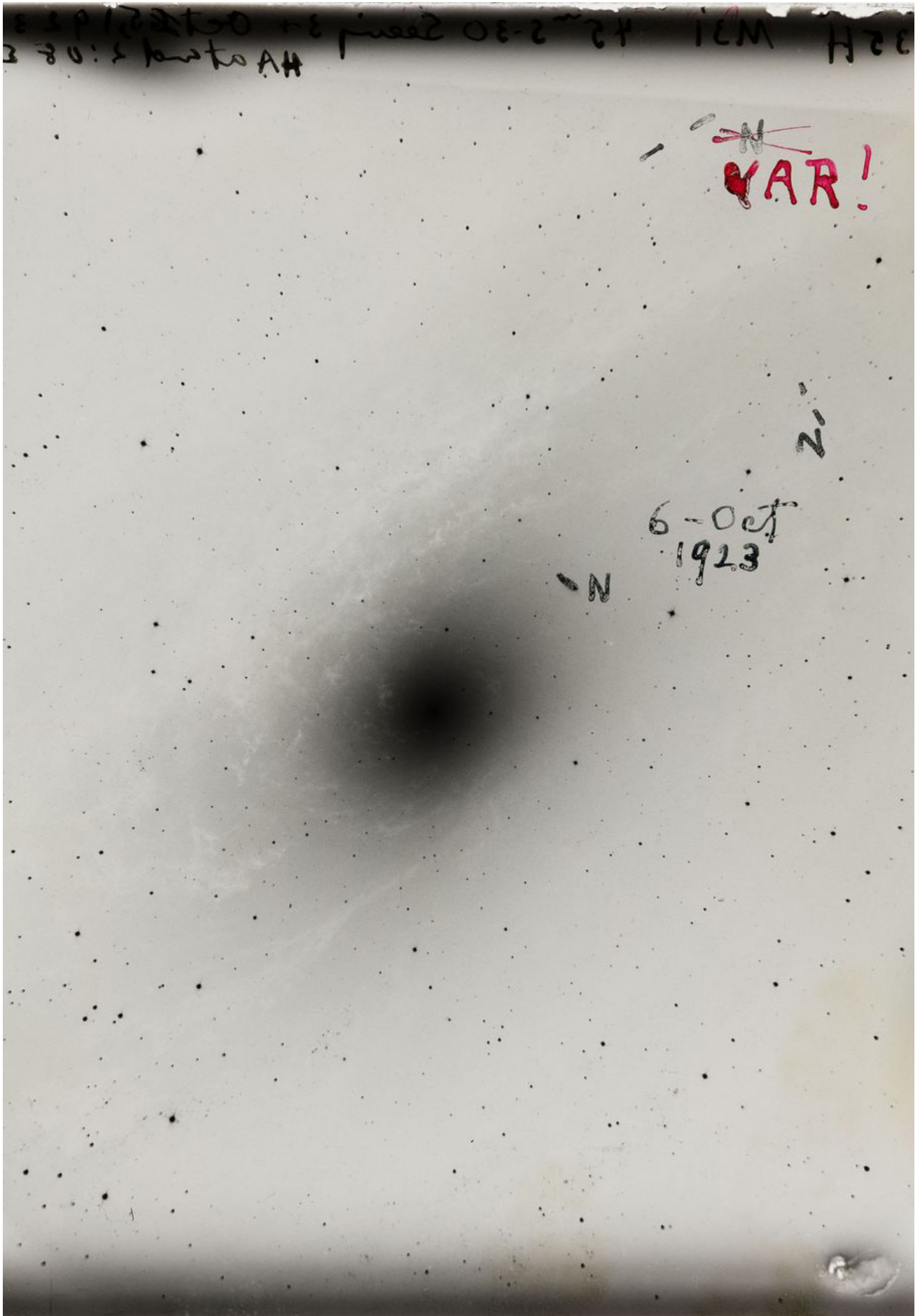
In the same way, Bill Morrison produces films from found footage presenting nitrate dam-age. By cutting and editing archival material, he creates an original approach to these ruined images, as in *Decasia* (2012), a meditation on old silent films in a state of decay.<sup>42</sup> Morrison's moving images stand as a powerful reflection on how time interacts with filmic material, giving it new form.

Moving on from these examples, in *The Quintessence* astrophotographic glassplates emerge both as scientific documents recording sky phenomena and as aesthetic objects in their own right, transformed by time interventions into eerily and evocative manifes-tations of universal light. Dots and halos produced by natural deterioration generate a reflection on how time interacts with the fragile materiality of the chemicals on the plates' surfaces. The light of stars and galaxies captured after a voyage of millions of years is now melting and dissolving into thin air.

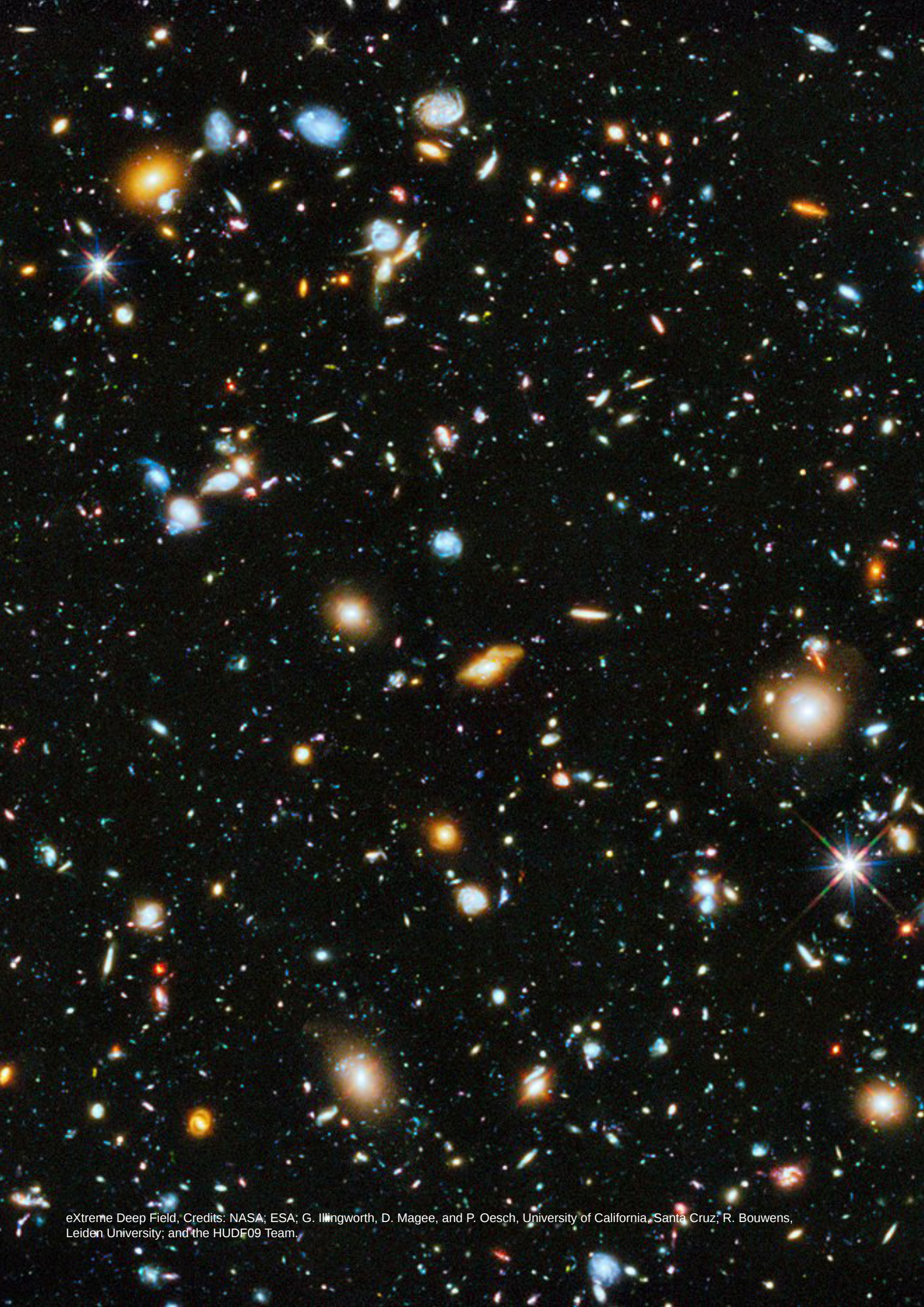
40 Stephen Heath, "Repetition Time: Notes Around Structural/Materialist Film", in Stephen Heath, *Questions of Cinema*, Bloomington IN, Indiana University Press, 2011, pp. 165-175, p. 167.

41 André Habib, "Ruin, Archive and the Time of Cinema: Peter Delpout's 'Lyrical Nitrate'", *SubStance*, 35 (2), 110, 2006, pp. 120-139.

42 Glenn Kenny, "Beauty in the broken: filmmaker Bill Morrison's visions of decay", *October*, 20, 2014, retrieved at <https://www.rogerebert.com/demanders/beauty-in-the-broken-filmmaker-bill-morrisons-visions-of-decay-celebrated-in-new-box-set> on 03/04/2018.



Andromeda Galaxy, 1923. Credits: Carnegie Observatories.



eXtreme Deep Field, Credits: NASA; ESA; G. Illingworth, D. Magee, and P. Oesch, University of California, Santa Cruz; R. Bouwens, Leiden University; and the HUDF09 Team.

Through editing, shots of the curators handling the plates are juxtaposed with wider views of libraries and archives where the same plates are preserved, stored in closed wooden boxes or sealed drawers, lying unnoticed, almost forgotten. The montage generates a discourse on the human desire to explore the universe through technologies that quickly become outdated and need to be constantly replaced.

## Hubble photographs

In one of the scenes, curator Lindsay C. Smith (Harvard University) confronts the image of a galaxy cluster taken on a glassplate around the 1950s with a contemporary image of the same region of space produced by the Hubble telescope. The latter appears on a Wikipedia page and is visualized on the screen of the curator's mobile phone. This scene generates a powerful visual clash: two images representing the same space object, but produced with a very different photographic apparatus, are placed side by side. The juxtaposition speaks about the technological advancements in visualization techniques: while the black and white image is rather small and presents only the main galaxy cluster and few stars around it, the Hubble photograph is an extremely detailed bright and colourful picture, capturing thousands of stars and galaxies.

In another scene, the computer screen of Prof. Ulrike Kuchner (Nottingham University) showcases a digital photograph of a distant region of the visible universe. The cursor moves through the image, revealing its huge dimensions and high level of detail. Accompanied by an evokative soundtrack, the cursor zooms out - revealing a huge region of space hosting thousands of stars and galaxies - and zooms in - magnifying the image to the point of revealing its pixels. In one of the scenes, shot at Harvard Astronomical Center, glassplates are digitized in a scanning laboratory. Details of the plates' surface shift rapidly on a computer screen, suggesting a clash between analogue and digital visualization techniques.

The physical trace of light travelling through the universe and fixed onto the glassplate undergoes a mathematical transformation and is finally converted into a binary code multiplied *ad infinitum* through digital copies stored as TIFF files in physical and digital hard drives. The three scenes just described shed light on how processes of sky observations are inherently shaped by the technology used to observe outer space. They make visible the dynamics through which raw data captured from the universe are transformed into a series of mathematical and computational data and subsequently edited into colourful visual images. The perfect example of this transformation is represented by Hubble Telescope photographs.

## The sublime of space images and beyond

In her thorough study of the contemporary visual imaginary of outer space, Elizabeth Kessler suggests that very much as romantic landscapes, present-day photographs of the universe are strongly linked to the concept of the sublime. A central idea in Romanticism's art and literature, the sublime was described by philosopher Immanuel Kant and poet Edmund Burke as "an extreme aesthetic experience, one that threatens to overwhelm even as it affirms humanity's potential".<sup>43</sup>

The concept of the sublime was elaborated in the classical and romantic tradition making reference to a mixed feeling of awe, admiration and fear generated by specific objects or situations. It was often associated with the idea of a powerful nature represented in great scale, producing a sensation of immensity and intensity so vast as to engulf the viewer.

In my work, I approach this concept as a feeling of admiration and wondering that transpires from the visual imaginary of space and - most importantly - can be found beyond this imaginary, embedded in the scientific labs and in the daily actions performed by the scientists trying to discover the mysteries of the universe.

Considering the raw images captured by Hubble, Kessler observes how they are often released by NASA as enlarged details of bigger photographs, usually rotated from their original angle. There is no scientific reason to perform this operation: it seems an aesthetic choice undertaken in order to make the images resonate with romantic scenarios. In this regard the author finds interesting aesthetic analogies between Hubble photographs and the natural landscapes of the American West, as represented by 19th century painters like Alfred Bierstadt and Thomas Moran.<sup>44</sup> I strongly agree with this analysis. I believe the 19<sup>th</sup> century representations of the frontiers of the space discovered up until that historical moment are mirrored and evoked by Hubble photographs depicting the present frontiers of known space, i.e. the borders of the visible universe.

In *The Quintessence* the concept of the sublime is evoked through the exploration of the Hubble photographs' aesthetic qualities. They often appear in the film accompanied by eerily evocative sounds, the sonic transpositions of frequencies and radio signals emitted from stars and galaxies and translated into basic audio tones by different scientific research groups around the world.<sup>45</sup>

43 Elizabeth A. Kessler, *Picturing the cosmos: Hubble Space Telescope images and the astronomical sublime*, Minneapolis MN, University of Minnesota Press, 2012, p. 5. See also Robert Doran, *The Theory of the Sublime from Longinus to Kant*, Cambridge MA, Cambridge University Press, 2015.

44 Joan Carpenter Troccoli, James P. Ronda, *Painters and the American West*, Volume I - II, Denver CO, American Museum of Western Art, the Anschutz Collection, 2013; Patricia A. Junker, *Albert Bierstadt. Puget Sound on the Pacific Coast: a superb vision of dreamland*, Seattle WA, Seattle Art Museum in association with University of Washington Press, 2011.

45 Sonification of frequencies coming from outer space are publicly accessible on ESO and NASA websites ([https://www.esa.int/Science\\_Exploration/Space\\_Science/Sounds\\_from\\_space](https://www.esa.int/Science_Exploration/Space_Science/Sounds_from_space); [https://www.nasa.gov/home/hqnews/2011/sep/HQ\\_11-321\\_NASA\\_Sounds.html](https://www.nasa.gov/home/hqnews/2011/sep/HQ_11-321_NASA_Sounds.html)). See also Adam Hadhazy, "Heavenly Sounds: Hearing Astronomical Data Can Lead to Scientific Insights", *Scientific American*, retrieved at <https://www.scientificamerican.com/article/heavenly-sounds-hear->

The combination of photographs documenting space objects and events, from supernovae explosions to distant planets, shooting stars and black holes - with mysterious sounds coming from the universe - can generate in the viewers a feeling of awe, fascination and amazement.

This aesthetic choice evokes a deeper layer of sublime, which I believe can be found beyond the surface of the Hubble space images. It stands as a subtle text informing the practices of contemporary astrophysical research and is brought to light through the documentation of observational tools and machines used to study the universe.

Some of the scenes shot at Jodrell Bank Observatory, Paris Observatoire, and Harvard University capture details of optical lenses, radio telescopes and technical operations conducted by scientists and engineers. Through montage, the contemporary sublime of space exploration emerges as a quality embedded in the instruments used by astrophysicists to observe the universe and in the combined efforts of thousands of scientists using advanced technology to explore the mysteries of outer space.

In one scene, Dr. Steve Fossey (UCL Observatory) operates the London Astronomical Observatory main telescope. While the observational platform is mechanically elevated, static shots capture details of the wide dome hosting the telescope, along with a number of machines, a vintage computer console and a model of the same telescope. The camera documents the complex actions required to operate such a large telescope while the voice commentary of Prof. Richard Ellis (University College London) speaks about the feeling of awe and amazement generated by the experience of a direct sky observation:

“I like to go to the telescope as a sort of going to church. I like to go and sit there and commune with the universe. That’s why I became an astronomer, to enjoy observing. You can see something which is meaningful. It is a fulfilling experience. It’s the kind of impression that you get when you see a beautiful painting or appreciate a piece of sculpture”.

The commentary provides a reflection on how the act of looking at the sky can lead to an almost religious admiration of interstellar distances and suggests further reflections on practices of space observation. While the camera’s gaze analyses the instruments used by scientists, the voiceover highlights the feeling of awe and amazement bringing cosmologists to envision new theories about the nature of space events and phenomena. Visual and auditory documentation thus invite the viewers to reflect on our position as humans observers wondering about the cosmos, looking for the origins of stars and galaxies, the possibility of life existing on other planets, the mysterious force bringing all of these elements together, and our own role within this bigger picture.



## Material practices of space exploration

The cinematographic focus on the physical and material features of machines and optical tools hosted in the laboratories generates a discourse on specific technical and cultural features framing contemporary astrophysics. This visual approach makes reference to a series of studies on scientific technical material constraints, in particular Bruno Latour's *Laboratory Life: The Construction of Scientific Facts*,<sup>46</sup> Ian Hacking's *The Self-Vindication of the Laboratory Sciences*,<sup>47</sup> Paul Feyerabend's *Against Method*,<sup>48</sup> Donna Haraway's *Situated knowledges* and Cristina Grasseni's *Skilled vision*.<sup>49</sup> Each text proposes a relativist approach to the scientific domain, shedding light on a complex network of interacting features - such as social contexts, individual points of view and technological apparatus - pivotal for the development of scientific knowledge.

The ideas and concepts put forward by these studies have been employed as research tools during multiple field visits in order to test at what level astrophysicists question established practices and research modalities in order to discover something new about the universe. The outcomes of the resulting dialogues demonstrate how these topics are usually neither addressed by individual researchers nor discussed within the wider community, calling for an increased attention on the matter.

Artistic practice as research brings these topics to the foreground, positing how the contemporary visual imaginary of the universe cannot be considered as a neutral or objective representation of outer space, but rather as the outcome of the combined agency of individual scientists - with their trained visions, personal ideas and beliefs, cultural frameworks - and technological constraints.

## Situated knowledge and trained visions

Throughout the film, the camera documents different technical operations performed by astrophysicists and engineers, making reference to the concepts of "situated knowledges" and "skilled vision" proposed respectively by Donna Haraway and Cristina Grasseni.

46 Bruno Latour, Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts*, Los Angeles CA, Sage, 1979.

47 Ian Hacking, "The Self-Vindication of the Laboratory Sciences" in Andrew Pickering (ed.), *Science as practice and culture*, Chicago IL, University of Chicago Press, 1992, pp. 29-64.

48 Paul Feyerabend, *Against Method*, London, Verso, 2010.

49 Donna Haraway, "Situated Knowledges: The Science Question in Feminism as a Site of Discourse on the Privilege of Partial Perspective", *Feminist Studies* 14 (3), 1988, pp. 575-599; Cristina Grasseni, "Skilled vision: An apprenticeship in breeding aesthetics", *Social Anthropology* 12, 1, 2004, pp. 1-15. See also Helen E. Longino, *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*, Princeton NJ, Princeton University Press, 1990.

According to Haraway, while scientific statements are accepted as unquestionable truths within a system that is recognized as objective and validating, the scientific gaze is anything but neutral.<sup>50</sup> On the contrary, such a gaze has been shaped by specific Western ideological approaches, usually established by white men in the early 16<sup>th</sup> century.

For example, in the film's initial scene, a technician working at the Paris Observatory is calibrating an observational instrument employed to study images of stars and supernovae on computer screens. Such an action is made possible by the situated knowledge of the technician, a mix of personal skills and abilities to operate specific machines hosted in the centre's mechanical labs. In another scene, a researcher is working inside a white room, running experiments to develop high-precision sensors able to capture detailed images of the most distant regions of the visible universe.

By documenting these specific actions, the scene makes reference to Cristina Grasseni's theory of "skilled vision". This is a specific type of visual-cognitive knowledge, necessary to understand the act of looking as a "situated practice", taking into consideration the constraints as well as the possibilities generated by material apparatus and cultural environments:

"Because skilled visions combine aspects of embodiment (as an educated capacity for selective perception) and of apprenticeship, they are both ecological and ideological, in the sense that they inform worldviews and practices".<sup>51</sup>

Another scene documents the process of glassplates' cleaning and scanning at Harvard Astrophotographic Centre, while the voiceover of Prof. Carolin Villforth (Bath University) explains how astrophysicists have to measure something they can't measure. In order to find the specific data they are looking for, scientists overcome the obstacle by combining pieces of information retrieved from different sources. In this case, the filmic montage brings to light how situated knowledges and skilled visions strongly inform cognitive and visualization practices at play in the astrophysical domain. In another scene, Prof. Stijn Wuyts (Bath University) describes some pictures he took at Silla Paranal Observatory (Chile) during a scientific research visit.

50 Considering the possible reconfiguration of scientific knowledge, Haraway hoped for the development of a somehow democratic science: "a doctrine and practice of objectivity that privileges contestation, deconstruction, passionate construction, webbed connections, and hope for transformation of systems of knowledge and ways of seeing". Donna Haraway, *ibid.*, pp. 584-585.

51 Cristina Grasseni, "Skilled Visions: Toward an Ecology of Visual Inscriptions", in Marcus Banks, Jay Ruby (eds.), *Made to be seen: perspectives on the history of visual anthropology*, Chicago IL, University of Chicago Press, 2011, pp. 19-44, p. 29.

Vistas of desert scenarios and spectacular night skies are accompanied by Prof. Wuyts' voice explaining how nowadays telescopes are remotely operated to look into outer space and transmit the data they collect - a series of numbers and codes - to the computers of scientists located all around the world. Through skilled visions and the help of technology, astrophysicists can see beyond these numbers and binary codes, making sense of raw data containing information about universal phenomena such as star clusters, supernovae explosions, exoplanets, etc.

In the film, photos of the Chilean desert landscape are juxtaposed with a long shot of Prof. Wuyts' laptop screen reflecting the room where the interview took place, bringing the viewer back to an earthly environment and to the practical, human-driven approach to astrophysical research.

## The laboratory as a system of fact construction

In *The Quintessence* the scientific labs are represented as spaces of fact construction, making reference to Bruno Latour's studies on the visual-cognitive dynamics at play in the scientific domain.<sup>52</sup> In his celebrated work *Laboratory life: the construction of scientific facts* - co-written with Steve Woolgar - Latour presents the study of a Californian scientific research centre: Roger Guillemin's neuroendocrinology laboratory at the Salk Institute.<sup>53</sup>

He argues that scientific facts should be seen as the product of a specific type of inquiry that functions to construct representations of the world which substitute phenomena and events taking place in the world.<sup>54</sup> The laboratory is described as a "system of fact construction": the technical machines built to conduct experiments produce certain outcomes that, in their turn, are taken as proof of certain theories at the detriment of others. According to Latour, the lab is structured around the concept of "inscription devices":

"any item of apparatus or particular configuration of such item which can transform a

<sup>52</sup> Bruno Latour was one among many intellectuals working in science and technology studies who examined the post-modernist deconstruction of a series of cultural frameworks developed in the last three centuries, based on culturally and politically driven dichotomies (such as human/non human, society/nature, etc.). Focusing on the inherent contradictions of a scientific system that generated hybrid situations located in between these dichotomies, Latour and others developed actor-network theory (ANT), according to which social phenomena are the result of the interplay between human and nonhuman actors. Bruno Latour, *We have never been modern*, Cambridge MA, Harvard University Press, 2002.

<sup>53</sup> Bruno Latour, Steve Woolgar, *Laboratory life: the construction of scientific facts*, Princeton NJ, Princeton University Press, 1986.

<sup>54</sup> Bruno Latour, *Science in action: how to follow scientists and engineers through society*, Cambridge MA, Harvard University Press, 1987; *Pandora's hope: essays on the reality of science studies*, Cambridge MA, Harvard University Press, 1999.

material substance into a figure or diagram".<sup>55</sup>

Inscription devices can be technological, but they can also be metaphorical, for example through a certain set of arrangements and means of cataloguing, or through ways of naming and labelling.<sup>56</sup> Moving on from this analysis, in *The Quintessence* I consider images of outer space as inscription devices. The film is punctuated by pictures of stars and galaxies produced with different technologies: drawn with ink, photographed on glassplates or captured through digital sensors, printed on paper or digitally uploaded on the web. Their generation is evoked through a strong focus on machines and technical tools, lenses and detectors, telescopes and radio receivers, cables and computer screens. The filmic montage suggests how beams of light, radio waves and other signals coming from space are transformed into something else: a highly constructed image of the universe.

In one of the scenes, the camera shifts from technical tools to wider views of astronomical domes and telescopes, while the voice of Prof. Richard Ellis describes how the objects of astrophysical enquiries are not phenomena directly observed in the sky, but rather data captured and stored through a global computer network. The cinematographic gaze generates a reflection on how scientific theories cannot be separated by the physical constraints of the laboratories. Moving from the material apparatus at their disposal, scientists collect data and create a specific epistemology about space events and phenomena translated into a highly crafted visual form.

## **Framing the material and the immaterial**

The visual documentation of mechanical laboratories, dirty machines and oily tools stands as a strong answer to my initial research question: where do images of space come from? It is precisely in these spaces that the light coming from distant stars and galaxies is captured by man-made instruments and transformed into series of digital data elaborated by scientists and edited in the form of shiny and colourful pictures of universal phenomena. The use of the camera on a tripod suggests the grounded nature of machines and tools, often quite big and extremely heavy. This aesthetic choice produces a sense of gravity and generates a strong contrast with the ethereal and incorporeal images of the universe born from these machines.

Stars are not solid bodies - they are made of gases and chemical reactions - yet their images are born from material and corporeal objects. The focus on optical instruments highlights the act of looking and closely observing something.

While scientists look at the sky to study stars and planets, I observe their actions, suggesting how each time we look at something, we are doing so through a subjective approach. In this regard, another artistic trigger for my research was Ian Hacking's *The Self-Vindication of the Laboratory Sciences*. A philosopher of science, Hacking analyses extensively the experimental and engineering practices of science and their relative autonomy from theory. He observes how:

“Our theories are at best true to the phenomena that were elicited by instrumentation in order to get a good mesh with theory. The process of modifying the workings of instruments both materially (we fix them up) and intellectually (we describe what they do) furnishes the glue that keeps our intellectual and material world together. Designing and adjusting scientific instruments generates a body of apparatus that goes along with the body of theories”.<sup>57</sup>

Following Hacking, I posit that the formation of scientific knowledge is far from a simple objective study of the universe at large. Through a montage style that combines shots of machines and optical instruments with images of cosmologists at work and voiceovers, I suggest scientific theories and technical apparatus strongly influence each other. In this sense, I move forward from Hacking who is somehow doubtful whether to include astrophysics - an observational science that cannot interact directly with the object of its research - in his analysis. I propose that it is precisely in light of its highly speculative nature that astrophysics should be approached as an essentially interpretative science.

The cinematographic exploration of material devices used to observe the sky suggests how even the most advanced contemporary scientific research methods are strongly influenced by individual trained visions and technological apparatus. Every new configuration of these elements - for example, different material conditions in different laboratories, or a different background knowledge possessed by scientists - might produce different outcomes, i.e. different interpretations of data, different theories about the universe and different images of outer space.

## **Film montage as mirror of scientific hypotheses**

In the film's opening scenes, engineers and technicians working at Paris Observatory Mechanical Labs are assembling small components that will be subsequently installed on powerful observational telescopes located in Chile and Hawaii. The images are ac-

<sup>57</sup> Ian Hacking, *ibid.*, p. 58.

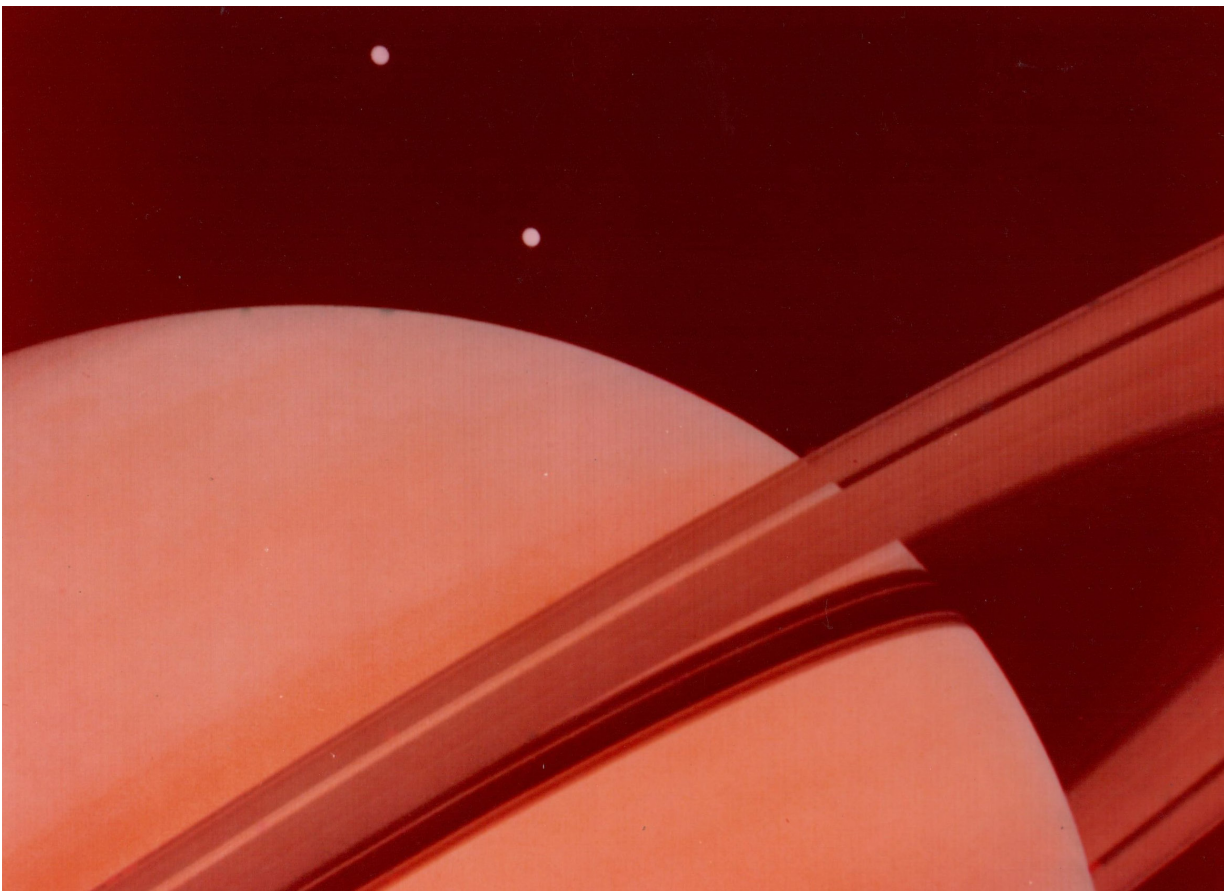
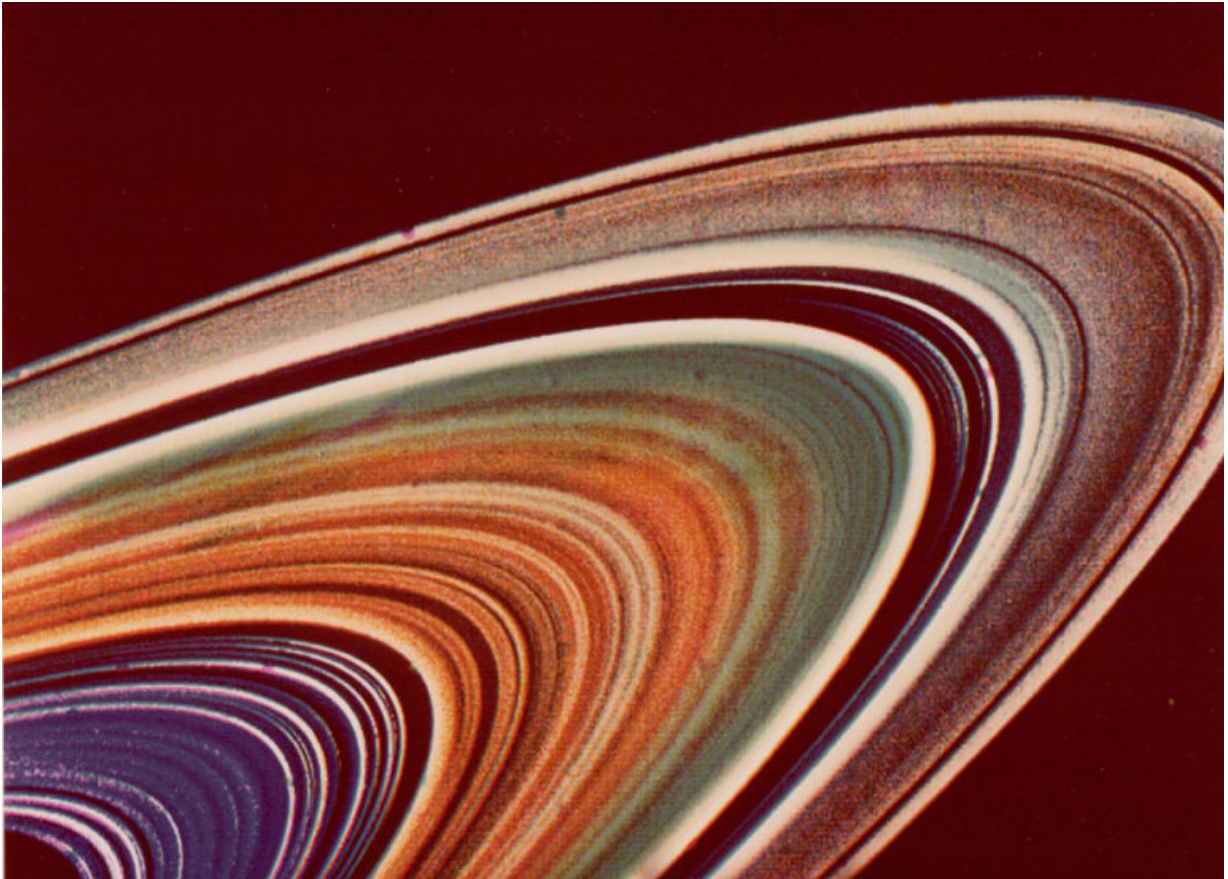
accompanied by the voice of engineer Thierry Melse Basile recalling his childhood passion for building toys and closely observing events around him. In another scene, an engineer tests a nano-sensor used to detect distant quasars: extremely luminous active galactic nuclei. As the images unfold on the screen, the offscreen commentary stresses how scientific research is conducted in terms of integrity and objectivity but it always starts from personal intuitions. In both scenes, technical tools and scientific operations are presented in great detail but no explanation is given about their functions. The editing generates a focused attention on the scientists' voices, highlighting the impact of individual approaches and personal inclinations in scientific research.

Astrophysics emerges as a space of hypotheses and theories constantly re-written at the borderline between objectivity and subjectivity. In order to visually represent this ambiguity, I approached each scene as a "tableau" or single unit. The shots of scientists at work and technical instruments are conceived as autonomous entities that function in themselves but could also be re-composed in many different ways. Likewise, the different voices of cosmologists and engineers suggest many possibilities in interpreting the data coming from the universe. The scientific gaze emerges as a human gaze, shaped by personal ideas and creative intuitions, questions and doubts.

Editing and montage leave space for some gaps of information, some silent moments. Not everything is described and explained. This choice is motivated by technical and conceptual constraints. Firstly, it would have been impossible to document every procedure and scientific experiment taking place in the different laboratories I visited. Secondly, this cinematographic approach suggests the fragmented nature of scientific research, constantly dealing with revisioned theories, reconfigurations of data and missing information. In this regard, *The Quintessence* is framed as being part of a reflexive methodology that makes visible the multiple, intricate and contradictory nature of one's own research practices, thereby mirroring and potentially (re)producing the complexity of the phenomena that are being studied.

## **A balance between points of views**

*The Quintessence* can be described as an experimental film situated at the interstice of the cinematographic genres of observational cinema, the essay film and the ethnographic film. My keen interest in documenting the activities taking place in the scientific labs brought me to record subjects and events through a "silent-observer" mode, in the tradition of observational cinema, described by Christian Suhr and Rane Willerslev as operating:



Segment of Saturn's rings, Voyager 2, 1981. Credits: NASA.  
Saturn and Three Moons, Voyager 2, 1981. Credits: NASA.



E. P. Hubble at the 200 inch telescope at the Palomar Observatory, from Robert Jastrow, Malcolm H. Thompson, *Astronomy: Fundamentals and Frontiers*, 1974, p. 344.





Part of the constellation Aquarius as depicted in a Persian manuscript of about A.D. 1650, from Fred Hoyle, *Astronomy: A History of Man's Investigation of the Universe*, 1962, p. 29.

“within an essentially realist cinematic paradigm, using film mainly as a medium of ‘mimesis’ [...] However, it would be wrong to approach this specific cinematographic form as a naive and simplistic observation of facts and events. On the contrary, the camera should be conceived as ‘a physical extension’ of the cameraperson’s body, thus allowing viewers intimate access to the filmmaker’s sensuous engagement with the social life portrayed”.<sup>58</sup>

Focused on the ordinary experiences taking place inside the scientific labs, visual documentation is approached as a tool to plunge the viewer into lived impressions of spaces and encounters. The camera becomes a physical extension of my own eyes: its mechanical gaze stands as my own gaze, trying to make sense of what I saw during my exploration of the astrophysical world.<sup>59</sup> The filmic approach makes reference to what Paul Henley defines as the “unprivileged” camera, presenting in a very simple and direct way the point of view of a human participant in the portrayed events:

“stylistically the camerawork should be low-key: the observational camera-person should take particular care that neither the distinctive temporal and spatial configurations of the events portrayed nor, more generally, the characteristic social and cultural aesthetics of their subjects’ world are smothered by demonstrations of technical or aesthetic virtuosity”.<sup>60</sup>

Throughout the film, the camera follows the scientists in their activities, enabling the viewers to feel - or “live” - their experiences in the same time. As David MacDougall observes, the gaze of the camera operates as a physical expansion of factual impressions:

“Our consciousness of our own being is not primarily an image, it is a feeling. But our consciousness of the being, the autonomous existence, of nearly everything else in the world involves vision. We assume that the things we see have the properties of being, but our grasp of this depends upon extending our own feeling of being into our seeing”.<sup>61</sup>

This is particularly significant considering the highly-secluded nature of the laboratories

58 Christian Suhr, Rane Willerslev, “Can Film Show the Invisible? The Work of Montage in Ethnographic Filmmaking”, *Current Anthropology*, Vol. 53, 3 (June 2012), pp. 282-301, p. 283.

59 See Anna Grimshaw, *The ethnographer’s eye: ways of seeing in anthropology*, Cambridge MA, Cambridge University Press, 2001; Anna Grimshaw, Amanda Ravetz, “Rethinking observational cinema”, *Journal of the Royal Anthropological Institute*, 15, 2009, pp. 538–556; Kirsten Hastrup, “Anthropological visions: some notes on visual and textual authority”, in Peter I. Crawford, David Turton (eds.), *Film as ethnography*, Manchester, Manchester University Press, 1992, pp. 8-25.

60 Paul Henley, “Putting film to work: observational cinema as practical ethnography”, in Sarah Pink, László Kürti, Ana Isabel Afonso (eds.), *Working images: visual research and representation in ethnography*, London, Routledge, 2006, pp. 109-130, p. 114.

61 David MacDougall, *The corporeal image: film, ethnography, and the senses*, Princeton NJ, Princeton University Press, 2006, p. 1.

visited throughout the research, often located in remote areas and usually not accessible to the general public. Their audio-visual documentation provides a first-hand impression that would have not been otherwise available to viewers. In this sense, the camera's gaze documents what Emmanuel Levinas described as the "excess of otherness", a distinct characteristic of the encounter with unknown subjects.<sup>62</sup> For this reason, the film can be more explicative than many scientific texts or theoretical analyses.<sup>63</sup> What might be perceived as a discourse on the alterity of the gaze becomes in my research a reflection on the act of looking, on practices of visualization and cognition. Every time we look at something, we are effectively constructing the object of our visual enquiry. In one of the scenes shot at the Paris White Lab, a scientist wearing a white protective suit looks into a magnifying instrument, carefully calibrating the machine with slow gestures.

The image is combined with shots of optical and radio instruments located in the room where the activity takes place, thus revealing connections between human agents and technical apparatus that would normally go unnoticed. To a scientist, these activities might seem banal or trivial. However, to my artistic gaze they look like performative acts, powerful signifiers revealing hidden links between laboratory practices, human actors, scientific theories and visual representations of outer space.

## **A visual ethnographic approach to scientific knowledge**

Informed by multiple visits to research centres and direct interactions with astrophysicists and engineers, the audio-visual documentation produced throughout my research has been strongly inspired by the ethnographic film tradition, informed by the necessity to record events and encounters while generating a critical discourse on the subject of analysis. While Karl Heider stresses the role of ethnographic film as record and Jay Ruby describes this cinematographic genre as text, David MacDougall and Lucien Castaing-Taylor conceive ethnographic film as "sense impression".<sup>64</sup>

My filmic approach was particularly inspired by the latter, with a specific reference to Taylor's written and cinematographic work. In a 1996 essay, he posited the necessity to overcome the traditional anthropological focus on language, claiming it was essential to

62 Emmanuel Levinas, *Time and the Other*, Pittsburgh PA, Duquesne University Press, 1987.

63 Sarah Pink, *Doing visual ethnography: images, media, and representation in research*, London, Sage, 2007. Alan Latham, in his discussion of photo-diaries, defines this characteristic as the 'feel and texture' of images. In Alan Latham, "Research and writing everyday accounts of the city: an introduction to the photo-diary, diary-interview method", in Caroline Knowles, Paul Sweetman (eds.), *Picturing the Social Landscape: Visual Methods and the Sociological Imagination*, London, Sage, 2004, pp. 117-131, p. 129.

64 P. Kerim Friedman "Defining Ethnographic Film", in Phillip Vannini (ed.), *The Routledge International Handbook of Ethnographic Film and Video*, Abingdon, Routledge, 2020, pp. 15-29, p. 17. In this regard, Friedman stresses how two of the major centres for training visual ethnographers, The Sensory Ethnography Lab at Harvard University (co-founded by Castaing-Taylor), and the Granada Center of Visual Anthropology at Manchester University, are strongly aligned with this conceptual approach to sensorial filmmaking.

work on “pictorial-visual” modes of representation in order to enhance anthropological research.<sup>65</sup> He observed how “film captures something of the lyricism of lived experience” in a direct way, overcoming traditional ethnographic research exclusively focused on texts and written reports.<sup>66</sup> *The Quintessence* moves forward from these theoretical premises in order to generate a sensorial transposition of activities, events and encounters on screen. The camera provides a unique visual record of spaces of research where the light coming from distant galaxies is captured by highly advanced telescopes and elaborated by scientists.

Combining visual and audio recordings, the film makes reference to Taylor’s comparison between the density of images and text, two elements that can complement each other in the film medium. In *The Quintessence*, these elements act as an invisible force projecting the film’s viewers into the distances of interstellar space, while being almost physically present in the scientific labs. Through a visual ethnographic approach, the activities performed by scientists inside the scientific labs become more accessible and tangible than any scientific paper or academic conference on the topic.<sup>67</sup>

## Filmmaking as subjective discourse

Throughout the film, objective and subjective gazes mingle and interact with each other. On one hand, the camera observes and records spaces and individuals in silence, aiming to produce an objective representation of witnessed events.

On the other hand, my subjective point of view comes to the foreground through artistic choices such as framing, cinematography and editing. In this regard, a relevant inspiration for my practice has been the essay film, a cinematographic genre derived from the essay form, described by Jean-François Lyotard as the quintessential form of postmodern thought in the second half of the 20th century.<sup>68</sup> The essay film is characterized by a documentary approach combined with audio commentaries or specific editing styles where the signature of the filmmaker is apparent. As Timothy Corrigan observes,

65 Lucien Castaing-Taylor, “Iconophobia”, *Transition*, 69, Spring 1996, pp. 64-88, p. 85.

66 A strong example of this approach can be seen in his film *Leviathan* (2012) shot onboard a fishing ship in North America. The filmmaker used GoPro cameras and worked 20-hour shifts to provide a highly sensorial and immersive documentation of the spaces and actions of the fishing domain. See Philip Hoare, “Leviathan: the film that lays bare the apocalyptic world of fishing”, *The Guardian*, retrieved at <https://www.theguardian.com/film/2013/nov/18/leviathan-fishing-film-moby-dick> on 10/02/2020.

67 John A. Hughes, Dave Randall, Dan Shapiro, “From Ethnographic Record to System Design. Some experiences from the field”, *Computer Supported Cooperative Work (CSCW)*, 1, 1993, pp. 123-141.

68 Jean-Francois Lyotard, *The Postmodern Condition: A Report on Knowledge*, Minneapolis, MN, University of Minnesota Press, 1984, p. 81. See also Graham Jones, *Acinemas: Lyotard’s philosophy of film*, Edinburgh, Edinburgh University Press, 2017.

“the essayistic stretches and balances itself between abstracted and exaggerated representation of the self (in language and image) and an experiential world encountered and acquired through the discourse of thinking out loud”.<sup>69</sup>

*The Quintessence* has been particularly inspired by the work of essay-filmmakers such as Chris Marker, Jean-Luc Godard, Adam Curtis and Werner Herzog for their narrative styles combining real and fictional features, multiple points of views and interpretations.<sup>70</sup> I was especially interested in Herzog’s poetic view: for him, the filmmaker should not aim at presenting an objective perspective on a specific subject, but rather at evoking an “ecstatic truth”, which he claims stands as an alternative to “accountant truth”. That latter truth is a superficial one searched for by the vast majority of journalists, scholars and documentary filmmakers who “resemble tourists who take pictures amid ancient ruins of facts”. On the other hand, “ecstatic truth” is linked to the notion of art:

“There are deeper strata of truth in cinema, and there is such a thing as poetic, ecstatic truth. It is mysterious and elusive and can be reached only through fabrication and imagination and stylization”.<sup>71</sup>

According to this perspective, documentary films do not present a truer version of reality than fictional films, since both genres depict things which are, at different levels, manipulated. As a consequence, an “aesthetic lie” can be “truer than the truth”.<sup>72</sup> This is a particularly relevant concept for my artistic research exploring the borderline between scientific objectivity and individual subjectivity.

Moving forward from Herzog’s ideas, *The Quintessence* stands as a reflexive analysis investigating the boundaries between truth, speculations and hypotheses. The cinematographic discourse extends beyond the actual scenes recorded by the camera to generate a more subtle exploration of images of outer space as tools to reflect about how we conceive and shape the world around us.<sup>73</sup> In *The Quintessence*, the technological gaze of the telescopes, the scientific gaze of astrophysicists and my own artistic

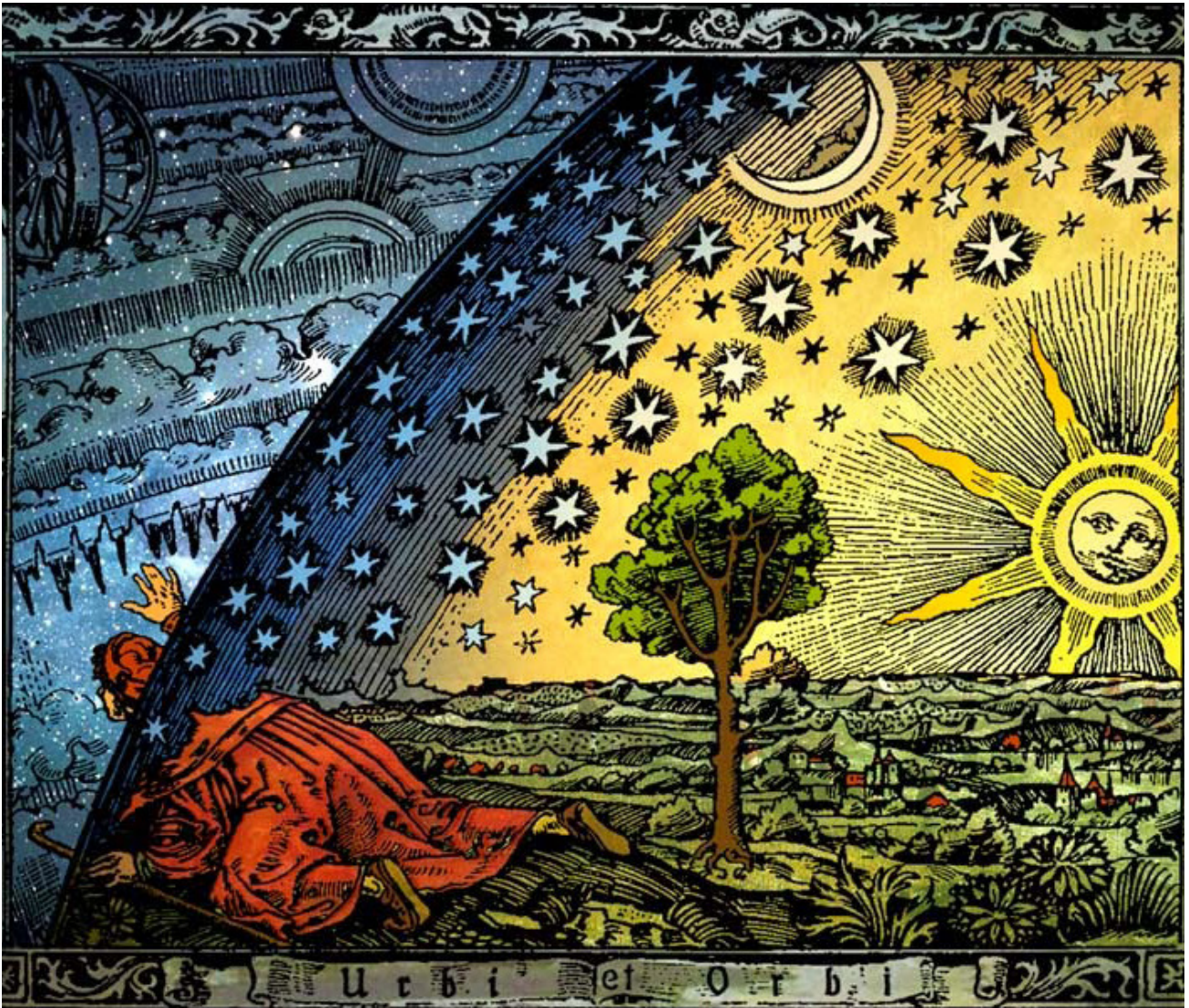
69 Timothy Corrigan, *The essay film: from Montaigne, after Marker*, Oxford, Oxford University Press, 2011, p. 15.

70 Sarah Cooper, *Chris Marker*, Manchester, Manchester University Press, 2019; Stefan Kristensen, *Jean-Luc Godard Philosophe*, Lausanne, Editions L’Age d’Homme, 2014; Jonathan Lethem, “Adam Curtis and the Secret History of Everything”, *The New York Times*, retrieved at <https://www.nytimes.com/interactive/2016/10/30/magazine/adam-curtis-documentaries.html> on 20/04/2019; Joshua Lund, *Werner Herzog*, Urbana IL, University of Illinois Press, 2020.

71 Paul Cronin, *Herzog on Herzog*, London, Faber and Faber, 2002, p. 301. See also Eric Ames, *Ferocious Reality: Documentary According to Werner Herzog*, Minneapolis MN, University of Minnesota Press, 2012; Roger Ebert, “Herzog’s Minnesota Declaration: Defining ‘ecstatic truth’”, [RogerEbert.com](http://www.rogerebert.com/roger-ebert/herzogs-minnesota-declaration-defining-ecstatic-truth), retrieved at <https://www.rogerebert.com/roger-ebert/herzogs-minnesota-declaration-defining-ecstatic-truth> on 15/03/2020.

72 Brad Prager, *The Cinema of Werner Herzog: Aesthetic Ecstasy and Truth*, London, Wallflower Press, 2007, p. 8.

73 Marcus Walz, Patrizia Hoyer, Matt Statler, “After Herzog: Blurring fact and fiction in visual organizational ethnography”, *Journal of Organizational Ethnography*, 5 (3), 2016, pp. 202-218, retrieved at <http://dx.doi.org/10.1108/JOE-07-2016-0017> on 1/02/2019.



Man on Earth peering through the universe, unknown author, from Camille Flammarion, *Popular astronomy, a general description of the heavens*, 1907.

gaze mingle together, generating a conflation of perspectives. In one of the scenes, Prof. Richard Ellis speaks about his search for the “first light”, the moment when stars began to shine in the universe. Through montage, different points of view are brought together: the indoor spaces of an observatory dome (the telescope gaze), the operations performed by a cosmologist looking at data on a computer screen (the scientist’s gaze), old and new images of space captured in the private location of my studio space (my own artistic gaze).

The dichotomy between objective and subjective points of view acts as a reflection on the role of the artist and the artwork in challenging traditional notions about the development of scientific knowledge. In this regard, I take as a point of reference the theories of filmmaker and writer Trinh T. Minh-ha, who wrote extensively about the role of objective and subjective descriptions of reality in cinema.<sup>74</sup>

<sup>74</sup> In her filmography, she explores the political frame of colonialism and its approaches to the study of “other” cultures.

In her films, Minh-ha deconstructs the traditional documentary approach to topics such as identity, otherness and authenticity, perceiving them as the result of specific cultural and political frames of reference. She goes as far as to state that there is no such thing as a documentary film. Referring to the liminal borders surrounding our own perception of the world, she observes that “reality is delicate”, since it is impossible to present a discourse or a narrative from a somehow neutral position:

“I don’t think of my films in terms of categories - documentary, fiction, film art, educational or experimental - but rather as fluid, interacting movements. The first is to let the world come to us through an outside-in movement - this is what some call ‘documentary’. The other is to reach out to the world from the inside out, which is what some call ‘fiction’. But these categories always overlap. I wrote ‘there is no such thing as documentary’ because it’s illusory to take the real and reality for granted and to think that a neutral language exists, even though we often strive for such neutrality in our scholarly work. To use an image is to enter fiction”.<sup>75</sup>

Descriptions of a certain reality, a certain individual or a certain space will always be somehow incomplete or imprecise, not corresponding directly to the experience that other people have of that reality, individual or space. As Trinh T. Minh-ha affirms, it is not possible to speak about something, but just to speak “nearby it”:

“When you decide to speak nearby, rather than speak about, the first thing you need to do is to acknowledge the possible gap between you and those who populate your film: in other words, to leave the space of representation open so that, although you’re very close to your subject, you’re also committed to not speaking on their behalf, in their place or on top of them”.<sup>76</sup>

In the same way, *The Quintessence* presents the domain of astrophysics through a multiplicity of points of view, voices and spaces, in order to suggest how nothing is fixed or certain in science. Through montage, shots of research centres, scientists at work and images of outer space are combined with audio commentaries evoking invisible dimensions related to everything we do not know about the universe. Shedding light on the complex interactions between astrophysics and its visual representation, the film

Her first feature film, *Reassemblage* (1982) is a montage of scenes shot in Senegal, punctuated by silence, music and occasional remarks by the author. Erika Balsom, “‘There is No Such Thing as Documentary’: An Interview with Trinh T. Minh-ha”, *Frieze*, retrieved at <https://frieze.com/article/there-no-such-thing-documentary-interview-trinh-t-minh-ha> on 15/03/2018.

<sup>75</sup> Erika Balsom, *ibid.*

<sup>76</sup> Erika Balsom, *ibid.*

thus reflects on the cognitive and visual processes at the core of scientific knowledge formation.

## Framing science through static shots

Light rays travel through space for millions of years before finally reaching the Earth. To make one complete orbit around the Milky Way, our galaxy rotates around the sun in about 230 million years. Time moves slowly in the universe, and this is reflected in the choice of employing long static shots throughout the film. This aesthetic style - used in classical cinema by filmmakers such as Roberto Rossellini, Carl Theodor Dreyer, Andrej Tarkovskij and Bela Tarr among others - makes reference to what has been recently defined as “slow cinema”, a cinematographic style emphasizing long takes and a minimalist, observational approach to the subject captured by the camera. Recent examples include Ben Rivers’ *Two Years at Sea* (2011), Michelangelo Frammartino’s *Le Quattro Volte* (2010) and Nili Portugali’s *And the alley she whitewashed in light blue* (2018).<sup>77</sup>

I choose to employ this specific framing style in order to generate a focused attention on the subjects captured by the camera. Inside an astrophysics research centre, time moves slowly. Scientists perform delicate and precise operations, often repetitively and with great care. Through the static shot, the viewers can perceive the slow development of outer space observations and testing, made of a long series of measurements, double-checks and calibrations. In one of the scene, glass plates from Harvard astrophotographic collection are being scanned in a dimly lit room.

Multiple static shots are combined to document the different stages of this highly sophisticated process while the voice of Prof. Martin Domink (St Andrews University) analyses the meaning of the word “imagination” and how this can be linked to broader questions on the nature of knowledge formation.

By working on stillness and duration, the static shot creates a strong attention on the actions captured by the camera’s lens, without much ground for distraction. At the same time, the offscreen commentary generates a powerful narrative seizing the viewers’ attention. Without camera movements or fast-paced action, simple gestures and powerful narratives about outer space become the main subjects of interest.

In one of the final scenes, the static shots of radio astronomical domes located in the Swiss mountains are combined with old and contemporary images of stars and galaxies,

<sup>77</sup> The question of slowness in film has been widely discussed in the last decade, in particular since 2003, when French film critic Michel Ciment coined the expression “cinema of slowness”, referring to films characterized by a minimalist approach, long takes and bare narratives. See also Tiago de Luca, “Slow Time, Visible Cinema: Duration, Experience, and Spectatorship”, *Cinema Journal*, Volume 53, 1, Fall 2016, pp. 23-42.



while the voice of Prof. Christopher Conselice (Nottingham University) explains how everything in the universe is interconnected, to the point that the shape of galaxies we can observe in outer space might have influenced our biological evolution. In this case, the static shots recall the grounded nature of astronomical research, an activity taking place in different geographical areas located on planet Earth, in remote locations often characterized by natural landscapes recalling primordial cosmic forces bringing light and life across the universe. Scientists study distant space events using concrete and analogue instruments. Through the fixed camera, this dichotomy clearly emerges as a key feature of astronomical research: the universal faraway converges into the nearby of research spaces and scientific labs.

## Mixing digital footage with archival material

*The Quintessence* is structured through the combination between my own original visual documentation and archival footage. Both are direct testimony of events and experiments taking place in front of the camera's lenses. Both are used to construct a wider narrative about the visual imaginary of outer space. However, they have been produced in different times and with different technological tools: while my footage is full HD digital video, the archival footage was mainly recorded on 35mm film.

It was retrieved on the open source website archive.org, after unsuccessful attempts to locate original footage from NASA and ESO space agencies' websites and digital collections. The combination of original and archival footage stresses how different technological apparatuses used to observe the universe generate different theories about outer space and different representations of cosmic events.

Through decontextualization, archival films give form to an epic narrative about the human efforts to observe and explore the space extending beyond planet Earth. The film thus constructs an undefined temporal framework, mirroring the mysteries of time evolution on universal scales.<sup>78</sup> The use of archival material was inspired by the work of the Armenian filmmaker Artavazd Pelechian, renowned for his original style of cinematographic editing called "Distance Montage", combining found and original footage.<sup>79</sup>

In particular, his film *Our Century* (1983) is built using archival material documenting pivotal moments of 20<sup>th</sup> century space exploration, from the early attempts to fly airplanes to the launch of space rockets. The images are accompanied by an epic musical score,

<sup>78</sup> For recent analysis of found footage usage within experimental filmmaking, see Andrea Lissoni, Filipa Ramos "The Rest of Borneo", *Mousse*, 36, pp. 120-124; Jacopo Natoli, "Introduzione al Found Footage Film: sette ipotesi", *Nodes*, anno II, 2, 2013, unpaginated, retrieved at [https://www.academia.edu/41754165/INTRODUZIONE\\_AL\\_FOUND\\_FOOTAGE\\_FILM\\_SETTE\\_IPOTESI](https://www.academia.edu/41754165/INTRODUZIONE_AL_FOUND_FOOTAGE_FILM_SETTE_IPOTESI) on 07/01/2019.

<sup>79</sup> Patrick Cazals, Laurent Daniélou, Artavazd Pelechian, "The Galaxy Pelechian: Interview with Artavazd Pelechian", *Discourse*, Vol. 22, 1, Screening Ethnicity (Winter 2000), pp. 99-102.

without any additional commentary or voiceover. In *The Quintessence* I move forward from this example, employing archival footage accompanied by evocative sounds recalling universal phenomena such as gamma bursts and low radio frequencies travelling through space.

This musical score highlights the poetic quality of images, moving from earthly boundaries towards interstellar distances. Another artistic inspiration in this regard was John Akomfrah's three-screen installation *Vertigo Sea* (2015), a visual exploration of the practice of whale hunting constructed through the combination of 4K footage of seascapes with old black and white silent films.<sup>80</sup> Moving forward from this example, I combined different footages in order to generate a visual reflection on the history of space observation and exploration as a compelling metaphor for 20<sup>th</sup> century human cultural and social evolution. From the construction of the first high-altitude telescopes on the summit of the Swiss mountains to the earliest tentative attempt to fly a rocket into the atmosphere, no matter what means we have at our disposal, we keep striving to reach for the stars.

## Revealing the invisible layers of astrophysical research

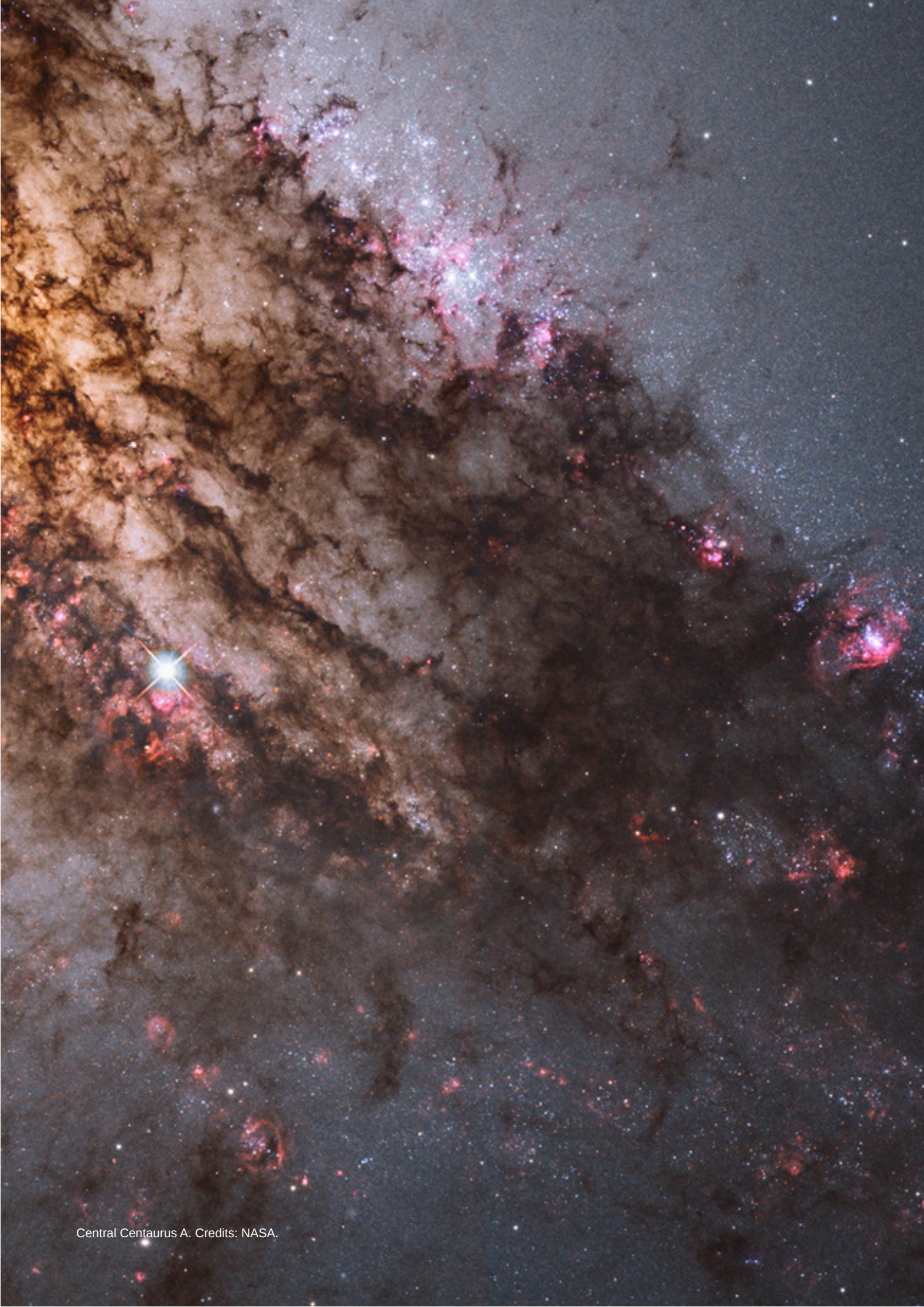
The cine-camera has often been approached as a tool to reveal what is hidden and to unveil specific truths, as has been associated with the works of Dziga Vertov and Jean Rouch.<sup>81</sup> Maya Deren went as far as to describe filmmakers as shamans able to drive the viewers into unknown territories, revealing unfamiliar worlds and realities through the filmic gaze.<sup>82</sup> Moving forward from these statements, in *The Quintessence* the camera becomes a tool to unveil hidden dynamics at play in the scientific labs. A detailed visual exploration of research centres reveals a series of interconnected invisible features shaping the contemporary imaginary of outer space.

The first is related to data coming from the universe, which are often invisible. Light rays, radio waves, x-rays and other types of signals detected from all corners of the universe cannot be seen with the naked eye. They are captured with highly advanced instruments, translated as binary codes and transformed into visual charts and graphs

80 Paola Nicolini, "John Akomfrah", *Flash Art*, retrieved at <https://flash---art.it/article/john-akomfrah/> on 15/01/2020.

81 Jeremy Hicks, *Dziga Vertov, Defining Documentary Film*, I. B. Tauris, New York NY, 2007, p. 10; Paul Henley, *The Adventure of the Real: Jean Rouch and the Craft of Ethnographic Cinema*, Chicago IL, University of Chicago Press, 2010, pp. 149-150. While traditional film theory and critique often accunate the two authors when approaching the concept of cinema verité, Henley observes how "for Vertov, the term kino-pravda referred primarily to the process of perceiving the world: the ciné-eye could go anywhere and see anywhere. For Rouch, on the other hand, it was not so much the perception of the world but rather the world itself that was transformed by the cinematographic process as the presence of the camera provoked the subjects into revelatory performances that were different from their normal forms of behavior". Henley, *ibid.*, pp. 149-150. See also Anna Grimshaw, Amanda Ravetz, *Observational cinema: anthropology, film, and the exploration of social life*, Bloomington, IN, Indiana University Press, 2009.

82 Massimiliano Mollona, "Seeing the Invisible: Maya Deren's Experiments in Cinematic Trance", *October*, 149, pp. 159-180.



Central Centaurus A. Credits: NASA.

that complement Hubble photographs with significant information on the chemical composition of specific regions of space. The original, raw traces of light travelling billions of years across the universe are hidden from plain sight. The second layer of invisibility is linked to the cognitive processes at the core of scientific knowledge development: a series of interdependent operations shaped by cultural frameworks, technological constraints, individual knowledge and creative intuitions. In order to convey these different levels of invisibility, I generated a connection between what stands in front of the camera lens - the reality of the laboratory space - and what is only evoked or suggested - the intangible substance of stars and galaxies. This choice is made stronger by the use of a-synchronous editing of visual and audio tracks. We never see the scientists actually speaking on camera, we only hear their voices.

The audio tracks evoke a presence which is not directly visible, in the same way as the indivisible data coming from the universe is echoed within the walls of scientific labs, in graphs and charts about the composition of stars and planets, and in the Hubble telescope's colourful images of distant galaxies.

## **Stars and screens: exploring light through images**

In *The Quintessence* the materiality of visual representations of the universe is approached as a form of mirror. The camera transfixes the representations of stars, galaxies and constellations, generating access to higher dimensions. It suggests further connections to the multidimensional planes of outer space, as well as to the intricate dynamics of our own being.

In one of the scenes, shot at Harvard Astrophysical Lab, photographs of galaxies, meteorites and other outer space objects emerge as screens and projections, making reference to the passage of time, a key element in light transmission and expansion. A curator scans some astrophotographic glassplates through careful gestures, while the voice of Prof. Carolin Villforth (Bath University) explains how astrophysicists have to deal with huge numbers of magnitude: it takes millions of years for an event in space to develop and be observed. The montage makes clear how representations of universal phenomena are constructed through the action of starlight combined with the time it took for that same light to travel immense distances before being captured by a man-made telescope.

Distances in space are also distances in time: starlight is literally a projection of a time-space reality that doesn't exist anymore. It is at the same time a trace of past events and a phantasmata, an echo of something already lost. Multiplied and magnified through the film screen, this universal light can trigger poetic connections in the mind of the viewers.

In the opening scene, printed representations of space events and constellations are combined with shots of skyscapes and images of people walking in the park surrounding the Paris Observatory. In the subsequent scene, shot at the Observatory's Mechanical Lab, the camera documents spaces where starlight is captured and transformed into scientific data. Through montage, images of space are approached as changeable surfaces, moving past their bi-dimensional plane in order to generate further reflections on the role of light travelling through the universe and shaping world views.

The different landscapes introducing the scene act as metaphors, making reference to other spaces, some located away from us - in the most distant region of the universe - and some within us: our inner worlds formed by dreams and expectations about what might exist in outer space. The artistic gaze opens the door to the microcosm of the scientific lab, which in its turn projects the viewer into the macrocosm of the universe.

Framed through the cinematographic camera and then represented onto a screen, images of space become multiple windows generating a space of encounter between the scientific world and the place where the viewer stands. This space in-between provides a sense of familiarity with previously unknown research centres, and - as a consequence - with the object of their scientific investigation. Therefore, the astrophysical lab becomes a space wherein the distance between human scales and universal spaces is erased and human and cosmic perspectives converge in unexpected ways.

## **Stars and surfaces: exploring images through light**

Through editing and montage, images of space act as triggers for the imagination. They become mirrors of humanity's unconscious drives and expectations. The physical realm of outer space is transfixed through the metaphysical realm of the human deep self, and huge vistas of space evoke unseen worlds which arise thoughts of spirituality and ethics. The film screen brings these different spaces together through an almost tactile encounter with surfaces and materials. As Prof. Richard Ellis states in one of the scenes, everything comes from stars. Nuclear reactions taking place in the hot and dense core of supernovae explosions produce bursts of energy and particles.

Debris floating in the vacuum of outer space slowly mix with other compounds and generate all known particles of matter: everything we see and touch was created inside a star. Originating in a hot nuclear-reactive bubble, light travels through the universe and reaches the lenses of our telescopes, enabling us to capture images of distant galaxies, gamma bursts, exoplanets and many other space events.

Through artistic practice I capture and transform these pictures on screens and surfaces wherein starlight takes a new life. The infinite temporal and spatial features of univer-

sal phenomena are expressed through the finite means of the camera and the screen. Aesthetic choices such as the frame composition and the use of a specific soundtrack create a bridge between that which can be seen and that which can only be imagined. As Vivian Sobchack observes:

“the camera seeks a parallel *ekstasis* in the ‘flesh’ of the world: it offers up a profane illumination of objective matter that opens into an apprehension of something ultimately unfathomable, uncontained and uncontainable - not only in the thing on which we gaze but also in ourselves”.<sup>83</sup>

In *The Quintessence* the proximate relation of the camera to the surfaces of machines, lenses and mechanical gears speaks about the tactile qualities of all these different materials. At the same time, it suggests how the scientific tools of research are more than mere technical devices: they “illuminate” something in excess of their functionality, providing information on the universe which mirrors human expectations and wonderings about the unknown. Reality is transfixed into a subjective experience: images that evoke the infinite space of the universe are transposed onto photographic and filmic supports, changeable surfaces made of light and matter.

## Light projected into space through film screens

As the camera lingers on printed images of stars, galaxies and supernovae, their gigantic dimensions and otherworldly existence are made significant for our human scales of perception. Through their rendition into the finite space of the film screen, we get a glimpse of the story of the universe.

Space phenomena are transfixed to infinity: since the light from distant stars takes millions of years to reach our instruments of observation, images of outer space often document objects and events that do not exist anymore. In *The Quintessence* the cinematographic focus on these representations enhance and widen the very existence of universal phenomena which are approached through a non-linear temporality. One of the scenes presents photos of asteroids and planets combined with details of Jodrell Bank Radio Telescope (UK). The editing moves from pictures of outer space objects that might not exist anymore to the concrete presence of a wide physical radio telescope - located in the blossoming English countryside - built to detect these objects.

<sup>83</sup> Vivian Carol Sobchack, *Carnal thoughts: embodiment and moving image culture*, Berkeley CA, University of California Press, 2004, p. 298.

This non-linear sequentiality evokes the complex nature of the phenomena represented on screen. Images of outer space are transfixed firstly through the cinematographic gaze, and secondly through their projections and screenings. Inside the closed walls of the gallery space, starlight takes new life, it bounces and multiplies. Photons and particles of this universal light will eventually leak beyond the gallery's walls and above the Earth's surface, moving towards interstellar distances.

The film screen thus becomes a space of encounter uniting the Earth and the sky, a space that allows the gaze to move from the images captured on camera to other spaces and dimensions, from what appears in front of the eyes to what is hidden from sight. The viewers are asked not only to look at, but to look into and beyond the surface of space images. Through their transposition onto the screening surface, pictures of the universe shift from a bi-dimensional plane to acquire the status of presences, occupying a real physical dimension. Drawing from Giordana Bruno, in this sense the filmic image

“is made out of layers and tissues. It contains strata, sediments and deposits. It is constituted as an imprint, which always leaves behind a trace. A visual text is also textural for the ways in which it can show the patterns of history, in the form of a coating, a film, or a stain”.<sup>84</sup>

The screen projecting the film in the exhibition space becomes the site of an alchemical transformation of the universal light into surface and new matter, slowly changing the subjects of representation. At the same time, the scientists' voices create statements that act almost like spells, adding to the images' meaning and status with a power of their own. The visual and the spatial, starlight and its representation, come together through surface tension. The screen is activated as a cultural dense space, a memory device generated from a technology of light, a material object constructed around ethereal substances.

## Chapter Conclusion

As I have argued, *The Quintessence* is an experimental film situated at the meeting-point of observational cinema, ethnographic and essay film. Moving from theoretical analyses

<sup>84</sup> Giordana Bruno, *Surface: matters of aesthetics, materiality, and media*, Chicago IL, University of Chicago Press, Chicago, 2014, p.5.

of the scientific laboratory as a system of fact constructions and trained visions, the film aims to generate an original discourse on space's visual imaginary.

Through montage, the materiality of research spaces is combined with the ethereal quality of space images produced in these centres. Visual representations of cosmic events and phenomena are approached as a content-charged surface. Through exhibitions and screenings, multiple gazes and points of view, an alternative approach is proposed to the traditional representation of astrophysical research. A way of seeing that resists preconceptions and standardized construction is slowly developed through editing and montage. The act of looking at the sky emerges as something far from a simple or neutral activity. On the contrary, it is an action that implies a certain background knowledge possessed by scientists, a specific way of looking and interpreting data coming from the universe and well-defined technical skills.

The scientific lab appears as a cultural scenario speaking at the same time about the here and now of contemporary astrophysics and also of other times and spaces made of vast cosmic distances. Through cinematographic montage, the laboratory is trans-fixed as a stage wherein scientists and engineers are working to solve the riddles of the cosmos, giving shape to raw data collected by optical and radio telescopes in order to generate dramatic vistas of the universe and a specific visuality of the "beyond". Through the artistic gaze, the depiction of the great drama of cosmic events mingles with our own history as human beings, shaped by cultural, social, material and subjective constraints.

Artistic practice thus suggests that as humans we are driven by the desire to discover the hidden dynamics of the world beyond the Earth, and in so doing we are also shaping the image of that world. The two processes are interdependent from one another. We are giving form to the universe and at the same time its immensity and mysteries are shaping our desire to know more about it.





Carina Nebula. Credits: NASA.

## CHAPTER IV

### ORAL NARRATIVES AND PRACTICES OF LISTENING

This chapter will analyse the role of oral narratives and storytelling approached through artistic practice in order to shed light on contemporary practices of astrophysical research. I will provide a detailed description of a series of audio-video interviews conducted with selected astrophysicists, cosmologists and engineers. The interviews were carefully designed to touch upon key research topics such as the influence of technological apparatus and economical restraints in the collection and elaboration of scientific data from space. Related philosophy of science questions and frames of reference such as levels of fallibility and trustworthiness of scientific data have also been considered. Special emphasis was given to the role of scientists' individual background knowledge, biases and creativity, and how these features might affect the development of theories and hypotheses about outer space.

A dedicated paragraph will consider how the interviews aimed at triggering original thoughts and reflections on how visual observations and representations of the universe are approached within the scientific community. Closely describing the interviews' questions and answers, this chapter will demonstrate how the interviews generate a unique portrait of the interviewed scientists as human beings, providing an original perspective on the domain of astrophysics.

Theoretical references employed to construct the interviews will be considered through examples of significant topics and how they have been used to reflect on the wider research questions. Finally, extracts from the interviews used as voiceovers in different experimental films will be described in close detail, with particular reference to the role of offscreen commentaries as tools to enhance a critical understanding of contemporary practices of space's observation and visualization.

## Questioning the nature of scientific knowledge through audio interventions

In 1927, the physicist Werner Heisenberg developed a controversial theory called the “Uncertainty Principle”. The theory stated that the more precisely the position of a particle is determined, the less precisely its momentum can be known, and vice versa. In other words, the more precise one’s measurement of the energy of a specific electron, the more uncertain is the measurement of its lifetime.<sup>85</sup> This episode led to the formulation of the so-called “Observer Effect”, according to which the act of observing an event necessarily changes its outcomes.<sup>86</sup> This discovery has generated what Karen Barad called “experimental metaphysics”:

“questions that were previously believed to pertain exclusively to the philosophical domain are now part of the scientific debate”.<sup>87</sup>

If any measurement of a certain system cannot be made without affecting the system, how are we to approach astrophysics, a science exclusively based on observations of outer space’s phenomena? At what level do the modalities through which we look at the universe influence the outcomes of our observations? How can we consider pictures of galaxies and supernovae explosions as objective depictions of events and phenomena located at gigantic distances from our own observational point?

In order to answer these questions, I undertook a series of interviews with selected astrophysicists and cosmologists. The resulting dialogic exchanges aimed at exploring the delicate balance between individual points of view and scientific cognitive-visualization practices. Constructing a sense of familiarity with scientists enabled me to get a deeper insight into their ideas and unique approaches to the act of looking and studying the universe.<sup>88</sup> In this regard, I paid attention to what Barbara Tedlock has described as “narrative ethnography”, wherein the researcher makes explicit reference to the interrelations between her own active role and the individuals with whom she is interacting.<sup>89</sup>

85 Werner Heisenberg, *Physics and philosophy: the revolution in modern science*, New York NY, Harper Perennial, 2007, p. 137.

86 Massimiliano Sassoli de Bianchi, “The Observer Effect”, *Foundations of Science*, 18, 2013, pp. 213-243.

87 Karen Barad, *Meeting the universe halfway: quantum physics and the entanglement of matter and meaning*, Durham NC, Duke University Press, 2007, p. 35.

88 Max Travers, *Qualitative Research Through Case Studies*, London, Sage, 2001, p. 25.

89 Barbara Tedlock, “From Participant Observation to the Observation of Participation: The Emergence of Narrative Ethnography”, *Journal of Anthropological Research*, Vol. 47, 1 (Spring 1991), pp. 69-94, p. 70.

The audio interviews have an intrinsic content value, based on the uniqueness of the unpredictable encounters between my own sensitivity and the specific points of view of the interviewed scientists. Much in the same way as listening to stories captures our attention and awareness, when we listen to someone speaking - describing a certain situation, an event, an encounter, etc. - we visualize what we hear.

The recorded voices thus act as triggers of multiple reflections on the dynamics through which science narrates itself. While the scientists' voices present their own researches about the universe, the listeners can have a deeper access to theories and hypotheses that are normally presented in a technical jargon difficult to understand. While they have an explanatory function, the interviews act also as analyses of individual approaches to the cultural, philosophical and ethical implications of the act of looking at the universe. They can be considered artworks in their own right, as well as notes on the research process. They have been employed as voiceovers and audio commentaries in the films *The Quintessence*, *The Infinite* and *The Beyond*, and have been transmitted as a series of podcasts at RadioRadio, a radioweb program curated by ENSA/La Box Galerie (Bourges, F).

## **Audio interviews: a unique approach to scientific research**

Scientists are generally perceived to be individuals possessing unquestionable knowledge about natural events and phenomena. Scientific discoveries are usually presented to the general public as established facts measured through objective investigations and precise mathematical operations. This information is communicated in conferences and written works through statements that always remain on the surface, since they do not provide a deeper analysis of the actual processes that led to the claimed results.

As Jean François Lyotard stated in *The Postmodern Condition*, contemporary science is not perceived as an objective pursuit of knowledge in order to find some ultimate truth, but as an assemblage of different “language games” in which facts are no longer important. Instead they are taken over by what he calls “performativity”.<sup>90</sup> Language becomes a form of social action, and scientific statements are validated by the system within which they are uttered. With my interviews, I aimed to move past this point, to go deeper under the surface of the generally-acknowledged status of scientific statements as truth-encompassing. Developing a series of dialogues with scientists enabled me to generate a “fresh perspective” on the subject of enquiry, i.e. the interaction between astrophysicists and individuals outside of their community.

90 Jean-François Lyotard, *The postmodern condition: a report on knowledge*, Minneapolis MN, University of Minnesota Press, 2010.

I acted as an external agent - a visual artist - asking provocative questions about subjects rarely or never discussed within the astrophysical domain. Together we considered topics such as the criteria according to which some theories are validated at the detriment of others, questions of feasibility, technological and economical constraints, individual imagination, biases and skilled visions. The interviews were devised to generate an original approach to what scientists know about outer space, in order to understand how this might influence the modalities through which they represent the universe. The interviewees were very keen in engaging in a dialogue quite unusual for them: in some instances, they thanked me because my questions made them reflect on their own research in a new light.

The interviews were designed around critical debates on science's relativism, with a particular regard for some concepts discussed by philosophers of knowledge and science: Gaston Bachelard, Karl Popper, Thomas Kuhn, Paul Feyerabend and Peter Galison.<sup>91</sup> These authors question cognitive and visual processes of knowledge formation, such as the ontological and ethical features at play inside scientific labs and the role of subjectivity and cultural backgrounds in the development of scientific knowledge. In the following paragraphs I will consider these key theoretical concepts and how they were approached in the audio interviews.

## Interview Questions

Along with many other natural sciences, astrophysics is characterized by its own history, theoretical points of reference and experimental approaches: an established set of knowledge that forms the main framework within which scientists operate. For this reason, one of the first questions I put forward during the interviews was: "Do scientists question the theoretical frame of reference within which they operate?"

This problem was put forward in the 1930s by Gaston Bachelard, who posited the progress of science can be blocked by certain types of mental patterns. He suggested the task of epistemology was to undercover them in order to reach new frontiers of knowledge. Moving on from this point, Karl Popper analysed what he called the "Demarcation Problem", i.e. the criteria according to which scientists establish if a theory is valid or not following certain intellectual patterns.

91 Gaston Bachelard, *The Formation of the Scientific Mind*, Manchester, Clinamen, 2002; Thomas Kuhn, *The Structure of Scientific Revolutions*, Chicago IL, University of Chicago Press, 1996; Karl R. Popper, *The Logic of Scientific Discovery*, London, Taylor and Francis, 2010; Paul Feyerabend, *Against Method*, London, Verso, 2010; Peter Galison, Lorraine Daston, *Objectivity*, New York NY, Zone Books, 2018.

The interviewed astrophysicists agreed this can be indeed controversial ground: some innovative theories and ideas are often ostracized and fought against by the scientific community because they do not conform to the current theoretical frames of reference or accepted theories. Another key question was: “How is it possible to know what’s happening in the most distant regions of the universe?”. In one of the audio recordings, Dr. Tessa Baker (Oxford University) stresses how outer space phenomena are defined by conditions that are more extreme than anything that can be artificially generated in a terrestrial laboratory, such as large ranges of temperatures, pressures, and spatial and temporal scales. Such conditions are impossible to replicate in a terrestrial lab: cosmologists and astrophysicists cannot physically handle the objects of their research.

Observing the space surrounding our planet and making hypotheses about its dynamics is a highly speculative activity. Cosmologists look through telescopes, study and compare the collected data and propose theories to explain them. New hypotheses about the dynamics of cosmic events can slowly be accepted and validated by the scientific community or discharged and abandoned.

The vast majority of contemporary astrophysicists do not work directly with images of outer space. As Dr. Baker explains, her own research is mathematically-based, rather than image-based: she approaches data coming from the universe through the language of mathematics, which is the ingredient of a transformation whose results are the scientific images of colourful stars, planets and other spaces events we are familiar with. Reflecting on these points, another question I asked during the interviews was: “How do scientists define certainty?”

Prof. Stijn Wuyts (Bath University) answered there is no such thing in science: astrophysical research constantly faces different levels of uncertainty as it slowly develops through trials and errors. Moving forward from this point, I made some enquiries about the concept of “paradigm shifts”, with reference to Thomas Kuhn’s analysis of epochal changes which take place in the scientific domain whenever a new discovery is made. Paradigm shifts lead to a complete reconfiguration of the overall theoretical frame of reference within which science operates.<sup>92</sup>

When asked “What do you think about paradigm shifts?”, Prof. Francesco Pace (Manchester University) observed how the history of science has been constructed through a series of ideas that, when originally put forward, were rejected, mocked or altogether censored, only to be slowly accepted at a later stage. With time, original theories and hypotheses initially labelled as eccentric became recognized and validated by the scientific community, from Galileo’s Heliocentric system to Higgs’ Boson.

<sup>92</sup> Thomas Kuhn, *ibid.*

I further explored this point by making reference to Paul Feyerabend's deconstruction of the scientific approach to knowledge. According to this perspective, science was born as a liberation movement but across the centuries it progressively became a repressive ideology obsessed with its own myth.<sup>93</sup> An interesting example in this regard is the conversation I had with Prof. Peter Galison (Harvard University), who has worked extensively on how the concept of scientific objectivity has always been shaped by specific cultural and historical contexts.

Nowadays the word "objective" implies mathematical rigour, a neutral approach and a detached methodology in the study of specific events. However, some centuries ago attempts at scientific objectivity were connected to the idea of representing natural phenomena as truthfully as possible. The only way to do this was by drawing attentively what was visible to the human eye. In the mid 19th century, the invention of photography created a revolution in this regard, providing a supposedly more neutral look on the universe.

This demonstrates how throughout history the development of new scientific visual imaginaries always paved the way for the redefinition of concepts such as "objective" and "truthful". Another question I asked during the interviews was: "How do you, as a scientist, approach images of outer space?". This question left some of the interviewees silent and reflective for some minutes. Some astrophysicists observed that they consider photographs of the universe as poetic visual traces of starlight travelling in outer space, as when Professor Roger Davies (Oxford University) observed:

"An astronomical image is a beautiful thing. When I look at a picture of a nebulae, I could tell you that it is a sea creature on the bottom of the ocean, and it could be, right? It's actually a region where stars are formed".

The scientist's voice evokes images of interstellar distances and faraway galaxies, otherworldly planets and perhaps the possibility of life existing somewhere else in the universe. The audio establishes a deep connection between the invisibility of the topic spoken about with the imaginative capabilities of the mind, a condition described by Isobel Anderson as a "productive listening state".<sup>94</sup> The recording can project its auditors to the most distant regions of the universe, encouraging them to imagine what may exist beyond the borders of known space.

<sup>93</sup> Feyerabend was especially indignant about the attitude of many scientists to alternative traditions. For example, the negative opinions they generally hold on astrology and the effectiveness of the rain dance were not justified by scientific research. Consequently, the predominantly negative behavior of scientists towards such phenomena should be regarded as elitist. Paul Feyerabend, *ibid*.

<sup>94</sup> Isobel Anderson, "Voice, Narrative, Place: Listening to Stories", *Journal of Sonic Studies*, Volume 2, 1 (May 2012), retrieved at <http://journal.sonicstudies.org/vol02/nr01/a10> on 13/02/2020.

To give a better idea of the dialogic exchange developed through the interviews, in the following paragraphs I will present extracts from two dialogues conducted at Paris Observatory with chief engineer Philippe Laporte and astrophysicist Pier Stefano Corasanti.

### **Interview sample#1: Mr. Philippe Laporte**

Mr. Laporte works at the intersection between astrophysical theory and practice. His work represents the point of juncture between the imagination of cosmologists and the constraints of the laboratory life. Scientists present him with a precise idea of the instruments they need in order to observe outer space, and his team of engineers tries to transform this idea into a reality. I asked Mr. Laporte how he would define creativity for his own research and if he thinks imagination plays a role in his job. Quite surprisingly, he observed how an astrophysical engineer should first of all read some contemporary science fiction:

“It’s incredible what has been imagined in the 1950s or 1960s and is now a reality. And what is nowadays written in science fiction could be reality in twenty or thirty years. It’s a way to try and guess what we will be able to do in the future. Another important thing to do is to read many technical magazines, to have a feeling of how the technology evolves today and tomorrow. Mixing these two sources of information I try to imagine the future for technical instruments.”

When I asked Mr. Laporte how he conceives a scientific image of space, he observed:

“An image? Well a scientific image is very different from what we are used to looking at because the instruments that analyse the light coming from space change the nature of that light, in order to get the information embedded inside it. For instance, the white light is the sum of all the colours. Astronomers never look at the white light, they always split it in all the colours to see different lines that correspond to the different materials forming the objects they’re looking at. There is a lot of information into the light, and that’s a good thing, because the astronomer has a particularity compared to the other researchers: he is not able to touch the object he is looking at, it’s too far. It’s impossible to take a star inside our hands”.

This passage is interesting for two reasons. Firstly, it highlights the transformative pow-



er of observational instruments changing the nature of light coming from outer space. Additionally, it provides useful information on the importance of collecting and studying universal light as a source of key data on the physical properties of stars, exoplanets and other space objects. Another topic of discussion was the concept of paradigm shifts in the scientific realm and how scientists approach them. In this regard, Mr. Laporte observed:

“Usually new ideas are not welcome in science. For example, when the concept of the Big Bang was accepted, the main idea was that the universe was static, with no movement at all. Einstein was sure about this and he imagined a constant - the cosmological constant - to make the results of his equation fit with a static universe. But it was a scientific fault. He invented a constant to have a static universe that would match his theory, because the main idea in the scientific domain was that the universe was static. A theory is something that is true while observations give proofs for this theory. But one single observation that goes against a theory can make it collapse.”

This passage stresses a key point explored throughout the practice-based research, i.e. the dynamics at play between theory and observation and how these two domains can influence each other. Mr. Laporte’s voice suggests how scientists develop their research prompted by their own ideas and background knowledge, highlighting my artistic proposition that theories and hypotheses about the dynamics of universal events and phenomena should be approached as a constantly evolving narrative. The scientists’ voices create new layers of meaning to the act of looking at the night sky, a point further discussed during the interview with Prof. Pier Stefano Corasaniti.

## **Interview sample#2: Pier Stefano Corasaniti**

Prof. Corasaniti is a cosmologist researching the nature of the invisible components of the universe. I began the interview by asking if he believed creativity plays a part in science and if so, at what level. He observed how, while the meaning of the word can be manifold,<sup>95</sup> in relation to the scientific domain creativity is often associated with visual thinking, i.e. thinking through visual processes.

95 Peter Meusburger speaks about dozens of definitions of the concept to be found in literature. Peter Meusburger, “Milieus of Creativity: The Role of Places, Environments, and Spatial Contexts” in Peter Meusburger, Joachim Funke, Edgar Wunder, *Milieus of Creativity: An Interdisciplinary Approach to Spatiality of Creativity*, Heidelberg, Klaus Tschira Stiftung, 2010, p. 99-100. See also Ruth Richards, *Everyday Creativity and New Views of Human Nature: Psychological, Social and Spiritual Perspectives*, Washington DC, American Psychological Association, 2007; Keith R. Sawyer, *Explaining Creativity: The Science of Human Innovation*, New York NY, Oxford University Press, 2006.

For example, Albert Einstein was keen on “visual imagining of thought experiments”.<sup>96</sup> Prof. Corasaniti illustrated this concept through his research on the development of mathematical models and computer simulations of observable properties of galaxies in the universe:

“Through observations we can test these predictions. By comparing observations versus predictions we can understand which model is closer to reality. It’s a phenomenological approach: we don’t possess knowledge about the outer world, and we try by trial and error”.

Failures and mistakes are essential for the development of scientific knowledge. They might lead to serendipitous discoveries and can help to introduce different points of views and ideas, paving the way for new approaches to questions that have been previously left unanswered. Once again, the audio recording provides an insight into scientific dynamics of knowledge formation, evoking the struggles and wrong turns often encounters by scientists. In this regard Prof. Corasaniti observed:

“Frontier science is to be found at the edge of normal scientific processes. There is a trench where a war is happening between the normal science and the unknown. What is happening here works a lot by consensus: there is a strong social aspect in the development of science and neglecting this would be misleading the picture we have about how science works.

Our research can sometimes become very visible because we polarize with the consensus forming on this edge of the normal scientific process. But sometimes a scientist can remain totally isolated. It’s up to him to make the effort to explain why he thinks his research is important and spread his theory around. These elements of sociology in the development of science are very important and can actually change the level of constraints. The idea that scientists are like new saints, wearing a white lab coat, synonymous of intellectual and ethical pureness, doesn’t correspond to human nature. We try to limit our theoretical or intellectual prejudices, but we are still humans. We have preferences and we have needs, such as the need for recognition, the need that our work is appreciated. All these factors contribute to define our boundaries and constraints”.

This passage sheds light on how astrophysicists are first of all human beings with individual ideas, desires and expectations.

<sup>96</sup> Eugene Garfield, “Art and Science. Part 1. The Art-Science Connection”, *Current Contents*, 8, 20 February 1989, pp. 1-10, p. 1.

These intimate and unique features shape their own scientific research and might influence, at different levels, the modalities in which they approach and study data. I was particularly interested in shedding light on the criteria according to which cosmologists approve or reject certain theories. In this regard Prof. Corasaniti observed how:

“The best description of scientific research is that we may be like a worm inside an onion, trying to move away from the center. Every time we cross a layer of the onion, we understand something. But we don’t know if this onion is infinite - so we will keep discovering layers of reality - or whether we will be stuck in a thick layer for a very long time, as it happened before Galileo. In science, you don’t know what’s the next layer you will find. Maybe at some point there are no more layers, or maybe our understanding of reality is limited. We don’t know.

The success of physics is progressive proportionally to our capacity to isolate the system. What is very difficult to understand to a profound level is the very ultimate nature of systems that cannot be isolated, because the phenomena arise from interactions within multiple parts of the systems.

This is the case for instance of neuroscience, biology, sociology and economics. The more there is complexity, the more is difficult to have a fundamental understanding of things, especially in our understanding of the universe. So it is not guaranteed that we will always find an answer. We believe that we can find it, and this is what pushes us to do research, to always ask questions and to have new ideas, but there is no guarantee that we will find what we are looking for”.

This interview passage highlights very well how the astrophysical domain is surrounded by a metaphorical border made of imaginative thoughts and hypotheses, uncertainties and doubts. The example of the onion layer is especially descriptive, suggesting not only how the physical properties of the universe might be far more complex and intertwined than we think, but also that we might indeed be unable to see something because we have no knowledge or experience of it. Each new discovery about the universe brings scientists to a redefinition of their current theoretical frame of knowledge and its related visual imaginary.

The data they collect today will be at some point in the future revised and discharged, substituted by new ones. The interview makes clear reference to the everchanging status of scientific cognitive and visual patterns of knowledge formation. It brings to light hidden narratives that can be found beyond the surface of contemporary practices of space exploration, giving new meaning to the visual imaginary of the universe we are habituated to.

## Artistic approach to acousmatic sounds

As described in the previous chapter, audio extracts from the interviews have been embedded in the film *The Quintessence* and in other short experimental films produced through the PhD, in particular *The Beyond* and *The Infinite*. This editing choice was inspired by a series of essay films employing the use of voiceovers and audio commentaries, such as Andrés Duque's *Oleg y las raras artes* (2016), Wang Bing's *Beauty lives in freedom* (2018), Chris Marker's *Sans Soleil* (1983) and Werner Herzog's *Cave of Forgotten Dreams* (2011).<sup>97</sup>

Duque and Bing's films have been taken as example of a powerful cinematic use of narrative voice born out of a dialogue between the director and the main character. Andrés Duque's film is a delicate portrait of the celebrated Russian pianist Oleg Nikolaevitch Karavaychuk (1927-2016), 89 years old at the time of filming.<sup>98</sup>

The movie evolves around different scenes presenting Oleg playing the piano inside the Hermitage, walking around its empty corridors or wandering around his old neighborhood. It is a film of rare delicacy, carefully constructed as an intimate monologue that reveals the composer's inner world. In the same way, the scientists I interviewed gradually revealed their profound thoughts about life, science, knowledge and the fascination with the unknown.

Wang Bing's *Beauty lives in freedom* is an experimental documentary about Gao Ertai, a Chinese artist, teacher, activist and philosopher born in 1931 and imprisoned in a Chinese labour camp in the 1950s. Wang's film is an observational portrait of Gao's lifelong pursuit of freedom constructed as a five-hour confessional interview in his Las Vegas home. As Bing himself explains:

"For me, my filmmaking is just a way of empowering my subjects and enabling them to tell their story. I see myself as a tool for them. I use basic film language because I know my story is best expressed through words".<sup>99</sup>

97 Neil Young, "'Oleg and the Rare Arts' ('Oleg y las raras artes'): Rotterdam Review", *Hollywood Reporter*, retrieved at <https://www.hollywoodreporter.com/review/oleg-rare-arts-oleg-y-868117> on 16/07/2019; Patrick Gamble, "To film what is spoken: Wang Bing on 'Beauty Lives in Freedom'", *Kinoscope*, retrieved at <https://read.kinoscope.org/2019/05/24/to-film-what-is-spoken-wang-bing-on-beauty-lives-in-freedom/> on 13/03/2019; Catherine Summerhayes, "A Play of Memory: Chris Marker's *Sans Soleil*", *SCAN Journal of Media Arts Culture*, retrieved at [http://scan.net.au/scan/journal/display.php?journal\\_id=97](http://scan.net.au/scan/journal/display.php?journal_id=97) on 17/04/2019; Kevin Fisher, "The Ecstatic Gestalt in Werner Herzog's *Cave of Forgotten Dreams*", *Refractory: a Journal of Entertainment Media*, retrieved at <http://refractory.unimelb.edu.au/2014/08/06/fisher/> on 16/03/2018.

98 A musical child prodigy, throughout his career Oleg Nikolaevitch Karavaychuk composed music for theatre and film, most notably for directors like Sergej Paradjanov and Kira Muratova. Giampiero Raganelli, "Oleg and the rare arts", *Quinlan*, retrieved at <https://quinlan.it/2016/02/09/oleg-and-the-rare-arts/> on 22/04/2018.

99 Patrick Gamble, *ibid*.

In the same way, through the interviews I let scientists tell their own stories and personal points of view. However, my work differs from these two examples because in my films the interviewees are mostly heard, rather than seen. Their voices are offscreen since the audio recordings are employed as acousmatic sounds, i.e. sounds heard without the originating source being seen.

The word comes from the ancient Greek *akousmatikoi*, the name of Pythagoras' pupils who were required to sit in silence while they listened to the philosopher lecturing from behind a veil or screen. This modality of engagement would make them better concentrate on the teachings and their deep meanings.<sup>100</sup> With regard to off-screen sound in film, the term was first used by French writer and composer Michel Chion.<sup>101</sup> He observed how sound generated an “added value” to the moving images,

“the expressive and informative value with which a sound enriches a given image so as to create the definite impression, in the immediate or remembered experience one has of it, that this information or expression ‘naturally’ comes from what is seen, and is already contained in the image itself”.<sup>102</sup>

In my films, the choice of employing offscreen sounds was motivated by aesthetic and conceptual preoccupations alike. On the one hand, the evocation of an absent body creates a focused attention on the objects and actions explored by the camera's lens. At the same time, it generates a powerful stress on what is being said. In fact, as Chion observes, sound in film is “verbocentric” more than anything else, since we, as human beings, are also verbocentric. This means that in any sound environment, when we hear a voice - or more voices - they capture our attention before, and above, any other sound (like ambient sound, noise, traffic, etc.):

“Sound shows us the image differently than what the image shows alone, and the image likewise makes us hear sound differently than if the sound were ringing out in the dark. Transformed by the image it influences, sound ultimately reprojects onto the image the product of their mutual influences”.<sup>103</sup>

In this way, the auditory tool becomes a trigger to facilitate a sensory experience by proximity and by knowing, through the actual voices of cosmologists and engineers,

100 The term “acousmatic” was used in modern times by the French composer and pioneer of musique concrète Pierre Schaeffer, and subsequently by François Bayle in the 1970s. See Marc Battier, “What the GRM Brought to Music: from Musique Concrète to Acousmatic Music”, *Organised Sound*, 12/3, 2007, pp. 189-202.

101 Michel Chion, *Audio-Vision: Sound on Screen*, New York NY, Columbia University Press, 2019.

102 Michel Chion, *ibid.*, p. 5.

103 Michel Chion, *ibid.*, pp. 21-22.

bringing to light hidden features and critical questions at the very core of astrophysical research.

## **Audio recordings as narrative devices**

In *The Quintessence* several scenes depict scientists at work - calibrating observational instruments, observing images of stars, scanning glassplates, etc. These actions are always accompanied by offscreen commentaries suggesting possible interactions between the voices and the spaces and actions documented by the camera's lens. The voiceover of scientists are kept anonymous, since I wanted to convey the idea that the domain of contemporary astrophysics is constructed through multiple researches carried out by thousands of individual scientists operating through their own unique points of view and perspectives. This is an aesthetic choice that mirrors the present state-of-the-arts in scientific research. The traditional image of a single scientific genius making big discoveries by himself is out of date, as many astrophysicists explained to me. Nowadays science is developed by large teams of scientists working together from different locations throughout the world.

Another reason for employing the voiceovers without any indication of the individual speaking is the necessity to create the fluid and everchanging development of scientific research, always producing new ideas and recalibrating previous theories. Finally, the offscreen commentaries are combined with the images in order to create a contemporary fairy tale narrative style, wherein the imaginative capability of the mind is triggered by the sounds of human voices speaking about distant galaxies and faraway planets.

One of the scenes presents an engineer testing mechanical components in a white lab room at Paris Observatory. The images are combined with the voice of Prof. Ulrike Kuchner (Nottingham University) describing the goal of science: to make experiments and formulate theories that can be tested and confirmed everywhere in the universe.

At the same time, Prof. Kuchner observes how the questions motivating science come from a very personal, subjective space. While the images documenting a highly technologically-driven scientific experiment provide a layer of objectivity, the voiceover introduces a subjective approach to the scientific research, generating a multiplicity of points of view. In this sense, I was inspired by Chris Marker's *Sans Soleil* (1983), a film which make use of acousmatic sounds to create powerful and evocative narratives. The film is structured as a visual diary narrated through the voiceover of an unnamed female character reading letters supposedly sent her by a (fictitious) cameraman named Sandor Krasna.

Through montage, Marker brings together scenes shot in different countries, documenting urban and natural scenarios, encounters with people and events, accompanied by voiceovers reflecting about the nature of human memory. In the same way, in my film I employed the scientists' voices as a metaphorical thread bringing together the multifaceted elements of astrophysical research and the spaces wherein this research is taking place.

In one of the initial scenes, the offscreen commentary of Prof. Martin Dominik (University of St Andrews) considers the role of human communication and how we could construct a dialogue with an extraterrestrial civilization. The recording is punctuated by silences and pauses that mirror uncertainties and doubts on this specific topic expressed by Prof. Dominik during the interview.

The audio track thus becomes a sensory tool to visualize interstellar distances, exoplanetary landscapes and gigantic clusters of galaxies. Enquiring about possible explanations for space phenomena, Prof. Dominik's voice generates an almost invisible bridge across the universe. Another scene, mentioned in the previous chapter, presenting the image of glassplates being scanned and digitally preserved, is accompanied by the voice of Prof. Dominik describing how the word "imagination" comes from "image": when we imagine, we do so from pre-existing visual references which are part of our cultural background.

Here the voice acts as a thread bringing together the materiality of laboratory activities with the visual imaginary of outer space to which the scientist's words make reference. The offscreen commentary triggers a deeper analysis of what is being presented on screen, leading to a reflection on the act of looking and finding meaning in and through images.

An important visual reference for the use of acousmatic sounds in my film has been Werner Herzog's films, in particular *Cave of Forgotten Dreams* (2010), a documentary shot in the highly secured spaces of the Chauvet cave - a natural cavity located in southern France - hosting some of the best-preserved prehistoric cave paintings in the world. In the film, interviews with scientists and paleo-anthropologists are intertwined with scenes shot in and around the cave. Herzog's off-screen commentary tries to solve the mysteries behind these paintings and their ancient authors, while discussing ideas about human nature, history, life and death.

Acousmatic sound generates a special attention to what is being said, enriching with meaning the spaces and encounters documented through the camera's lens. Moving forward from this example, in *The Quintessence* acousmatic sound produces a focused attention on what scientists say and how their words' content relates to spaces, events and people captured through the camera's lens. In a scene shot at London University Astronomical Observatory, we hear Prof. Richard Ellis (University College London) describing how there was a moment when starlight began to shine in the universe.

While the images on screen present archival footage of distant stars and the surface of the burning sun, Prof. Ellis' voice analyses key philosophical concepts related to the act of looking at outer space. His offscreen commentary generates an added layer of meaning to the documentary quality of the footage: while scientists look at planets and stars through powerful telescopes, they enquire about the origin of universal light giving form to everything we see. Doubts and uncertainties mingle with wonder and awe about the immensity of outer space and our place in it.

## Asynchronous sound

By calling attention to its spatial and temporal features, sound generates a powerful sensory experience, made stronger by the inability of the viewers to access the scientific labs documented in the film. This feature is enhanced by the use of off-screen commentaries as asynchronous sounds: they were not recorded at the same time as the images, but in a different moment. As Jennifer L. Heuson and Kevin T. Allen observe:

“While the synchronized ear-eye depends upon “clock time” and “coeval presence”, the non-synchronous presumes to clearly separate ear and eye, placing them in distinct temporal and spatial zones, creating a relation of action-reaction, of randomness or commentary. In contrast, the asynchronous moves *in between* these two modalities, offering an ear-eye sometimes “in sync,” sometimes not. Aporetic gaps, uncertainties, disruptions, and durations are crucial”.<sup>104</sup>

In one of the scenes, Prof. Wuyts observes how in many cases the light coming from distant stars and galaxies and captured by powerful telescopes was created when the Sun wasn't formed yet and the Earth didn't even exist. The audio commentary evokes a time which is not linear but intertwined. It stands as a powerful metaphor of the process through which images of outer space are generated: the very moment when light that has travelled for billions of years finally lands on a digital sensor placed on a telescope located on Earth.

A huge amount of time has passed between the original transmission of light from a distant star and the moment when the same light is seized by human-made instruments. The use of asynchronous sound suggests how the act of looking at the sky is always

<sup>104</sup> Jennifer L. Heuson, Kevin T. Allen, “Asynchronicity: Rethinking the Relation of Ear and Eye in Ethnographic Practice” in Arnd Schneider, Caterina Pasqualino (eds.), *Experimental Film and Anthropology*, London, Bloomsbury Academic, 2014, pp. 113-130, p. 114.



out-of-synch, an encounter between our own present and a very distant universal past. In the film's final scene, Prof. Martin Dominik explores the connections between the scientific quest to study outer space and the human need to understand ourselves and our role within an infinite universe. His voice accompanies images of laboratories and scientific workshops where technicians and engineers are building new instruments to study the cosmos. As the montage develops, the camera moves from the labs' interior to outdoor spaces, capturing serene and peaceful natural landscapes.

The voiceover generates a contextual frame of reference: the act of looking at the sky and wondering about its mysteries emerges as an activity rooted in the physical and temporal framework of planet Earth. The asynchronic separation between looking and listening makes reference to specific cognitive patterns at play within the astrophysics domain. Space observations and scientific experiments often lead to puzzling results, unexplained outcomes and new questions being asked.

Scientists always encounter gaps of information, empty spaces and silent moments. The construction of an intermittent rhythm between images and audio commentaries mirrors these dynamics. The recorded voices are not merely explanatory descriptions of scientific research, but reflections on the wider dynamics at play in the formation of scientific knowledge.

## **Chapter conclusion**

Audio interviews recorded with different cosmologists and astrophysicists present the act of looking at the universe as being far from a passive activity. The scientists' voices depict research activities such as observing distant galaxies, measuring the composition of exoplanets or envisioning theories about dark matter as highly constructed actions shaped by a number of interrelated factors.

Through the generation of a "Fresh Perspective" the dialogic exchange between an artist and different scientists challenges the traditional approach to the visual imaginary of outer space through thought-provoking questions usually never considered or altogether censored within the scientific community. The points of view expressed by the interviewees emerge as intimate confessions on personal ideas and intuitions, dreams and expectations, doubts and biases at play in the contemporary study of the universe.

As cosmologists propose possible explanations about cosmic phenomena, they test hypotheses, double-check experiments' outcomes, combine data and develop theories guided by their own professional knowledge as well as by instinctive insight and creativity.

Audio recordings thus reveal unexpected narratives and unforeseen circumstances shaping contemporary scientific knowledge formation and visualization. Artistic practice sheds light on how science should be conceived as a constant and ever-changing enquiry, rather than as a fixed and immutable domain of knowledge.

Employed as acousmatic sounds in different experimental films produced throughout the research, the audio interviews deconstruct the inner features of high-resolution photographs of the universe in order to discover what lies at the core of their production and manipulation.

By so doing, they bring to light the narrative potential embedded in visual representations of outer space and highlight the modality through which science narrates itself. They expand the potentiality of the moving images and engage the imaginative mind of the listeners. They generate a suggestive representation of what it means for humanity to observe and explore the universe, projecting the listeners into outer space, where the light coming from distant galaxies clashes with the surface of unknown planets and mysterious forces, leading to further reflections on our role as human beings as spectator of universal wonders.

# RESEARCH REFLECTIONS

## Reflection# 01

My research began at night. Looking at starlight shining through the dark, I thought about what was happening billions of light years away from me. I went online and looked for images of stars and planets, supernovae explosions and distant galaxies. When I found them, I was at the same time amazed by their aesthetic qualities and puzzled about their very existence. How was it possible to capture images of space objects located so far away from our own planet? Why did these images look so different from my own experience of the night sky? Where did their colours and haloes come from? I then realized contemporary photographs of universal phenomena were very different from the ones published in astronomical publications some decades ago.

Looking further back in time, I could see how ancient drawings of shooting stars and vintage photographs of constellations had been slowly substituted by analogue photography and later by advanced HD digital photographs capturing space objects located at the border of the visible universe. How was it possible that in such a brief span of years - some 150 years - the visual imaginary of outer space had changed so much?

I began to wonder whether it would be possible to discover specific aesthetic and conceptual features in the modalities through which the cosmos is observed and represented. I decided to approach images of the universe as a mirror of cultural and social dynamics embedded in our own, specific way of looking at the space above the Earth. I wanted to understand how scientists capture the light of stars and galaxies and to explore how individual ideas and biases inform cosmological knowledge. I wanted to know how images of space tell a story, and how much this narrative can be seen as a mirror of our own human desires, fears and aspirations. Through artistic practice as research, I set on a quest to reveal the hidden features embedded in the visual imaginary of outer space.

## Reflection# 02

My aim was not to provide conclusive answers to my research questions, but rather to generate new questions on how the universe is observed and represented. The intention was to move beyond the Hubble telescope's glossy and colourful photographs and to consider how images of outer space are actually generated. The artistic gaze explores the activity taking place inside the scientific labs in a way that disrupts more official modalities of representation. Through documentation, montage and editing, the visual imaginary of cosmic events is approached as a fluid domain, constantly re-shaped by technological apparatus and scientists' trained visions. Whether we consider old or contemporary ideas about outer space, each time we look at the sky through a specific apparatus (the naked eye, a telescope, a computer-operated software) we are choosing a specific way to look, and, therefore, the outcomes of this action will always be partial, open to scrutiny and interpretation.

Through a series of interviews I tested how cosmologists approach their research from individual points of views and at what level they question the theoretical and conceptual frames of reference within which they operate. Dialogic exchanges touched upon delicate subjects such as the reliability of scientific theories, the level of trustworthiness of scientific data and the criteria according to which something is qualified - or disqualified - as scientifically validated knowledge. The scientists' own voices generate compelling narratives which stand both as scientific reflections on specific topics and also as private confessions about individual approaches to the wonders of the universe. Employed as offscreen commentaries in a series of experimental films, they provide an original portrait of the astrophysical domain, giving way to thoughts about the nature of scientific knowledge, our role as humans investigating the universe and the responsibilities we face towards the present and future exploration of outer space.

## Reflection# 03

While the Hubble telescope's photographs are sharper than ever, there is an accompanying depletion of their power to connect us to outer space. Through original artworks, I reactivate this power, giving new and original meaning to the light travelling through the universe. Generating an a-systematic representation of research spaces and activities, my artistic practice moves past the traditional depiction of astrophysics as a hyper-objective world, where super-telescopes and highly advanced software capture data from outer space and scientists elaborate clear and unquestionable theories about the universe.

My approach in producing different artworks has been motivated by the necessity to generate multiple points of views on the research subject. I propose that only through an artistic approach we can gain a better understanding of the hidden dynamics at play in the development of astrophysical knowledge. Capturing on video and audio the complexity and interconnected nature of multiple researches on outer space, artistic practice reveals how the act of looking at the sky is far from a neutral activity. When looking at data collected through a telescope or captured by a radio antenna, astrophysicists are influenced by their individual knowledge, skills and trained visions. Theories and hypotheses about the universe emerge as the complex result of the interaction between theoretical frames of reference, hardware/software technology and human agency.

Films, photographs, audio recordings and installations generate an original approach to the visual imaginary of outer space at a sensorial, emotional and even supra-emotional level. The dialectic movement between data coming from the universe and their transposition into visual form comes to the foreground through the combination of old and recent images of outer space: glassplates, printed charts, advanced digital images of stars, galaxies and supernovae explosions. Images and audio recordings become a powerful tool to question the process of scientific knowledge formation and visualization. They stand as a symbol of inexhaustible and unlimited depth of meaning, speaking of something that cannot be fully grasped or comprehended, but sensed, perceived and admired.

## Reflection# 04

The camera's gaze displays the materiality of the scientific labs, exposing what is visible and at the same time suggesting what is hidden. The audio recordings excavate the visual surface and give a deeper meaning to what we see. One after the other, layers of signification can be metaphorically peeled off. There exists an intricate relationship between the act of looking at something and the knowledge gained through observation. This reflection can trigger further considerations on the nature of scientific knowledge, our role as humans investigating the universe and the responsibilities we face towards the Earth as a tiny yet precious planet existing within a much bigger context.

Artistic practice analyses how images of space come into being, as a unique encounter: between light rays clashing onto the surface of glassplates or manmade sensors, and the combined agency of technical instruments and scientific intervention. Through close-up and panning shots of printed images of stars and galaxies, the camera generates a shifting focus on different types of outer space representations. Rather than objective recordings of the universe, they are approached as visual discourses constructed on a balancing point between multiple points of view and agencies.

Films and installations approach images of the universe as surfaces and material projections, objects and components of sculptural installations. They communicate ideas of space and time that go beyond earthly boundaries through a gaze which creates folds, interruptions and non-linear sequences. Every picture of a star, a galaxy, a planet, a meteorite, a supernova, takes back its original power as a unique trace made possible by a huge number of factors. The different artworks bring together multiple points of view - of the artist, the scientist and the viewer - through the unifying action of starlight being re-generated on cinematographic screens and photographic surfaces.

## Reflection# 05

Standing at the crossover between documentation of scientific activities and artistic analysis of the dynamics at play between what we know and how we represent it, my artworks are characterized by levels of conceptual self-reflection. Films, audio recordings and photographs can be experienced as a metaphorical space triggering questions about how we develop and visualize knowledge. There is a strong parallel between how scientists look at the sky and how I look at their own practice. Both activities involve the use of mechanical tools to make observations and elaborate data in visual form. The mechanical eye of the camera mirrors the mechanical eye of advanced telescopes used to observe the universe. The conflation between different perspectives generates open narratives.

Artistic practice as research brings to the surface a series of interconnected layers of invisibility inherent to the study of outer space, from the invisible radio and x-ray signals coming from the most distant regions of the universe to the contemporary sublime of astrophysical research: a hidden trigger shaping the need to find answers to fundamental universal questions. These invisible dimensions are evoked through the combination of visual and audio recordings, exposing an intricate web of visions of and about outer space.

Looking at the cosmos and depicting its phenomena through the lenses of our technologies is a highly authorial and performative action that implies a reflection on ourselves. Wondering about the universe in which we live, we can become much more aware of our human condition as part of an infinite universe.

This insight might lead to further considerations about the connections between cultural and ecological viewpoints concerning our planet and our role within a cosmological context. Astrophysics thus becomes a metaphorical space which mirrors our human dreams, expectations, doubts and fears about the origins and nature of the universe, and, ultimately, of our own place within it.

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