

ASTRONOMIA RESIDENCY



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FATIMA
MIRACLE OF THE SUN
13 OCTOBER 1917

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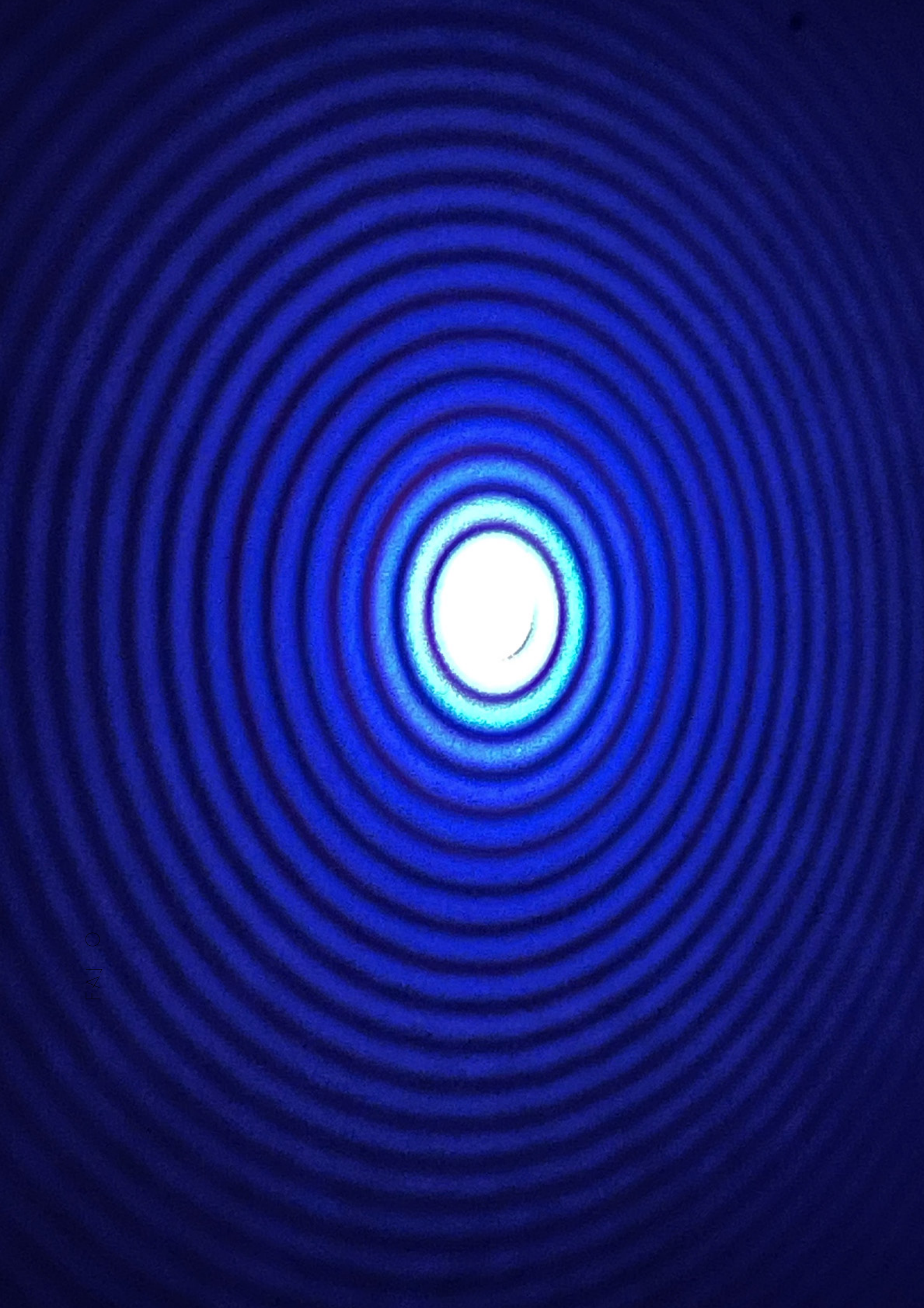
ASTRONOMIA RESIDENCY

Astronomia residency is an artistic research residency connecting astronomy and arts, with the aim of exploring the relationship between sky and earth, art and science, landscape and natural phenomena. Connecting several sites, cultural and scientific institutions in Europe, the residency consists of a series of research trips during 2023 and 2024 across the mountains of Portugal and France. The program is facilitated by the network for contemporary art in mountain areas Entre Serras and their project Inhabit and move in the mountain territories, supported by the Creative Europe program.

Universally, mountains bear a unique character often considered sacred, either for their difficulty of access, the versatility of their nature or their vicinity to the skies. It is from their summits that we are the most physically able to take the necessary step back to sense our place into this world. Under our eyes, reliefs left by tectonic forces lay the remains of long-gone seas; lines between mankind and its environment are drawn; above our heads, fossil lights travel from far-away stars illuminating us among other non-perceptible phenomena.

Guided by scientific necessity and the growing attractivity of astronomical tourism, the construction of star observatories connects as much as it reveals the landscapes it dominates. Between land and sky, this equipment facilitates encounters. It is a liminal zone between two time horizons: a pastor's sheep herd strolls on a trail trodden by centuries of ancient seasonal migrations while state-of-the-art technologies study exoplanets' densities located light-years away from us. Hence, mountains have been and remain incredibly powerful inspiration sites where science, spirituality and philosophy meet one another. Therefore there we find artists. The Entre Serras Project institutions seizes this opportunity to bind new relationships between institutions from different European countries.





AIRY DISK, THE GREEN FLASH & OTHER ATMOSPHERIC PHENOMENA

I was invited to Astronomia residency with the aim of continuing my research with astronomical phenomena as well as to prepare for the development of a new work that could be realised in one of the visited locations and further. Residency results will be presented at Castelo Branco (PT- July 2024), Campagne Première in Arles (FR – September 2024), Museo Vostell Malpartida de Cáceres (ES – Spring 2025). A new commissioned work will be exhibited on the location of the Observatory of Haute-Provence in October 2025.

Continuing my current research in light and sound as sensing devices for particle motion in a vacuum, I proposed to focus on light, as both the medium and the topic of my study. I set out to investigate an optical phenomena known as Airy Disk as well as the Green Flash and other naturally occurring optical phenomena in planetary atmospheres. While researching for my new work Origin v.2.0 (currently in development with Technical University Delft), I became fascinated by the light phenomena known as Airy Disk. This fascination became the starting point for my residency work.

Airy Disk is a light pattern that appears at the limits of our light capturing devices - starlight or a small source of light passing through a spherical aperture perfectly centred will diffract the light in concentric circles, giving the impression of

existence of star rings. This is also how Sir John Herschel first describes an Airy Disk in 1828, while observing a distant, bright star under strong magnification:

“ a perfectly round, well-defined planetary disk, surrounded by two, three, or more alternately dark and bright rings which (...) seem to be slightly coloured at their borders.”

He goes on to call these discs *unreal images*, being results of optical causes that in the scientific history came to be considered unwanted noise, then later - well understood optical limits of light that appear with any light detector (eye, film, digital). Today, this diffraction phenomena, or the circular bending of light, is of great importance for physics, optics and astronomy, being a constitutive part of direct imaging of distant solar systems and detection of exoplanets.

I conducted my first Airy Disk experiments in spring 2023 and presented them at the Astronomical Observatory in Belgrade in July, at an event titled On the Threshold of the Invisible, part of my solo exhibition Approaching Zero at the Cultural Center of Belgrade.

All eyes were again turned towards the West. The sun seemed to sink with greater rapidity as it approached the sea; it threw a long trail of dazzling light over the trembling surface of the water; its disc soon changed from a shade of old gold, to fiery red, and, through their half-closed eyes, seemed to glitter with all the varying shades of a kaleidoscope. Faint, waving lines streaked the quivering trail of light cast on the surface of the water, like a spangled mass of glittering gems.

Not the faintest sign of cloud, haze, or mist was visible along the whole of the horizon, which was clearly defined as a black line traced on white paper.

Motionless, and with intense excitement, they watched the fiery globe as it sank nearer and nearer the horizon, and, for an instant, hung suspended over the abyss. Then, through the refraction of the rays, its disk seemed to change till it looked like an Etruscan vase, with bulging sides, standing on the water. There was no longer any doubt as to the appearance of the phenomenon. Nothing could now interfere with this glorious sunset! Nothing could prevent its last ray from being seen!

The sun was just half way below the horizon, and its powerful rays were shot across the sky like golden arrows; in the distance the cliffs of

Mull and the summit of Bon More were bathed in brilliant, purple light.

At last only a faint rim of gold skimmed the surface of the sea.

"The Green Ray! The Green Ray!" cried in one breath the brothers Daine Bess and Partridge, whose eyes for one second had revelled in the incomparable tint of liquid jade.

Oliver and Helena alone had missed the phenomenon which had at last appeared after so many fruitless observations.

Just as the sun was shooting its last rays into space their eyes met, and all else was forgotten in that glance!

But Helena had caught the black ray, shining from the young man's eyes, and Oliver the blue beaming from hers!

The sun had gone down, and neither Oliver nor Helena had seen the Green Ray.

*p.305-306
The Green Ray,
Jules Verne, 1883
(transl. Mary de Hauteville)*



SOURCE



JACOB HEINRICH ELBFAS
VÄDERSOLSTAVLAN
XVII C.

Green Flash or Green Ray is a meteorological optical phenomenon that occurs because of the Earth's atmosphere that refracts the light of the Sun into different frequencies.

Green Flashes are enhanced by mirages, which increase refraction. It's more likely to be seen in stable, clean air, when more light from the setting sun reaches the observer without being scattered. One might expect to see a blue flash, since blue light is refracted the most and the blue component of the Sun's light is therefore the last to disappear below the horizon. But blue is preferentially scattered out of the line of sight, and the remaining light ends up appearing green.

With slight magnification, on the top of a solar disc may be seen on most clear-day sunsets, although the flash or ray effects require a stronger layering of the atmosphere and a mirage - which magnifies the green from a fraction of a second to a couple of seconds.¹

"Mirage is a meteorological optical phenomena in which light rays are bent to produce distorted or multiple images of an astronomical object. They are distinguished by vertically produced images."

I am fascinated by the proposition of being able to see the invisible emissions or hear undetectable vibrations, with the help of technology. I want to

develop new way of augmenting our senses so to be able to zoom in on the invisible and the unknown. In that search and by chance, I stumbled into the phenomena of Green Flash (thanks Sara!) and the term photometeor.

Photometeor is a term that covers many different optical phenomena produced by Sunlight or Moon light in the planet's atmosphere. It is a moment when nature's play allows for new aspects of light and motion to be observed.

Photometeors are usually explained as: "A luminous phenomenon produced in the atmosphere by the reflection, refraction, diffraction or interference of light from the Sun or the Moon." Examples include halos, rainbows, fogbows, cloud iridescences (or irisation), glories, Bishop's rings, coronas, crepuscular rays, sun dogs, light pillars, mirages, scintillations, and green flashes.

In addition I was also on the look-out for meteors, but more about that later.

¹ In addition to atmospheric refraction and lensing, another primary cause of the Green Flash may be due to a phenomenon discovered by researchers at the Washington University in St. Louis Medical School (Vladimir J. Kefalov, 2014) - which found that when two photons of infrared light collide with a human retina cell, causing what researchers called "a double hit", it creates the perception of bright neon green.

- *The Human Eye can see 'invisible' infrared light:* <https://source.wustl.edu/2014/12/the-human-eye-can-see-invisible-infrared-light/>

RESIDENCY JOURNAL

I was invited to do the Astronomia residency in two phases. First phase: research trip to Portugal in the summer 2023 and the second research trip to France in spring / summer 2024.

Portugal residency lasted two weeks and it was divided into two research visits to two different mountain ranges, each a week long. First week I was based in Fajão, Aldeia do Xisto at Serra do Açor and the second at Sabugueiro, Serra da Estrela UNESCO Geopark.

The residency started on Monday 17th of July 2023 - the first day of the New Moon. This date was chosen on purpose as the following days would provide full darkness for night sky observations. Making sure that the dark sky is truly dark in already one of the darkest places in Europe.

First week I spent at Fajão, one of the Schist villages in the Serra do Açor (Açor mountain range). My visit was hosted by Aldeias do Xisto, an organisation that connects 27 Schist villages and focuses on local culture, ecology and astro-tourism. Aldeia do Xisto de Fajão, in the municipality of Pampilhosa da Serra, is one of the best places in the world to observe the dark sky with limited light pollution (and controlled street light system), being a certified Starlight Tourist Destination. Starlight is an integrated action of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and is supported by the International Astronomical Union (IAU) and by the World Tourism Organization (UNWTO).

Second week I spent at Serra da Estrela (Estrela mountain range), lodging in Sabugueiro village, the highest altitude village in continental Portugal (nearly 1200 m). My stay there was facilitated by Estrela UNESCO Global Geopark, an organisation focusing on preserving and promoting cultural, natural and geological heritage of the Serra da Estrela region. Serra da Estrela is the highest mountain range of Portugal with very rich (geological) history including prehistoric human occupation.

The important part of doing my research was walking through the landscape, learning about the environment and the ways people live and build their relationship to the Earth and to the Sky.

These two locations - Serra do Açor or the Hawk mountain (Eurasian Goshawk to be precise) and the Serra da Estrela - the Star mountain, have been the sites of many exceptional insights, encounters and observations that I will discuss further in the form of a daily journal.

Week 1

Sunday 16 July

After a short stay in Lisbon and midnight celebration of my birthday, the next day heading towards the Açor mountains. That morning, while looking at the map and planning the trip - I noticed a town called Fatima. Quickly, I learned from my friend and artist Jonathan Boutefeu that this place has a very special history. Serendipitously it is precisely what I am interested in investigating during the residency. I decided to make a short stop at Fatima on the way to Fajão, the Schist village where I'll be staying for a week.

Miracle of the Sun

Beginning in the spring 1916, three Catholic shepherd children - Lucia, Francisco and Jacinta - living near Fatima, started reporting apparitions of an angel. In May 1917, they reported an apparition of Virgin Mary which they described as the Lady of the Rosary that announced the third apparition. On October 13th 1917 the anticipated third apparition of Virgin Mary brought a large crowd to Fatima. Some newspapers reported 30,000 others 100,000 people but all of them reported solar events with various elements.

According to many witnesses, after a period of rain, the dark clouds broke, and the Sun appeared as an opaque, spinning disc in the sky. It was said to be significantly duller than normal, and to cast multicolored lights across the landscape, the people and the surrounding clouds. The Sun then careened towards the Earth before zig-zagging back to its normal position. Witnesses reported that their wet clothes became "suddenly and completely dry, as well as wet and muddy ground that had been previously soaked because of the rain that had been falling."¹

Since the event, Cova da Iria, a quarter in the city of Fatima, become one of the most important destinations of religious tourism internationally. There have been many papal visits since the 60s and the site still receives 6-8 million pilgrims every year.

That Sunday, I arrived on time to see the Mass happening at the Basilica da Santissima Trindade (Basilica of the Most Holy Trinity), a 21st century basilica designed by Alexandros Tombazis, a Greek architect who developed the idea around the space that would serve as Great Covered Space for Assemblies. Indeed, the sense of communion in this building reminded me more of socialist buildings I frequented as a child in Yugoslavia, then of religious architecture. Even though all the signs were there: crucified Christ, golden mosaics and the kneeling men.

A stroll through Fatima's historic centre revealed touristic focus, and the visit to the souvenir shop brought a surprise. You could buy pieces of the human body made out of silicone - something I've never seen before. You could also buy a 3D image of the three shepherd children with Virgin Mary set in a prism. Does this prism souvenir then confirm the scientific explanation of the miracle of the sun, as the diffraction of sunlight as through a prism?

Arrived at Fajão in the early evening. On the way I met a Dutch lady that served coffee for free as I forgot to take any cash before going to the mountains. Fun and funny coincidence to meet a fellow country-woman in the middle of nowhere road cafe. The trip to Fajão was demanding but beautiful. Arriving just before sunset, I was welcomed by Sandra and was happy to find a beautiful cottage house at the edge of a very beautiful village that will be my residence for the coming week. That night I had dinner in one of the best restaurants in the area - O Pascoal, and it was a restaurant where I'd eat and meet the locals all throughout that week.

Monday 17 July

The first day of the residency begins with the press conference where all the different partners and hosting institutions came together for a public announcement of the Astronomia program.² The press conference was held by Carlos Simões - mayor of Fajão, Rui Simão - city councilor of Pampilhosa da Serra, Bruno Ramos - director of communications and marketing at Aldeias do Xisto, Lucas Cezar - Geopark Estrela, Carlos Casteleira - Entre Serras project and me.

1 https://en.wikipedia.org/wiki/Miracle_of_the_Sun

2 News & Events: <https://www.aldeiasdoxisto.pt/en/news/aldeias-do-xisto-and-geopark-estrela-art-and-science-come-together-in-artistic-residency/>



After the wonderful afternoon of meeting everyone and having lunch at Barragem de Santa Luzia, the rest of the day was spent getting to know and walking through that area and the village of Fajão.

Tuesday 18 July

Observatory Pampilhosa da Serra

The Space Observatory of Pampilhosa da Serra (PASO) is one of the rare places where both space science and astronomy research are conducted side by side. Located in the hills above the village of Porto da Balsa, parish of Fajão-Vidual, in Pampilhosa da Serra municipality, the observatory is coordinated by prof. Domingos Barbosa, senior researcher at Institute of Telecommunications of the University of Aveiro. He was our host for the visit and he told us more about the space and research that is done here.

The observatory has three telescopes and soon four telescopes:

- Large radio telescope - 9-meter diameter antenna that was previously used for Galactic Noise observations or microwave background in the Milky Way - Galactic Emission Mapping project (GEM). Now used as a space radar it can track objects up to 1.000 km in the atmosphere
- ATLAS Radio telescope - a 5-meter diameter antenna that operates at 1.4 GHz (21cm wavelength), the emission from neutral Hydrogen in the cosmos)
- Telescope operated by the Ministry of Defense that tracks human-made objects in Earth's atmosphere from 300 to 36.000 km, taking 2° pictures of the sky (in a grid) every 2 seconds.

We were also privileged to see the 4th telescope that awaits its inauguration - a telescope for space science and astronomy that uses photometry to look for oxygen and sulfur emissions. Beside tracking space debris as well, these elements are monitored for tracking planet formations, asteroids, chemical enrichment - nuclear reactions in the stars. It will observe large objects in the sky and it has a large field of view. It extracts light curves - observing Andromeda galaxy - the closest to us. (You can see Andromeda by the naked eye in summer. Find the W shaped constellation of Cassiopeia, the second star Shedar sits

at the bottom of the 'deepest' of the two Vs making up the W shape. Shedar points almost directly to the Andromeda Galaxy).

Prof. Domingos also showed us an interesting discovery that he made recently but that didn't relate to the sky - an insect believed to be extinct from this area that was recently spotted at the observatory - Grille Sale - saddle bucket bush cricket. On our way to lunch, we stopped at the location prof. Domingos wanted to show us. Oldest chestnut trees in the area, more than 300 hundred years old.

Night canoing & star observation

Evening at the lake. Andreia from Aldeias do Xisto has made sure that both me and the visiting reporters have a good and encompassing stay in Pampilhosa da Serra. It was a full day.

After the observatory visit, lunch with the professor and a short break, I found myself at the lake Vidual. We waited for a few hours for the night to fall and all the atmospheric light to subside so that we can set out to canoe in pitch dark over the lake. Little before midnight, we got equipped with life jackets and headlamps and off we went into the dark. It was exciting, cold, strange yet so familiar to be lost under the full dome of stars and the Milky Way.

In a scattered group we headed over to the other side of the lake where the firefly installation was setup up and running. We went to the very open part of the lake - often getting lost in our direction. With the red light above our vision and just on the top of our head, I tried to look at the night sky and try to orient myself towards the constellations that I knew. But it was dizzying. Always in motion, and also in water - the experience of watching the full dark sky while being on the water - was more capturing than I anticipated. Unannounced, the group leader led us further along the opposite shore where we parked our sails and met Samuel - our night sky guide who not only put the ground under our feet but he also showed us the routes in the sky above.

Airy Disk in open air

After the canoe experience, I have set up the Airy Disk experiment in the open air at the beach cafe terrace of Praia Fluvial de Santa Luzia. I also made a

first test using the prism I bought at Fatima. This gave me ideas not only for the possibility of making a light installation in the open air and specific location, but that a series of lenses and optical apparatuses could be used spatially to achieve different light diffractions (simulating atmospheric phenomena).

Wednesday 19 July

Free flow. Going to Pampilhosa da Serra. Exploring the area. The river to swim in has disappeared. Evening at O Pascoal and tasting of local liquor aguardente.

Thursday 20 July

Reading and writing. Exploring the area. Noticing the forest fires and their impact. Wondering how long has passed since these the fire and how fast the regeneration process is. Hiking towards the old school on top the hill behind the village.

“Do you know of any physical phenomenon that can operate from a distance and make people see visions? The doctor gave this some thought. “Yes. I do. A while ago I was part of the medical team for the Shenzhou 19 space-craft. Some taikonauts engaged in extravehicular activities reported seeing flashes that didn’t exist. The astronauts on the International Space Station reported similar experiences. It was because during periods of intense solar activity, high-energy particles struck against the retina, causing them to see flashes. But you’re talking about numbers - a countdown, even. Solar activity can’t possibly cause that.”³

During the trip I had several books to read. I brought with me: the Chinese sci-fi novel *The Three Body*

Problem, Laws of Form by G. Spencer-Brown and *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century* by Katherine Hayles. As usual, I tried reading all of them interchangeably yet serendipitously, *The Three Body* Problem story kept bringing things up that were relevant to my research. Such as the reflection on the light flashes of invisible particles, interpretation of the main character that flickering lights are speaking to him, or simply the descriptions of the observatory on the top of the hill just above a small town. The book affected my residency experience, and now while I write this report I’m reading the second novel from the trilogy.

Friday 21 July

Guided night walk with Alexandra, a local shepherd. She shared many nice stories about the area but also about the windmills that dominate the landscape. The energy producing windmills are covering the mountain tops, disturbing not only the natural line of the landscape but adding a line of red lights at night. She told how disturbing they are to the locals - but surprisingly to me, the disturbance wasn’t visual. The locals were mostly affected by them because of the sound they make. A noise that never subsides and the sound of the continuous rapprochement. I haven’t thought about that before but the wind turbines are sound polluters and although they don’t make obvious noise, the low-frequency noise really does affect the otherwise pristine mountainous landscape.

Saturday 22 July

Exploring the area by foot in the morning. Running to the nearby Ponte de Fajao. Rest at lake Vidual. Visit to Poço do Caldeirão waterfalls and basin.

Sunday 23 July

Last day in Fajão. Visit to the museum Nunes Pereira. Drive towards Sabugueiro village in Serra da Estrela with a pit stop at Piódão, known as one of the most beautiful Schist villages. Water running through the village, between the houses, down the slopes. The crosses above the doors - protection and good weather. The same unchanged way of living with the

3 *The Three-Body Problem*, Liu Cixin (eng. Bloomsbury Publishing PLC, 2015), p.93

exception of hundreds of annoying tourists buzzing around aimlessly. The drive to Estrela was filled with old, scary roads, curves and impressive sights. Many abandoned villages and fertile lands. No traces of forest fires in this part of the mountain range.

In conversation with Alexandra, the night guide, I learned that the forest fires in Portugal. Due to two species of trees that have been imported to the Iberian peninsula - Eucalyptus and Acacia. The first one is grown for the quality of its wood and its fast growth and the latter because of its beauty. Acacia doesn't have market value but it is so invasive that the country has tried many different ways to control its growth - yet without much success. Both of these trees contribute to forest fires, making them a threat to the ecosystems and perhaps one of the most important reason why Portugal has so many forest fires. Eucalyptus sheds its bark throughout the year thereby forming a perfect ground for a spark to burst into forest fire. Acacia's seeds pop in fire, shedding pieces of the tree further.

Reached Sabugueiro in the early afternoon. The change of landscape was striking yet it happened gradually.

It felt as if I entered not only a different territory but a different time as well.

The chance would follow me here too. The first evening at Serra da Estrela, right before I was about to finish my walk through the new territory and head over to the apartment I noticed... I was welcomed by a photometeor - a rare cloud iridescence.

Cloud iridescence

Perhaps we could understand photometeors as "atmospheric images". However, the etymology of the word comes from phös / phöt which is Greek for light and meteōra - Greek for "the celestial phenomena, things in heaven above," plural of meteōron, literally "thing high up". So in translation, photometeor means the light of the things above.

Cloud iridescence or irisation is a colorful optical phenomenon that occurs in a cloud and appears in the general proximity of the Sun or Moon. It happens as a consequence of several parameters coming together,

sun being almost at the sun set, at the right angle from the cloud, that is a thin cloud, high up in the atmosphere that has formed ice crystals that reflect the sunlight. The colors resemble those seen in soap bubbles and oil on a water surface, or a liquid crystal. This is also what I thought when looking at it - that it resembles the liquid crystal light/color play - one of my most recent works. I hoped that it would increase in strength and so I chose to walk to down the road to a better view - a bridge over a small river. By the time I arrived the sun has set even lower and the iridescence decreased, slowly fading away. Knowing that the event has passed, I walked back to the lodging.

Week 2

Monday 24 July

This was a free-flow day. I spent the morning writing my response for Publico's article on AI in the creative sector. In the afternoon I drove to nearby Lake Comprida. Just 15 minutes away it was a wonderful sight to see. A hydroelectric plant, the grand artificial lake enclosed in the walls made of the same granite stone as its environment and the lovely path that leads to the highest peak of Portugal - Torre. I knew I might come back here for the guided tour tomorrow so I went for a short hike, not moving too far. On the way back I noticed these metal poles and the sound that was produced by them. Accidental art installation - wind flutes.

Wind flutes

Any flute is a wind flute but can one be designed to produce certain tones when East, West, North or South wind blows? Would there need to be 4 flutes or could it all be packed in one. I would like to research this further and experiment with a plastic or metal tube and wind. This would be such a nice place and a nice work for this site.

Tuesday 25 July

Grocery shopping and lunch at the main square in Saia. This is the day of the big guided tour through Geopark Estrela with Lucas Cezar, a biologist turned ge-

ologist who works for the parks' association. We met at 3 pm in the village, had a coffee got some stuff and all went into one car. First stop Lago da Comprida.

Serra de Estrela tour Lakes & glaciers

500 million years ago this mountain was as high as Himalaya. With the movement of African and European tectonic plates the mountain changed, went down and made a plateau. So with the last Ice Age (although it is very south) the high mountains allowed for the ice to form and the glacier valleys were formed between 100.000 and 12.000 years ago.

In the high mountain there are about 30 lakes related to the action of glaciers - some permanent some temporary. They are interconnected and leading to 4 power stations in the valley. This system was built in the 20th century. It was important for economy, wool production and industry. It meant that some cities in the vicinity had electricity before the cities at the coast.

The only place in Portugal where you can ski. But in the last years there is no snow. Back in the day, the locals would do saint parties where they used the ice from the top of the mountain to cool the beverages. This is unthinkable now.

There are three levels of altitudes for the mountain flora and fauna. Here we have species mixing from bottom and top of the mountain. Endemic species of Iberian peninsula have been restricted here and their closest related species are on other mountain tops. Such as a long horn beetle, a subspecies of lizard, etc.

An expedition in the 1950s (preparing for a trip to Africa) with geologists, biologist and a doctor learned that it would be good to make a health rehab and tourism in this area. Lichens we're indicators of good air quality so they've built tuberculosis treatment centers. A Portuguese Davos. However, it turned out that the granite houses can be poisonous because the stone has a radioactive component. One sanatorium nearby got people more sick then when they came in and they found out that it was due to radiation radiating from the stones.

Quartz Seiso Branco - where in between granites magma formed white and pink quartz. Close to Vale do Rossim.

Then, we went to Torre.

The highest point of mainland Portugal used to be 1991 m. Then as the story goes - King Don Juan VI (the one who ran to Brazil running away from Napoleon) ordered a pile of 9 m to be built on top of Torre to reach the 2000 m. First cartography 1802. In the second measurement in late 19th or 20th century showed that it is 1993 meter. The tower on top of the highest point is now 7 meters high so to reach the 2000 m goal, but in fact it has been changed and cut for 2 meters. Remodeled in 1949.

Abandoned observatories

The two blue-domed towers were used as radar trackers during the Cold War. They were tracking the European air space as Portugal is strategically located on the Atlantic Ocean. Today they are used by the police and the forest emergency services as storage. Maybe open on weekends. Listed as historic monuments. In the vicinity there was also a church, still in use today with a remarkable view onto the valleys, a view so open that it seemed you could almost see the sea.

Our Lady of the Good Star

From there we headed to Our Lady of the Good Star (Nossa Senhora da Boa Estrela) - a carved Mary in the rock where the legend has it Mary (as a shining star) helped a Shepard during a storm. She navigated him to the rocks where he could hide and wait for the weather to calm down. A priest from the nearby village ordered a sculpture to be made in the rock where the shepherd hid in 1949.

The glacier valley

From the rock carving we headed by foot into the glacier valley. Already here it was obvious that we were standing on what once was an ice bedrock. The ground was soft, full of small springs, green grass and tiny creatures in air and in water. The nature was booming and we were careful not to make too much disturbance. Walking up hill we reach a large rock with text inscription. From there we begin the climb that would last another 20 minutes.

The glacier valley was a beautiful and almost unreal experience. A walk through time accompanied by stones. Reaching an open point from which we could see the east side of the mountain range. Such a

remarkable view and such observable differences in the shapes, colors and patterns in the ground.

I noticed a plant with small, yellow flowers growing shyly in this tough terrain. Known as Caldoneira, it is an endemic species of the Serra da Estrela. It reminded me of narcissus but it is actually a flowering species from Fabaceae family or otherwise known as legumes.

Paulo Sergio Pereira - Amateur Astronomy Club, Sao Gao (Clube de Astronomia do Alva)

We went off for an almost hour long drive to Sao Gao to meet and visit Paolo, an amateur radio astronomer who works at the Travancinha observatory. First we decided to go for dinner as we spent most of the day on foot. Furthermore, visiting the observatory is better in the evening and Paolo got stuck with work. We were on a camping site restaurant that also had duck enclosure. It is a site that once a year, after the Boom festival, gets fully occupied. It looks like a perfect spot for an after party of a trans festival - rocks and river, swings and flowers.

Paulo has such a lovely energy walking to the terrace and introducing himself. He says right from the start I hear that you are an artist and I really don't know how I can help you. At that moment we are all a little clueless and unaware that he will have some really nice leads for my artistic research.

He begins talking about what they do at the amateur astronomy club he is running at Sao Gao. He says they have modest equipment, working from an old school building. Wondering for days now how come I didn't get to meet any meteor hunters - while in open nature with so many astronomy professionals and lovers, I ask Paulo if he knows of any in this part of the mountain. He says no, but they recently started looking for micrometeorites at their astronomy club. Micro-meteorites?!

Cosmic dust

Micrometeorites, micrometeorites or otherwise space dust or star dust are small particles of rock from space that have survived entry through the Earth's atmosphere. Usually found on Earth's surface, mi-

cro-meteorites differ from meteorites in that they are smaller in size, more abundant, and different in composition. The IAU officially defines meteoroids as 30 micrometers to 1 meter; micrometeorites are the small end of the range (~submillimeter). They are a subset of cosmic dust, which also includes the smaller interplanetary dust particles (IDPs)

Micrometeorites have mainly been found in the Antarctic, but also to some extent in prehistoric sediments, remote deserts, and in glaciers - places that are clear of the confusing anthropogenic influence.⁴ Yet in recent years and with the popularization of the project Stardust led by Norwegian photographer and researcher more people are finding micrometeorites in urban areas too. Paulo is learning this craft from Michiel Klaassen - a Dutch amateur astronomer who is also the owner of the largest antenna dish in mainland Portugal. A Dutch amateur radio astronomer in the middle of the Portuguese mountains with a large radio dish antenna? I have to know more!

Paulo tells that Michiel runs a separate amateur astronomy space, his own - named PARAC.EU. He is located outside of Sao Gao in the part of the mountain that doesn't even have a paved road leading to his house. He goes to visit him occasionally but for that he uses a four-wheeler motorcycle - a quad. He could see with him if he would be interested in welcoming us at his estate, if so we could visit him one of these days. I say yes immediately.

After dinner we headed out to the Clube de Astronomia do Alva Located in the old school building of Sao Gao that also serves as community center, the group of amateur astronomers has acquired some very nice equipment. Paulo shows us their telescopes with computerized mounts and tools they use to look for micrometeorites - from ultrasonic cleaners to microscopes and everything in between.

Mentioning my interest in camera-less photography and finding new ways of capturing light phenomena, Paulo shares his interests too and mentions that he was making Cyanotype kits with his girlfriend that are available online (<https://mariaazul.pt/>).

Paulo is fascinated by some many things and is curious and wondering just like a little child. Just like me.

⁴ *In Search of Stardust: Amazing Micrometeorites and Their Terrestrial Imposters*, Jon Larsen, Voyageur Press 2017; p. 7

He mentions how much he is intrigued by Red Sprites - large, vertical, red lightning strikes that form above thunderstorm clouds that he once managed to photograph himself. On our way out, he gives me a laser (strong as the one Samuel was using at the lake) and while I am outside playing he tells me how he thinks of village lights as constellations and he would like to do a project around it.

Wednesday 26 July

Strange day with the article from Publico published in the morning without prior notification. News about Janet and her accident.

Going to Valle do Rossim to check out the location and then to Manteigas. In Manteigas I first went to buy the newspaper, then to see the exhibition of minerals located in the area and then to Lukas and Geopark office. He gave me National Geographic magazine issues that featured Estrela and a few brochures with more information about the localities. I wanted to take a first sample for the micro-meteor search (Paulo gave me some zip-locks) but I forgot. Dinner at Infusio restaurant next to the river that once again reminded me of Norway. (The day before we were mentioning Norway quite a lot and then Paolo says that the guy who started this whole search for stardust is actually Norwegian. This link I think comes from the fact that Norway is the only other country I've been to that has glacier valleys).

On the way back I stop at Lake once again to look at the conditions for projection. Difficult of setting it up outside - electricity cable too short, too much light from the sun and the moon, no projection surface. So one idea is to project on the lake, on the stone or on the portable screen.

Thursday 27 July

Got up at 8. The boy shepherd with his dozen goats passes at the same time 8:30 am as previous days. I get ready right away and I'm waiting for Lucas to let me know if Fabio Silva, the archaeologist working on dolmens is there and available to meet with me today. Lucas texts and says that everything works! They are on the excavation site from 7-12 and 16-19h.

Carregal do Sal megalithic nucleus

I leave Sabugueiro around 10:30. It is about 50 minute drive from the mountain to the valley. I plan to arrive 30 minutes before their break so not to disturb their work too much. I arrive at Carregal do Sal, passing a beautiful old village Oliveira do Conde. Entering the circuito pre-historico (prehistoric circle) the road turns into cobblestone and I go higher up and deeper in the valley. There are more than 30 dolmens in this area alone that have been surveyed for the orientation of their entrances. Fabio Silva is the scientist exploring the orientation of these megalithic structures to the sky. Actually, he is an astronomer who became an archaeoastronomer.

Fabio studied Physics at Alveiro, just like prof. Domingos Barbosa - the astronomer running Pampillosa da Serra observatory. He then went to UK where he did his PhD in Astrophysics. Interested in the theoretical cosmology and the origins of the universe, as his post doc he wanted to study the string theory and see if Einsteins relativity theory could be used without the need of introducing Dark Energy into the equations. As there was no funding to continue this research (all the funding ofc goes to the formations of galaxies and the observable events in the universe) he thought that maybe he could shift gears and go back to some of his old loves - history. He found a Master study in Wales that was in Cultural Archeology that combines knowledge about time, sky, ethnography and other disciplines with archeology. He got in and very quickly his mathematics and physics background became useful for the research of the archaeological sites. Today he works in the field of archaeoastronomy which is a very small community, with about 80 researchers in the entire world.

First we meet at the current excavations site: Orquina da VÍbora, then we walked past Orca 2 do Ameal and Orca 1 do Ameal towards the Dólmen da Orca ou Lapa da Orca - one of the largest monoliths in Portugal and one of the best preserved. All of the monoliths in Carregal do Sal are just a kilometer or two away from Mondego river that originates at Serra da Estrela.

Other researchers on site: José Manuel Quintã Ventura and archaeologist leading the study Telma Susana de Oliveira Ribeiro. Ventura mentions that he has worked in the Balkans (I thought of Roman sites where I also used to work for a summer of conservation work) but no, it was in Croatia digging up mass-graves after the civil war (to my surprise). Painful to

know also not the reason why we are there, I hesitated to ask anything further. He also mentioned another mass grave site he excavated and said that he doesn't have a problem with digging up dead people, he has problems with the living ones.

During our walk past different dolmens, Fabio mentions a study done in Scotland that explored sound transmission through the ground between two Neolithic cairns.⁵ They had a drummer in one of the two mounts that were located near to each other and had their entrance passages oriented on different sides. One drummer was playing in one dolmen and you could hear it on the surface only if you were within the sight of the player (standing directly in front of the entrance). However, the second drummer in the second dolmen could hear the drumming perfectly in the distant mount. The sound traveled through the ground via vibrations (infrasound) and so the theory was proposed that the spaces were used to also amplify the surrounding sound. I later learned that the whole area of study came out of such research called archaeoacoustics and it began with Aaron Watson's explorations at the stone circle Easter Aquorthies in Scotland 1995.

Carregal do Sal, area was full of Neolithic and early bronze age monuments. The settlements were seasonal, during winter they were living on the plane and the speculation is that the tribes went to the mountains in spring-summer. But there is no evidence of settlements at all in these times neither in the valley nor in the mountain.

Settlements were more like camp sites, therefore there are no remains of the building but only traces of the food they ate. They have found acorn - burned therefore prepared in the season in which they grow which is autumn. There is evidence of human usage of the good pasture in spring and summer since the fifth millennium BC.⁶

Dolmens are man made elevated caves. They are burial mounts supported by the monumental stones. Closed off and dug in. At that time the soil was going up for several meters - so they would first dig and then cover (it wasn't as it appears to us today). No

human remains are found as the earth is too acidic.

Orquinha da Víbora (Viper monument)

The site they are investigating was probably used as a burial site. According to Ventura it was made for a man, a warrior, who wanted to be remembered but not have the monument easily seen since it is located in between two big rock plates, geographical markings in the landscape. From the point of the site you could see the mountain range (this is true for all of them). They have found two or three whole rock plates that were found that had an unknown function. It's a later site - or they suspect. It was dug up before, this is the second dig (in the description it says that it was discovered twice as it is not very noticeable). There are different theories about it and they don't really agree on it. They didn't find any deposits on the location (yet).

Orca 2 and 1 do Ameal

Not all dolmens are intact. Sometimes they are moved or replaced - sometimes the locals move them or ride bikes over them. Over time they get re-purposed. How do we know which stone goes where? Because of the holes in the ground (there is a name for it). With these they can sometimes reconstruct the formation.

Walls were incomplete, there were three left - one of them is standing upright which is not original. On the second one the top was replaced we can see that it was cut with modern tools. On one of them the entrance was simulated by one of the previous archaeologist but we have no evidence how the entries looked. A lot of it is guess-work.

Archaeoastronomy

Archaeoastronomy is a new discipline or rather an inter-discipline that studies the relationship between culture and astronomy and more specifically the astronomical alignments, orientation and symbolism in ancient and modern architecture. Effectively, archaeoastronomy falls under the larger Cultural

5 *Acoustics at the Grey Cairns of Camster*: <https://www.aaronwatson.co.uk/grey-cairns-of-camster>

6 Silva, F., (2013) "Landscape and Astronomy in Megalithic Portugal: the Carregal do Sal Nucleus and Star Mountain Range", *Papers from the Institute of Archaeology* 22, 99-114. doi: <https://doi.org/10.5334/pia.405>

Astronomy that studies our relationship with the cosmos.⁷

Researcher Fabio Silva has been investigating the Carregal do Sal megalithic nucleus for several years now. He has come to the conclusion that there are two stars that are found in the 10° sky view of all the mound entries in this nucleus and they are: Aldebaran (Alpha Tauri) and Betelgeuse (Alpha Orion).

At the end of April Aldebaran would show up to signify the coming of the new season. The shepherds today also go to the mountain on the 1st of May, however our sky view has changed since.

Some theories of what the dolmens were used for include: places of worship, initiation, burials, death and rebirth. Perhaps they were used for reading the sky: calendar, navigation – as a sort of camera obscuras or lens-less telescopes.

Lab studies under these conditions you can see fainter stars than usual. Aldebaran would appear as a red star very noticeable on a blue background. People in the mounds would see the star three to four days before everyone else if they would spend longer periods of time in the darkness, adjusting to the starry sky. Aldebaran is one of the 15 strongest lights on the northern hemisphere sky and it is a red giant that appears red also from the earth. It is located close to the Pleiades cluster that is visible to the naked eye (and from where we get the meteor showers usually early August – this year peaking around 12 August as Paolo tells us in the meeting on Tuesday).

Aldebaran (Alpha Tauri)
Arabic: “The Follower”, “ناربدل”

Aldebaran is a red giant, meaning that it is cooler than the Sun with a surface temperature of 3,900 K, but its radius is about 44 times the Sun's, so it is over 400 times as luminous. As a giant star, it has moved off the main sequence on the Hertzsprung–Russell diagram after depleting its supply of hydrogen in the core. The star spins slowly and takes 520 days to complete a

rotation. Aldebaran is believed to host a planet several times the mass of Jupiter, named Aldebaran b. The planetary exploration probe Pioneer 10 is heading in the general direction of the star and should make its closest approach in about two million years.

“The emergent narrative, linking a cluster of dolmens to a local mountain range and the star Aldebaran, not only fits the archaeological record, but is mirrored by local folklore, lending further support to the validity of this methodology.”⁸

After lunch with Fabio and his crew, I head back to Sabugueiro, stopping to observe the clouds rolling over the mountain at about 1000 m. I saw a hummingbird (slavuj) or a similar bird that feeds from the nectar of the flowers and I saw it disappear in the clouds. Sabugueiro was sunny with blue skies and warm weather – this climate shift has been a dramatic twist to an already such a full and surprising day.

Friday 28 July

First part of the day I spent writing and preparing for the presentation the next day. The second half of the day had a busy schedule. I met with Paulo who organized a visit to Michiel Klaassen and his PARAC station as well as a visit to Travencinha observatory where I also met with Dr. Miguel Pinto.

Portugal Amateur Radio Astronomy Center (PARAC)⁹ Michiel Klaassen is an electrical engineer who has been an amateur radio astronomer for a long time. He has worked at Dwinglo Observatory in The Nether-

⁷ Cultural Astronomy and Astrology (MA), University of Wales (<https://www.uwtsd.ac.uk/ma-cultural-astronomy-astrology/>)

⁸ Silva, F., “A Tomb with a View: New Methods for Bridging the Gap between Land and Sky in Megalithic Archaeology”, *Journal: Advances in Archaeological Practice*, 24-37 [<https://staffprofiles.bournemouth.ac.uk/display/journal-article/309098>]

⁹ <http://parac.eu/index.htm>

lands and it is there where he worked as a volunteer offering his technical knowledge and learning more about astronomy equipment. With his wife he bought a piece of land in the mountain where they spend most of their retirement.

The antenna he installed on his estate is the largest one on mainland Portugal. It is a 9.3 m diameter solid surface satellite dish – larger even than the one at the Pampilhosa da Serra Observatory. He bought it from the Dutch police on an online bid and transported it to the road-less mountain during the corona pandemic. It was shipped in pieces and he worked for months on its reassembly. He was kind enough to show me all the details of his observatory and the way he works.

The telescope has two 3-phase motors that drive the azimuth and elevation servo systems that allow Michiel to trace the objects on the sky with accuracy of 0.01 degree. It has a solid reflector surface that makes it suitable for observations of high frequencies up to 22 GHz.¹⁰ It is used to observe the hydrogen line¹¹ from our galaxy and maser signals from star-forming regions and late evolution of red giants or cool luminous stars.

Michiel is detecting hydroxide ('OH-molecule') in the formation of solar systems but also as Methanol CH₃OH. Methanol is found at the end of the cycle when the star ignites. The star expels lithium, hydrogen, nitrogen so you can't see it anymore – it is because it becomes obscured by the clouds of elements it expels. With this telescope you can peak inside. In the end it becomes a red giant going either to a pulsar or a red dwarf. As a pulsar it is also detectable.

He's posting his projects online and there you can find observations with listening frequencies on: 1.42 GHz – hydrogen line; 6.7 GHz; 450 MHz – pulsars; 12 GHz – masers. Michiel also showed me his setup and search for micrometeors, from whom Paulo is learning the craft. He had a lot of samples (all of them from The Netherlands), stored neatly and he offered me

one to take. In a cute little poison bottle I took my first micrometeor back with me, and finally I took it back to the country in which it fell. :)

Travancinha observatory

After a great and warm visit to PARAC, we went back with a quad through the hills and bushes of São Gião. We went for dinner and slowly made our way towards the Travancinha observatory. Arriving at 21:30h we saw a busy sight. With dr. Miguel Pinto the observatory was open to public and he was showing interested people around while trying to set the new telescope to work remotely (from the office below the dome).

The observatory is a new addition to the area and it officially opened in April 2023. Lead by a medical doctor and amateur astronomer dr. Miguel Pinto, Sergio Pereira, who is software developer and a small amateur astronomer community. They showed me their composite telescope that has a refractor and reflector aspects. We checked some large diffraction gratings he had and we observed Arcturus that was shining bright next to the Moon.

Arcturus is the fourth-brightest star on our sky. From the northern hemisphere, an easy way to find Arcturus is to follow the arc of the handle of the Big Dipper. By continuing in this path, one can find Spica, "Arc to Arcturus, then spike to Spica". Together with Spica and Denebola (or Regulus), Arcturus is part of the Spring Triangle asterism. Using diffraction grating we could see the composition of the star as a spectral analysis.

Optical spectrometers show the intensity of light as a function of wavelength or of frequency. Different wavelengths are separated by refraction in a prism or by diffraction in diffraction grating. The composition is determined by spectral signature of each element contained in the light emission.

I also briefly installed my setup with the Airy Disk and I've explained the optic phenomena to the small

¹⁰ São Gião Radio Telescope: https://en.wikipedia.org/wiki/São_Gião_Radio_Telescope

¹¹ Hydrogen line (aka the 21 centimeter line) is a spectral line created by a change in the energy state of hydrogen atoms. It is produced by a quantum state change where the electron-spin is reversed relative to the proton-spin. It is located in the lower end of the microwave region of EM spectrum and it is of great importance to astronomy. It has been used to reveal the spiral shape of the Milky Way, to calculate mass and dynamics of individual galaxies and to study the early Universe, among others.

crowd that participated in the experiment. I also tried using Paulo's green laser that he so generously offered to borrow me for tomorrow's open air presentation.

On the way back to Sabugueiro, the mountain again offered a theatrical play. The road was clear then foggy, clear and then mid-cloud and again at the same altitude of about 1000 m the clouds broke into clear skies. It is at this point where the clouds moves as waves of water that another photometeor happened - a Moon halo. It seemed that the Star mountain welcomed me and it was now saying goodbye.

Saturday 29 July

The last day of the residency. Most of the day was spent preparing the presentation that happen at the Vale de Rossim.

The presentation takes place at the end of the walk In Search of Erik Samakh's "Prilyampos", scheduled for 6:30 p.m. This is a circular route through the vicinity of the Rossim Valley reservoir, in which we revisit a history from about 300 million years to the present day, from the interpretation of natural heritage by the UNESCO World Geopark Star. With the support of Carlota Simões, from the University of Coimbra, we woke up to the relations between Mathematics, the natural heritage and the sky, in particular.¹²

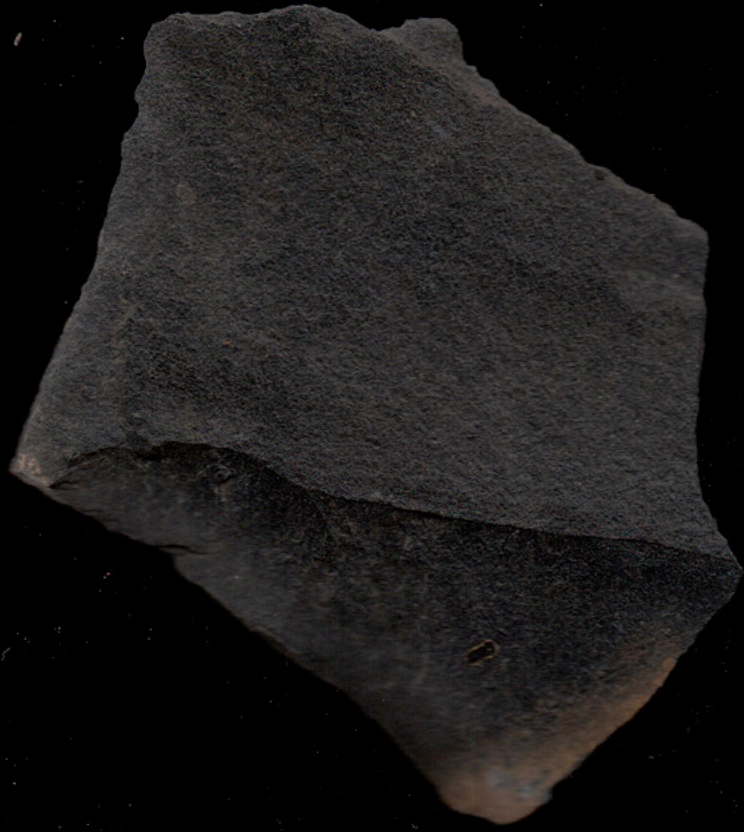
My presentation was a recap of the past two weeks, all the encounters, experiences and insights. The PDF of the presentation should be available online or by email on request. However, most of the visuals are incorporated in this document and found below.

12 News & events: <https://www.aldeiasdoxisto.pt/pt/agenda/em-busca-dos-pirilampos-de-erik-samakh/>



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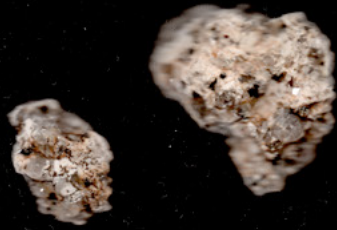






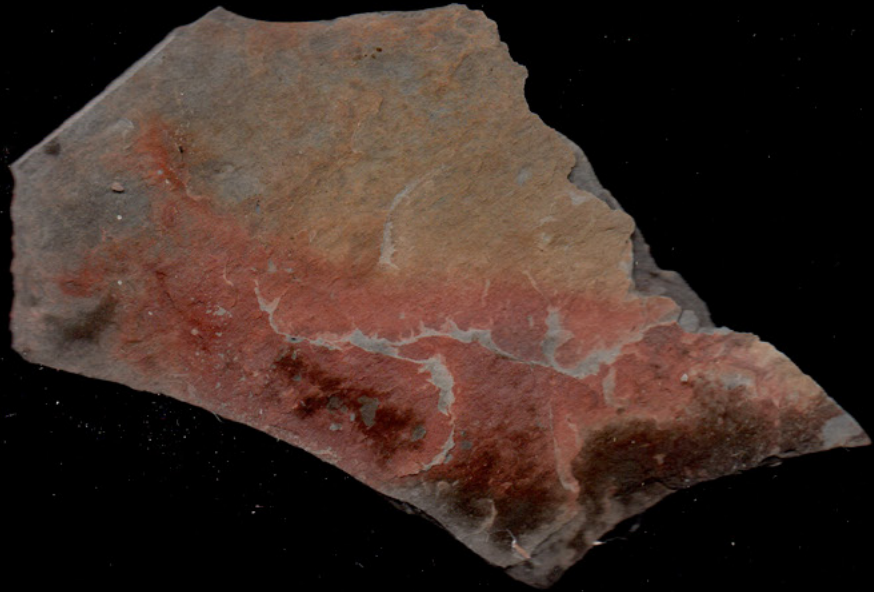


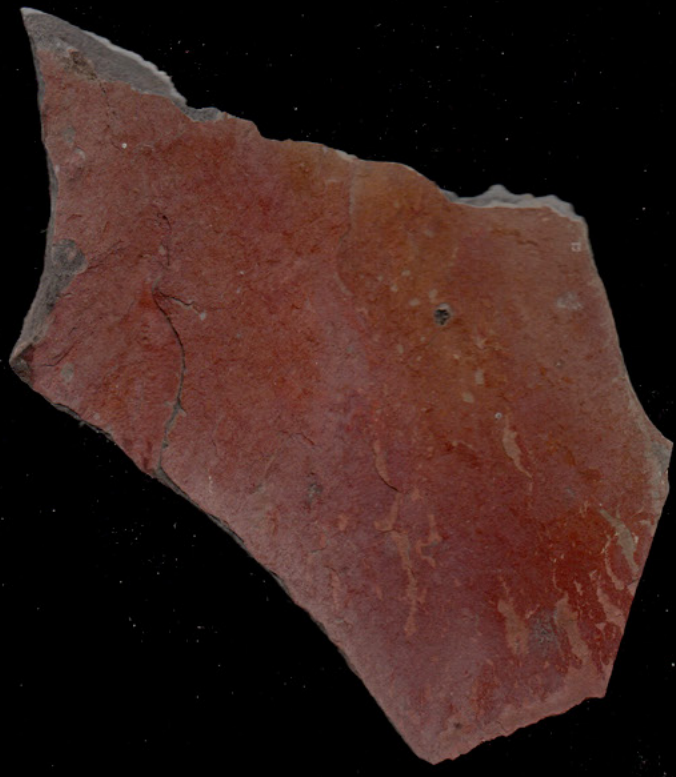
LAKE COMPRIDA (SERRA DA ESTRELA)
25-07-2023



CARREGAL DO SAL (DOLMENS NUCLEUS)-QUARTZ
27-07-2023







MICROMETEOR SAMPLE (SABUGUEIRO)
40.402294, -7.640728
28-07-2023



MICROMETEOR SAMPLE (LAGOA COMPRIDA)
40.365791, -7.645569
29-07-2023



PHOTO
DOCUMENTATION



17-07-2023
FAJAO



18-07-2023
PAMPILHOSA DA SERRA OBSERVATORY



19-07-2023
BARRAGEM DE SANTA LUZIA







22-07-2023
FAJAO



23-07-2023
SABUGUEIRO





24-07-2023
LAKE COMPRIDA



25-07-2023
WIND FLUTE



25-07-2023
TORRE



25-07-2023
TORRE RADAR TOWER







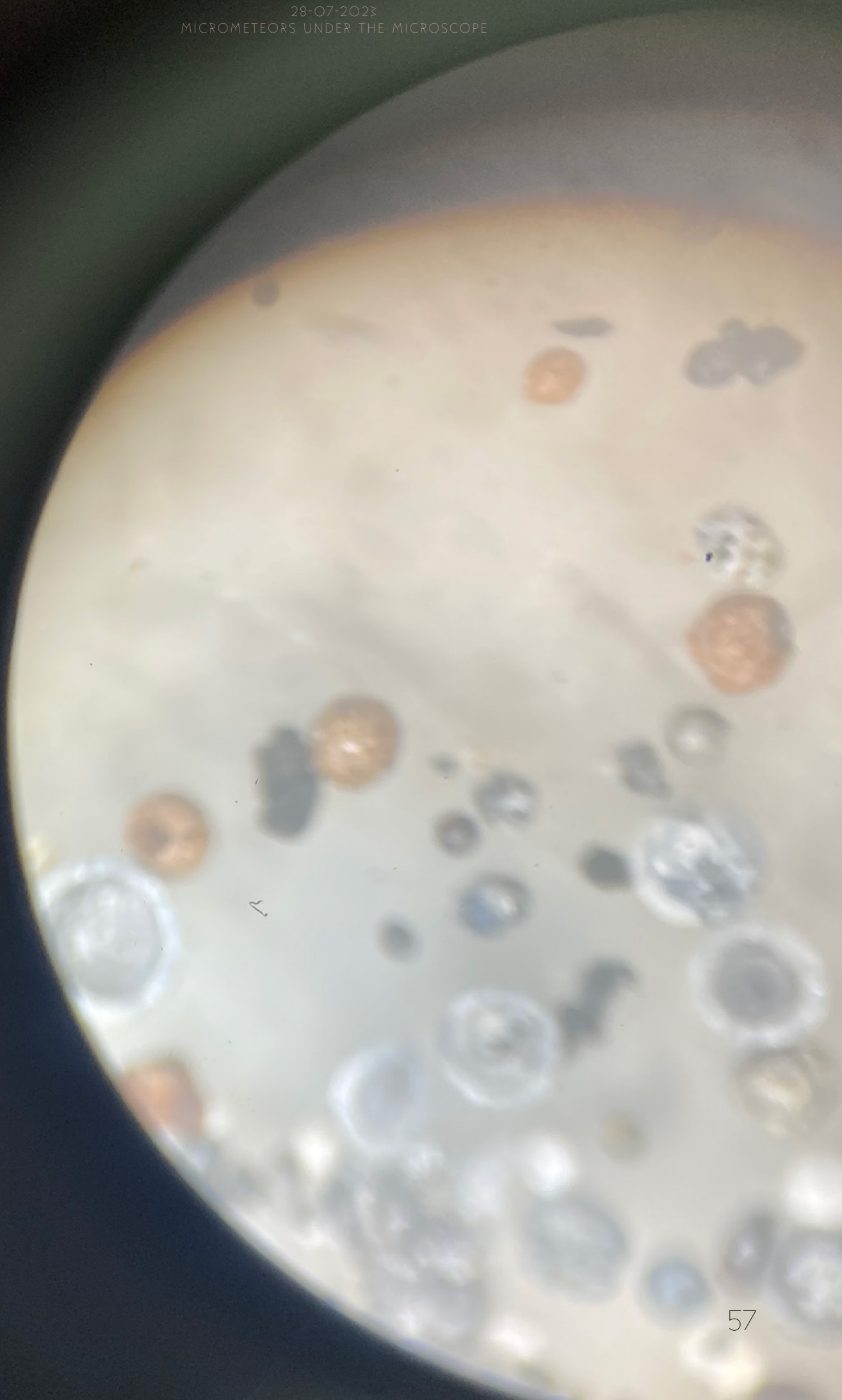


28-07-2023
GLACIER VALLEY



25-07-2023
SAO GIAO













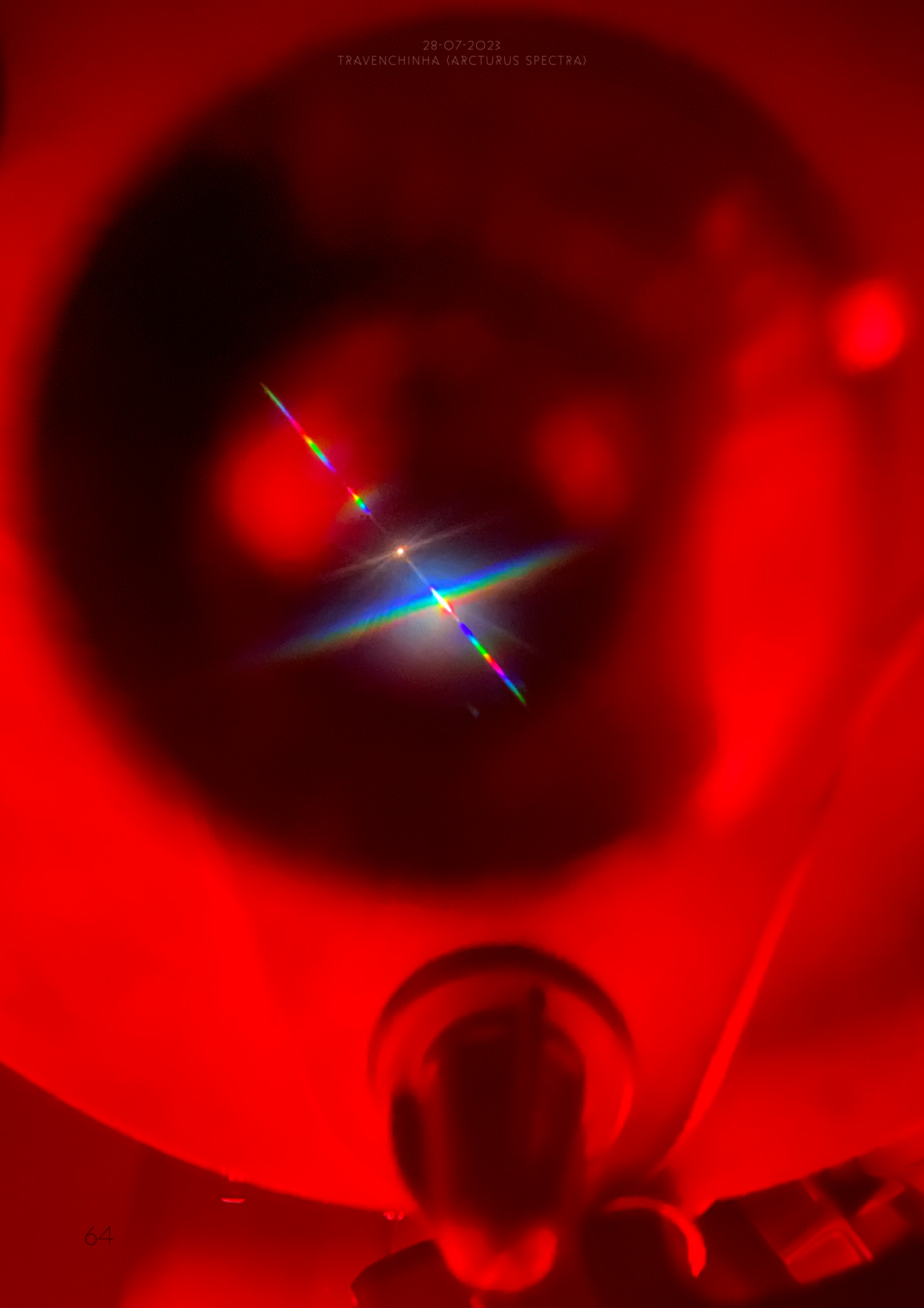
parac.eu



28-07-2023
TRAVENCHINHA OBSERVATORY









NEXT STEPS

DIGNE-LES-BAINS

The second part of Astronomia residency is scheduled for spring/summer 2024 taking place in France, again at two locations: CAIRN Center d'Art residency at Digne-les-Bains UNESCO Geopark and the Haute-Provence Observatory. The research trip will last three weeks. In one of the first preparing meetings I meet the director of the Observatory prof. Marc Ferrari. Very quickly, we learned that there is a nice overlap between our interests and that there is a fruitful ground for collaboration. The Airy Disk is a common method in optical astronomy and it is used in daily observations and imaging of exoplanets (with coronagraphs).

Exoplanets are planets found outside of our Solar system. The first one to be discovered and scientifically proven was in 1995 when two scientists working at the Observatory Haute-Provence had a realisation that the telescope data they were reading was not a binary star system but a star with a massive planet (hot Jupiter). This event marked a breakthrough in our search for life in the universe and it inaugurated a method for observing exoplanets. 51 Pegasi b, a planet in the solar system only 50 light years away, was discovered using a 1.92 m radius mirror telescope located in the Haute-Provence Observatory. For this discovery, two astronomers Michel Mayor and Didier Queloz received a Nobel Prize in Physics in 2019.

In preparation for the summer, I went for a short visit (23-29 Oct) to meet the scientists with whom I will be collaborating. This trip too was followed by photo-meteors. It started with cloud iridescence (seen from a plane) and it ended with partial Lunar eclipse on the 28 Oct. I visited Digne and spent several nights at the observatory in the company of astronomers working with the same mirror telescope. This was a fascinating experience. I learned about the methods and technologies they use but also about the way they live at night and in sync with the elements. I am excited to go back in the summer and continue the

research on ways of detecting exoplanets including direct imaging using Airy Disk and coronagraphs, transit photometry, spectroscopy and radial velocity. I also want to research the extensive exoplanet data (approx. 5529 planets, 4078 planetary systems and 885 multiple planet systems discovered yet).

“My devices don’t take me places they take me to different times. Zooming in on the map shows me years - now we are in 1840 and now in 1972.”¹

Looking deeper into the space means looking deeper into time. In that regard, astronomy is very similar to archaeology. They both navigate different times as much as they navigate the space, trace objects or movements. However, with the strange dream I had after visiting the observatory it became clear to me that the investigations into the limits of light and the limits of seeing, is a quest in (the limit of) time too. How far we can see is how far we can know in time. I’m curious to see where this line of thought will lead.

In their study of the exoplanets, the scientists at the Observatory are not only analyzing the size, distance and mass of the planets through the analysis of light - they are also able to determine the composition of the atmosphere (if the planet has one) - and all of this by just a few photos reaching the telescope mirror. Through spectrograms and the passage of light through atmosphere as through a prism, we are able to say that the composition of the atmosphere is mostly the combination of ozone, molecular oxygen, water, carbon dioxide and methane - as is the case of Earth’s spectrum.²

¹ A strange dream 27-10-2023

² Pallé, E., Osorio, M., Barrena, R. et al. Earth’s transmission spectrum from lunar eclipse observations. *Nature* 459, 814–816 (2009). <https://doi.org/10.1038/nature08050>



24-
KE



24-07-2023
LAKE COMPRIDA

ET DE PROPRETE
VOS REPAS
RE DISPOSITION.
PAS
ERVATION
ERVATION ROOM
THE KITCHEN

NE PAS OUBLIER
LES OBS DE SERVICE
DERRIERE VOUS !!!

Merci de faire
un petit point
à la fin de la journée



28-07-2023
MICROMETEORS UNDER THE MICROSCOPE



24-07-2023
LAKE COMPRIDA



28-07-2023
MICROMETEORS UNDER THE MICROSCOPE





28-07-2023
MICROMETEORS UNDER THE MICROSCOPE



FUTURE DIRECTIONS

I started an Astronomia residency with the intention of researching Airy Disk and other atmospheric and astronomical light phenomena that stand at the threshold of visible. The residency has granted me an extraordinary opportunity to work with an array of professional and amateur astronomers, specialists, scientific and cultural institutions in France and Portugal to explore this fascinating subject. It is a remarkable opportunity that has given me access to an extensive network and resources of the astronomical community but it also contributed to the invitation for the commission of new work by the Haute Provence Observatory. The work would be presented at the observatory site during the international conference in 2025 - marking 30 years since the discovery of the first exoplanet.

My interest in light and its (quantum) properties has been steadily growing and navigating my practice towards a new direction and this residency has been paving the way. In the future I'm looking to play with light in a mixed setting of an artist studio / optics lab / astronomical observatory - and create prototypes for light based works to be developed in 2025. Relating physical phenomena and concepts that connect the micro and macro - the cosmic, planetary and microscopic scales - this project is opening new doors to a spectrum of light investigations; from atmospheric light phenomena to optical and astronomical observations.

At this phase, there are many possibilities to explore and it is difficult to imagine the final form. However, I do intend to do various light experiments and make a light installation that combines optical and microscopic elements with astronomical observations. One piece could be a light observatory that invites viewers to explore the spectra of light. And the other could rely on micrometeors to be the speckles of dust in a light beam (as exoplanets appear from afar). Importantly, I want to make a link between micro and macro, by creating a setup that at first glance resembles an astronomical observation but that reveals a nano-sized light source.

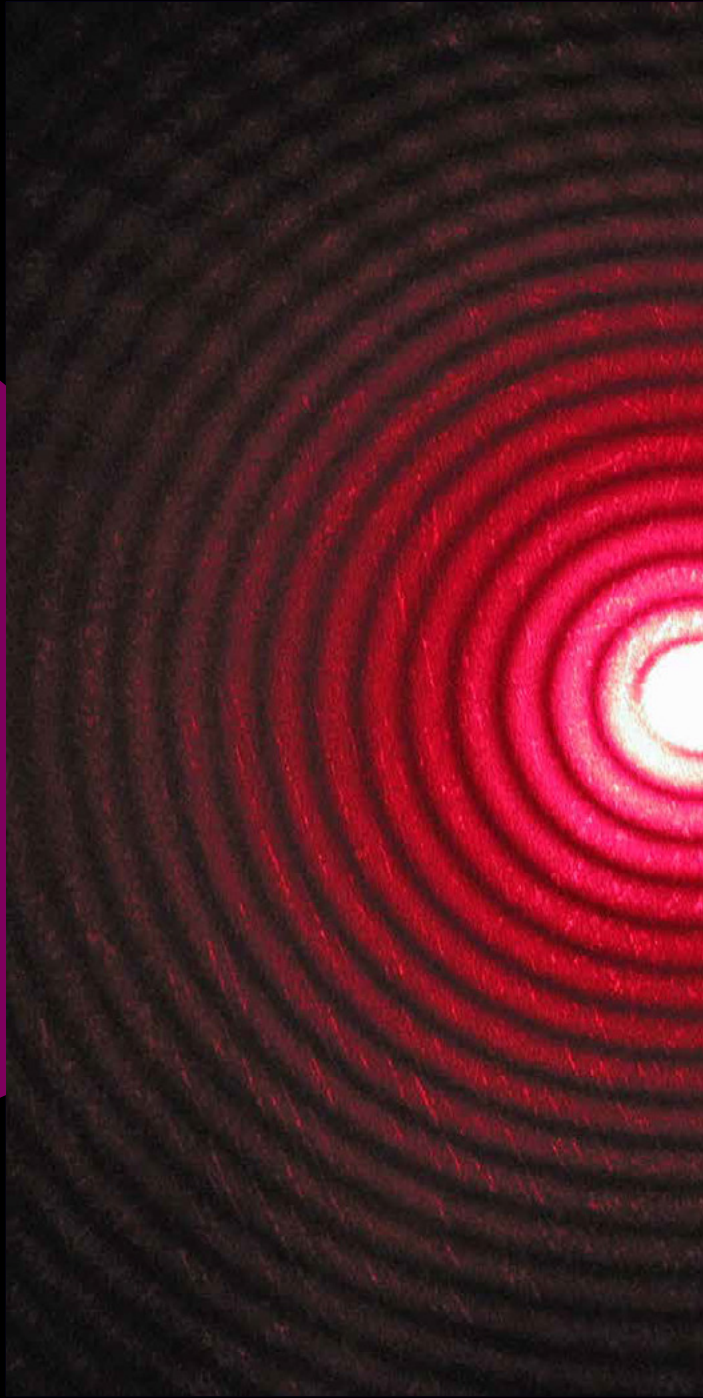
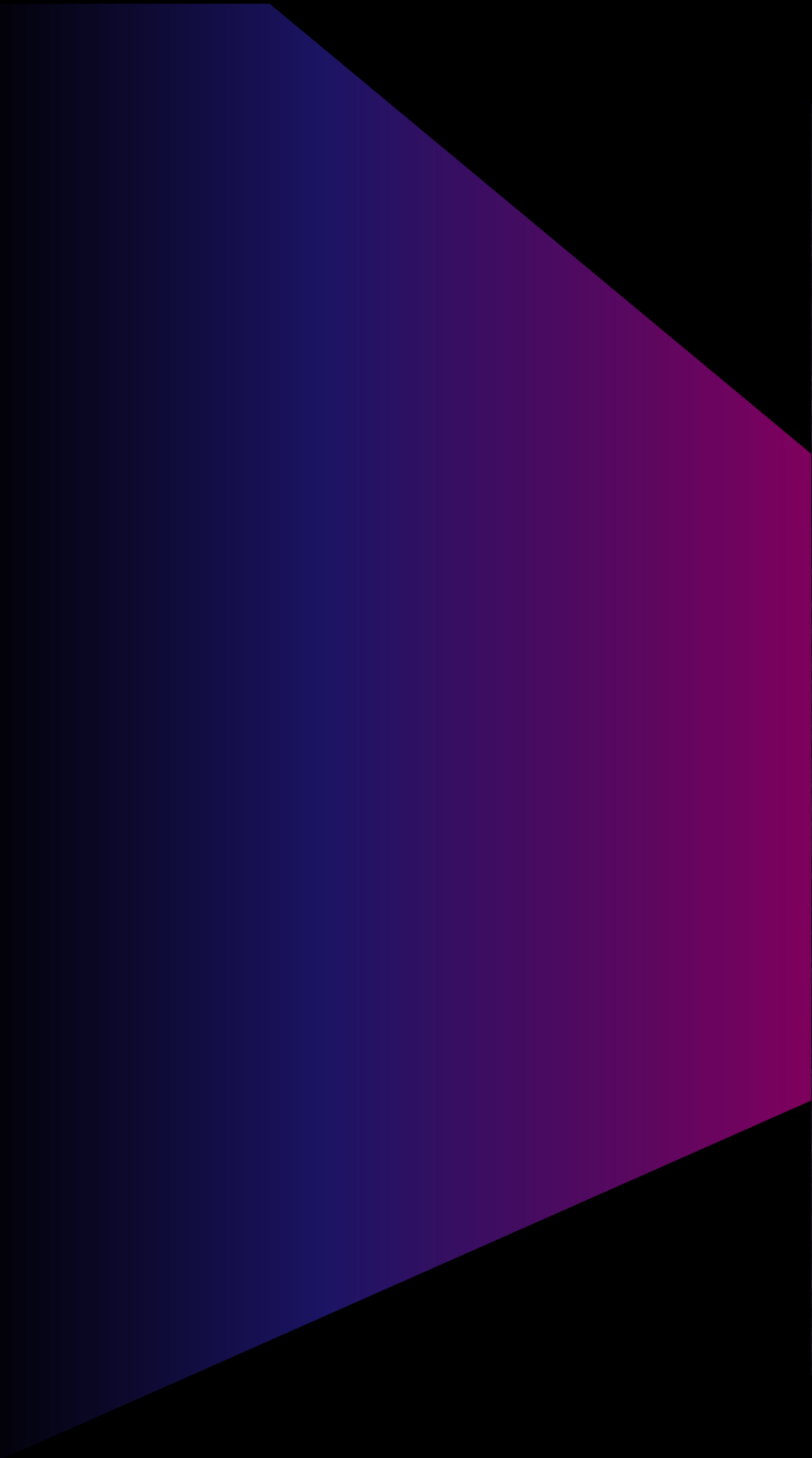
I will work at the Haute-Provence Observatory in early summer 2024 researching direct imaging, transit photometry, spectroscopy and radial velocity, and proposing works that can relate to some of their concepts, insights, scientific observations and data.

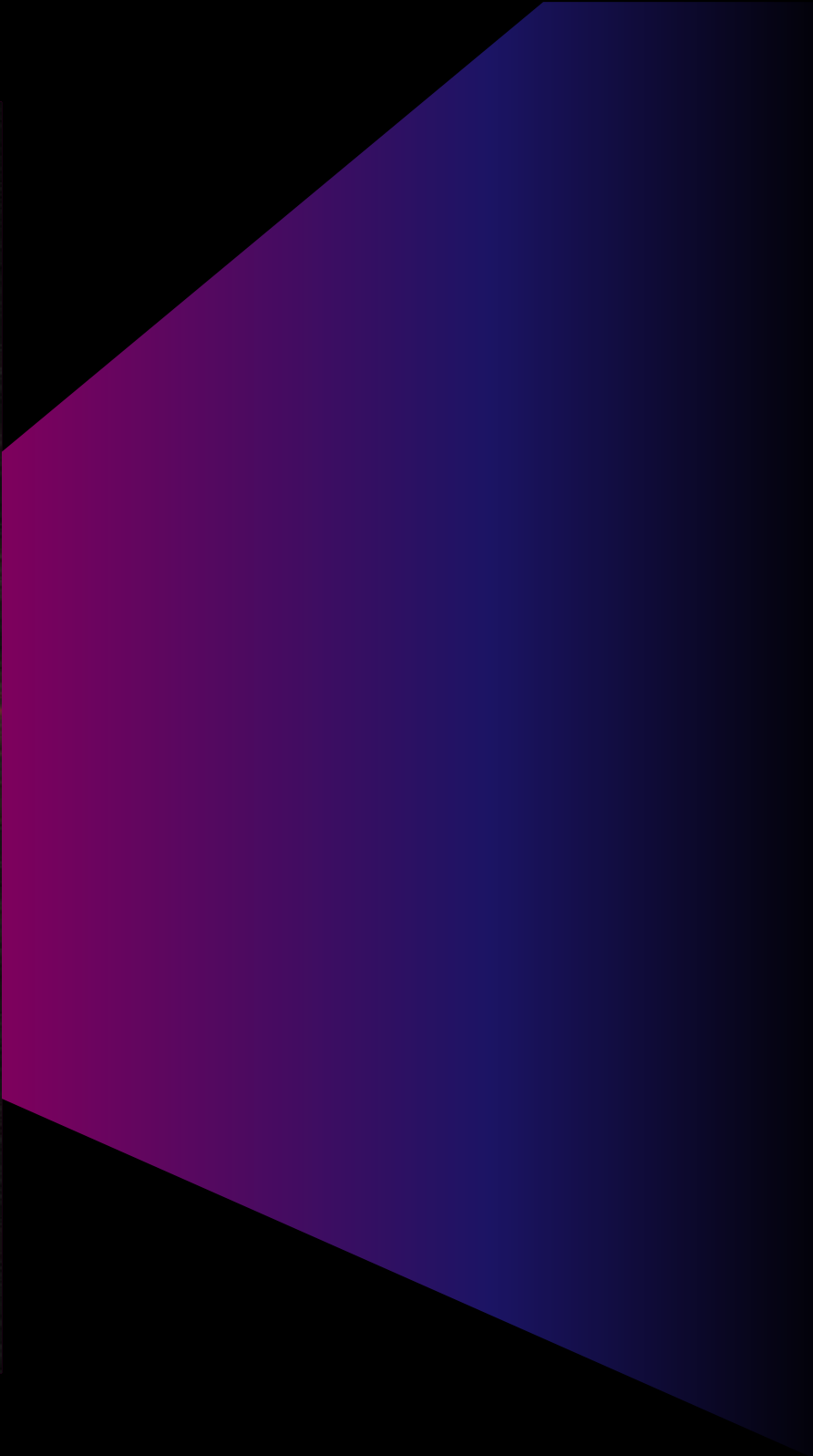
In addition, I have applied for Art Explora, - Cité Internationale des Arts residency in Paris that is geared towards ArtScience practices. If I am awarded, right after summer I would move to a studio space in Montmartre where I would work from, for the next 6 months (Sep. 2024 - Feb. 2025). The timing and location is perfect because being based in Paris during this time would not only allow me to travel more easily and more frequently to Haute-Provence but it would facilitate a continuation of exchange with French scientists and cultural institutions. My plan is to organise a body of research materials during these 6 months, develop a series of light experiments that I would present in studio visits and on location in Haute Provence and start the production of new works to be presented in 2025 at the Haute-Provence observatory, at the Museo Vostell Malpartida in Spain and possibly on locations in two geoparks in Digne-les-Bains in France and Estrela mountain in Portugal.

In short, project has the following stages:

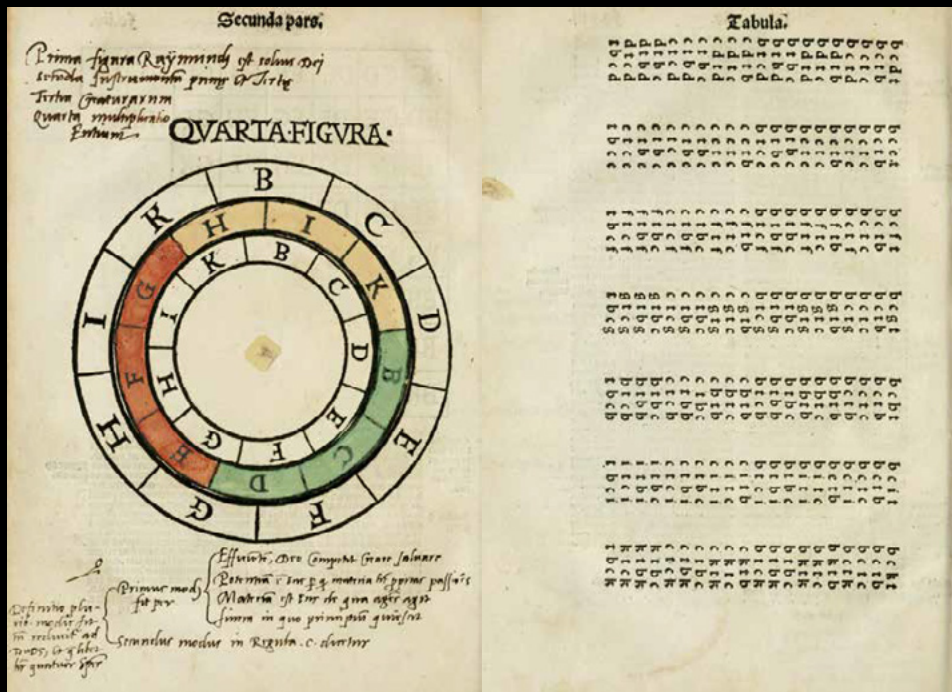
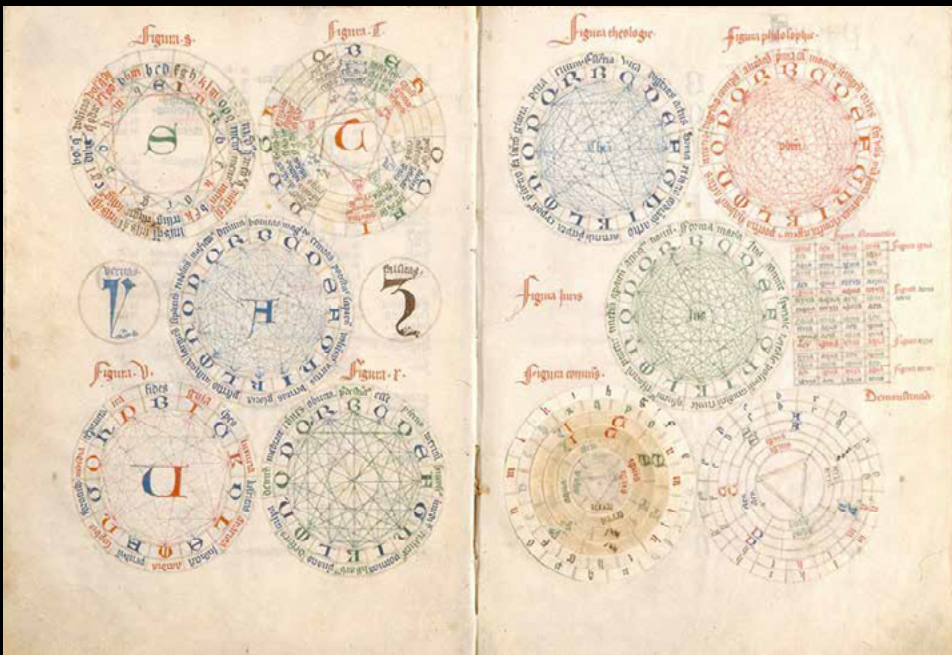
1. Preliminary research: first part of Astronomia residency in Portugal and preliminary research visit to France (summer/autumn '23)
2. Body of research - organising materials & prototyping light experiments: second part of the residency in France (spring/summer '24)
3. Development, test setups & presentations by invite: Cite des Arts (Sep - Feb 2025)
4. Production, site-specific development: Observatoire (Mar - Sep 2025)
5. Exhibitions: Museo Vostell Malpartida, Spain; open-air locations in Portugal and France UNESCO Geoparks and Haute-Provence Observatory in October 2025.

SKETCHBOARD



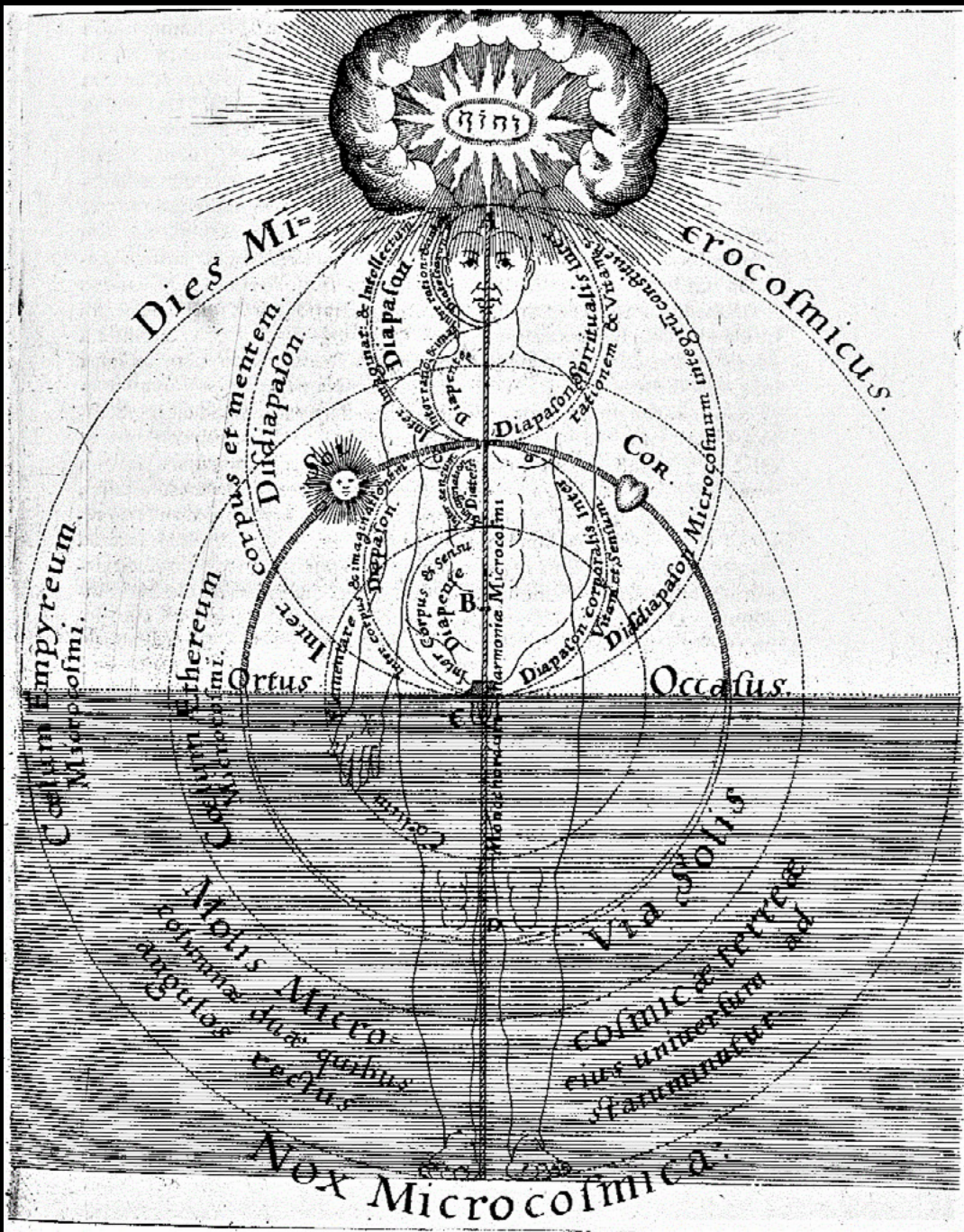


"As above, so below."



Quod est superius est sicut quod inferius,
 That which is above is like to that which is below, and
 - Hermes Trismegistus,

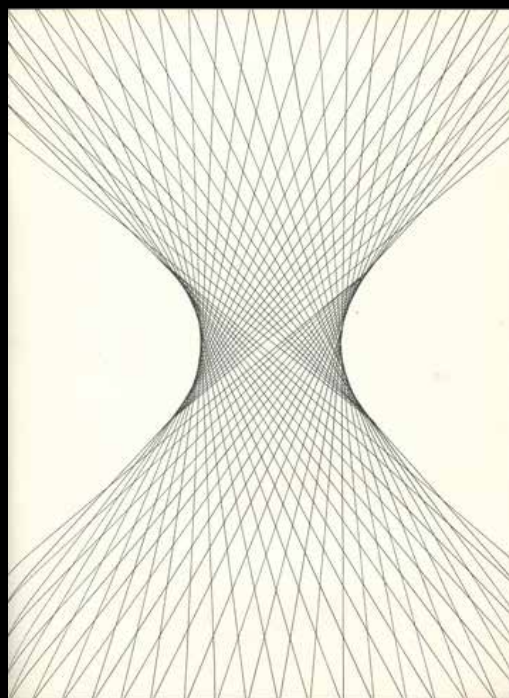
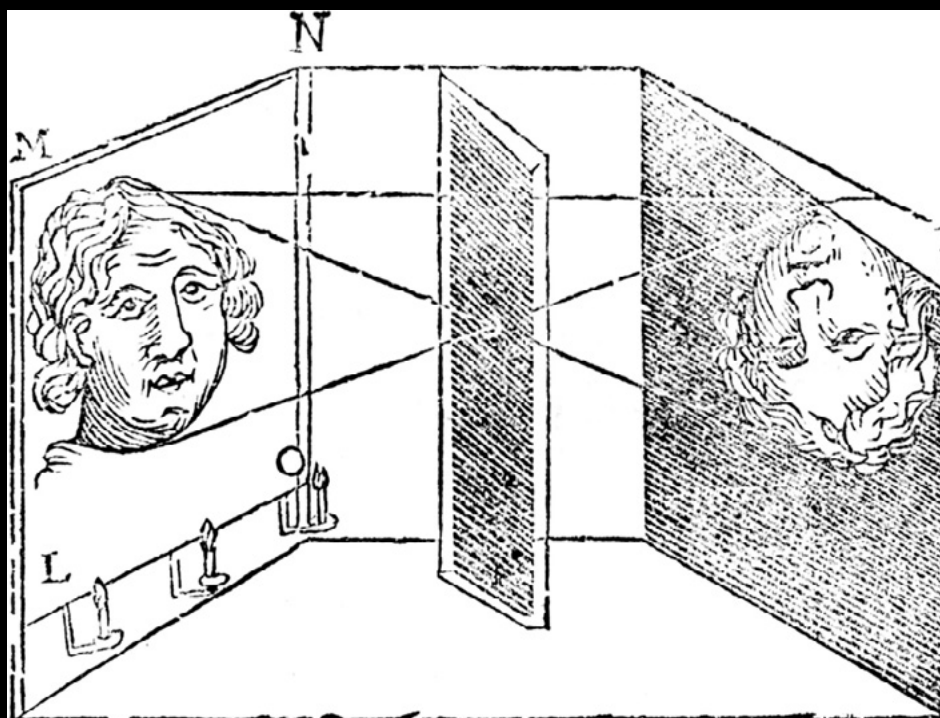
Ars Magna, Ramon Llull (1274)

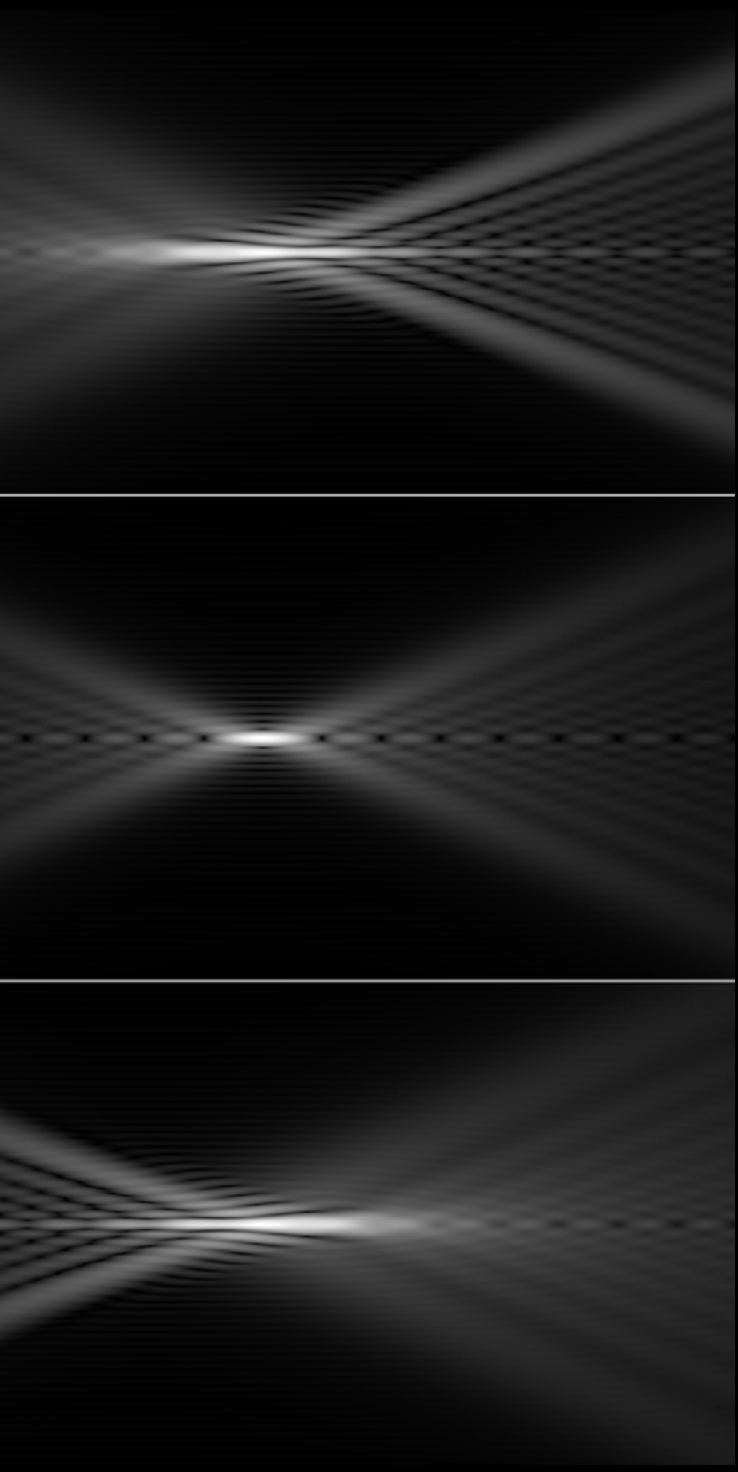
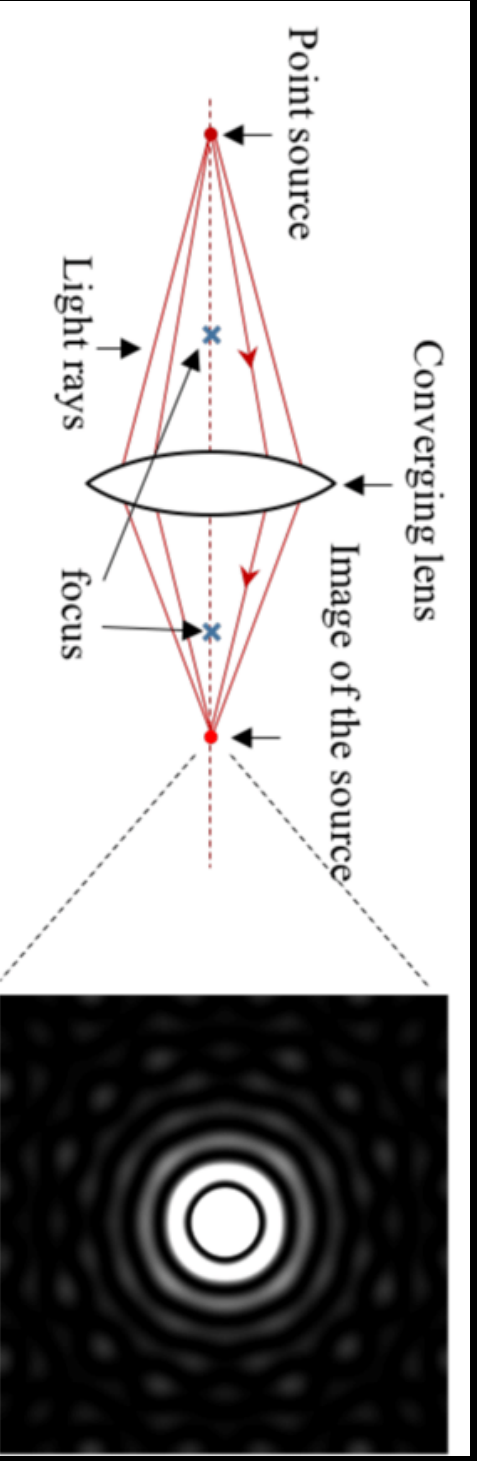


et quod inferius est sicut quod est superius
 and that which is below is like to that which is above.
 Emerald Tablet (XVIII c.)

Utriusque Cosmi, Robert Fludd (1617)

Point infinite (lens & mirror)

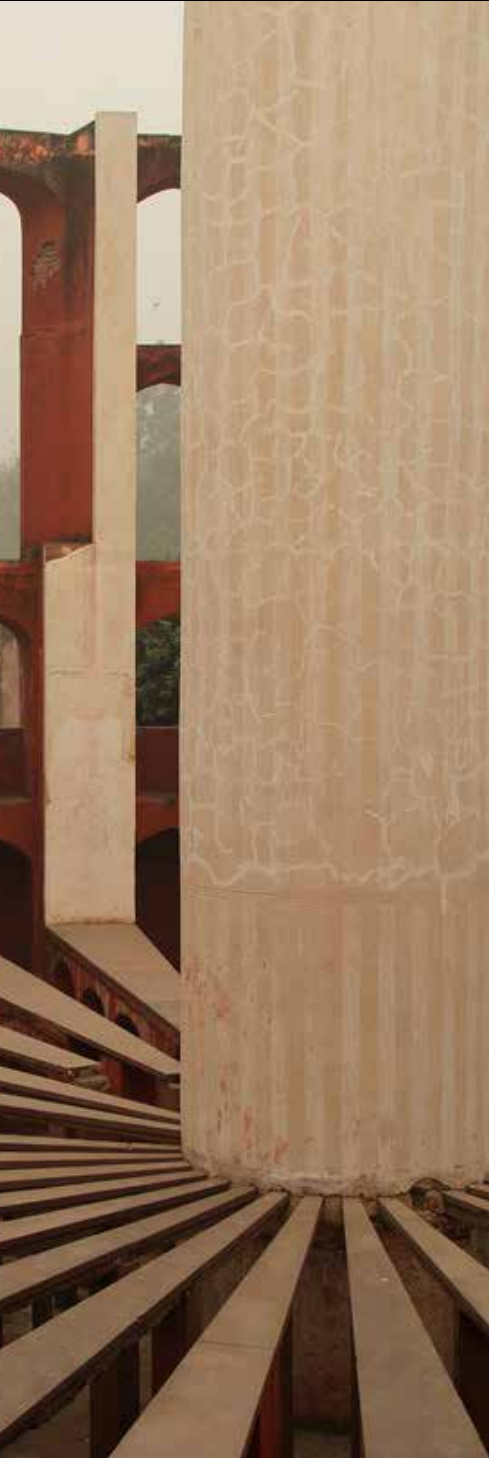




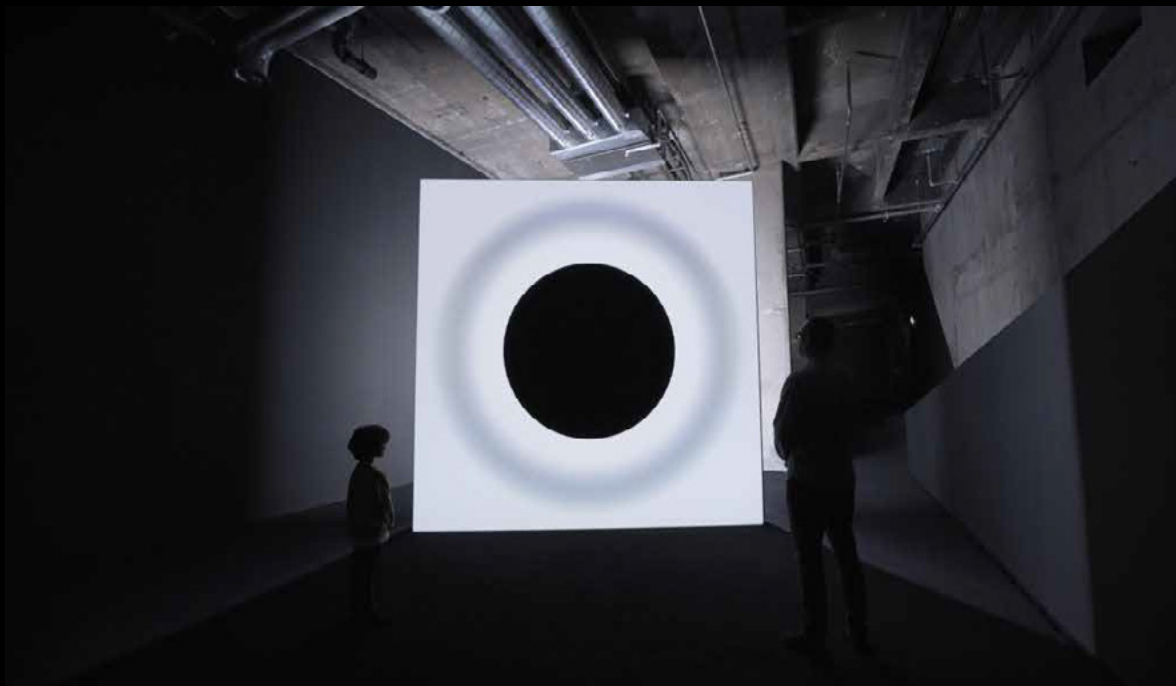
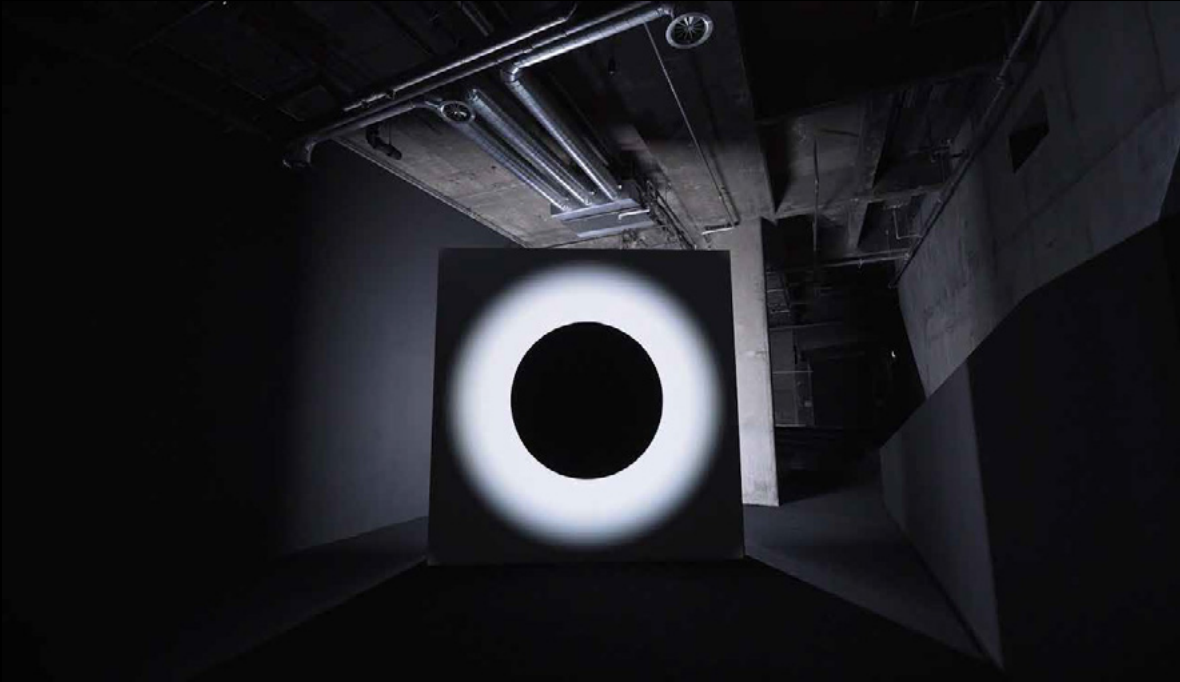
space, observatory - image of time



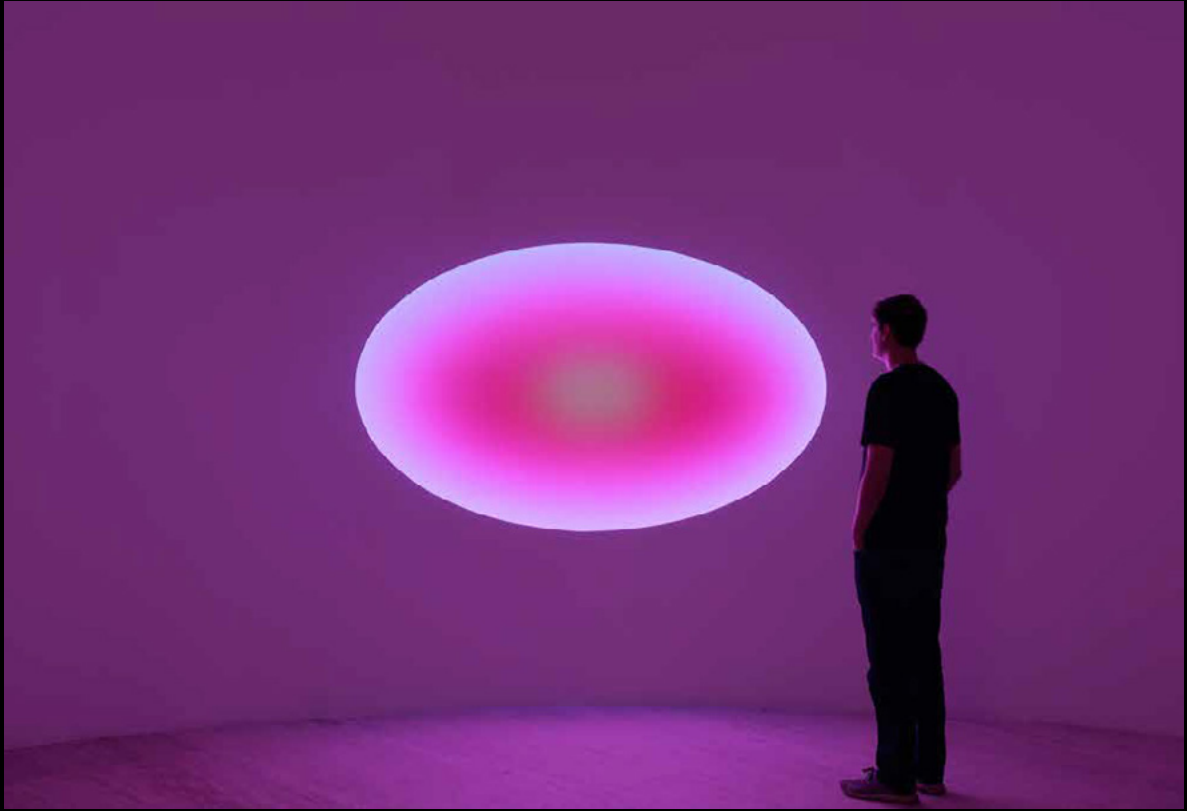
“light as unreal image”



work examples / references

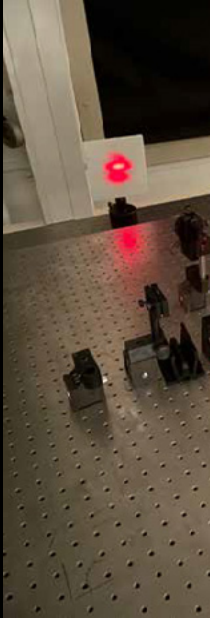
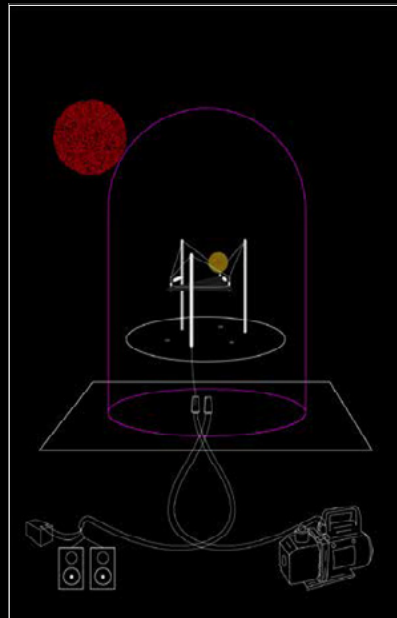
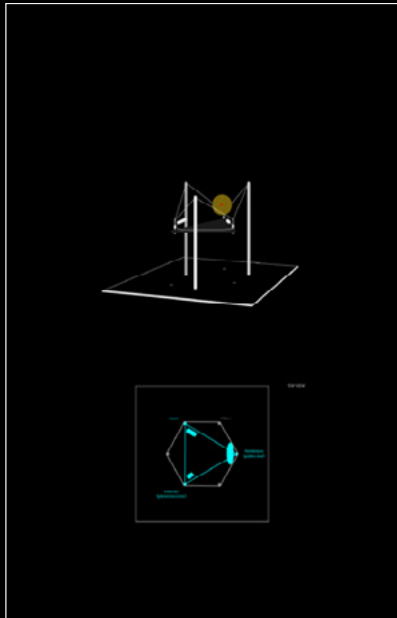
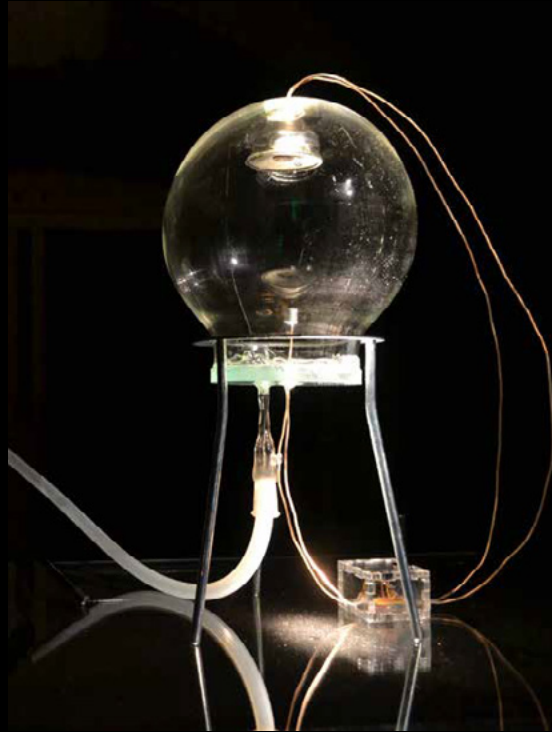


POINT OF NO RETURN, Rioji Ikeda, 2018



Gathas from the Curved Elliptical Glass series, James Turrell, 2019

previous work: Origin v.1.0 & v.2.0 work in development



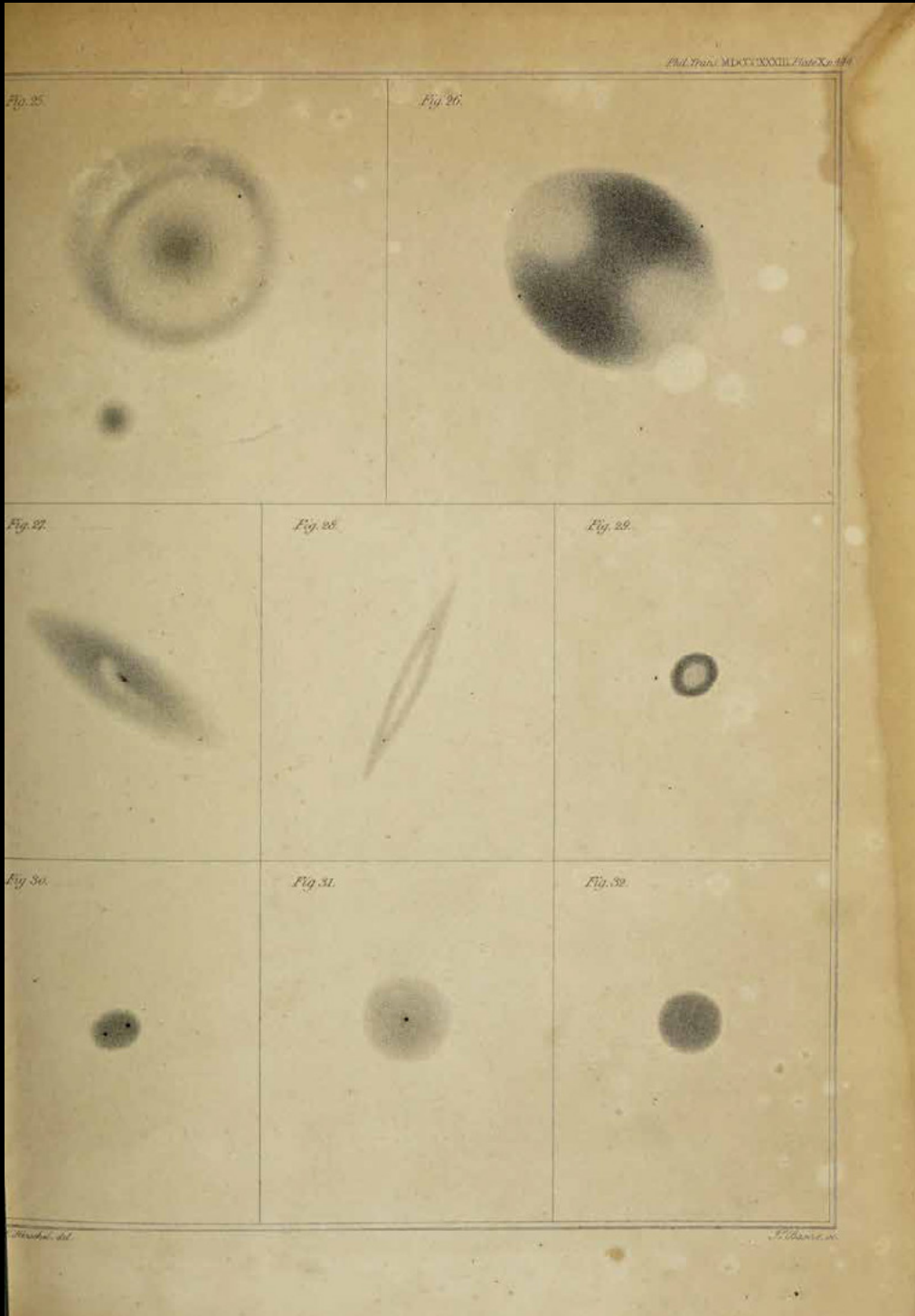




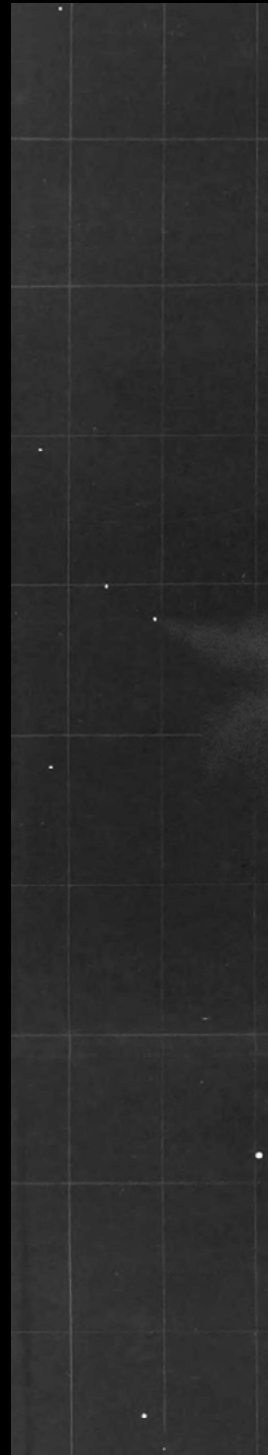


SPECTRA, Rioji Ikeda, London 2014
SUN PROJECTOR STUDY, Leonie Le Mercier 2023
SUN OBSERVATORY, Nathalie Blugerman, 2016

Sir John Herschel / first description of an Airy Disk in the Treatises on physical astronomy, light

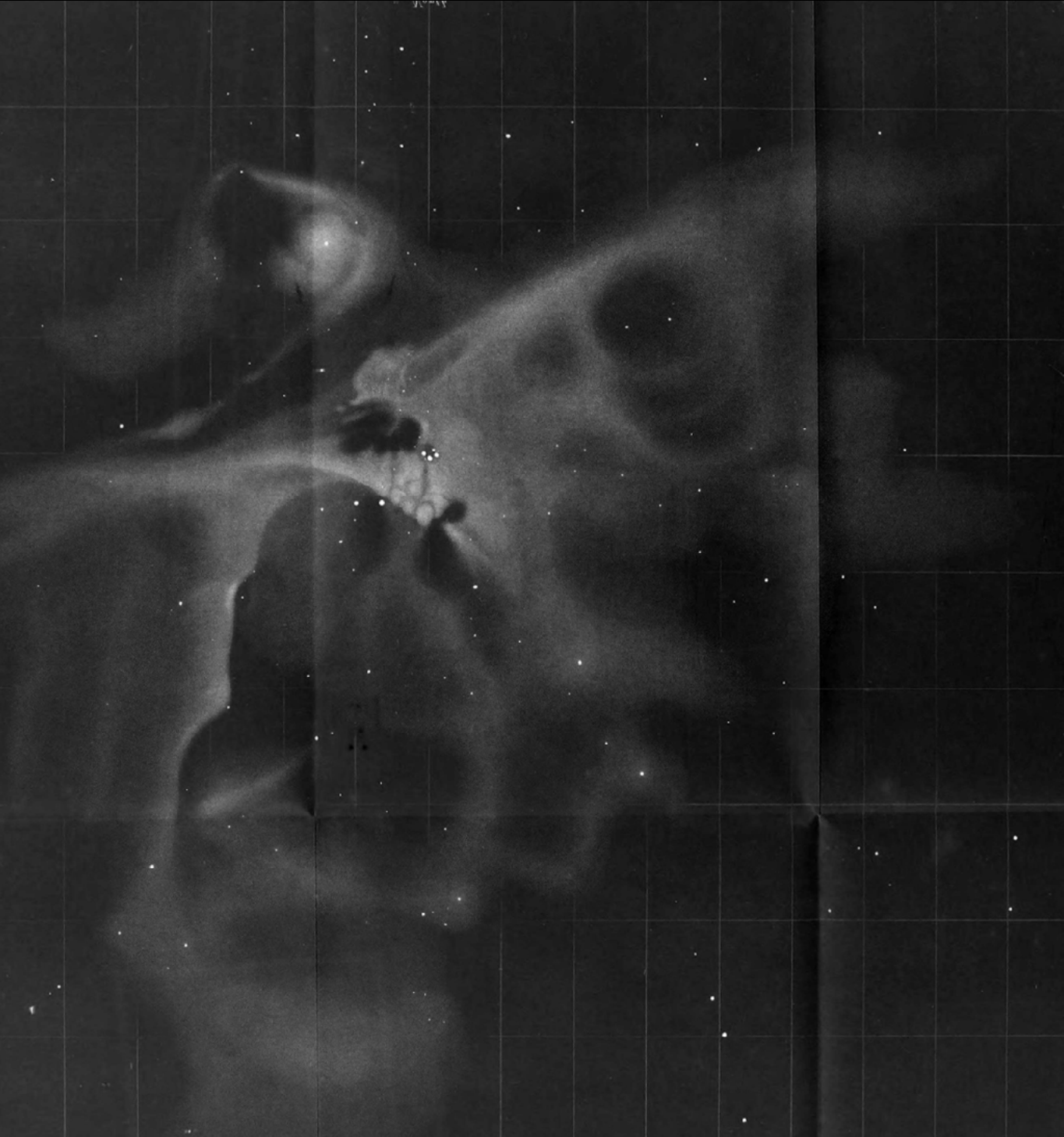


Dumbbell Nebula illustrations in "Observations of Nebulae and Clusters of Stars, Made at Slough, with a Twenty-Foot Reflector, between the Years 1825 and 1833" in Philosophical Transactions of the Royal Society, London, 1833



Results of astronomical observations, showing the completion of a telescopic survey.

and sound contributed to the Encyclopaedia metropolitana (1817-1845)



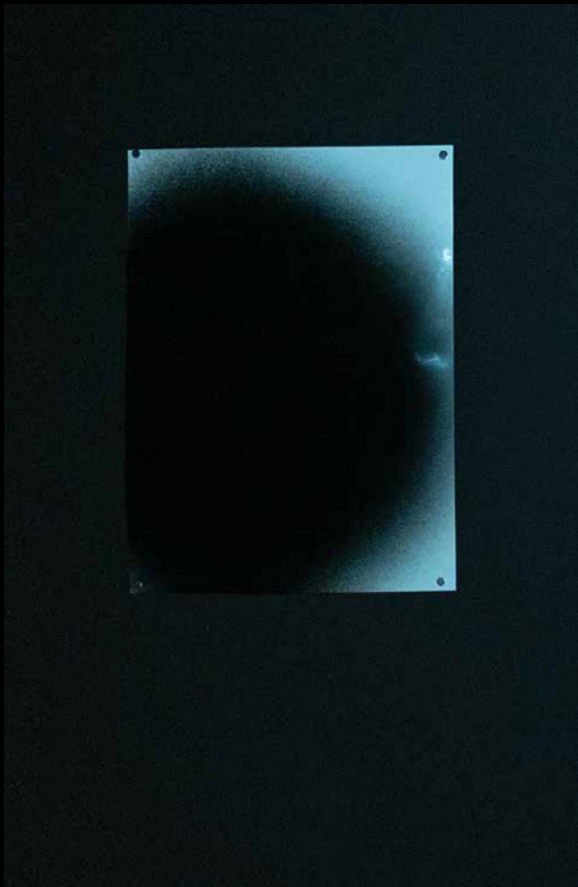
Observations made during the years 1834, 5, 6, 7, 8, at the Cape of Good Hope; being the
Survey of the whole surface of the visible heavens, commenced in 1825

photograms / lasergrams - highly sensitive way of capturing light & dy

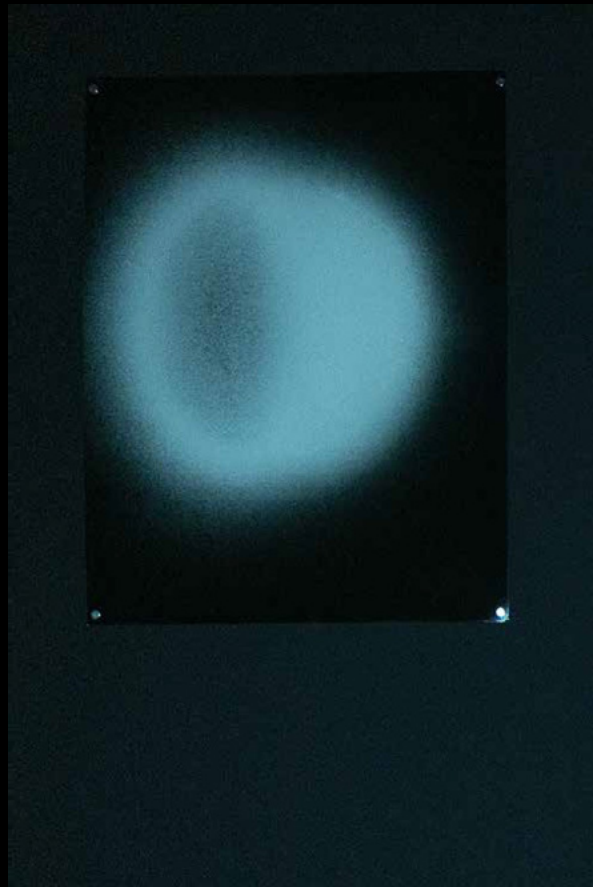


dissolution of bla
exposed to color

ynamic pro-



Black ink in water
negative paper, 2022



5CK liquid crystal exposed to 4 ms light flash 2023

ACKNOWLEDGMENTS

First light/optics research has been conducted during the Crossing Parallels residency at TU Delft and in collaboration with: theoretical physicist and chemist prof. Stephen Picken (Chemical Engineering), engineer Thim Zuidwijk (Imaging Physics), Optics and Makers Lab, as well as with support of my mentors artist Evelina Domnitch and Dmitry Gelfant.

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Additionally, there is interest in collaborating with the Astronomical Observatory of Leiden University in development and presentation of the work and research in 2024/25.

Much of the art and science overlap resides precisely on the ever-shifting boundary of what can be seen or sensed, and what cannot. It is this study of the black box - be it intelligence, complex systems, natural phenomena or a man-made process - that fascinates and drives us to investigate it anyway we can. As an artist working in the field of ArtScience I often combine scientific theories with knowledge from various domains paying special attention to language and ways of sensing the world. This kind of work can only be possible with the exchange and collaboration with many different disciplines, partners and with much dedication. For the opportunity to continue my work and with such great support, I thank everyone who has contributed to my Astronomia residency.



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ABOUT ME

KATARINA PETROVIC

Katarina Petrović is a Serbian-Dutch artist creating process-based works that explore the relationship between language and natural phenomena. Interlinking art, science, humanities and technology, her practice focuses on creative processes – from cosmogony, cognition and creation of meaning to physics of sound, light and vacuum. Katarina holds a MMus degree from ArtScience Interfaculty, Royal Conservatoire and Royal Academy of Arts, The Hague and an MFA from the Academy of Fine Arts, Belgrade. In 2019 she was the winner of the Young Visual Artist Award for Serbia (Mangelos award). Katarina is a member and board chair of artist-run space Trixie and an affiliated researcher at the trans-disciplinary research Center Leo Apostel (VUB) in Brussels where she started an ArtScience research group. Katarina often works as a guest lecturer and is currently teaching at ArtScience Interfaculty in The Hague and postgraduate School of Thinking (VUB) in Brussels.

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