

Arcsecond

28/05/2025 - Lisa Ziebermayr

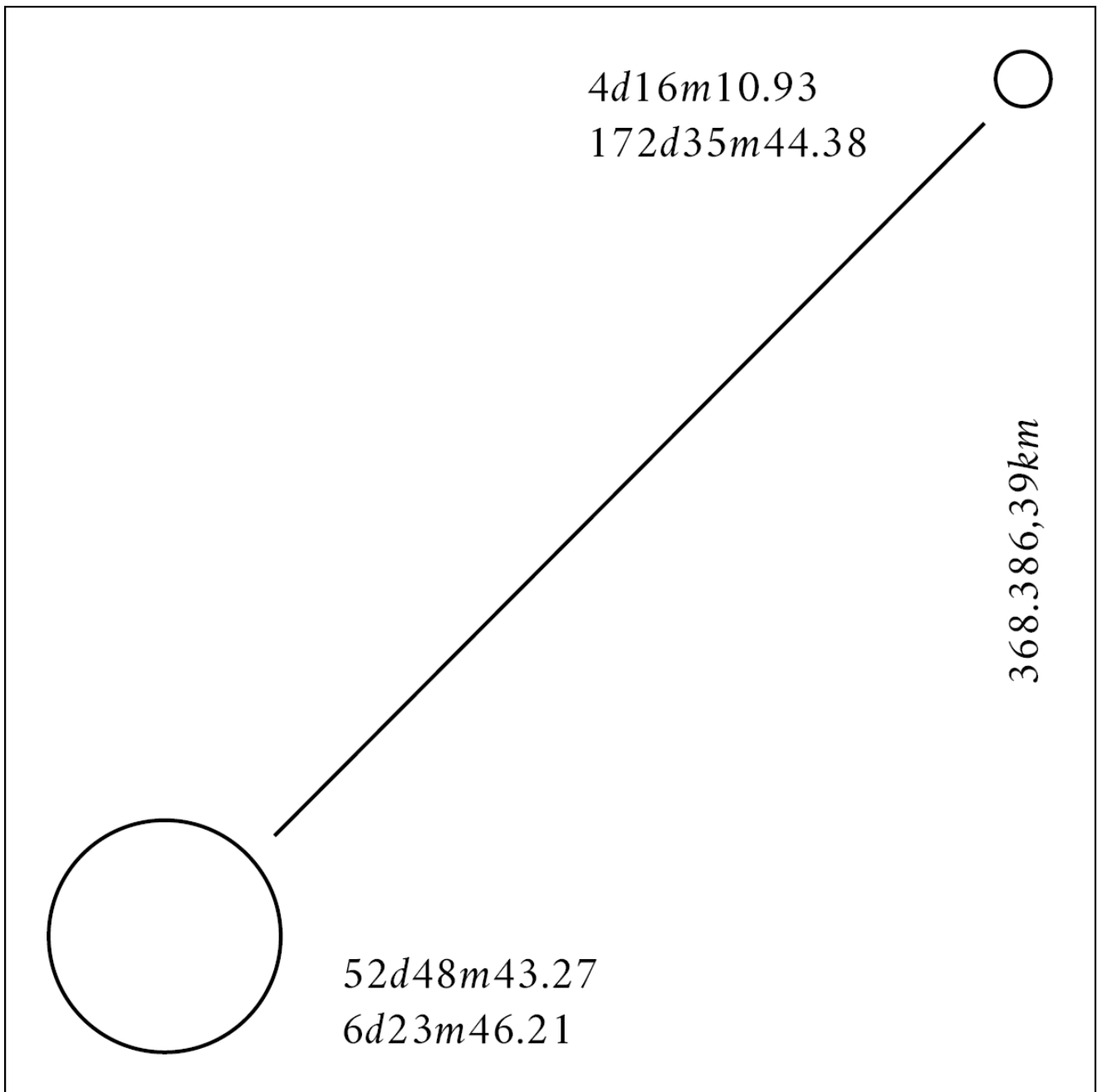
5x copper plate, 8mm thick, 100x100 mm

1x cast pewter

[ArcSecond tells the story of two events: One calculated before the 24th April 2025, the other experienced on the 24th April, 2025 21:00 (UTC/GMT +2).]

Intersection point

The distance from earth to moon is 268.386,39km. Moon and earth looking each other at 52d 48m 43.27 seconds lat, 6d 23m 46.21 seconds long and 4d 16m 10.93 seconds lat, 172d 35m 44.38seconds long.



We have algorithms describing the position of the moon (up to a certain degree - one would have to keep hundreds of periodic terms of the moons latitude and longitude into account).^[1]

$$\sin \pi = \frac{6378.14}{\Delta}$$

unfortunately, we will never see the moon at 21:00 (UTC/GMT +2): It's beyond the horizon, all we would point at is the far side of the moon, something we cannot be able to experience while we are on earth.

Of course
there's always plenty to listen to
that you can't see.



$3d31m3.27$
 $172d53m2.67$

The intersection point
is on the Moon's far side

(not visible from Earth)

What is left when we discover, that being able to calculate where something is in space at a certain moment in time we cannot ever experience or know for sure?

What if one day, we make the correct calculations but we are met with silence?^[2]

*I ask for you to come back despite the DISTANCES,
I hope because so many times I have enclosed every
VELOCITY.TO possible EQUIVALENCIES,*

*Even when I'm gone
Will you listen to my FREQUENCY?*

```
distances = moon_distance(time + [[[-1], [+1]]] * u.s, location=location)
velocity = 2 * ((distances[:, 1] - distances[:, 0]) / (2 * u.s)).to(u.km / u.s)
freq_to_vel = u.doppler_radio(restfreq)
newfreq = velocity.to(u.MHz, equivalencies=freq_to_vel)
```

When we are faced with infinity, how do we still place ourselves into space, knowing there are no borders we can possibly perceive - how can we comfort ourselves with a beginning and an end of a line in a graph when we can't know if there is a limit?^[3]

THAT SPACE IS UNLIMITED IS

I WANT TO DRAW OUT IS OBVIOUS.

```
fig, ax = plt.subplots(figsize=(12, 8))
ax.imshow(
    np.flipud(delay_doppler.T),
    extent=[
        freq_axis[-1],
        freq_axis[0],
        time_axis[0] / fs - transmission_start,
        time_axis[-1] / fs - transmission_start,
    ],
    aspect="auto",
    vmin=20, vmax=37
)
```

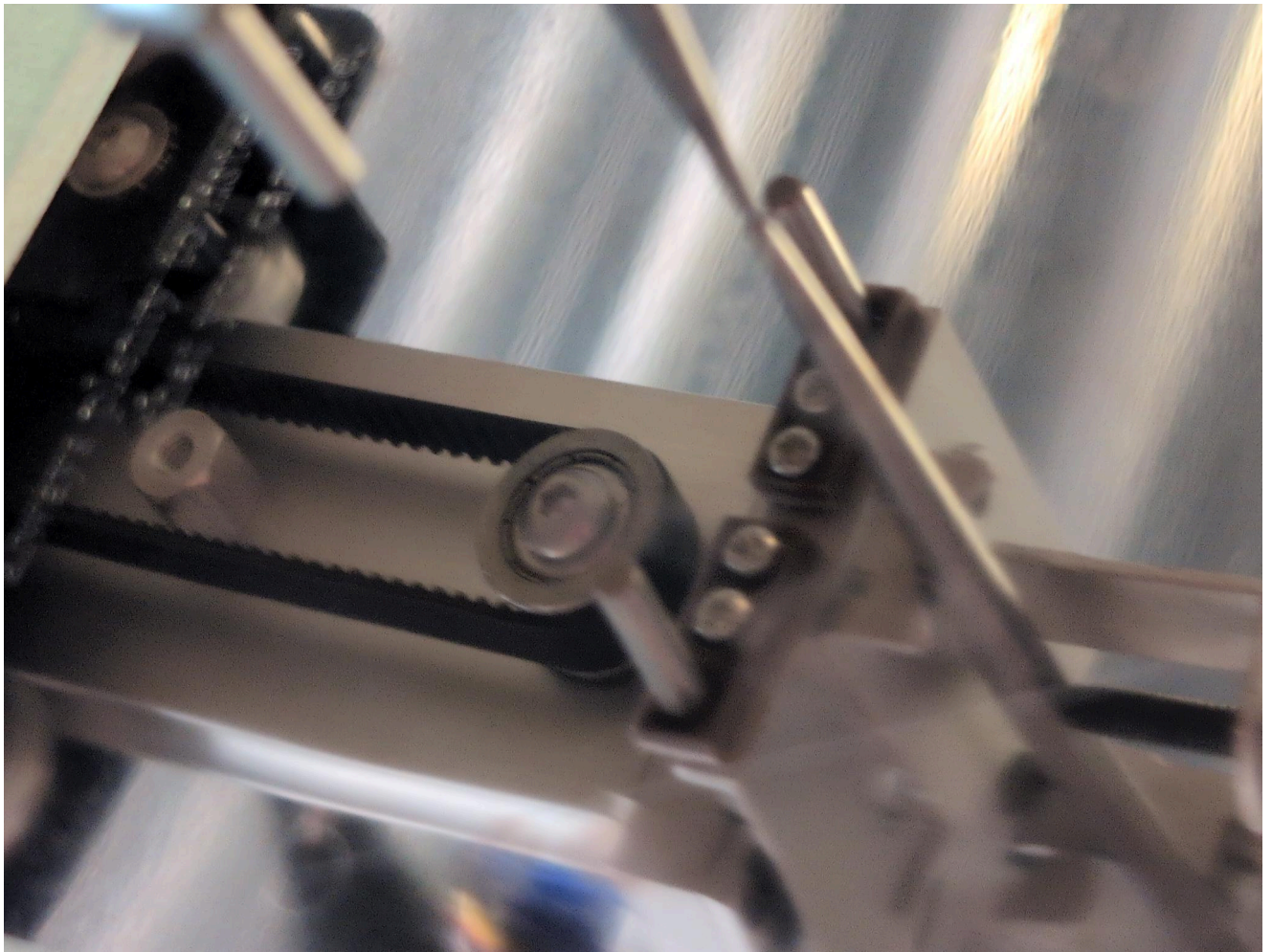
EVIDENTLY CONCEDED BY EVERYBODY.

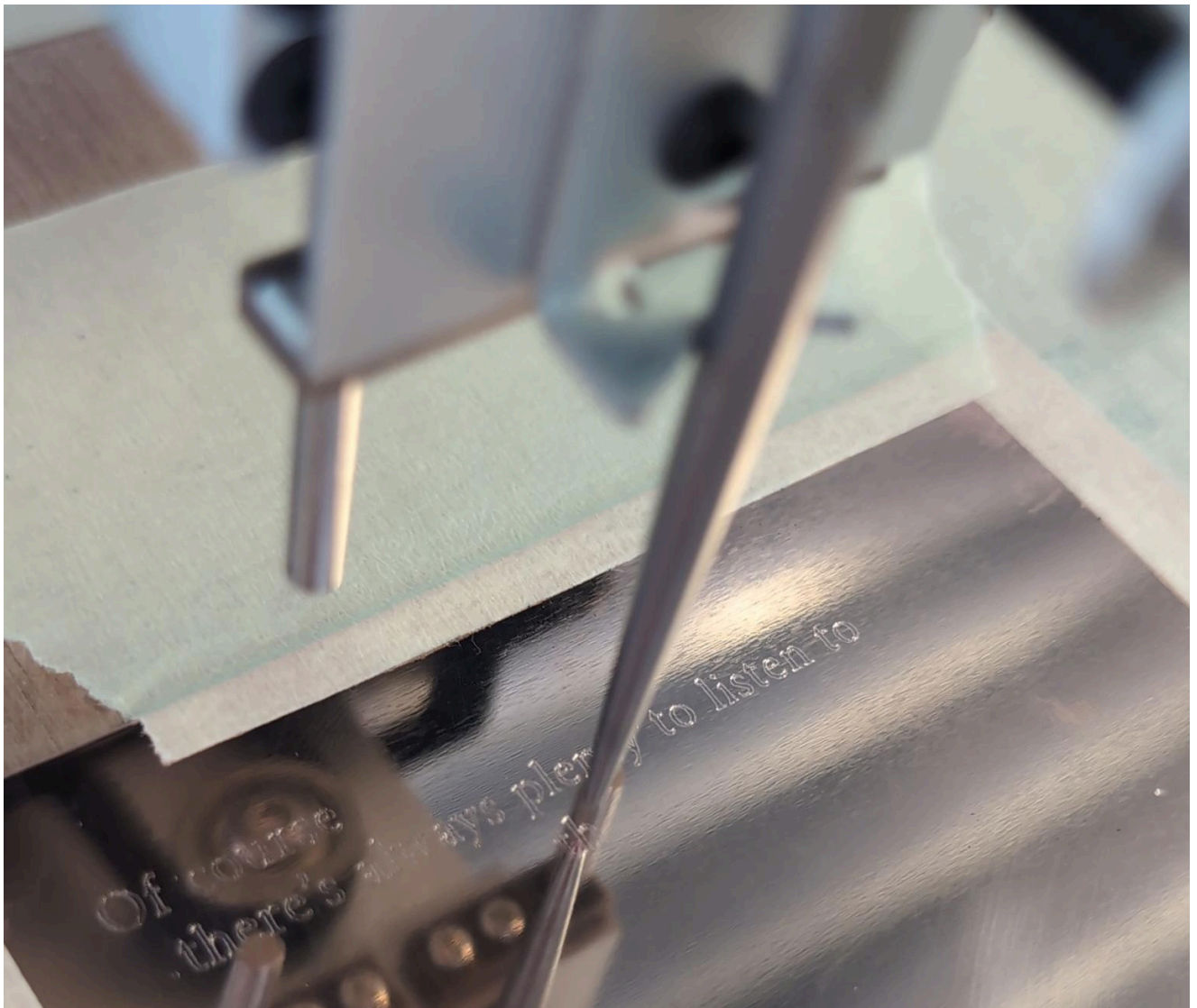
THAT THE NON-EXPERIENCED

Drawing the line

Modern western astronomy has an interesting intersection point with the development of print. Not long after the Gutenberg Bible was printed Astronomy books were put into print as well^[4]. This resulted in more advanced editions with the evolution of printing techniques. These two practices may have grown independantly from each other, but they both mutually benefited from one another: Common people were made aware of astronomy and shaped the aesthetics of the depiction of Astronomical bodies; fine and detailed copperplate prints recognizable for their clear and sharp lines. Print was more profitable than ever, with calendars and astronomic picture prints selling well.

It may be a coincidence that the aesthetics of etched copperplate prints - clear and precise markings - correlates with the obsession to precisely *observe* space and eliminate as much grey area (noise in the signal) as possible in modern western astronomy.





[polished copper plate engraving]



Struggling for Explanation

The arts and science share a universal problem: The struggle to explain.

We reach our limits when we try to explain a specific feeling tied to our own experience:

When I say I love my friends, there will be a general idea of what that *looks* like, but I will struggle to explain what it is that I feel. I can try to put it into a poem, I can talk of metaphors, I place the feeling into space^[5] and name examples - so I can bring the audience as close as possible to what it feels like for me to love my friends.

When we talk about black holes, we know we will never experience them: It's not something you see, it's a force beyond our senses. Besides, the closest black hole is 1,500 ly away.^[6] There is no chance any of us would come even close to it. What we can do is understand that we never see it, but find traces of nothingness - and what the remaining gases around it look like^[7].

We base knowledge and understanding on our perception: What we see around us, how it feels to be somewhere, experiencing a space. Knowledge is prescribed the attribute of objectivity - but really, our understanding of things and how we build knowledge is based on subjective perception.^[8]

This also explains the struggle: When understanding is a subjective experience, explaining with the goal to be as objective as possible becomes impossible; approximating another person's subjective experience might fail as well.

Explaining through metaphors is not only isolated to poetry and the arts.^[9] It is a universal tool used to understand the world around us better for ourselves, but also to let others know how we see the world and give our environment meaning. New concepts need definitions, calculations require words for us to grasp what they mean to us - to give them a body to experience them in some form.

With a similar approach to explaining, we can find poetry in science more often than we would think. An example from the official Astronomy newsletter from NASA:

| [...] At the end the meteor was gone in a second, but the galaxy will last billions of years.
| ^[10]

An article reporting on the first pictures of a black hole: ^[11]

| "During a single observation, Sgr A* doesn't sit still, whereas M87 does," says Özel, an astrophysicist at the University of Arizona in Tucson. "Just based on this 'Does the black hole sit still and pose for me?' point of view, we knew M87 would cooperate more."

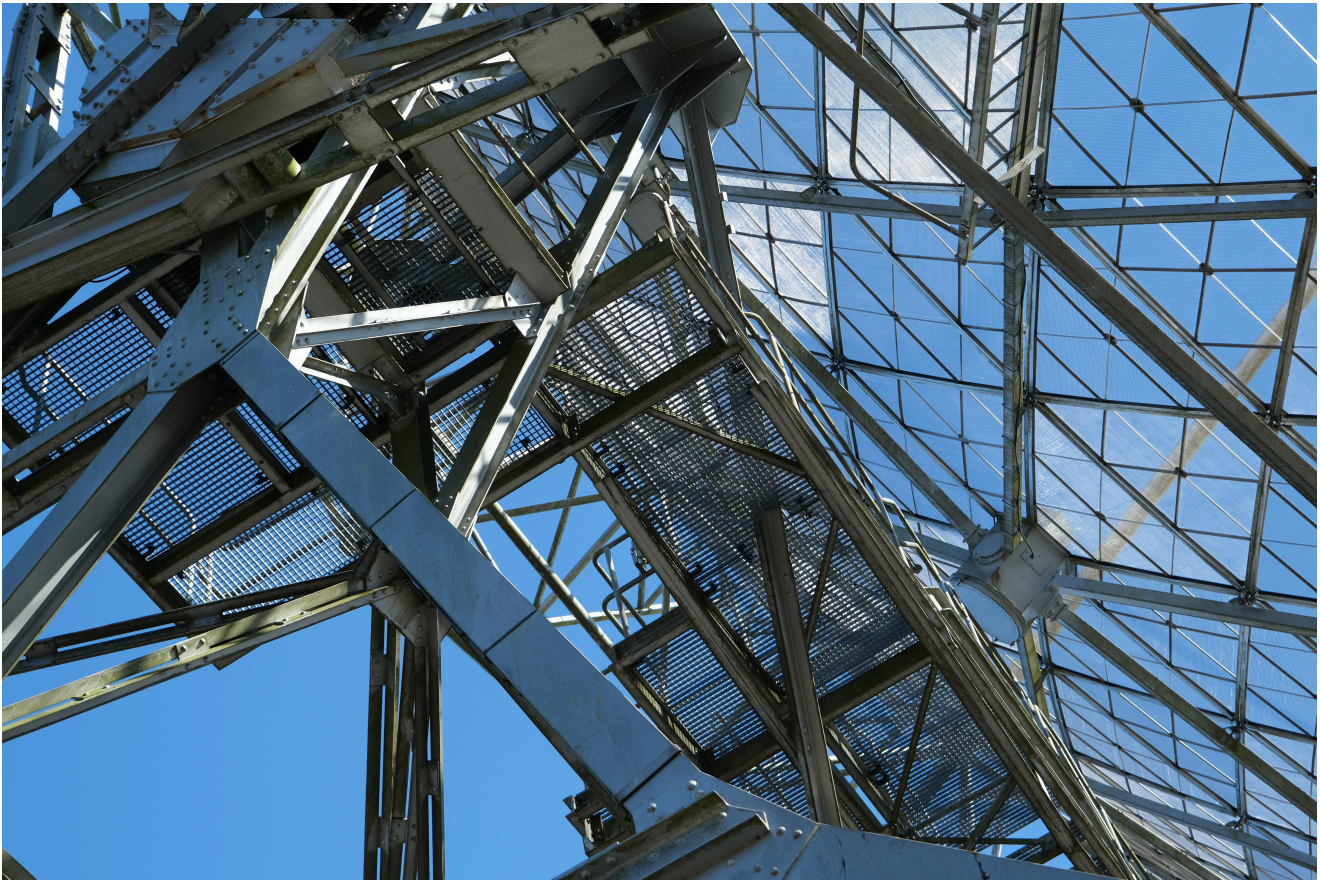
The Black Hole does not really "pose" or "sit still". But when we hear someone talk about "sitting still and cooperate more" we understand because we can picture a person posing for us and sitting still - so we can capture their image. This metaphor allows us to place the *concept* of a black hole into space and understand how an *image* of something we cannot perceive could be taken.

Science and poetry share a common goal. The struggle for words may be a significant reason why the explaining is an inherently poetic endeavour.

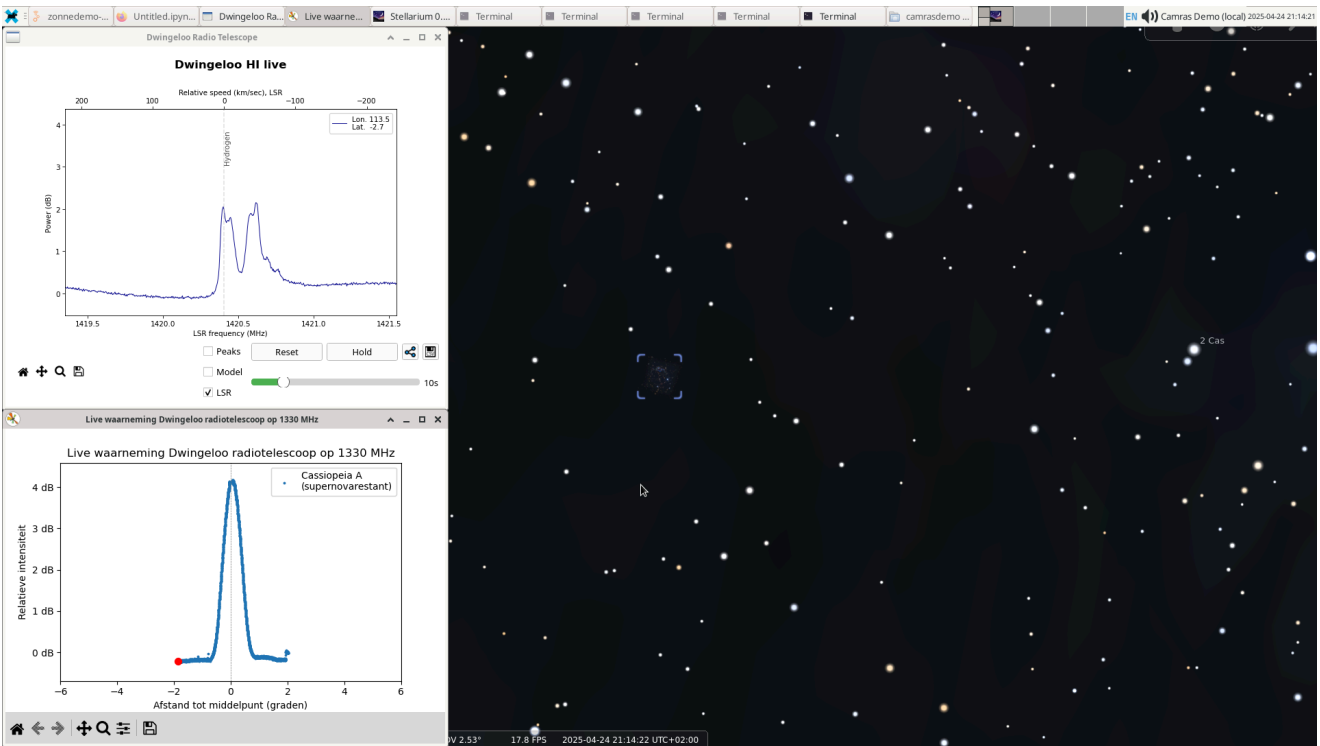
6000 Datapoints

We visited CAMRAS three different times. Once, beginning of the semester, getting to know the radiotelescope. A second time during spring, spending more time with the radiotelescope; listening and sending messages.





A third time, we presented our final stages in the project: *ArcSecond*'s calculated engravings have been produced, and preparation for witnessing an event have been made: The telescope parked into a position, so it rotates with the earth, listening to Sagittarius A (east), remnants of a supernova, at exactly 21:00 local time. This resulted in a 10 minute collective listening of Sagittarius A - and a large set of datapoints, documenting the noise picked up by the radio-source.



Calculated Observation

An interesting problem in Astronomy is "personal bias" which occurs even to seasoned Astronomers when observing Astronomical bodies. The phenomenon, known as personal equation, relates to the idea that (human) observations in Astronomy are fundamentally subjective: Human produced data varies depending on a persons experiences and perception. [\[12\]](#)

Anton Pannekoek was an Astronomer who pointed this out in his works: Observing the faintness of stars in the Milky Way, he noticed that the human eye receives these light stimuli not reliable enough to produce an objective mapping of the Galaxy in the first place. Instead, he created a series of Cluster Points, showing patterns from Astronomers observations of these stars: And created a depiction of the *phenomenon* known as the Milky Way, instead of trying to visualize the Milky Way as an *object*.

Remembering the paradoxical focus on precision and exactitude present in sciences, it is strange to see us place an object in space on exact milliseconds but remembering the fact that ultimately, our systems are flawed by design. [\[13\]](#) It may be this drive that hinders us from seeing beyond the numbers. When depicting a hydrogen cloud I know the colours have been edited into the image, When I see a high definition image of Saturn I know it is a constellation of multiple scans. Realism gets claimed without addressing the fact that we will never actually perceive things as they are themselves (or have an objective position in the universe in the first place) - especially not lightyears away. What if we can take this as a chance, to explore visualizations of the universe that address this inherent subjectivity of experiencing space?

Embedded into Metal



[heat-treated (oxidised) copper plate]



[hand-engraved details]

The first stages of the project are shaped by its precision: clean polished plates, carefully positioned coordinates and formulae. A calculated event, engraved onto new material. The plates oxidise, leaving traces of wear and time behind - until we document the witnessed event: Listening to Sagittarius A.

The documentation utilizes the recorded data, as well as a mapping of the radio-source through hand-engraving stars onto the plate. Technical measurements side by side with flowing lines, interpreting the experience of hearing remaining radio waves of a supernova.

The plates tell a story by utilizing two very different but relating techniques - we can focus on the rare moment of experiencing an astronomical event as it happens because we have found what we cannot explain - we understand without seeing and embrace the struggle to explain our experience of the universe.

Documenting ourselves in space

Humanity has documented stars and planets over 3,600 years ago^[14]. And we continued to do so, until now vigorously. Stone carvings, copper engravings and drawings are a

documentation of what societies have found worth documenting and keeping of the universe.

When we look at Astronomical calendars we get reminded of meteor showers, solar eclipses and full moons - things we can see from earth. What is often not mentioned is the fact that really, when you look far enough there is always something to listen to - even if we are not able to visually perceive it.

It's understandable why we pay more attention towards the things we can see: When looking at the stars its more about ourselves, than about the ball of gas travelling through the galaxy. When in 1972s *Solaris* a crew member reflects: "We don't want to conquer the cosmos, we want to extend the boundaries of Earth to the cosmos. We are only seeking Man. We don't want other worlds, we want mirrors."^[15] I believe that part of why we are looking up is so that we get a chance to look at ourselves.

However, we have done things the other way around: We sent a record of human experience into space, travelling towards a destination we cannot reach in our lifetime. The Voyager Golden Record.

Take a close look

The Golden Record is an archive of humanity. A comprehensive legacy, designed to outlast human existence. During the conception of the golden record, the decision was made to not include struggles humanity is faced with: war and famine, natural catastrophes. The argument at that time was that "the worst needn't be sent across the galaxy".^[16]

We chose to send an image of our best selves, but in order to decode this, we added instructions that inform the aesthetics of the disk far more than what its contents are: If the disk would reach someone else, they would first have to decode our enthusiastic attempts at explaining a human artifact.

Its quite fitting then, that next to transporting the precision engravings in the disk and choice of material (12-inch gold-plated copper) we also tasked Voyager (the spacecraft transporting) to send us one last image of ourselves: the pale blue dot.^[17]



[upscaled image (2020), celebrating the anniversary of voyagers shot of the earth]

Looking at an archive of documented events, we have to be aware that with every plate etched and another page printed, many more astronomical events have not been captured, ignored or just not been witnessed. We couldn't produce a picture of a black hole until 2019^[18], we can only listen to 200 galaxies in the observable universe - from earth.^[19] What we show and what we document is inherently tied to human perception - and the tools we use to observe space.

Inevitably, if one chooses to add something to an archive, a multitude of other things will be excluded. Archival curation is much more a process of eliminating than collecting; telling a very specific story.

I chose to engrave the distance between moon and earth. I chose to engrave faulty calculations. I chose to engrave an event that will never happen in real life. I chose to engrave a wishful thinking, landing on the far side of the moon. I chose to cast the representation of a representation of a surface. I chose to engrave the place I wanted to listen to, if I could. I chose to engrave my fear of what happens when we are gone, and who will still listen.

I didn't engrave my lack of experience, I didn't engrave the gas explosion and its chemical constellations. I didn't engrave when I was experiencing Sagittarius on the 24th of April, 2025 (UTC/GMT +2).

What I did was listen. To the changes in noise, witnessing a shift of my attention towards an event I cannot perceive with my eyes. Visualizing such a feeling will inevitably end with a million things unsaid. And that's okay - this is something experienced in the moment, and we did it without words.

Footnotes

- ① [astronomical algorithms](#), p 337 ↩
- ② https://en.wikipedia.org/wiki/Comet_Kohoutek#Observing_campaigns_and_scientific_results ↩
- ③ [Infinity of the universe essay -> the damn source](#) ↩
- ④ <https://thonyc.wordpress.com/2019/02/20/the-emergence-of-modern-astronomy-a-complex-mosaic-part-iv/> ↩
- ⑤ [Lyn Hejinian, The Rejection of Closure \(2009\)](#) ↩
- ⑥ <https://science.nasa.gov/universe/black-holes/> ↩
- ⑦ <https://www.sciencenews.org/article/black-hole-first-picture-event-horizon-telescope> ↩
- ⑧ <https://www.sciencedirect.com/topics/psychology/explanatory-gap> ↩
- ⑨ [TELL ALL THE TRUTH BUT TELL IT SLANT: THE ESSENTIAL ROLE OF METAPHOR IN CONSTRUCTING PHYSICS](#) ↩
- ⑩ <https://apod.nasa.gov/apod/astropix.html> ↩
- ⑪ <https://www.sciencenews.org/article/black-hole-first-picture-event-horizon-telescope> ↩
- ⑫ <https://publicdomainreview.org/essay/marxist-astronomy-the-milky-way-according-to-anton-pannekoek/> ↩
- ⑬ [Reference to time in programming \(and astronomy\) being displayed in unix time on computers, and the YEAR 2038 PROBLEM](#) ↩
- ⑭ <https://www.landesmuseum-vorgeschichte.de/en/nebra-sky-disc> ↩
- ⑮ <https://medium.com/british-film-institute/andrei-tarkovsky-solaris-and-stalker-b313b553b52e> ↩
- ⑯ [FUTURE MEMORY AND REWRITING IN VERÓNICA GERBER BICECCI'S OTRO DÍA... \(POEMAS SINTÉTICOS\)](#), page 63 ↩
- ⑰ <https://science.nasa.gov/missions/voyager-program/pale-blue-dot-images-turn-25/> ↩
- ⑱ <https://science.nasa.gov/resource/first-image-of-a-black-hole/> ↩

19 [HTTPS://SCIENCE.NASA.GOV/MISSIONS/HUBBLE/HUBBLE-REVEALS-OBSERVABLE-UNIVERSE-CONTAINS-10-TIMES-MORE-GALAXIES-THAN-PREVIOUSLY-THOUGHT/](https://science.nasa.gov/missions/hubble/hubble-reveals-observable-universe-contains-10-times-more-galaxies-than-previously-thought/) ↩