Kovács/O'Doherty – *Twin Moons*
Summary Report 1 – 12.10.2016

1. Work to date

We began our work on *Twin Moons* during our meetings at LACMA in June 2016. Through these meetings and contacts, we have gathered critical information about how we can best implement our proposed project. The project involves combining the signal of an abandoned satellite, the LES-1, with another 'matching' signal.

One of the significant items of advice that we received was from Tom Spilker (of NASA's Jet Propulsion Laboratory) to get in touch with amateur radio enthusiasts, in order to find out ways of receiving the signal of the LES-1. This became our first aim: to find a way to reliable receive the signal of the LES-1.

Once back in Berlin, we discussed the details of our plan with Kris Slyka, our technical collaborator and adviser, who is a constant help for us. Additionally, we got in touch with various amateur-radio enthusiasts, in order to gain advice on how to proceed. As a result of these discussions, we decided to build two antennas, and researched further what kinds of antennas to build, what kind of hardware and software to build and to buy, and further related information. We also received advice from Ulrich Seipelt, owner of Funktechnik Seipelt and radio equipment retailer. Herr Seipelt also gifted us a copy of Rothammels *Antennenbuch*, the standard reference work for building and operating antennas.

We have begun a blog with details of our research, here: https://medium.com/twin-moons.

As a result of our work to date, we have received several good-quality signals from the LES-1, via one of the two antennas that we have made. This data, once captured, can be output as both audio and visual information via GQRX (http://gqrx.dk), an open-source software-defined radio application. An example of how this looks and sounds is available on our YouTube channel: https://www.youtube.com/watch?v=ltdrN6Wqg-E.

2. Next steps

2.1. Next steps related to the LES-1:

- Continue monitoring and recording passes of the LES-1 when possible, following orbital data available online (e.g. via the Heavens Above website, and other similar sites)
- Record subsequent passes with the second of our two antennas, in order to receive a stronger and more precise signal
- Research the options for presenting the signal from the satellite in real-time as the overhead pass occurs, rather than as a result of subsequent signal processing
- Contact other satellite and radio enthusiasts who have also successfully managed to receive the signal of the LES-1
- Research how this process of signal reception and presentation can be repeated in Los Angeles – what equipment and tasks would be involved, etc.

2.2. Next steps related to responding signal:

We are also considering the options about what kind of responding signal would be given to the signal of the LES-1.

- One of the options available would be to compose or commission music and sound design specifically for this purpose, and we have started to research our options in this regard. We intend to take further steps related to this in the time between this report and the end of the year.
- We will be researching the practical steps involved in renting or accessing bandwidth on a commercial satellite. On this question, we expect to collaborate with the Art + Technology Lab's technology partners.

2.3. Other next steps:

- We will be researching the practicalities of the required visas for admission to live and work in the United States in early 2017.

3. Changes from originally submitted plans:

- We originally proposed to make one trip to Los Angeles. We now anticipate that we will need to undertake both a first trip, in March 2017, and a second trip, later in 2017. The first trip will be to undertake various of the next steps outlined above, and will last approximately one month. The second trip would be to collate the results of these steps and finalise the installation of the work as originally proposed. This would most likely occur in September-October 2017. In the timing of this second trip, we will also have to take into consideration the orbital behaviour of the LES-1, which alters strongly between the different times of the year.

4. Costs:

To date, we have purchased the necessary items to build two different antennas, to transfer the received signals to software, and to process and output them. Our costs so far have been of materials and devices for this process, as well as artist fees for both ourselves and our collaborator.

We foresee further costs for visa applications, potential visa lawyer consultations, and flight tickets. For this we request [redacted] USD in total, split into two halves: [redacted] USD each Kata and Tom. For administrative reasons we would like to receive the grant planned for our first milestone (June 2016 – January 2017) in two installments: [redacted] USD in October 2016, and the remaining [redacted] USD in January 2017.

Tom O'Doherty
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10245 Berlin-Friedrichshain
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Invoice date: 12. Oct. 2016
Invoice number: 2016LAC001
Tax number (Steuernr): [redacted]
Ust-IdNr.: [redacted]

To:
Los Angeles County Museum of Art
5905 Wilshire Blvd, Los Angeles, CA 90036
USA

Invoice – October 2016 – Twin Moons

Grant received for the implementation of a new work, with the title *Twin Moons*, in collaboration with Katalin Kovács, for the timeframe June-September 2016.

Sum US$[redacted]

Bank details:

Account name: Tom Eoin O'Doherty and Katalin Kovács
Bank: [redacted]
[redacted]
[redacted]

Kovács/O'Doherty – Twin Moons
Summary Report 2 – 19.12.2016

In the past two months, our main work related to *Twin Moons* has been collaborative – both in organising the technical next steps in our work, and in organising the practicalities of our visit to Los Angeles in March 2017. We outline the concrete details of our steps below.

1. Satellite tracking

We have been continuing with our work of tracking the signal of the LES-1 satellite. As outlined in our prior report, we had built two antennas by hand, of two different designs, in an attempt to get both a 'wide' and a 'deep' signal. One of the antennas has not been working properly, and we altered the wiring to attempt to fix it. Unfortunately, the autumn and winter weather in Berlin has now made further tracking unlikely in the next few weeks. The rainy and cloudy days, combined with passes of the LES-1 at a low angle in the sky, has provided only a couple of occasions to do further satellite tracking. These tests are documented on our blog (https://medium.com/twin-moons).

2. Doppler shift effect

The existing satellite pass data that we have recorded are all affected by the same issue, which is that the satellite signal has a distinct doppler shift, due to the speed at which it moves around the Earth. This means that any audible signal will drop out of audible range within a few seconds, and has to be constantly manually re-tuned in order to hear longer excerpts.

We have been attempting to find a way to compensate for the doppler-shift effect in our existing recordings of the satellite signal. Ideally, this doppler-compensation process should be repeatable and generalisable, so that it can be applied to future recordings regardless of the variations in the other parameters of data (location in the sky, strength of signal, angle of the sun, or any other similarly unpredictable element).

Kris, our technical collaborator, has combined the capabilities of Gqrx and Gpredict to do this doppler-shift compensation. We uploaded a screen recording of this process of compensating for the doppler shift in one of our existing sets of I/Q data (of a pass of the LES-1 in September this year), using Gqrx and Gpredict. It's viewable here: https://www.youtube.com/watch?v=WC_JEhXK1QQ – The static is pretty harsh, and the signal gets a bit stronger about ten minutes in.

3. Phone-meeting with SpaceX

We got in touch with Lilian Haney, our contact from SpaceX, who arranged a phone call with one of their engineers. We were hoping to get some advice about the doppler shift effect, automated satellite tracking, and general views on how we should proceed with our project.

Lilian was very helpful, and helped to arrange a phone meeting, which we had on November 22nd. In this talk, we discussed our processes, and our progress to date, and made plans for further talks. At the moment we're waiting to hear back about related practical details and follow-up plans. Their answers will be crucial for our planning about how to proceed, as well as what actions to plan for our time in Los Angeles.

We were discussing – and we're hoping to get further advice on – the following subjects:

- Getting a cleaner signal from the LES-1 – ideally one which would be clear and consistent enough to be usable as an accompaniment to music.
- Next steps for being able to receive and output the LES-1 signal as audio 'live' – which would be necessary for

the basic functionality of the final installation as we imagine it at present.

- Help with questions about practical tracking of the LES-1 satellite – gimballing mechanisms, USRP devices, and related technology.
- Further advice on how to reduce the doppler shift effect in our data recording.
- Possibilities and difficulties involved in trying to rent a bandwidth on a commercial or other satellite in order to broadcast the response signal that we had intended to use as an accompaniment to the signal sound of the LES-1.

4. Musical collaboration

We have had further talks and meetings related to potential musical collaboration. At the moment we are discussing the possibility to meet in either Los Angeles while we're there in March, or on the US east coast before or after. Ideally this would lead to a collaboration for the accompanying sound for the LES-1.

5. Practical tasks:

Some of our time has been spent figuring out our visa situation for our March visit, including discussions with visa attorneys through LACMA. We have also booked flights, and started to make plans for our time in March, for meetings and potential public events.

6. Next steps:

- We need to take further steps to arrange the practicalities related to our trip to Los Angeles (booking further flights, booking accommodation, arranging next steps related to sound collaborations, starting to arrange further local meetings with our technology partners, etc.)
- We will be talking with Joel Ferree at the beginning of January about the possibilities for public discussions or presentations in March, as well as for meeting people that could help us in our subsequent steps after March.
- We hope to be able to talk to SpaceX again in January, and with their help to make further practical plans for March, specifically for trying to tracking the LES-1 in Los Angeles and find a way to do get a 'live' signal.

7. Potential changes:

Through our talk with SpaceX, it became clear for us that renting a commercial satellite for artistic purposes is unlikely. Therefore, we are considering the possibility that the sound that will accompany the signal of the LES-1 satellite would be played locally – as opposed to our original plan, of transmitting it as a signal from another accompanying satellite. This initial idea was what originated the title *Twin Moons*. This potentially means that we will alter the title of our final presentation, in a way that would be more accurate in how it refers to the implications of the piece.

8. Finances:

In the past two months we have had costs for material and equipment related to fixing our second antenna, artist fees for both ourselves and our technical collaborator, and we have bought our flight tickets. For the next phase we foresee various costs related to our trip to Los Angeles.

We would like to ask for the second half of the budget that we had planned for our first milestone, as well as part of our budget planned for the second milestone. This is different from the submitted application, as we now plan three main phases of our project – the third one being the time after our trip to Los Angeles in March, in which we will be working on the preparation of a final presentation in September, when we intend to return to Los Angeles.

Specifically, this means that we would like to ask for the remaining [redacted] USD from our first milestone budget, and a further [redacted] USD from our second milestone budget, for a total of [redacted] USD.

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Invoice date: 02. Jan. 2017
Invoice number: 2017LAC001
Tax number (Steuernr): [redacted]
Ust-IdNr.: [redacted]

To:
Los Angeles County Museum of Art
5905 Wilshire Blvd, Los Angeles, CA 90036
USA

Invoice – October 2016 – Twin Moons

Grant received for the implementation of a new work, with the title *Twin Moons*, in collaboration with Katalin Kovács, for the timeframe January-March 2016.

Sum US$ [redacted]

Bank details:
Account name: [redacted]

Kovács/O'Doherty – *Signal Tide* (formerly *Twin Moons*)
Summary Report 3 – 11. July 2017

In the last six months, we have undertaken several significant further steps in realising *Signal Tide* (formerly *Twin Moons*), and we have provisionally arranged to present the finished work at LACMA in September of this year. We describe the steps taken since January below, in part A. However, much remains to be done before presenting the work, which we also describe, in part B, below.

A. Work on *Signal Tide*, January–June 2017

A 1. Work in Massachusetts, Feb 2017

We began the *Signal Tide* project with the central conceptual point that the final outcome of the work would combine audio, derived from the signal of the LES-1 satellite, with accompanying audio that would exist alongside it, juxtaposed or paired with it. However, at the beginning of the year, we were not yet clear about exactly what this accompanying or pairing audio would be. Our initial thought was that it ought to align with the four-second-long 'rhythm' of the LES-1 signal (caused by the satellite's rotation around its own axis as it orbits the earth). However, we were also curious about the potential to use audio that would not just use this metronomic limitation, but that would also be able to be both sonically rich and expressive (in distinction to the minimal and simple satellite signal audio), and also be conceptually coherent with the aims of the work. We also knew that we would be collaborating with David Bryant, and that his prior work with Hiss Tracts, Godspeed You! Black Emperor, and Set Fire To Flames runs a wide gamut of musical and sonic possibilities.

We also knew that the LES-1 satellite had been designed and created at MIT in Boston, and that the musical folk traditions of Boston and the wider New England area would potentially be able to provide us with a compelling series of starting-points in considering the available options for our accompanying music and sound – to serenade the satellite with music that is part of a folk tradition of a place which is, in an anthropomorphised sense, its home and point of origin.

In February, we visited Massachusetts and Connecticut, where we met with scholars and practitioners involved with the various currents of the folk music traditions of New England. Through discussing the project with them — most significantly, through talking to musician, musicologist, and academic Tim Eriksen — we became curious about the possibilities of using sacred harp music as the organising principle of the 'paired' music for the installation.

Sacred harp singing is a distinct tradition of American and Canadian shape-note choral music, which has a centuries-long history as Christian sacred music, with distinct 'southern' and 'northern' schools. One of the areas where the 'northern' tradition is particularly strong is in Boston, and the wider New England area. The lyrics of sacred harp songs often consider themes of ephemerality, hope, resurrection, and transcendence. The metaphorical potential of these beautiful, haunting songs, as an accompaniment to the weary and lonely LES-1, seemed that it could be a rich artistic point of departure in considering the musical elements of the finished work.

A 2. Work in Los Angeles, March 2017

We followed our work on the east coast of the United States with a month spent in Los Angeles, in March. This was a busy and informative time, during which we were able to clarify many of the basic technical points that we needed to address in order to ensure that the piece could work.

We had a series of meetings with a group from SpaceX, comprising Meharban Sobti, Jeremy Fields, Paul Weiss, Devin Williams, and Han Lin, which were organised and facilitated by Lilian Haney. Through these meetings, we planned work on both the hardware and software side of the technical problems that we needed to solve.

Together with Meharban Sobti, we outlined the software requirements for the project. He advised us that our requirements would be best served by using GNU Radio, an “open-source development toolkit that provides signal processing blocks to implement software-defined radios and signal-processing systems” [Wikipedia]. Meharban prepared a series of GNU Radio applications for us to use, and we have used, tested, and refined these applications over the past few months, both in the time that we were in Los Angeles and subsequently.

On the more hardware-dependent side of our work, we undertook several attempts to receive the signal from the LES-1 while we were in Los Angeles, combining the new GNU Radio applications with a series of antennas and setups. Although we were not able to receive the signal while we were in Los Angeles, the process was a very practical debugging of our setup, and it meant that once we got back to Germany in the middle of May, we were able to receive the signal (using the antennas that we had previously used in mid-to-late 2016) without significant difficulties.

Separately, we also met up with Dan Goods, Visual Strategist at NASA's Jet Propulsion Laboratory and advisor to the LACMA Art + Tech Lab. Through Dan, we were able to meet with Stephan Esterhuizen of the GPS Systems Group at the NASA Jet Propulsion Lab. One of Stephan’s areas of expertise is in receiving and working with weak signals, similar to the kind of signal that can be received from the LES-1. Stephan was able to provide us with audio derived from the I/Q data that we already had from previous monitoring of the LES-1, which was a very useful and practical outcome to take with us into the following phase of our work, working with the accompanying music (more on this below). We have been checking in with Stephan in our subsequent work over the last few months, and he has been able to give us some very helpful pointers on how to approach the problems that we are attempting to overcome.

We also met with Brian Mulford, Kenric McDowell, and Andrea Held from Google, and discussed the project with them. At Kenric’s suggestion, we attended the *Machines of Loving Grace* symposium, hosted by the Architecture and Urban Design department of UCLA, and talked with one of the organisers, Guvenc Ozel. We also later met with Guvenc again, to discuss the architectural and built-environment implications of various options for presenting our finished installation.

Additionally, during our time in Los Angeles, we met several times with Joel Ferree at LACMA, to keep him up-to-date on the work we were undertaking, and to plan for the presentation of the finished work later in the year. This also involved investigating the various possible locations for presenting the work, and considering the options for how to present it.

Throughout our time in Los Angeles, we had also been attempting to contact representatives from Lincoln Laboratories at MIT in Boston, home of the LES-1. Thus far, without success. We’ll keep trying.

A 3. Work in Montréal, April 2017

After our time in Los Angeles, we visited Montréal to take the first steps in creating the sound accompaniment for *Signal Tide*. We met with our collaborator, David Bryant, and started to work on the accompanying music. As we discussed above, our intention was to start with a selection of sacred harp songs and use the melodies from these musical works as the basis for our recordings. With this

in mind, we spent just under two weeks recording, editing, and mixing, including recording a four-person choir, assembled from local sacred harp singers, along with organ, guitar, bass, violin, and electronics, and with future plans for french horn, tape loops, further vocal arrangements, and more.

We left Montréal with rough mixes of our intended musical accompaniment, and with plans for future additions to music that will be included in the work. We also clarified the musical structures that will be used to underpin the functioning of the work, including the planning for the generative structure of the piece — it will never repeat in the same way, and so each pass of the satellite will have its own unique accompaniment.

A 4. Work in Berlin and Stolzenhagen, May 2017–present

Arriving back to Germany, we turned back to the task of monitoring passes of the LES-1 satellite, now with a much-expanded range of knowledge about the possibilities for doing so. We made adjustments based on the suggestions that we received from Stephen Esterhuizen. We also bought one more new antenna, a commercially-available periodic dipole VHF antenna. This brings our total to four – one newly-bought, one brought back with us from Los Angeles, and two home-made. Through these options, we could use variations in our setup to undertake satellite monitoring and compare the results.

We could again reliably get signal from the LES-1 – though with some results that were somewhat strange and unexpected, which we examined in greater detail in a post on our project blog.

We still need to undertake some further work regarding doppler-shift compensation of received signals, for which we will require assistance from Meharban Sobti and Stephan Esterhuizen – we are currently attempting to organise a time when this work can occur.

Through undertaking this work, we have also been able to make some decisions related to how to work with the antenna in the installation:

- We will install the antenna on the roof of the Bing Theater building at LACMA. We had initially thought that we might try to avoid this, as we were worried that any signals that we would try to receive would be subject to interference as a result of the presence on the skyline of 5900 Wilshire, the large skyscraper building immediately to the south of LACMA. However, with our dates for the installation provisionally confirmed, we could ascertain – thanks to some roof-clambering on Joel Ferree's part – that the building would not be particularly problematic during the passes that will occur on these dates, and as a result it would be possible to install the antenna on the roof of the theater building.
- With the antenna on the roof of the theater building, we will be able to have easier access to the antenna during the time that the installation will be running, and we will not need to transmit the signal online from another location, which would have been another practical difficulty in realising the work should we have not been able to install the antenna locally. We will also be able to have the antenna be attended (by us or an assistant), so that the functionality of the antenna can be monitored.

We have also been in regular contact with our musical collaborators in Montréal, and the mixing and recording process is continuing.

We are also undertaking research into the exact hardware to use for the installation, and work continues on this. Joel will be doing an on-site test with our cables and connectors, in order to confirm that the speaker-hanging plan that we have (with speakers suspended from overhead wire-rope cables) can work in the intended location.

During our time since we returned to Germany, we also built a website for the work, and put it live: www.signaltide.com.

In all this process, Erik, our technical collaborator, is an enormous and invaluable help. He will also join us in Los Angeles in September, for two weeks, to help with setting up and troubleshooting the installation.

A 5. Name change

We have been working on this project throughout the last twelve months, and in that time, it has slowly changed and evolved. When it first began, the provisional title that we gave to the entire project was *Twin Moons*. Since then, we have given a lot of thought as to what the final title of the work would be.

The provisional name reflected an initial plan that anticipated combining two separate signals, from two different satellites, one of which would have been the LES-1. Two satellites of the earth — twin moons. However, we realised over the course of our work that we were more interested in juxtaposing the sounds derived from the satellite's signal with other, earth-bound sounds. In particular, as outlined above, we have become curious about the possibility of using music derived from sacred harp singing as our accompanying sound.

As we also outlined above, our intention is for the sounds to accompany the satellite in real-time as it passes overhead, thus combining the audio from the resurrected satellite's signal with a musical 'answering' signal, in order to create a sound installation in which the satellite pulls an earthbound 'tide' of sound toward it, in a fleeting accompaniment, as it passes overhead on its looping extraterrestrial pilgrimage. Hence the final title: *Signal Tide*.

B. Upcoming work on *Signal Tide*, July—September 2017

B 1. Next Steps

The work has several significant steps remaining before it can be presented. Among these are:

- We hope to get a confirmation soon from Joel that our plan for the installation hardware will be acceptable to all at LACMA – including the building safety teams, and others who will need to sign-off on the presentation of the work.
- We hope to soon organise some work together with Meharban Sobti for a few final steps related to the software for the antenna and signal tracking.
- We are currently planning all of the items that we will require to present the work, and planning which items will be rented, shipped, bought in Los Angeles, or bought in Germany and brought with us in September.
- And many, many, small details to get right.

The installation production and setup will require more time then we had originally anticipated. Some of the required hardware will have to be built on-site in Los Angeles, and there will most likely be plenty of troubleshooting and problem-solving to get everything working. As a result, we are planning to spend more time in Los Angeles prior to the public presentation of the installation. Kata and Tom will be there for three weeks (and Erik for ten days) prior to the installation, so we can build and test everything.

Kata and Tom will travel to Los Angeles on Aug 26. Kris/Erik will join on Sept 10. All three of them will be there until and during the four days of the installation.

B 2. Costs

In the past six months we had the following costs:

- Kata and Tom travelling to and staying in Massachusetts, Los Angeles, and Montreal.
- Fees for our technical collaborator, Erik.
- Fees for the musicians in Montreal.
- Costs of buying new antenna and related items.
- Costs of buying elements for a self-built amplifier and other hardware that will be necessary for the installation.
- Artist fees for Kata and Tom.

We anticipate that in the upcoming three months we will have the following costs:

- Kata, Tom, and Erik travelling to Los Angeles.
- Kata and Tom accommodation in Los Angeles.
- Kata, Tom, and Erik living costs in Los Angeles.
- Further fees for the work of the musicians in Montreal and other musical collaborators.
- Further fees for Erik's work
- Costs of speakers and other hardware for installation.
- Costs of further items for the self-built amplifiers and other hardware.
- Costs of hardware for the mesh that holds the overhead section of the installation.
- Kata and Tom artist fees.

Kovács/O'Doherty – *Signal Tide* (formerly *Twin Moons*)
Supplement to Summary Report 3, 17. July 2017

Anticipated budget for Signal Tide, June–September 2017.

Item	**Cost**
Visa fees (1 person)	[redacted]
Travel costs (3 people)	$[redacted]
Accommodation (2 people)	[redacted]
Living costs in Los Angeles (3 people)	[redacted]
Travel insurance 3 people	[redacted]
Fees (musicians)	[redacted]
Fees (technical support, June-Sept)	[redacted]
Fees (artist fees, Kovács/O'Doherty)	[redacted]
Installation materials	[redacted]
Total	[redacted]

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Invoice date: 13. Jul. 2017
Invoice number: [redacted]
Tax number (Steuernr): [redacted]
Ust-IdNr.: [redacted]

To:
Los Angeles County Museum of Art
5905 Wilshire Blvd, Los Angeles, CA 90036
USA

Invoice – July 2017 – *Signal Tide* (formerly *Twin Moons*)

Grant received for the implementation of a new work, with the title *Signal Tide*, in collaboration with Katalin Kovács, for the timeframe July-October 2017.

Sum US$ [redacted]

Bank details:

Account name: [redacted]
Bank: [redacted]
IBAN: [redacted]
BIC: [redacted]

Kovács/O'Doherty – *Signal Tide* (formerly *Twin Moons*)
Summary Report 4 (Final Report) – May 2018

A little over half a year has passed since we finalised the work we undertook as part of the LACMA Art + Technology Lab Award 2016, and presented *Signal Tide* at LACMA, at the end of September 2017. In the intervening time, we have been able to reflect on the entire process, and make provisional plans for how they can be developed further in future.

We outline three phases of time below. The first are the steps that we took between our last summary report (July 2017) and our departure to Los Angeles (August 2017). The second is the time we began preparations for presenting the work at LACMA, up to and including presenting the completed work (September 2017). The third covers the time since then, and the plans we have for future development of the work.

July–August 2017

We (Kata and Tom) spent the month of July 2017 testing and refining different hardware options for presenting the installation. Together with our technician, Erik, we planned out our general audio hardware design. In May, we had ordered amplifier modules online, which Erik now used to build a 10-channel amplifier, custom-made for using in *Signal Tide*. This amplifier, together with a number of other pieces of audio and electronic equipment, were then shipped to Los Angeles.

In this time, we also made travel plans, booked accommodation, and planned what other equipment we would bring with us and what we would order or buy in the United States. (A few weeks after we booked our flights, the airline we were flying with, Air Berlin, went bankrupt. That was fun.)

At the same time, and on into August, we continued work on several other parallel strands of the preparations for presenting Signal Tide. Specifically, we were busy with the following tasks:

- Monitoring the passes of the LES-1 satellite, from where we were in Stolzenhagen, Germany.
- Working together with David and Drew, our musical collaborators, on finalising the music and sound for the finished work, which would accompany the sound derived from the signal of the LES-1 satellite.
- Working with Kevin Nelson and Will Light, developers of the digital audio workstation Substrate, on the adapting the capacities of Substrate to be used in presenting Signal Tide.
- Contacting journalists and other members of the press with details about our planned presentation.
- Planning work on the design for the speaker enclosures that we were intending to 3D-print in Los Angeles, which would be used to play the satellite signal from overhead in the completed work.

August–September 2017

We flew from Berlin to Los Angeles on August 26., to start a three-week-long period of finalising all details about the work, and then a week of presenting the completed work. Once we arrived, we were able to work directly in the Art + Technology Lab spaces, which became our de-facto studio for the time we were preparing and presenting the work.

On August 31., we took a trip out to Costa Mesa to collect a 3D printer that we would be using to print the speaker enclosures for the piece. Over the following two weeks, the speaker enclosures were printed.

On September 10., we were joined by Erik, to help finalise the technical details of the running of the installation.

Our main tasks during this time were:

- Monitoring passes of the satellite.
- Preparing the ‘sky-side’ audio — checking the chain of the signal as it passed from the satellite, to the antenna, to the laptop, to a DI box, through a thousand-foot-long run of XLR cable, to the main amplifier, and from there out into the overhead speakers.
- 3D printing the speaker enclosures.
- Testing the setup of the wire-rope mesh that was going to hold up the overhead speakers.
- Testing the process of building up and breaking down the installation – this was a necessity as we had to do this each day during the four days of the presentation (the area where we were presenting the work was a fire access point, so the mesh could not be left installed overnight).

For this time, we made a detailed plan and schedule for all the things we anticipated that we would need to do — that is attached here below.

Everything went more or less according to the plans, and the four days of the installation ran well and were well attended. We had planned to do three presentations each day during the four days of the installation — each presentation aligning to a the time of each pass of the LES-1 over Los Angeles. On the first day, we had a surprising rain shower, as a result of which we had to cancel the second pass of the day. We hadn’t prepared our equipment to be water proof, having not expected rain in California, so we had to take a break to dry everything out. Apart from that, all the other presentations ran without any difficulties.

The LACMA guard crew was extremely helpful and kind – watching our equipment overnight, helping us accessing the roof, and guiding us into the lab at 5am on the days of the presentations, meanwhile also being curious and engaged about the work itself.

September 2017 and beyond

We are currently still working on the next iteration of Signal Tide, and we are hoping to be able to present it again soon, in Europe and elsewhere.

In the time since our initial presentation, we have had contact with scientists and engineers working at Lincoln Labs, in MIT — where the LES-1 satellite was designed and built — which has allowed us to begin the process of improving the approach we have for receiving signals from the satellite. We are also working together with our musical collaborators on further development of the accompanying music and sound in the piece. We are hopeful that these next steps will allow us to present an extended and improved version of the work in due course.

We are very thankful for the possibility of being able to work on and present Signal Tide with the support of LACMA. We have met a lot of wonderful people through the process, and it has allowed us to to try out an idea we wouldn't have been able to try out without this support and assistance. In particular, the support given by Joel Ferree throughout the work was invaluable, and we are extremely grateful for it.

***Signal Tide* – Time plan and rehearsal requirements**

Sat., Aug. 26. – Mon., Sept. 25., 2017

Sat., Aug 26. *Kata and Tom arrive*

Sun., Aug 27. *Jetlag and settling-in*

Mon., Aug. 28. Visit LACMA, meet up with Joel, look through sites, walk through set-up (roof, lab, installation valley, etc.), check ordered stuff

Tue., Aug. 29. 11:30am Lab
Test audio connection between roof and lab, antenna set-up and test — access to roof required
Rooftop power connection needed on upper roof
1:18pm — satellite pass (80 degrees) – guard 1:00-2:00pm
4:30 Running XLR cable from roof to lab
(3:57pm — backup satellite pass if needed)
6:36pm — satellite pass (45 degrees) – guard 6:15pm–7:15pm

Wed., Aug. 30. Set up and test wire-rope mesh in installation valley
plan out speaker hanging – measure audio cable length needed
See if we need more hardware (also for hanging speakers) – place Home Depot order
Check if we need more audio cable – Parts Express order

Thu., Aug. 31. Trip to 3D printing place, tutorial at 11:30am (tbc), transport
3D printing tests
4:33pm Satellite monitoring — access to roof required (guard 4:15pm–5:15pm)

Fri., Sept. 1. ***2:10pm*** Satellite monitoring — access to roof required (guard 2:00pm–3:00pm)
3D printing tests
Museum hours 9-4, Joel here til 7

Sat., Sept. 2. 3D printing tests
2:00pm Satellite monitoring — access to roof required (guard 2:15pm–3:15pm)
4:45pm Satellite monitoring — access to roof required (guard: 4:45pm–6:00pm)
Museum hours 10-7

Sun., Sept. 3. ***11:45am*** Satellite monitoring — access to roof required (guard 11:45am–1:00pm)
5:27pm Satellite monitoring — access to roof required (guard 5:15pm–6:15pm)
3D printing tests
Museum hours 10-7

Mon., Sept. 4. – Sat., Sep. 9.
Trouble-shooting all problems from first week of tests — likely to require roof access — however, this will strongly depend on the results of the first week's tests

Wed: hopefully another mesh set up+speaker hanging plan

Sun., Sept. 10. *Erik arrives*

Mon., Sept. 11. Show Erik around (probably in late-afternoon/evening), visit all sites (roof, lab, installation valley) — access to roof required

Tue., Sept. 12. Testing antenna set-up:
9:30–10:15am: Satellite monitoring — access to roof required
12:10–12:55pm: Satellite monitoring — access to roof required
2:53–3:40pm: Satellite monitoring — access to roof required
After 8pm: Set-up of equipment — is this possible? Can we start setting up on Tuesday evening? Ideally so that we can be ready early on Wednesday to catch the satellite passes with a full set-up of the installation. If this is possible, then rental equipment needed by 8pm.

Wed., Sept. 13. Full test, with all equipment. Require all rented equipment and access to all sites, all day.
Satellite passes on this day:
7:10–7:55am (may not be required)
9:53–10:33am
12:32–1:12pm
3:11–3:49pm

Thu., Sept. 14.–Tue., Sept. 19.
Trouble-shooting anything that comes up during tests. Possible 3D printing fixes, but hopefully not.

Tue., Sept. 19. Getting extra hardware (thin wire rope and cable connector)
Getting cymbal stand from rental place
Redo speaker wire length / audio cable length
Arranging audio in Ardour
Finishing audio mixing

1pm – Gear arrives
Laying down all cables (XLR, Speakon)

5pm – start rigging
fine tuning speaker hanging length
leave rigging the way we want it on Wed. morning

Wed., Sept. 20. Set-up and final tests, with full equipment. All day access to all sites and all rented equipment needed.
5am – arrive at LACMA, access to Lab
5-6:30am – rigging
satellite pass: ***6:43–7:23am*** (not monitored)
Breakfast

setting up lab
monitor speakers line check?
charging computer and phone
9am meeting guard to go on roof
satellite pass: ***9:21–10:02am*** (full test)
put gear on charger
10:30-11:30am BREAK
11:40am meeting guard to go on roof
satellite pass:***12:00–12:40pm*** (full test)
put gear on charger
1:00-2:20 BREAK
2:20 meet guard for roof (if needed)
2:39–3:15pm (backup pass)
take down speakers
take down rigging?
Cover ground speakers
redo rigging?

Thu., Sept. 21.	Presenting complete installation. Full equipment, all day access to all sites and all rented equipment needed.
5am	arrive at LACMA
	charging gear if needed
5-6:30am	rigging
6.30am	Prep for pass
	(check charging, pack bag, start linux)
6:40am	meet guard to go to roof
	(antenna, airspy, laptop, linux stick, DI box, headphones, jack adapters x 2, minijack cables x 2)
6:50	announced starting time
7:00-7:41	satellite pass
7:41-8:00	down from roof, put gear on charger, check in
8:00-9:10	BREAK
9.10am	Prep for pass
	(check charging, pack bag, start linux)
9:20	meet guard to go to roof
	(antenna, airspy, laptop, linux stick, DI box, headphones, jack adapters x 2, minijack cables x 2)
9:29	announced starting time
9:39-10:20	satellite pass
10:20-10:40	down from roof, put gear on charger
10:40-11:45	BREAK – go out for food?
11.45am	Prep for pass
	(check charging, pack bag, start linux)

	11:55	meet guard to go to roof (antenna, airspy, laptop, linux stick, DI box, headphones, jack adapters x 2, minijack cables x 2)
	12:08	announced starting time
	12:18-12:58	last satellite pass
	12:58-13:15	taping up cable on roof down from roof
	14:00	breaking down rigging covering speakers check in about day, planning if anything need to happen before 7pm KOD posts online about day BREAK
	19:00	redo rigging
Fri., Sept. 22.		Presenting complete installation. Full equipment, all day access to all sites and all rented equipment needed. Satellite passes on this day: ***7:18am – 7:59am*** ***9:57am – 10:38am*** ***12:36pm – 1:15pm***
Sat., Sept. 23.		Presenting complete installation. Full equipment, all day access to all sites and all rented equipment needed. Satellite passes on this day: ***7:36am – 8:17am*** ***10:15am – 10:56am*** ***12:54pm – 1:33pm***
Sun., Sept. 24.		Presenting complete installation. Full equipment, all day access to all sites and all rented equipment needed. Satellite passes on this day: ***7:54am – 8:35am*** ***10:33am – 11:14am*** ***1:13pm – 1:50pm***
Mon., Sept. 25.		Lots of dismantling and packing.