THE CODEX
A DEEPTECH REVIEW BY DA VINCI LABS

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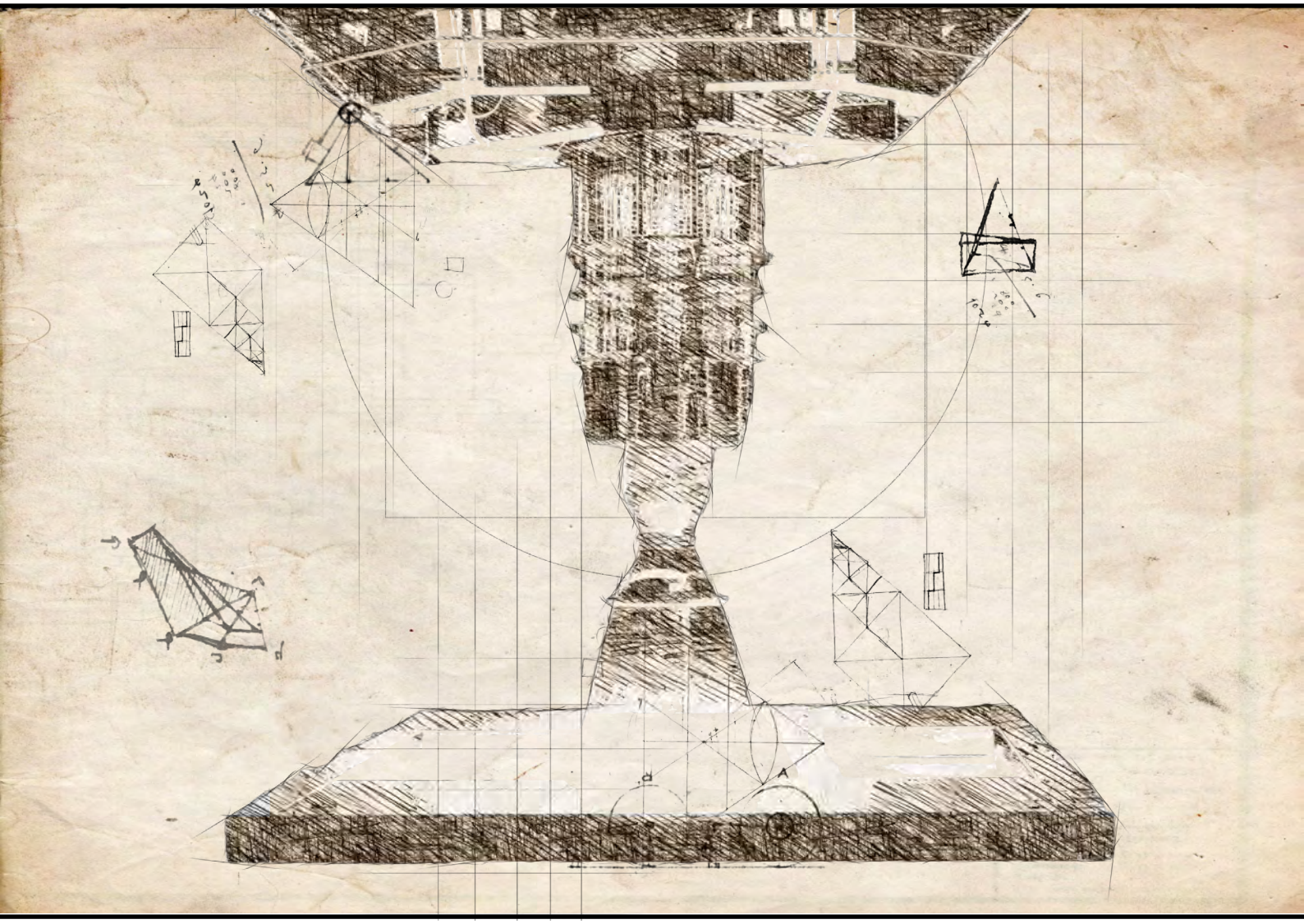
Building the Quantum Ecosystem, One Company at a Time: A Conversation with Christophe Jurczak

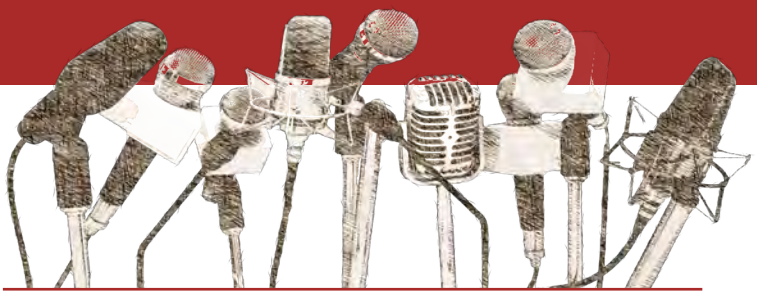


Leonardo Rebooted: AI & Quantum Computing

Leonardo Rebooted: Synthetic Biology

No Injection Necessary: Taking Global Immunisation to the Next Level with Intranasal Vaccines

Building the quantum ecosystem, one company at a time: A conversation with Christophe Jurczak



For this Codex edition we spoke with Christophe Jurczak. Christophe is a key figure in the global quantum ecosystem and a good friend of the Da Vinci Labs. Christophe is the co-founder and managing partner of Quantonation, the first early-stage venture fund dedicated to deep physics startups focusing on emerging quantum technologies. He has held government and executive positions in the energy and defence sectors in France, Italy, and the US. He has played a central role in the early phases of the quantum industry in Europe and Silicon Valley. We spoke about his trajectory, his views on the quantum economy and future collaborations. Below, you can read an excerpt from our conversation.

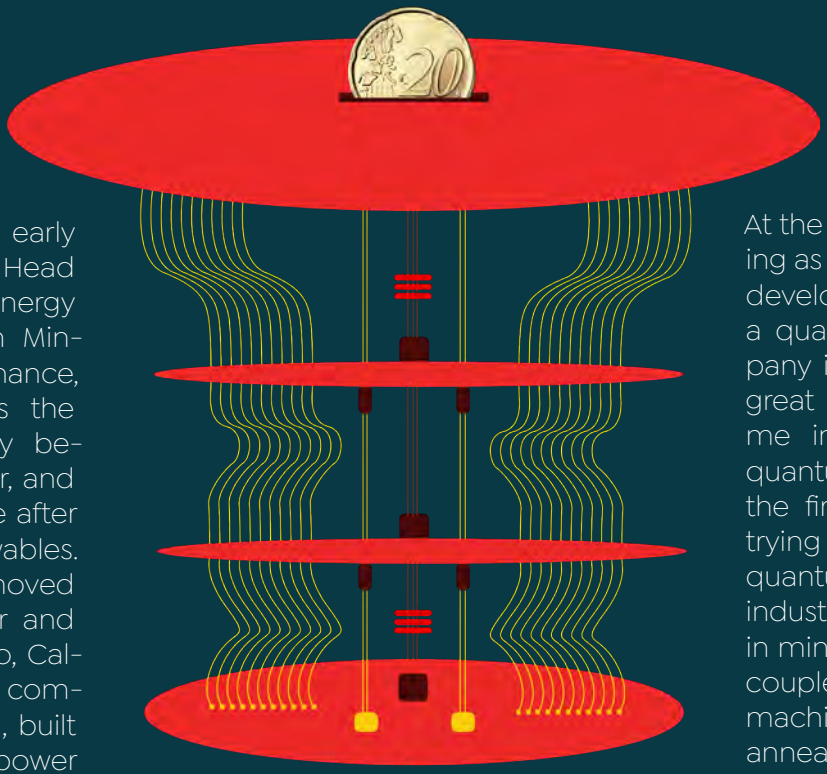
Alvaro Veliz Osorio **Tell us a bit about your background and how you started working on technology deployment.**

Christophe Jurczak I got my PhD in quantum physics at the École Polytechnique under the supervision of Alain Aspect. Then, I became a postdoc at the École Normale Supérieure in Paris. But I realised that I really didn't wish to pursue an academic career further. I joined the French Ministry of Armed Forces at the Directorate General of Armaments, where my job was to help turn innovations into next-generation weapon systems for the French forces. At the time, we were thinking about automation, IoT, lasers, etc. It was a remarkably collaborative environment with several brilliant people and very few constraints. This was in 1998-2000, and we had a very long-term vision. I saw the results from some of these programs only 20 years later, on July 14th on the Champs Elysees.

Alvaro **What are the most important lessons you learned from your work at the armed forces?**

Christophe It brought focus to the questions: What is this technology good for? Why should we use a new technology? Is there a need to be satisfied? Laser weapons are a good example. It sounds really cool, right? But pretty fast, you realise that you need to have a line of sight with the target. This limitation goes against the whole point of artillery going "beyond line of sight". In fact, weapon systems have evolved in a completely different direction. So, having an exciting technology, doesn't necessarily mean that it will be useful.

Alvaro **What came next?**



Christophe In the early 2000s, I became the Head of the Renewable Energy Office at the French Ministry of Economy, Finance, and Industry. It was the time when Germany began to subsidise solar, and there was conference after conference on renewables. After some time, I moved to the private sector and relocated to Palo Alto, California. There, I ran a company that developed, built and operated solar power plants. My interest started from the technological angle. Solar was super interesting at the time, and we were exploring different alternatives, e.g. concentrated PV, organic materials, etc. But everything changed from one day to the next when Chinese companies slashed prices. Innovation stopped, and most Silicon Valley start-ups in the space vanished overnight. Basically, only Tesla survived the Clean Tech boom and bust cycle.

Alvaro **How did you find your way back to quantum?**

Christophe I kept an eye on the developments in quantum computing and followed the work of early quantum startups like Rigetti and IonQ. I also kept in touch with my PhD colleague and good friend Bruno Desruelle, the founder of Muquans–one of Europe's first quantum companies. He motivated me to get back into quantum. I had the idea of working again with my PhD advisor and came to see him in 2016. He told me that if we wanted to get something off the ground, I should talk to Antoine Browaeys from the Institut d'Optique about quantum simulation hardware. These discussions and the encounter with Georges-Olivier Reymond, its CEO, led to the foundation of Pasqal,.

At the time, I was also working as the Head of Business development at QC Ware, a quantum software company in California. It was a great experience as it got me into commercialising quantum technologies for the first time. I was there trying to sell software for quantum computers to industry customers. Keep in mind that we only had a couple of qubits from IBM machines and the D-Wave annealers at the time. It wasn't clear what was going to happen, but it was really exciting. It also helped me understand better quantum computing. My research background is in experimental quantum physics, but quantum computing wasn't as mainstream back then.

Alvaro **Tell us a bit about the origins of Quantonation.**

Christophe The idea of starting an early-stage venture fund dedicated to quantum technologies took shape around this time. We built Quantonation first as an investment vehicle and then as a fund, thanks to Charles Beigbeder, who helped us start. Interestingly, this didn't begin in Silicon Valley, even though I lived there. I had to come to France to find smart and daring investors willing to bet in quantum. This taught me something very interesting. There is a lot of money in the US, but not so much for early-stage deep tech startups especially when it's about hardware. Also, at the time (2017-2018) everyone was talking about other very cool things such as blockchain and IoT, so quantum wasn't a priority. We started with the support of successful renewable energy entrepreneurs from Charles' and my network. And 4 years later we just did the final closing of the fund itself, Quantonation 1, at €91 million!

Alvaro **Now, that you are playing an active role in a new technology revolution. What lessons from the Clean Tech boom and bust cycle inform your decision making?**

Christophe There are some vital lessons. Perhaps the most important one is that even if a technology is exciting and better, that doesn't guarantee success. With solar, we were aiming at solar cell efficiencies of 25%, but market dynamics prevailed. At the end of the day, price and scale were the determining factors. When the Chinese built massive facilities and brought prices down, it became clear that 14-15% efficiency with less sophisticated technology was good enough. You didn't need 25% efficiency for a high price module. Nobody cared about the efficiency and how unique the underlying technology was if the competition was able to give you solar power at half the price.

We should avoid this trap in quantum. I often see money being invested in technologies without giving much thought to commercialisation. Investors and VCs are not here to fund research. It is important to support it for early-stage deep tech, in combination with non-dilutive grants, but we are not a funding agency. We want to support companies building a product, scaling, and dominating the market, not technology for its own sake. This being said, early stage companies need to mature their technology until they have something to show and sell. That takes time and I often advise refraining from selling too early, because that can be counterproductive. It's a very subtle transition.

Alvaro **Europe seems to be quite active in the quantum technology space. How can we keep the momentum?**

Christophe We have a decent number of European-born quantum companies–13 and counting. And they are growing strong. It's fair to say that we have supported the transition of technologies from the lab into companies able to compete globally. This has been thanks to a wave of outstanding entrepreneurs with the right knowledge and mindset. People we both know well like, in our portfolio, Georges-Olivier Reymond, Valerian Giesz, Simon Gröblacher and beyond our portfolio, Jan Goetze, Thomas Monz, Tommaso Calarco, etc. The question is: Can we find enough people like that? This is a big challenge. You need excellent science to build great quantum companies, but that's not enough. This is why ideas like the quantum venture studio we are starting with Da Vinci Labs and Deeptech Founders are essential. We want to help projects mature and take off. We will be making more announcements in the near future.

A key point to keep in mind is that we need to build projects capable of delivering at different timescales. We can have big dreams about the future impact of quantum. But, in the near term, we need to deliver even if the applications are a bit niche. There are interesting applications in sensing and communications that can have a short-term impact. If quantum computers are used only to solve academic problems in the near future, that's ok. It is a good enough use case with a reasonably sized market. The important thing is to balance the short term realisations and the longer term bets.

Alvaro **I think that the problem is that when we look back at the history of technology, we mostly focus on the watershed moments. But there are several critical intermediate developments which are forgotten.**

Christophe I am 100% with you there. In fact, I have been struggling for years with the notion of gate-based digital computing. It is an interesting idea, but it was developed with perfect machines in mind, without errors. We have to credit companies like IBM, IonQ, Rigetti and others for releasing noisy machines. It was a good pragmatic approach, very American in a way. European researchers seemed, for a long time, more fixated on the perfect quantum computer idea. But I think the best strategy is to start playing with what we have and see if we can build something useful.

Alvaro **I would even ditch the term 'computer.' I think it has too much baggage. I see these machines as programmable quantum many-body systems where entanglement and superposition can be used as resources. I feel this perspective is more liberating.**

Christophe That was Alain Aspect's point of view when he introduced me to Antoine Browaeys. If you look at Antoine's paper from last November, you can see what I mean. They simulated a paradigmatic quantum system at a scale which is impossible to run using classical hardware. If you read it, you can see anti-ferromagnetic order emerging. We have a system that's undeniably quantum, but we cannot simulate it with classical

methods. People keep asking about quantum supremacy. It is there!

I've been dreaming about a company working on quantum materials. I think these materials will hugely impact the economy and society in 30-50 years. I am talking about new types of superconductors, capacitors, etc. It is the perfect use case for quantum computers. It sounds purely scientific today, but I think it will be really transformative.

Alvaro **It does sound scientific. But things like transistors and integrated circuits were also deep physics in their time. People working on that were winning Nobel prizes. Let me switch gears to a topic that has received a lot of attention recently, quantum hype. What is your perspective on the matter?**

Christophe Some say that the space is overheating and there is too much money. If anything, I believe that there isn't enough investment. If you look at VC investments from last year, AI got about $90 billion, quantum $3 billion, at most. It is minuscule. Yes, there is a lot of noise, but more resources are needed to build a robust ecosystem. There are inflated expectations, but the people that matter know what's going on and what's at stake. Hype is coming from different sources, not just startups and investors. I sometimes see universities making grandiose headlines for scientific breakthroughs. It might be that they underestimate the difficulties involved in turning promising experiments into products.

We need to remove the mystique around quantum. People treat it as if it is some unexplainable magic. This needs to stop. Quantum is just another technology, and we need the proper education. The problem is that communication is an afterthought unless a strong ecosystem can allocate enough resources to it. Another important response to hype is to deliver results. If we keep pushing the timeline to deliver value people will lose patience. We cannot just say 'okay, guys, it's not working but in 10 years, I swear, something will happen.'

Alvaro **Besides the technical challenges and the need for more finance, what do you see as potential bottlenecks for the industry?**

Christophe Once we demonstrate quantum advantage, which I am convinced will happen soon, albeit at first for problems of limited commercial value and there will be intense competition. Then, people will push to build more powerful machines. But how are we going to build the machines we need? One thing is to scale the number of qubits. Scaling the industry is a different question. Large companies like IBM or IonQ have just 10-30 machines; Pasqal has a couple to start with. The day we want to turn technical into commercial advantage, we'll have to deal with a backlog of orders.

Also, we need to work with industry standards in terms of reliability and cost. Many of the tools we use are not industry-grade. Technologies for manipulating lasers and ions still need to mature. Even microwave technology has to improve. Companies like Quantum Machines are doing good work in this direction, but there is still a long way to go. This is a risk we are collectively underestimating. The industry's mindset is 'let's achieve quantum advantage, and then we'll sort it out.' The problem is that we'll need to deliver once we reach quantum advantage. It's an exciting challenge, I trust it will be solved.

Alvaro **This is a very important point. Also, I think that having better components might be key to achieving quantum advantage. Quantum gains can 'leak' due to clunky electronics, slow laser control, etc. How do we support these developments?**

Christophe This is a challenge for us venture capitalists because investing in the supply chain - and there needs to be investment in the supply chain without a doubt - is not what VCs do best. Companies in this sector are small or mid-sized. Also, it is not obvious how to anticipate the needs of the industry, the market size. People tell me about picks and shovels, but it might still be uncomfortable for investors. Nonetheless, we have invested in interesting supply chain companies like Pixel Photonics, who are making high-performance single-photon detectors.

Alvaro **Selling picks and shovels was a good business during the gold rush because digging methods were well established.**

Now, let me ask you about software. I sometimes feel that companies are developing tools without too much consideration for the available hardware, both quantum and classical.

Christophe Our viewpoint is reflected in Quantonation's portfolio. Qubit Pharmaceuticals is an excellent example. Here is a company developing software to solve concrete problems with a quantum twist. I really like these types of companies. They understand their sector deeply, and quantum is a technical choice. Qubit Pharmaceuticals is primarily - from the point of view of implementation - a GPU company running on classical computers. They are well aware of the potential of quantum computing, but the targeted problem comes first. I think this is a good approach for quantum startups.

Several companies don't understand the best classical technologies and how fast they are evolving. Just look at Nvidia's roadmap; it is incredible! I think that only the companies with a deep understanding of the classical state-of-the-art will be able to deliver value. I sometimes struggle with pure quantum players in software because of that. In the end, many of them end up becoming machine learning companies, and not necessarily good ones. My preference goes to companies with strong subject matter expertise.

Alvaro **Also, since quantum hardware capabilities are still quite limited, do you think that hardware companies should develop their own software?**

Christophe I am a strong believer in the full-stack approach in the short term, opening with time to more focus on the application layer and software companies. This is in line with the recent merger between two of our portfolio companies, Qu&Co specialising in software and Pasqal in hardware. I believe in the strong connection between hardware and software. I think most hardware companies will do software internally. Still, I am very curious to see how third-party quantum software players evolve.

Alvaro **What makes you excited about the future?**

Christophe Can you imagine a full-stack quantum computing company becoming a global leader in computing in general? Wouldn't that be amazing? Once you have a quantum advantage, you could get a competitive edge and build around it. The Intel of the next century might start as a quantum company.

I strongly believe that the future is quantum. It won't happen overnight, but we should set short-term milestones in sensing and communications or moderate gains in computing. If we step back and look at the progress over the past 5-6 years it is remarkable. People are building and purchasing quantum computers. Companies like L'Oreal are looking for use cases. Things are moving fast!

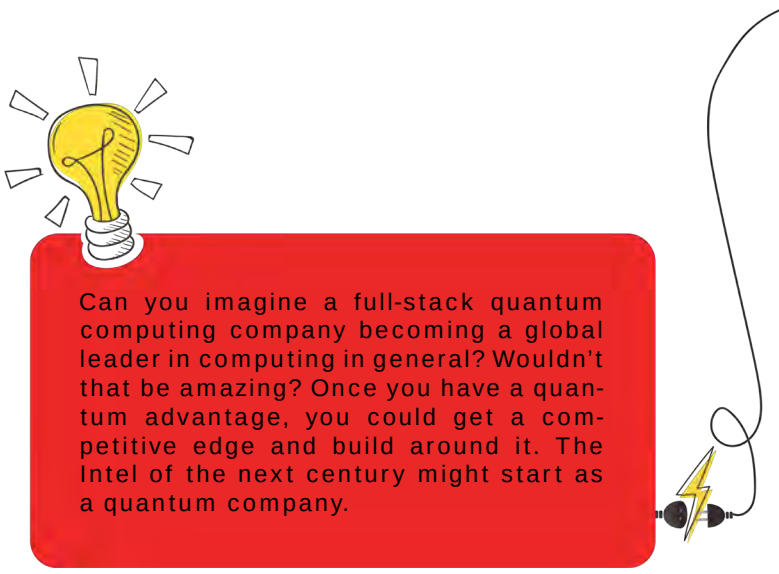
Alvaro **I think we can work together and help move things even faster!**

Christophe This is why we decided to start a quantum venture studio and work together. We can use the experience gained and all we have witnessed over the last five years. We are ideally positioned to bring things to the next level. Our venture studio, in combination with other initiatives worldwide, will fill a fundamental need by helping increase the deal flow to match the market's needs. There are a lot of open problems that scientists and entrepreneurs need to solve. Actually, I think the most significant risk is quantum hype. It is making people believe: 'ok! We solved everything in quantum, let's move on.'

Deal flow is super important for us investors and growing the quantum economy. The next generation of researchers and entrepreneurs need support to turn science into products. We should and can help them. We already have some great success stories. There are very nice companies we've helped in Europe and North America.

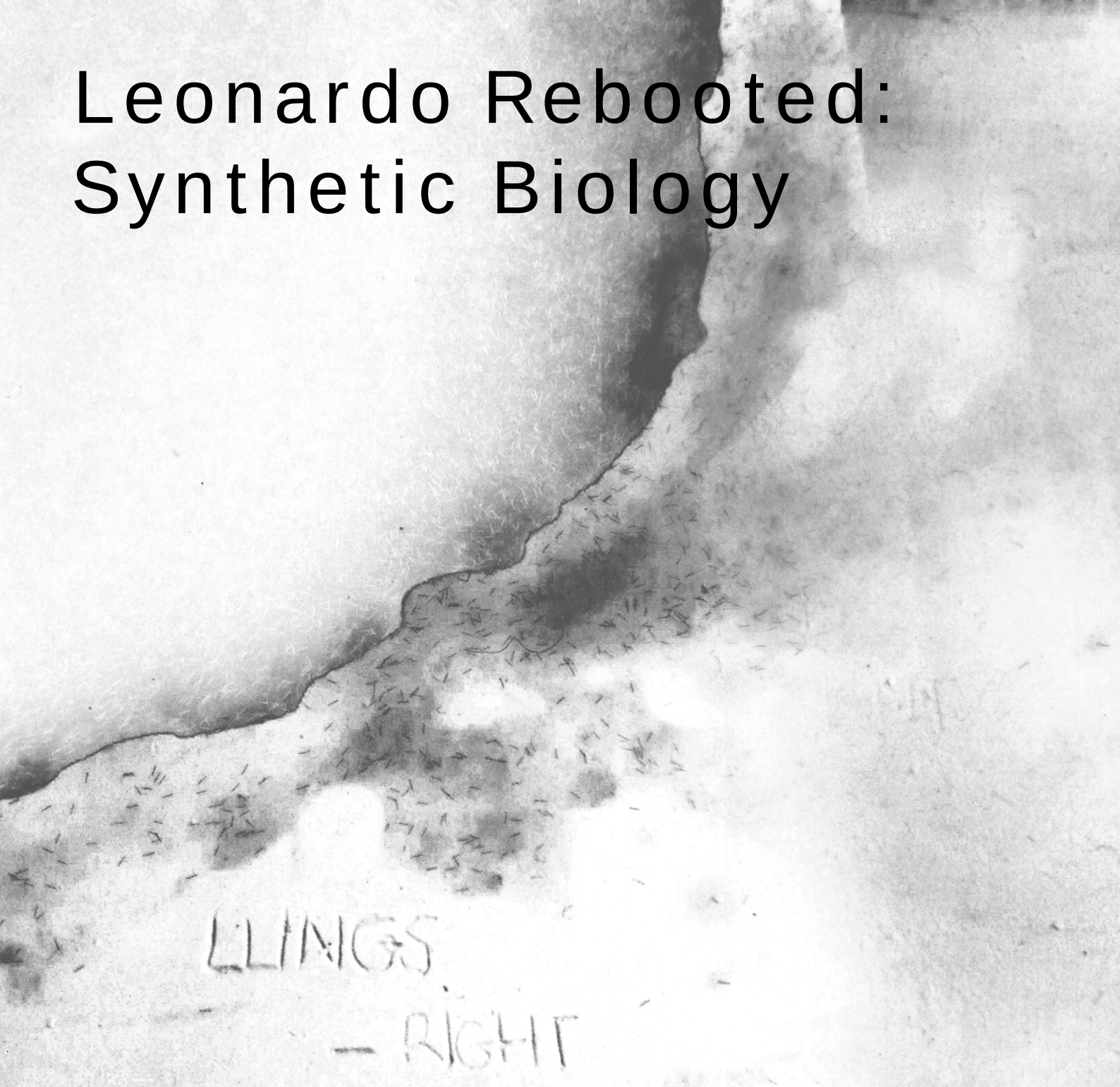
The studio we are building together can help build bridges between various ecosystems. I believe that the emphasis on sovereignty and nationalism in quantum is misguided. I believe this is because people are thinking about the quantum threat to cryptography. Surely, this is an interesting use case, but has received a disproportionate amount of attention. In reality, the majority of applications of quantum technology won't pose any threats. This is why I think we should foster collaboration. I am a firm believer in grassroots approaches. Scientists collaborate, and we should keep that spirit. Also, not everybody has all the skills and the same interests. We can build synergies with our colleagues in Sherbrooke, Maryland, Delft, etc.

We have reached a critical mass of like-minded people. We have the chance to create something big here.



Can you imagine a full-stack quantum computing company becoming a global leader in computing in general? Wouldn't that be amazing? Once you have a quantum advantage, you could get a competitive edge and build around it. The Intel of the next century might start as a quantum company.

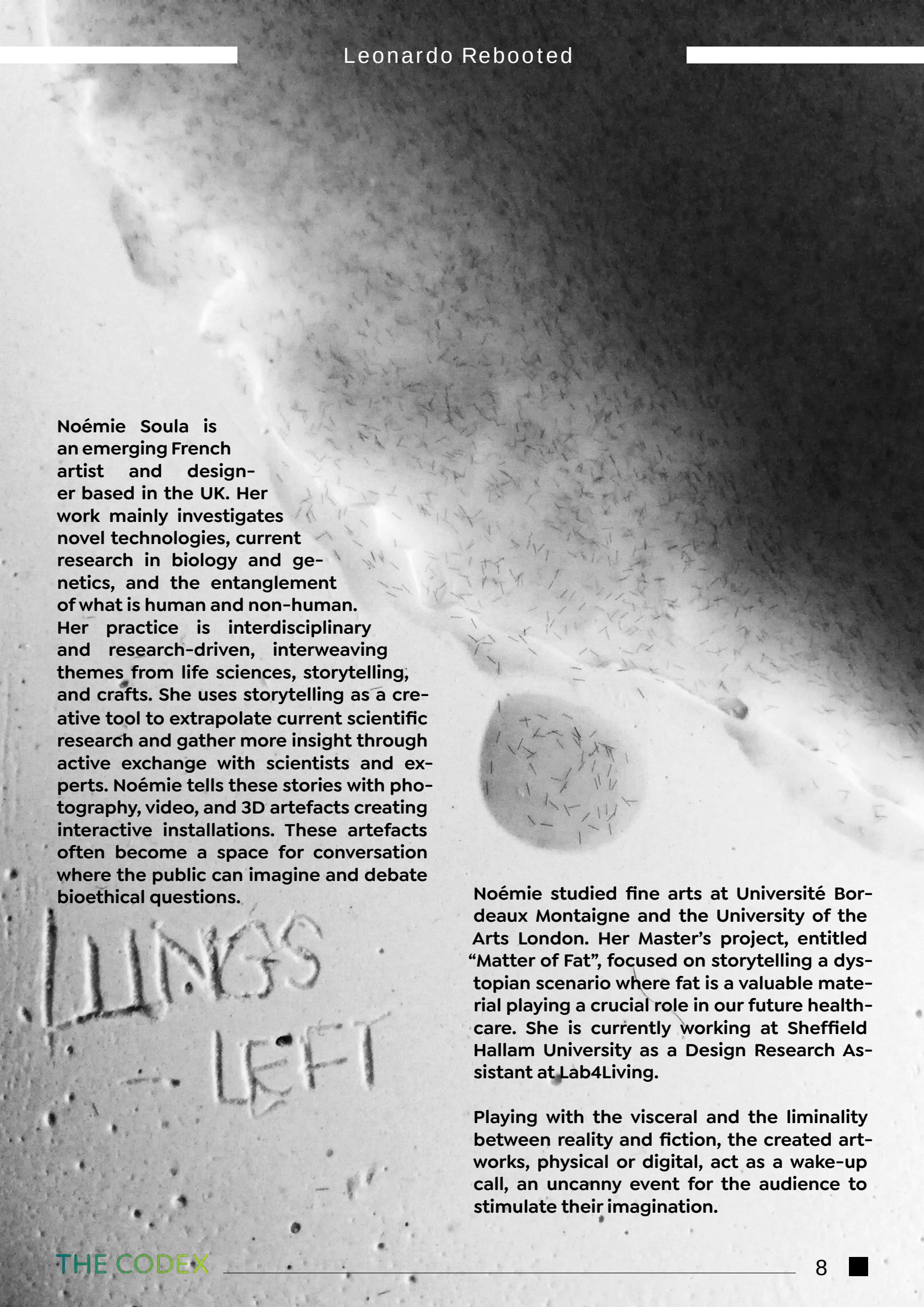
Leonardo Rebooted: Synthetic Biology



Connect with Noémie: noemiesoula.com

Noémie Soula was selected among 115 artists to receive the Leonardo Rebooted grant supported by Da Vinci Labs in the Synthetic Biology category for her project titled "Mythical living data: an inquiry into the future of DNA as data storage."

Our world is changing rapidly, and the increasing pollution is not without impact on human lives. But can it also be one of the drivers of evolution? Or will pollution become integral to our bodies, sneaking into our DNA? In her project, Noémie mixes legend with science by examining the concept of chimaeras to investigate and find answers to these questions. She explores how rapidly evolving & often artificial environments can influence and change our DNA. She is also interested in the blurring lines between what is still considered human and what is already a chimaera–a creature that is more than human.



Noémie Soula is an emerging French artist and designer based in the UK. Her work mainly investigates novel technologies, current research in biology and genetics, and the entanglement of what is human and non-human. Her practice is interdisciplinary and research-driven, interweaving themes from life sciences, storytelling, and crafts. She uses storytelling as a creative tool to extrapolate current scientific research and gather more insight through active exchange with scientists and experts. Noémie tells these stories with photography, video, and 3D artefacts creating interactive installations. These artefacts often become a space for conversation where the public can imagine and debate bioethical questions.

Noémie studied fine arts at Université Bordeaux Montaigne and the University of the Arts London. Her Master's project, entitled "Matter of Fat", focused on storytelling a dystopian scenario where fat is a valuable material playing a crucial role in our future healthcare. She is currently working at Sheffield Hallam University as a Design Research Assistant at Lab4Living.

Playing with the visceral and the liminality between reality and fiction, the created artworks, physical or digital, act as a wake-up call, an uncanny event for the audience to stimulate their imagination.

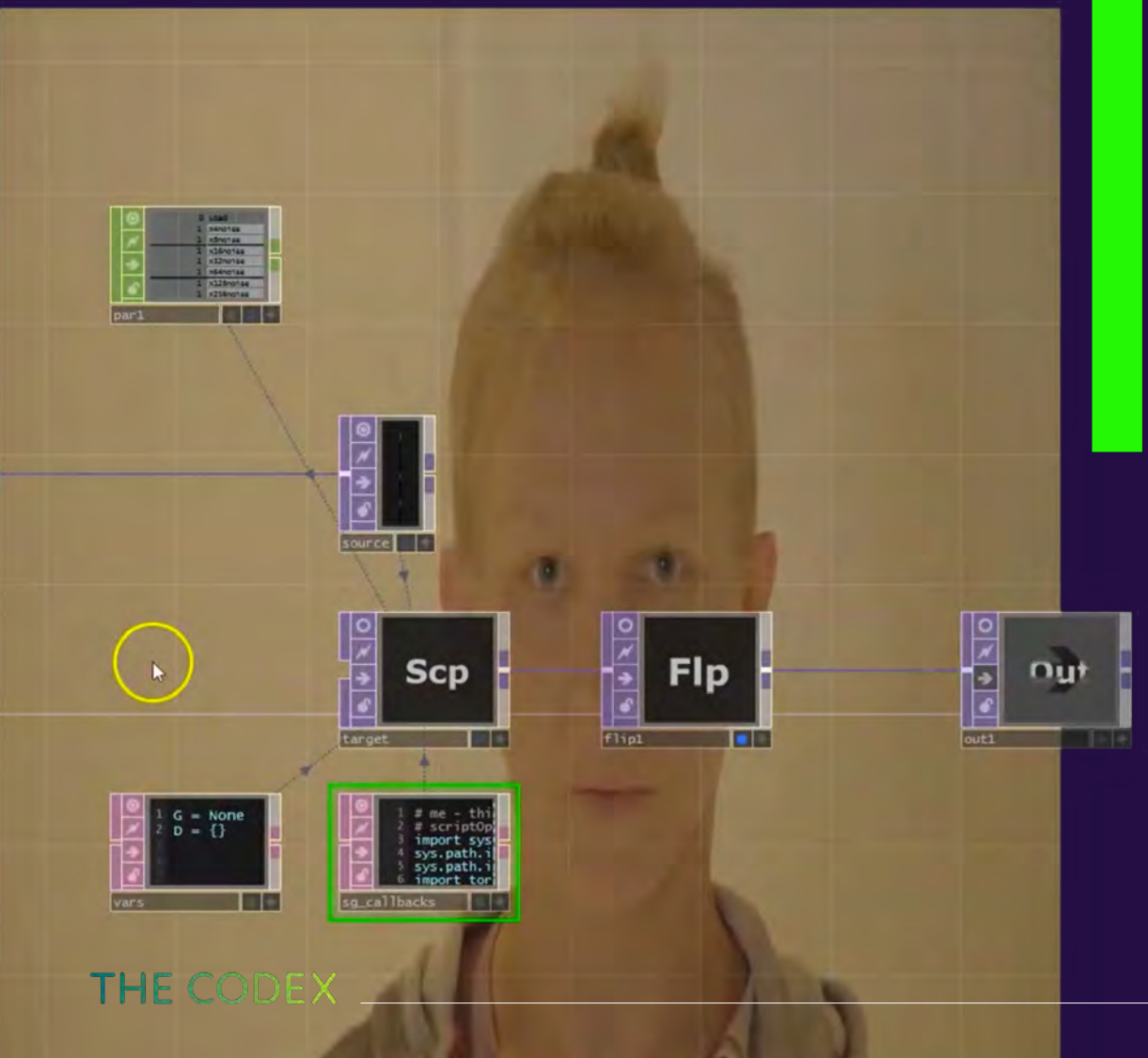
Leonardo Rebooted: AI & Quantum Computing

Find out more about Shawn: shawnlawson.com

Shawn Lawson was selected among 115 artists to receive the Leonardo Rebooted grant supported by Da Vinci Labs in the Artificial Intelligence & Quantum Computing category for his "XAI: Living guts" project.

Shawn Lawson is an artist and researcher creating the computational sublime. His practice is based on research foundations and suggests that the awareness of computation - the universal computability towards the creation/representation of anything - can connote a sense of awe and a pause in consciousness. He creates these moments of wonder with computational artistic outputs or live coding performances, algorithmic art, and interactive displays.

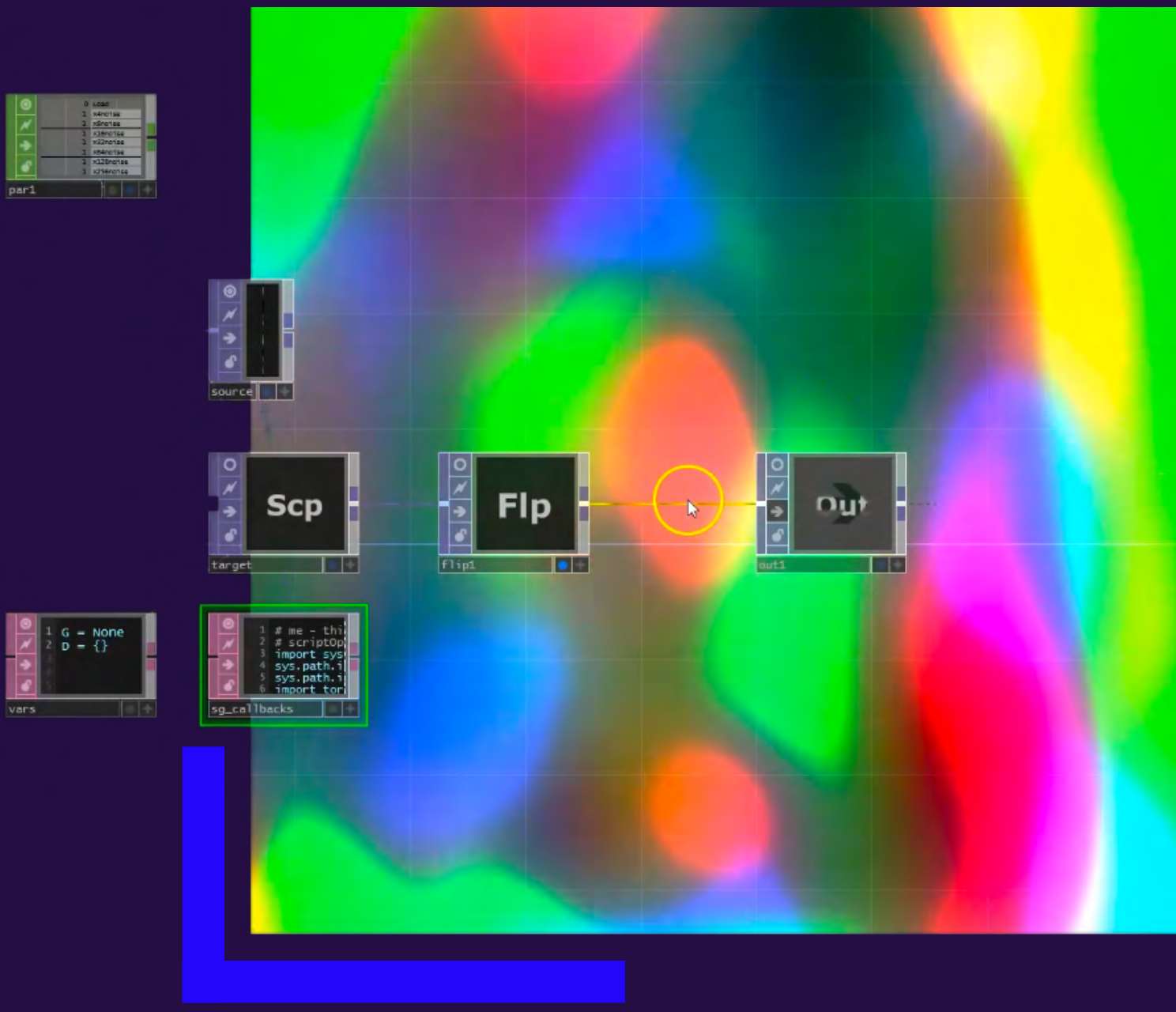
In his project, Shawn will focus on the role of Artificial Intelligence and machine learning which are rapidly changing nearly every aspect of post-modern life. He is motivated by the challenge of understanding these complex tools to benchmark them and prevent bias. Explainable AI, or XAI, is a burgeoning field of research



to open the algorithm's black box and explain how it works. Different approaches can help achieve this understanding, technically, where input & output are compared. Shawn takes a different approach. He is looking at this problem from the visual art's point of view, looking at changes introduced by the algorithm to photos and images, creating a visual arts XAI.

He has performed at numerous exhibitions and live coding events in Australia, Spain, Portugal, the UK, Canada, Mexico, Chile, ISEA, Germany, and more. In addition, Shawn's artwork has been exhibited or screened in museums, galleries, festivals, and public spaces in England, Denmark, Russia, Italy, Korea, Portugal, Spain, Brazil, Turkey, Malaysia, Iran, and Canada; locally in ACM SIGGRAPH, IEEE ProCams, ACM MM, The Art Institute of Chicago, Milwaukee Art Museum, Chelsea Art Museum, Eyebeam, Aperture Foundation Gallery, Nicholas Robinson Gallery, MIT, OSU, ASU, and LTU.

Shawn studied fine arts at Carnegie Mellon University and École Nationale Supèrieure des Beaux-Arts. He received his MFA in Art and Technology Studies from the School of the Art Institute of Chicago in 2003. He is an Associate Professor and Animation Area Coordinator at Arizona State University.



Injection Necessary:

Taking Global Immunisation to the Next Level with Intranasal vaccines

Global immunisation – Public health's greatest success

Smallpox claimed the lives of 300-500 million people over the 20th century. Before large-scale immunisation efforts by the World Health Organisation, deaths were at an average of 15 million per year. The first smallpox vaccine was developed in 1798, but it was only in 1979 that mass immunisation culminated in the global eradication of smallpox.

Today, our society faces a similar challenge. The ongoing COVID-19 has claimed more than 6.3 million lives globally and brought the economy to a halt. We are fortunate to have novel vaccines that were developed and distributed rapidly. These are more readily available in developed countries, but the WHO has established the immunisation agenda 2030 as part of their Global Strategy to Leave No One Behind.

But how to know which threat is the most relevant and what control measures to apply?

As a first step, we must understand how a pathogen spreads. The key metric is the basic reproduction rate, or R0, used to measure the transmission reach. It corresponds to the expected number of secondary cases produced by a single primary infection. If R0 is larger than one, the infection will spread if it is smaller, it will abate.

R0 is a crucial variable to consider when determining herd immunity and planning vaccination campaigns. For example, the R0 for measles is estimated at 12-18, meaning that 1 person will lead to 12-18 infected people (where nobody had immunity) or 95% of the population. Thus, this 95% is the needed herd immunity to stop the spread of the disease.

How do vaccines work?

Vaccines are safe training exercises for the immune system that "teach" the antibodies how to recognise and neutralise an antigen (bacterium or virus). Standard vaccines contain weakened antigens or a specific protein subunit. A new generation of vaccines, introduced for patient use during the COVID-19 pandemic, use mRNA molecules to carry the coding sequences for protein synthesis by the patient's own body.

Standard vaccines use inactivated ('dead') antigens or less virulent strains. In the former, the pathogen is inactivated by heat or a chemical agent and injected to train the immune system to recognize the pathogen. For the latter, the pathogen is weakened through repeated cell cultures. These vaccine types grant a robust & lasting immune protection, practically identical to naturally gained immunity. However, this is also a drawback of this method, as it might be too strong an option for people with a compromised immune system, whose bodies

may not be able to control the infection.

The newest addition to the vaccine family are vaccines based on mRNA technology. In principle, these vaccines are similar to those containing specific proteins but carry mRNA fragments from the antigen. But this technology is not new! mRNA was discovered in the 1960s', and since then, scientists have been working on deploying mRNA for therapeutic use. The progress was slow. The first influenza vaccine was only tested in 1995 in mice, and this technology's first clinical trial began in 2015. These foundations enabled BioNTech / Pfizer and Moderna to introduce and certify the COVID-19 vaccines rapidly.

mRNA vaccines have proven to be an exciting alternative to conventional vaccine approaches due to their high potency, rapid development times, and potential low-cost manufacturing. As mRNA is just an information carrier, this technology can carry information to the immune system required to prepare the organism to fight dangerous diseases such as HIV, Zika virus, Ebola, melanoma, and ovarian cancer.

Mucosal immunity - New paradigm shift to stop virus circulation and prevent contagion

Yet, these vaccines are injected via parenteral routes. Thus, they only provide systemic cellular response antibodies and/or antibodies in serum and extracellular fluid. The problem is that systemic immunity alone is not able to stop contagiousness. On the other hand, when mucosal immunity is activated, the antibodies on the mucosal surface form a physical barrier to viruses wanting to enter the organism. When the respiratory pathogen is in contact with the mucosal barrier, the respiratory epithelial layer and the innate and humoral immunities of the upper airway mucosa are the first barrier against the infection. Diverse immune cells (phagocytic neutrophils, macrophages, dendritic cells, natural killers, mast cells) are activated to degrade the pathogen. The release of the RNA of the pathogen will initiate the secretion of proinflamma-

Box 1: How health officials estimate R0

In practice, R0 is estimated retrospectively on serial epidemiologic data or based on mathematical models. Epidemiologists determine R0 using contact-tracing data and cumulative incidence data. Mathematical models use ordinary differential equations, including variables on the number of cases at a determined time, the time between the onset of the primary and secondary case and the prediction time, the duration of the ineffectivity after the first infection, the likelihood of the transmission per contact between a susceptible person and an infected individual and the contact rate.

For example, at the beginning of the COVID-19 pandemic, WHO estimated R0 of the initial SARS-CoV-2 strain between 1.4 and 2.4. Epidemiology later established a R0 ranging from 2.79 to 3.28, and can vary between different variants. In early 2020, governments implemented qua antines and lockdowns acting on these predictions precisely to decrease the R0, and control the spread of the disease.

tory cytokines such as INF-γ to fight the infection directly from the nasal cavity!

The challenge in developing intranasal vaccines resides in delivering the antigen to antigen-presenting cells that mediate the immune response. The epithelium of the mucosal cavity is covered by a mucus layer that will trap any intruder and remove them from the body (sneezing, natural mucosal clearance). Consequently, while 100+ classical against COVID-19 are in development, only 8 target the intranasal route.

A promising player in this space is the French start-up LoValTech. They have developed a protein-based vaccine to stop contagion between 2 individuals completely. Moreover, researchers demonstrated that the activation of the local mucosal immunity via the intranasal route triggers any local mucosal immunity (buccal, uterine, intestinal). This opens the door to the development of vaccines against not only respiratory pathogens. But also any pathogen that will meet a mucosa while penetrating the human body, such as monkeypox or HIV.

Climate change - Outbreaks are inevitable, but pandemics are optional.

It could be monkeypox, multi-antibiotic resistant bacteria, or a new SARS-CoV-2 variant, but the next outbreak might be at our doors. Scientists have warned for years about our weakness in managing emerging viruses, bacteria, or fungi. The rapid spread of the SARS-CoV-2 finally raised the general population's awareness.

The role of environment and climate change is prevalent in the (re)-emergence of new pathogens that modern medicine can still not stop nor cure. And while our planet warms, not only the tropical and subtropical regions are considered at high risk, but all the temperate regions are affected too. Pathogens do not know borders, and airborne-transmitted infections are the most dangerous. In 2018, WHO declared that major vector-borne diseases account for 17% of all infectious diseases causing 700k deaths/year.

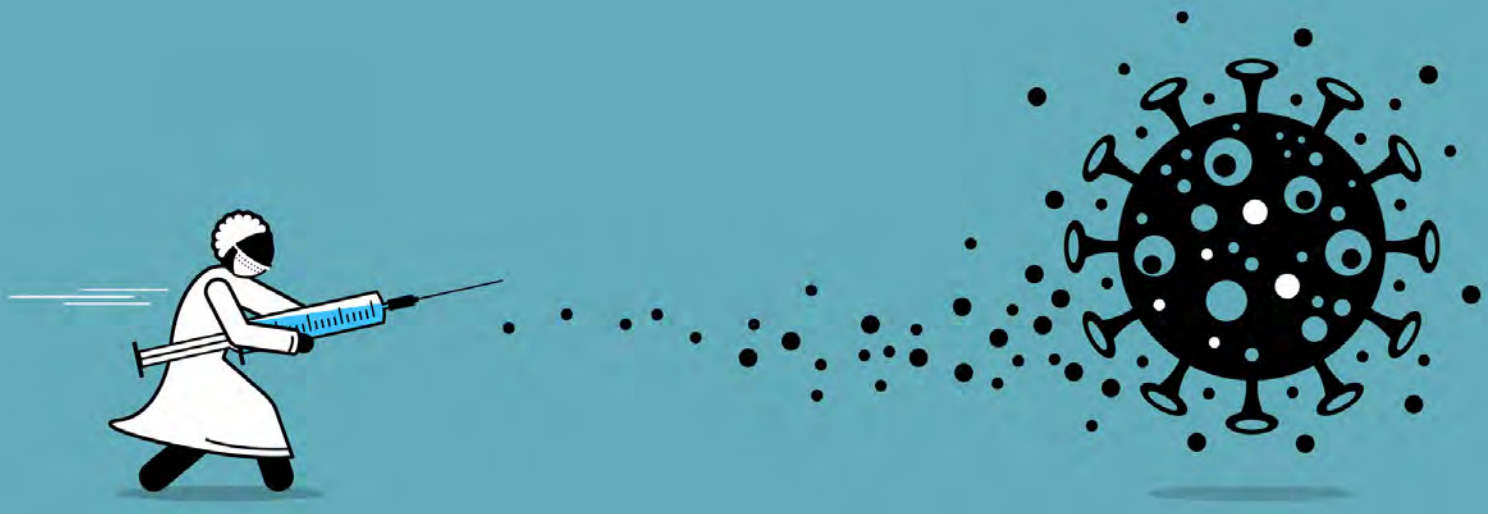
Natural living spaces are shrinking, bringing humans and wild animals closer together. Scientific research shows that 6 out of every 10 known infectious diseases in people can be spread from animals and not less than 3 out of every 4 new or emerging infectious diseases in people come from animals. Direct or indirect contacts, food or water contaminations, bites or scratches, and contamination routes are abundant to start an outbreak.

We need to be prepared. This pandemic is teaching us important lessons and highlights the importance of novel technologies in life sciences. mRNA vaccines might become a robust and scalable platform for fighting a multitude of diseases. Other technologies might also become part of our toolkit to fight future outbreaks. We believe that mucosal vaccines might be one of these, and we'll keep an eye on the developments in this space.

Nadège Grabowski

Learn more:

History of vaccines
The Tangled history of mRNA vaccines
mRNA vaccines - a new era in vaccinology
Mucosal immunity and vaccines



Da Vinci Labs, a multidisciplinary research center project located in Touraine (France), aims to put deeptech at the service of the planet, leveraging artificial intelligence, synthetic biology and quantum computing to fight against climate change, protect biodiversity and combat pollution.

Da Vinci Labs will provide researchers and entrepreneurs with a unique multidisciplinary research platform to develop innovations in sustainable food production, renewable energies, green construction, circular economy and other eco-innovations.

Building on Leonardo da Vinci's legacy and his extraordinary ability to rely on complex bodies of knowledge across different fields to solve specific problems, Da Vinci Labs is heralding a new green technological renaissance able to reconcile technological innovation with sustainable development.

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