Opinions Libres
le blog d'Olivier Ezratty

Decode Quantum with Sebastian Weidt from Universal Quantum

Welcome to the 78th episode of Decode Quantum, where we continue to travel around the world. We are now in the UK with Sebastian Weidt, the founder and CEO of Universal Quantum, a startup creating scalable trapped-ions quantum computers.

Sebastian Weidt is the CEO and co-founder of Universal Quantum since 2019, when the company was created. He is also a professor of quantum computing and entrepreneurship at the University of Sussex, which is in Brighton, south of London, near the Channel. He was a lecturer on quantum technology at this university. He was a postdoc research fellow at the same university between 2013 and 2015, and since 2015, a senior scientist in the trapped-ion group led by Winfried Hensinger.

Here is an edited transcript from the podcast.

Fanny Bouton: we start with our usual first traditional question: how did you land in quantum? Where is this passion coming from?

Sebastian Weidt: I took a non-traditional route. I can't tell you some dreamy story of me having woken up when I was four or five years old and I dreamt about quantum. I have always been very impact-driven and thought that the way to have impact is to work in business but I always liked physics. I thought that demonstrating some analytical mind would be a great step towards that sort of goal. So I did an undergrad in physics with management and afterwards actually went into consulting for for a bit. I remembered that I enjoyed quantum a lot at undergrad. It piqued my interest a lot so I started doing some research around that and decided to do a PhD in quantum, focusing on quantum technologies. and started to look at quantum computing. Through the PhD work, I gained a good understanding around what quantum technologies can do and, in particular, what quantum computing could do and on timescales that weren't actually as bad as I used to think. So I could work on something that has impact on a reasonable time scale. And in terms of the scale of impact, it's hard to beat quantum computing, I followed that drive. My passion really comes from what technology can actually deliver for humanity. That's really the driver that I have.

Olivier Ezratty: is that explaining why you are teaching both quantum computing and entrepreneurship, which is kind of weird? I've never seen such a combination. That's because you had this passion for entrepreneurship at the beginning?

Sebastian Weidt: I've always had a strong business mind, I think, and combining the impact you can get through doing things in the business world and quantum is really where I'm really comfortable and where I get very, very excited and I think through the work I was doing at the university and then in the company, that's how these two things came together. I don't teach anymore. I am focused on the company.

Olivier Ezratty: when you were teaching entrepreneurship, did you do that in a generic way or was it entrepreneurship in the quantum world, which is a very specific domain?

Sebastian Weidt: It's really combining things in unique ways and one of the things that I think Sussex is quite keen on driving the quantum agenda. It also comes up with courses that are business relevant from a quantum perspective. So either training people in the business world in in quantum space or also making sure that the quantum physicists we train up keep an eye on on commercial impact.

Olivier Ezratty: learning on how to become an entrepreneur long term oriented in that space seems very different from traditional web service e-commerce whatever, as an example.

Sebastian Weidt: we need to look at the quantum commercial space and need more quantum people to come into that area. They have that obviously great passion. If they have a passion for business as well, there's a huge need and we have to push that forward. That's really important for the sector to grow.

Fanny Bouton: do you remember the title of your thesis?

Olivier Ezratty: it's not that old, I mean, it's 2013, so it's only 11 years old.

Sebastian Weidt: it's probably around towards microwave-based quantum technologies.

Towards microwave based ion trap quantum technology by Sebastian Weidt, 2013 (202 pages).

Fanny Bouton: based on ion trap quantum technology.

Sebastian Weidt: yes, trapped ions! I got very interested in finding ways to scale up trapped ions. I've always been a huge believer in trapped ions as a qubit. I think it's never been so clear how to scale the niceness of trapped ion qubits up to large numbers of qubits. I spent quite a bit of my time doing my PhD focusing on coming up with ways to control these qubits in a more scalable way, an to reduce noise on that. Then, maybe outside the quantum computing topic, I also did some work on quantum simulation and in particular developing architectures that uses two-dimensional arrays of trapped ion qubits. Not qubits in that case, but trapped ions that would allow you to do some really interesting quantum simulations. As part of that work, we were the first ones to have a two-dimensional array of ions on a microchip.

Olivier Ezratty: we should talk a little about Winfried Hensinger. He was your PhD supervisor and he's your co-founder of the company. This is a scheme that we see in many quantum companies created by a lead researcher (PI, aka principal investigator), and his postdoc, who becomes the CEO, the PI being the chief scientist or CTO in the company. It's very typical, like Chris Monroe in the US at Ionq. Can you comment on this kind of dualship? How does it work?

Blueprint for a microwave trapped ion quantum computer by Bjoern Lekitsch, Sebastian Weidt, Austin G. Fowler, Klaus Mølmer, Simon J. Devitt, Christof Wunderlich, Winfried K. Hensinger, Science Advances, 2017 (11 pages).

Sebastian Weidt: it is a common thing to see academics get involved on the commercial side. Someone needs to drive that commercial side in a full-time capacity. I'm a strong believer of that. You can't do this 50-50 thing of, "well, I do a bit of this and a bit of that."

Olivier Ezratty: when I look at the startups in this space, they still do R&D. They still do a lot of research, but still, you academic research do fundamental and experimental research. A startup in quantum computing even sometimes do fundamental research and applied research, and then engineering and technology development. So, how do you see the balance between those two sides of the coin, the academic side and the startup side?

Sebastian Weidt: I can only speak for us in University Quantum. For us, it was very important to separate those two things clearly to make sure that there's alignment between the two in terms of what we work on. So one of the great things we've been able to set up, and also thanks to the University of Sussex and allowing us to do this, is to set this up in a way that University Quantum can completely operate on their own ways that there's no IP issues. And there's been some horror stories in the sector. University Quantum can focus on building scalable quantum computers and follow a very strong engineering approach. The University of Sussex can focus on some of the more academic topics, looking ahead a little bit for what may be useful in a few years' time that Universal Quantum could benefit from and drive that forward. Then, we have a very nice way of introducing that work into Universal Quantum through a special agreement. What we were very clear on at the beginning is that it's important to separate those two things. We were not keen to operate in a university research lab. It's a separate entity and a different location, building, people, separate everything. Through my involvement and Winfried's involvement, we make sure that there's a strategic alignment between the two organizations.

Olivier Ezratty: I met a while ago, remotely, with Wolfgang Lechner, the CEO of ParityQC in Austria. When he was presenting the company, he was considering that the team in the University of Innsbruck was part of the start-up, more or less an extension. So there are many ways to look at the way to integrate those things. It's interesting because when you look at the kinds of people who work in start-ups, there are many PhDs around, not just engineers. So there’s a kind of crisscrossing between those fields. That’s interesting to observe that, that it’s clear you have more engineering in start-ups than pure fundamental research that you have in the academic space.

Sebastian Weidt: we’re probably quite extreme on the sense of how we have that separation between the two, and also how the University of Gothenburg has a very, very, very strong engineering focus. One that you couldn’t really get away with in academia, and nor do we want to have all of the academic mindset in the company. There’s just ways you have to do differently as you want to scale these things up and turn them into work. It’s really, really useful products. And that’s not the mindset of a PhD student in a university. So that’s why we’re keen to separate that. But there’s, you know, for other companies, the model of having those two things a lot closer together may work for them. It’s just for us that wasn’t the vision that we had in mind.

Olivier Ezratty: Now, let’s compare ions and other qubits, and then, compare the various trapped ions approaches.

Sebastian Weidt: let’s start with ions and other qubits. Ions are charged atoms. Because there’s a charge, it means it feels an electric field. The way we capture or trap these charged atoms is by developing ion traps, which nowadays are chips that we can apply a combination of static and oscillating voltages to. This chip emits an electric field environment that traps these ions. Once you have them, you can then start manipulating them. And one of the great things, I think, that’s been shown over the years is that the ability that we have to control, control of them, the way We can isolate ions from the environment which has really led to this qubit being the world’s best performing one, or the gate fidelity where records come out of this sector, coherence times are really, really long. These are really well-performing qubits. Now, people found it hard to scale this work that people have done on small numbers of qubits, to hundreds of thousands and millions of qubits. That’s where some innovations were needed. This is really where Universal Quantum comes in. That’s where there are some differences within the trapped ion space between the different companies. We have developed a very unique way of connecting modules together. As of today, it’s still the only way of really scaling that technology up.

On the control side, we like microwaves, and not just microwaves but global microwaves. We developed a way to control an arbitrary number of qubits with only a handful of microwave fields. When you look at quantum computing, you usually end up with having a strong correlation between the number of qubits you have in your system and the number of radiation fields you have to send in to control these qubits. It’s fine with a small number of qubits. As you get to larger numbers, you all of a sudden need thousands, millions of radiation fields that you have to send in to control to operate these qubits. We’ve been able to basically get rid of this correlation, so we generate a handful of these global fields and still maintain the individual controllability of the qubits.

Olivier Ezratty: it’s interesting to compare trapped ions and not just all the qubits, but just cold atoms. Cold atoms are not ionized. You control them with lasers, but it looks like there’s some kind of trade-off because when with trapped ions, you have many technologies involved. You have the circuit, the traps, use a mix of microwaves for control, lasers for cooling, control and readout. It looks simpler with atoms because you’re just using lasers. You use lasers for cooling, control, gates, and readout. So what explains that the fidelities that you get with ions, which looks more complicated from the engineering standpoint, and those with cold atoms which are not as good.

Sebastian Weidt: the way quantum gates are implemented with cold atoms is different to trapped ions. For example, with a two qubit gate, to get two trapped ion qubits to interact, we actually make use of the fact that our atoms are charged. It’s the way we couple them together. If you have neutral atoms you can’t easily do that because they’re not charged, so you have to use other schemes to get them to interact and that process turns out not to be quite as high quality as what we can demonstrate in the trapped ion system. We have seen some beautiful work come out of the neutral atom space and I do think in that sort of medium scale bracket that they’ve got a really nice position. When we think about what we ultimately have to scale to, there are certain things that start to hurt that sort of platform where we still need some answers on how they would do that.

Olivier Ezratty: so you mentioned microwaves, which is of course a big differentiation here. Can you explain what are the pros and cons of using microwaves to drive the ions compared to lasers that IonQ, for example, is using? I presume that like in each and every quantum tech, you’ve got pros and cons, I mean, everywhere. So, for example, can you do precise single-qubit gates, two-qubit gates with that? And how about many-to-many connectivity? Because it’s one of the advantages of trapped ions that’s often put forward by some vendors.

Sebastian Weidt: I’ll start answering your questions in the reverse order. On the connectivity, it has no impact on that. We still use microwave driven gates, let’s say through shuttling operations, to get the connectivity that you may want in your system. The differences really are usually when you do microwave gates, you keep everything within the sort of qubit subspace so what the qubits normally live in the microwave space and we apply fields that directly drive that qubit. If you use lasers you always go through some sort of intermediate state to implement the required operation. That has advantages and disadvantages but, usually, what you find is when you look at microwave-based gates, the fundamental sort of fidelity limitations are higher than in a laser-based gate approach. On average, there’s usually a few more error terms that are coming on the laser side than on the microwave side because with the microwave, it doesn’t include additional energy levels. One of the things that people have traditionally pointed to for microwaves is that they’re a bit slower than laser gates. That is slowly working itself out and microwave gates are getting faster and faster, and so that disadvantage is slowly being minimized.

Olivier Ezratty: what’s the duration of those gates in your plans?

Sebastian Weidt: if you look at laser gates at some people that they’re sitting at a couple of hundred microseconds with some pushing below the 100 microseconds or tens of microseconds. I think equally with microwaves. They’re now in the hundreds of microseconds range. There’s really good work that shows that you can also get microwaves down to sub 100 microseconds. Laser gates have been developed for a very, very long time, and microwaves are a bit newer. It just needs a bit of time to get them to the same level that laser gates got to over the years. We’re seeing that catch up really nicely at the moment, which is promising.

Olivier Ezratty: but this is still 1,000 times slower than superconducting qubit gates, as far as I know, so what are the ways to counter that? Probably many-to-many connectivity to some extent, and there are other reasons, better fidelity, so it reduces the number of physical qubits per logical qubits, but how do you cope with this speed that’s not good?

Sebastian Weidt: what people point to is that trapped ions in general are slower than superconducting qubits. At the gate level, that is absolutely right. When you envision larger scale systems and think about the real life problems that these machines will solve, incorporating all of the hardware specifications, capabilities, connectivity and error correction, and ask how long it takes for one of these machines to solve a particular problem, it turns out you are pretty much on par with the superconducting qubit machines. We’ve recently put a couple of papers out on that, and there’s a few more coming shortly, where we’re really going to highlight.

Olivier Ezratty: with regards to microwaves drive, what’s the shape and form of that? People know mostly about microwaves being transmitted using coaxial and flat cables driving superconducting qubits in cryostats. It’s of course different in your case so are you flowing the signals from electronics to the ions.

Sebastian Weidt: for us it’s global. The entire architecture gets a handful of microwave fields emitted using special antenna arrays. So they get sent everywhere. Then we have special techniques applied locally to get specific qubits to interact with whichever global microwave field that you sent in, get them to interact with that to perform a particular quantum gate.

We're leveraging very mature microwave engineering that's been out for a very long time. Laser-based gates have performed very well on the smaller scale, but for every qubit that you want to operate on in parallel, you need a pair of laser beams that you to send in. Right, carefully. focused high power very stabilized clean beam. It becomes very hard to do that as you scale up. With our global microwave approach, we send it everywhere using very standard technology. In Germany, one of our major customers is getting one QPU. It's incorporating these scalable aspects and putting that onto an engineering platform that just more naturally scales up.

Olivier Ezratty: how do you control individual qubits and single and two qubit gates?

Sebastian Weidt: we move our qubits around and that gives us our connectivity. We developed a way where small movements of these qubits allow us to tune a qubit into interacting with a particular global field that you have. We're using what's already there, with voltage control, and there's no additional control fields or signals. It's a mix of a global microwave field and local voltage that controls the whole thing around. The voltages are there to move the qubits around to give us that full connectivity so we're just using what's already there.

Fanny Bouton: can you talk about what cooling is required?

Sebastian Weidt: temperature doesn't really matter too much at the smaller scale, but as you think about larger scale systems, cooling capacity as a whole becomes a really really big topic. We don't need these sort of milli-Kelvin temperatures or four-Kelvin temperatures. We're sitting at 70 K, which is a scalable cooling temperature. There's lots of cooling power available there. And we've developed a cooling system that take us all the way to the million-qubit scale, without running into any sort of cooling power bottlenecks that I think you normally find yourself in when you're looking at quantum computing.

Fanny Bouton: It's like with photons, it's also running at higher temperature.

Olivier Ezratty: photons need a colder temperature, 4K for photon source and detectors. Photons themselves can travel in some room temperature circuit, even though PsiQuantum wants to use a low-temp circuit that embeds everything.

Sebastian Weidt: we need a vacuum pump that isolates ions from from any other particles bouncing into them. That's that's a very mature technology. This sort of vacuum system, even at the million-qubit scale, is easy engineering.

Olivier Ezratty: you're using ytterbium, so why this beast? There are so many different ions. You see barium, calcium, so there are different transitions that you can play with. So why is ytterbium frequently used in that space?

Sebastian Weidt: a lot of people use ytterbium. I think there's also slowly a push to barium, but ytterbium is a nice qubit. The wavelengths needed for Doppler cooling and detection are readily available. The way we do our quantum gates, the way the atomic level structure is very nicely lends itself to how we implement it. We also have barium in there as a sort of sympathetic cooling type ion. They go well as a pair, those two together.

Olivier Ezratty: what is sympathetic cooling?

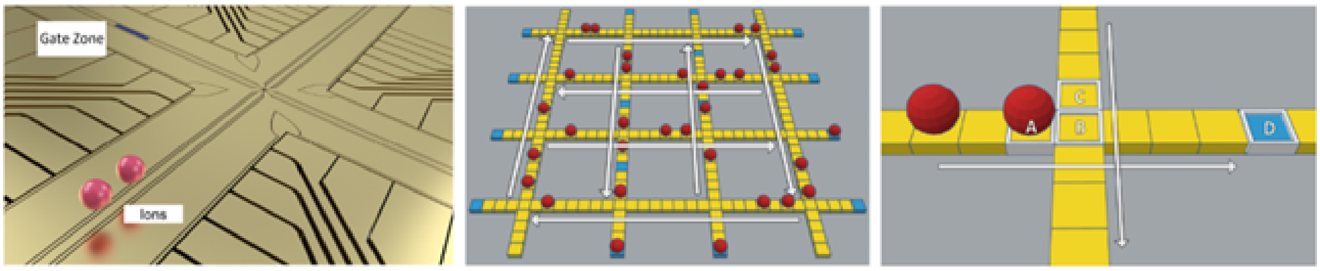
Sebastian Weidt: if you want to cool an ion, then you usually send a laser in and that laser would usually destroy the quantum information that is encoded in that ion. So to get around that, you use a different ion, an ion that needs lasers that are at a different wavelength to the one where you've encoded your quantum information. When you send the laser in, it only interacts with the ion that doesn't have the quantum information and the one that holds the quantum information doesn't see the laser. Then you do the cooling on the barium ions. When you bring them close together, they are actually coupled, the motion is coupled between the two. You cool barium ions and that cools the ytterbium ions as well but never actually touches the quantum information that that's the beauty on on that that was a very good way of describing sympathetic.

Olivier Ezratty: when you know about the classical thermodynamics and you think about cooling individual atoms, it's kind of weird because it's not statistic, it's just single atoms that you cool down.

Sebastian Weidt: when you bring them close enough together, it's like a couple of pendulums. They actually feel each other's motion and what you can do is by cooling down one, it cools down the other as way as well through that coupled motion.

Fanny Bouton: moving to the ions in 2D, what are the challenges about ion-shuttling?

Sebastian Weidt: that has been done. Usually, you have ion-trap chips that include an X-junction, for example. It's a particular electro-geometry that allows you to move a qubit along one arm and then turn a corner and go a different direction. That's a particular junction architecture that a number of companies are pursuing. We're pursuing that as well. We think that is a very efficient way of scaling up and enabling the connectivity that we would like to maintain as we increase the number of qubits. That sort of two-dimensional shuttling has been demonstrated before. That's actually quite a classical electrostatic type problem, which the trapped ion sector is quite good at implementing.



Efficient Qubit Routing for a Globally Connected Trapped Ion Quantum Computer by Winfried Hensinger et al, February 2020 (13 pages).

Fanny Bouton: how do you manufacture this ion trap?

Sebastian Weidt: I can't say too much for Universal Quantum. We have all of our chip work done in commercial foundries. We do not fabricate our own chips. If you truly want to scale it and if you want to follow this sort of strong engineering approach, you want to leverage the multi-billion dollar silicon chip community and basically make sure that your chips can be made based on standard processes out there. It took us a long time to get it right. Other people will use standard clean rooms and do some really beautiful work there. If you look at some of the chips out there, it's really nice, but for us at least, we always like to think about how do we scale quickly? How do we get to the right units that we need to get to? How do we get to the right reliability? And so on. And we think that actually comes out by piggybacking on what's being done. What's been done in the silicon foundry space.

Olivier Ezratty: how many chips do you want to assemble using your chip tiling approach? I remember in that blueprint that it was talking about a football field full of circuits. I presume it's not the size of this thing you want to develop. By the way, what's the qubit density of these chips?

Sebastian Weidt: this football pitch stuff actually came out after the blueprint was published in 2017. The Daily Mail or something very kindly coined that term because we were kind of extrapolating out to billions of qubits and we we took a very academic uh approach back then. With some of the amazing engineers that we have, things have changed quite dramatically and you know reach for a million qubits. This should fit in a small meeting.

Olivier Ezratty: do you have an idea about the power consumption of such a system with one million qubits, in just a power of ten?

Sebastian Weidt: it is actually not different to a standard data center that people are building. We're not breaking the bank on that side.

Olivier Ezratty: it depends on what kind of data center you're talking about. Usually, we took the reference of HPCs like the Frontier in the US or smaller ones, so you know it's between 10 and 40 MW. So if your computer fits in a room, I would guess it's lower than that.

Sebastian Weidt: there used to be this thinking that you have to build a power plant next to quantum computers. We're not in that game at all. We're in very sort of standard computing power consumption terms.

Olivier Ezratty: when you mean "data center", it's the equivalent of a rack, let's say, a couple of racks in a data center.

Sebastian Weidt: it's more than one rack in a data center. But not 1,000. This is not something anyone would necessarily have to worry about, right, so power for us at least, the way we're doing it, it's not something that we need to internally make sure we keep track of that, and we think a lot about it, and we optimize things a lot to make sure that as we get to that sort of scale, we are still in a reasonable environment, but we know nowadays through our development work that that is the sort of level we will be at.

Olivier Ezratty: it's interesting to look at, for each technology, how power is scaling for a number of qubits. You sometimes have misconceptions, typically for cold atoms, you cool them, but atoms cooling comes from the lasers, not from cooling the chamber that is used in some settings, so in your case, the cooling probably is a fixed cost to some extent, but the variable cost is mostly controlling the microwaves and the voltage and stuff like that, so electronics plays a key role there.

Sebastian Weidt: yeah and there's still some lasers, but you're right, it doesn't scale as strongly for for us as it may do for for some other technologies.

Fanny Bouton: you sold a QPU to DLR in Germany. Can you tell us a bit about this project? What you to deliver?

Sebastian Weidt: we were very fortunate to get two contracts from DLR. They bought two machines. One is centered around this integrated quantum processing unit we call it iQPU which is basically related to what i was talking earlier about the the modularity of a system we start to integrate classical control onto onto our modules to get into a way that we can really naturally scale this this architecture up so that that is, one machine they're getting and then they also got very interested in how we're connecting individual modules together to scale, up. So they're also getting a machine where we deliver multiple modules already connected together as a separate part.

They've been quite transformational for us. I think we got roughly 70M€. It's really been a great enabler to move us forward as a company as well without having to rely on investment rounds and dilution. We're very grateful for those contracts. This was a very painful process as you can imagine, for Germany to give out, I think it was the world's biggest contracts at the time in quantum computing. The due diligence we had to go through was pretty epic. It took a long, long time. But at the end of the day, it was absolutely worth it.

Fanny Bouton: there are some other non-German companies working with DLR, and it’s good that you are one of them.

Olivier Ezratty: I think they have QuiX, but I’m not sure about it, but most of them are from Germany. And besides that, they have D-Wave and IBM machines sitting in Germany, but in different organizations than DLR.

Sebastian Weidt: one of the things they said was, don’t just come along with a beautiful 50 qubit system, proposal or whatever. You have to show and demonstrate how you can scale up to millions of qubits. They recognized that it is ultimately where we need to get to. We are so focused on getting to utility as quickly as possible. It was a match. What we actually sold to Germany was 100% directly on our roadmap. We didn’t have to go left or right too much at all. It just aligned so well with how we think it should be done in quantum computing anyway.

Fanny Bouton: can you tell us a bit about your roadmap? How many qubits you have actually? How many maybe logical qubits? And where are you going.

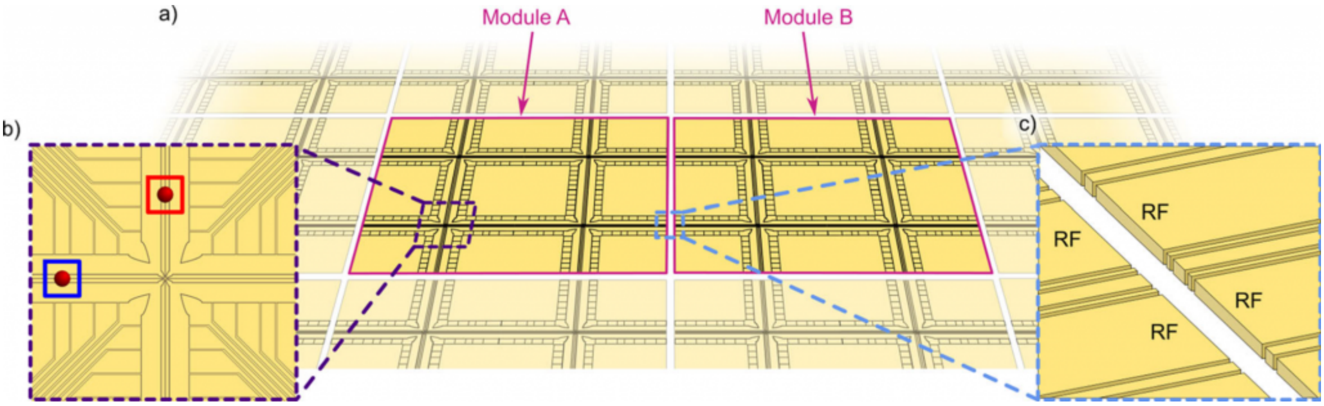
Sebastian Weidt: there’s not much I can say on that. What I can say from a roadmap perspective, is that we are building a couple of machines for Germany right now and a couple of other machines we’re putting together at the moment. When we think about next generation, we do not get excited or look to add 10 or 20 qubits here or there. Our modular architecture is allowing us to do is to think much bigger. We also demonstrated in a paper a year ago that shuttling ions between our modules is nearly error free.

Olivier Ezratty: most of the startups I know who are either traded or raising funds with VCs, have these big roadmaps with number of logical qubits per year. So you’ve got more flexibility thanks to not relying on this kind of funding. Is that the connection?

Sebastian Weidt: for serious people who want to partner with us and where it makes sense, of course, we have more detailed conversations, but in terms of what we put out publicly is maybe a different question. But what we do do and we have started to become more active publicly is why we let people know certain milestones. This first commercial ASIC that we’ve put out a few months ago, we told people about. We talk very clearly about where our error correction thinking is going and what we talked about already, how we can introduce connectivity into the surface code transfer. So we’re starting to be a bit more open in terms of what we’re doing, but I don’t think it’s wise, or necessary or helpful right now to have this very detailed road map out in the open.

Olivier Ezratty: one figure of merit was amazing in that experiment you published last spring, I think the tiling thing you had, how many 9s did you have?

Sebastian Weidt: I think it’s six or seven. That’s amazing. What I can tell you is that we couldn’t really tell the difference between the qubit just staying on one module or us moving it between these modules.



A high-fidelity quantum matter-link between ion-trap microchip modules by M. Akhtar, W. K. Hensinger et al, Nature Communications, February 2023 (8 pages).

Olivier Ezratty: what is the size limit for each module?

Sebastian Weidt: my very unhelpful answer is it doesn't matter. What we've shown is because the connection between modules has so little overhead and is so error-free, that we can actually select module size being purely guided by engineering.

Fanny Bouton: can you talk about the composition of your team, how many people and, how is there a divider with the sales but also, engineers?

Sebastian Weidt: we're about 80 people at the moment, and we are very heavy engineering driven. We have quantum physicists, then we have a lot more engineers than quantum physicists, including our own ASIC team, chip development team, we have mechanical engineers, electronic engineers and software engineers. There's so much in that software stack that you have to get right, to get the most out of the hardware. So we have a lot of engineers. We have a great team as well, error correction we've already talked about, and on the application side we have a team, so we do cover the basis, but if you come in, you see a lot of engineers running around.

Olivier Ezratty: when you mention software, it's middleware, it's compilers, I presume, firmware, because what I see in many cases with many QPU vendors, they delegate a lot of resources to build, say, kind of case studies with customers when they even don't have the machines, using emulation or NISQ systems with a very low number of physical qubits. So thanks to what you do with DLR, can you avoid that, which is consuming a lot of energy, I would say, in startups.

Sebastian Weidt: I could do a whole hour just on that topic. We're very careful about NISQ. We keep it in mind where true utility really comes about. Let's see what people can squeeze out of NISQ and if there's something great. Of course, we can tap it into as well. But we keep our eyes focused firmly on these larger scale systems. Now, it is important to work with end users. We must understand what our technology needs to be used for. It impacts how we develop our machines, but not for the sake of it, not for a logo hunting activity, to make some grand announcements. It's very much focused on what allows us to get to the next step and what is truly helpful to the end user. So yes, in special cases, we do partner on that side. But I think the other customer is someone like a DLR and actually working with them on their needs. And indeed, as partners, part of these projects, we do plug into a cloud infrastructure. We have to make sure that our software stack can do that so that they can interact with these machines so we we do take it all the way but in a whenever we get involved there to your great point because it can often be a distraction there's got to be a good reason of why we're doing it it's going to move us forward um towards that utility goal otherwise we try really hard to.

Olivier Ezratty: DLR is an interesting case because they have so many contracts with so many QPU vendors that they can do comparisons, they can challenge the vendors. I don't know any customer who acquired more than one machine. There’s Cleveland Clinic in the USA with an IBM system. There are over 10 QPU projects at DLR with different TRL levels. Is that creating some kind of challenging pressure for you?

Sebastian Weidt: we’re focusing on what we’re doing. I think we’ve got a very clear path to larger scale systems and we’re, you know, we’re going to deliver on what we’re promising. So there’s no pressure necessarily there. I’m sure they’re all doing great work. Some may have different focuses, but we’re just focusing on us arriving up and delivering. I think that’s all we can do at this point.

Olivier Ezratty: they have a deal with Electron. You have two systems compared in parallel and it’s probably a very different technology. So that’s interesting.

Sebastian Weidt: I think we’re probably one of the very few in that ecosystem who have that, I mean, really relentless focus on those larger scale systems. Even within the DLR ecosystem, there are certain players that focus more on maybe NISQ and some of those sort of things, but they were very clear to us what they were after. We were very clear about that. very clear what we’re after. And it is that scalability part. So everything we deliver to them, everything that I think they got excited about is around how we engineer things. It’s about the next generation. It’s about scaling and they understood that. And I think that’s why they like working with us and why we like working with them.

Olivier Ezratty: what did we miss? Something you would like to say that we missed in our questions?

Sebastian Weidt: I think you’ve done very, very well compared to, you know, some of the other interviews that I often do. This has actually been great. Very technical. I think you’ve hit most of them. I’m just checking my notes if there’s anything. People talk about scalability more and more nowadays. One of the things that we’re missing in the sector is how to actually evaluate scalability. I’d love to fix that. We’ve put an inside report at a very high level to start pointing people to the sort of questions to even ask themselves or other people when they evaluate, you know, hardware approaches, quantum computing, prototypes, because usually people will say, how many qubits do you have? And what’s your fidelity? And that somehow in their mind gives them an understanding of how good some one is. That that’s not even half the story at all. In fact, that should be at the bottom of your pile of questions that you should ask if you truly want to find out who has the biggest promise, who has the biggest chance of getting to utility as quickly as possible. There’s completely different things that you should really deeply care about. People who evaluate these sort of things have to get used to, get more used to thinking that way. Otherwise, we would drive ourselves into a corner as a sector if we don’t start allocating capital in the most efficient way to to get to those ultra-scale systems. We have to remind ourselves that it is not necessarily about fidelity and qubit numbers. You’ve got to get the qubit numbers and you’ve got to get the fidelities but actually they become really important as you’re able to scale up so then I’d leave people with that thought. I’d love people talking about that a lot more.

It’s been great, you guys and the questions you’ve asked clearly you have that, mind. And that’s just, that’s really nice to see.

See Universal Quantum’s latest Insight Report on quantum scalability **here**.

Fanny Bouton: Thank you, Sebastian. It was our 78th episode of Decode Quantum. And it was about Universal Quantum. And we were with their CEO, Sebastian Weidt. Thank you very much and see you soon.

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