INTERVIEW

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Interview with Eleni Diamanti

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What first sparked your interest in science?

I come from a family where discussions about science were common at home, both my parents were physicists, my mother a university professor and my father a high school teacher in physics, chemistry, and astronomy. He had a true passion for all branches of science, and we were surrounded by scientific books. Today, in turn, I try to pass on this enthusiasm for science to my children and to the students I meet.

How did you discover quantum optics?

I pursued my studies in Greece. After high school, I was admitted to the National Technical University of Athens, in the Electrical and Computer Engineering department, with a demanding five-year curriculum. It was a highly engineering-oriented program with a strong scientific approach. It was during my studies in Athens that I became interested in quantum physics and its applications, including in optics, particularly through a course in this field. When I arrived at Stanford in 2000, I was in the Electrical Engineering department but I already knew I wanted to focus on this domain. I chose my PhD thesis accordingly. My PhD advisor, Professor Yoshihisa Yamamoto, had just introduced quantum cryptography to his research group and at that time, it was still an emerging topic. As my first assignment, he gave me a paper on quantum computing with photonic systems, which was far from quantum cryptography. His question was: Is quantum computing with photons feasible? After careful thought and analysis, we concluded that it was not realistic within the scope of a PhD—a conclusion that turned out to be correct, as even 25 years later, despite major advances, photonic quantum computing still faces many challenges. So, we redirected the research topic to quantum cryptography and quantum communication, which were also still in their early stages at that time.

Did you receive any specific training in quantum optics before your PhD?

Not really. I had taken a few lab courses in optics at the university, but looking back, I realize how valuable the trust placed in me was. I was assigned an experimental PhD even though I had not been formally trained in the field in depth. A senior PhD student trained me during my first few months. Comparing this to today's students, I notice they arrive with a much stronger background, which is clearly very helpful for the teams and also for the students. In general, nowadays, young researchers tend to be more experienced than I was at the time.

What was the topic of your PhD thesis?

My PhD focused on the implementation and security analysis of a quantum cryptography protocol, which we were developing in collaboration with Japanese colleagues. I had to design a quantum cryptography system from scratch. I started with an empty optical table, gradually building up the necessary components. Another key part of my thesis was designing single-photon detectors, based on frequency conversion in nonlinear waveguides, which were fabricated by collaborators in another research group at Stanford. The outcome of my work was the development of these up-conversion single-photon detectors, along with the security analysis and the demonstration of secret key generation using a quantum cryptography system. I defended my PhD in 2006.

How did you organize your return to Europe?

In 2006, I returned to Europe, thanks to a double Marie Curie MSCA fellowship. At the time, it was possible to obtain two types of grants simultaneously: a returning European fellowship, allowing a European citizen to return from abroad and work in another European country, and a second grant to finance scientific projects for postdoctoral scholars. This was a perfect fit for my situation since I was Greek and applying to a position in Philippe Grangier's group at the Institut d'Optique (IOGS) in France. The first grant covered my salary, and the second funded my research project. This created ideal conditions for my return to Europe. I didn't even consider other opportunities in the US—it was Europe or nothing.

Can you describe your MSCA research project?

The project was focused on quantum cryptography, but approached through a different type of protocol called continuous-variable quantum key distribution (CV-QKD). This protocol still relies on quantum optics but is conceptually quite different. When I arrived as a postdoc, the main challenge was making these systems deployable in real-world applications. Philippe Grangier was among the leaders in a European project aimed at developing such systems. I contributed to creating CV-QKD prototypes, with the goal of deploying and operating them in real-world settings. This experience allowed me not only to learn new concepts on continuous variables but also to get hands-on experience with practical aspects of quantum communication infrastructures. These are topics I continue working on today, in various contexts. Looking back, I see a clear continuity in my research journey.

How did you manage the transition between your MSCA grant and your permanent position?
I stayed for a little over two years at Institut d'Optique. During my second year, I got a permanent CNRS position. I could have started in the fall of 2008, but I decided to finish my experiments before beginning my new position, which postponed my arrival at CNRS to January 2009.

What did you start your own research activities?
I was recruited to work at the Laboratory for Information Processing and Communication at Télécom Paris (I have now moved; since 2016 I am at the LIP6, the Computer Science Laboratory of Sorbonne University). I spent the first two years securing funding to establish an experimental research activity in this field. Philippe Grangier was incredibly supportive during this phase, notably by lending me equipment to continue my work in CV-QKD. This support allowed me to get started. At the same time, I spent a lot of time applying for additional funding for new projects. This included the successful application for a Franco-Canadian collaboration funded by the French National Research Agency (ANR) I was very happy about.

What were your main research activities during these years?
The most impactful results before 2015 were undoubtedly our demonstration that our continuous-variable QKD system could operate over long distances. At that time, funding was still relatively modest, but this demonstration brought great visibility to our team. That was when I started gaining international recognition for my expertise in QKD, and it also encouraged other teams to enter this field, contributing for example later to building a European Quantum Flagship project around this topic.
At the same time, I began developing a new research direction at the intersection of physics and computer science. I was already interested in this approach back then: taking quantum cryptography protocols beyond QKD, which were mostly theoretical at the time, and demonstrating their practical relevance using photonic systems. These efforts strengthened my collaborations with computer scientists, who appreciated that a physicist was engaging with their work and seeking to experimentally validate the quantum advantage of their protocols. This opened two parallel lines of research for me at that point.

The years 2016–2018 were a turning point for your research funding.
Yes, 2016 was a pivotal year with the launch of the European Quantum Technologies Flagship. I was immediately very involved in this initiative. Then, in 2018, I secured an ERC project, which allowed me to launch new research activities that took several years to come to fruition. The COVID crisis slowed progress, particularly on the experimental side, but now, five or six years later, we are seeing the full results.
Thanks to this funding and the support of talented PhD students, within the stimulating environment of our Quantum Information group at LIP6, we were able to conduct ambitious experiments, particularly on the generation of multipartite entangled states—a topic that had long interested me. This led to major advances in demonstrating quantum advantage, applied to cryptographic protocols and advanced quantum communications.

How did you become involved in the European quantum ecosystem?
Our team's expertise was well recognized, and we were actively sought after to participate in European projects on quantum cryptography. Beyond the scientific results, this also led me to take on a more strategic role in shaping the field in Europe, particularly through participation in the management of large quantum communication projects. I now dedicate a significant part of my time to these collective and strategic activities. I strongly believe in collective intelligence and collaborative dynamics—everything we are building today should benefit the entire scientific and industrial community.

Can you describe your involvement in the European Quantum Flagship?
I was present in 2016 when the Flagship manifesto was officially announced, but my involvement came in a later phase. In 2018, I joined the working groups responsible for setting up the strategic agenda, roadmap, and structuring of the program. The creation of the Flagship was a long process that took place between 2008 and 2015. At that time, I was still in the phase of building my team and developing my own research projects. It was researchers with already well-established teams who had the opportunity to dedicate time to this structuring effort. Today, I find myself playing that role. What these researchers were doing ten years ago, I am doing now—interacting with the European Commission and contributing to strategic decisions, in particular through my role as member of the Strategic Advisory Board of the program. We are currently discussing a future Quantum Act, which is the natural evolution of the Flagship, and I am happy to contribute to these discussions.

Do you manage quantum science at a national level?
Yes, I coordinate the Paris Center for Quantum Technologies (PCQT), which brings together multiple teams from Sorbonne University, PSL University, Université Paris Cité, CNRS, and Inria, along with collaborations with other universities and research institutions in the Paris region. This center has become a major hub for quantum technologies in Paris and beyond. PCQT was initially created to bridge physics and computer science for quantum technologies, but it has since expanded to cover all aspects of the field. Today, we have strong research hubs in Saclay, Paris, and Grenoble, but other cities like Nice, Montpellier, Strasbourg, and Toulouse are also deeply involved in quantum research. The synergy between these different centers is, in my view, •••

one of the keys to the success of the national program. We are also participating in projects like Quantedu France, a national training program in quantum technologies that brings together all major universities in the country. It's truly a collective effort, and I think it's very positive to see the entire French scientific community working together on these strategic issues.

How do you organize your time between your different activities?
Today, my time is split between three major areas:
- Academic research, which remains my primary activity and something I always want to prioritize.
- Entrepreneurship, with the startup I co-founded, which requires significant involvement.
- Participation in European scientific bodies, where I help define research and innovation strategies in the quantum field.

The challenge is finding the right balance between these three aspects of my work, which isn't always easy!

How was Welinq created?
From a scientific perspective, the creation of Welinq was based on a complementary set of expertise with Julien Laurat, who is also a co-founder of the company. His team had been developing highly advanced quantum memory technology for several years, and at some point, these memories reached a level of maturity that made industrialization possible.
That's when Julien and his team approached me to propose a collaboration. My expertise in quantum system engineering and quantum networking protocols perfectly complemented their work on quantum memories. The idea was to combine these skills to bring a real industrial application to life by integrating quantum memories into quantum communication and computing infrastructures. This synergy turned out to be extremely fruitful and led to the creation of Welinq, with the ambition of equipping quantum networks and quantum data centers with real interconnection capabilities, which is fundamental for their scaling.

How did you train yourself in entrepreneurship?
After multiple discussions, we realized that this project required a strong entrepreneurial commitment. It was a completely new adventure for us—neither Julien nor I were experts in entrepreneurship. So, together with our CEO, Tom Darras, who was a former PhD student from Julien's team, who had joined this venture by then, we took training courses, and received precious support from CNRS Innovation, Sorbonne University, and BPI France, among other institutions. We officially launched Welinq in 2022. We secured significant European funding through the EIC Transition and Accelerator grants, as well as support from BPI and other programs. But beyond public funding, we had to convince private investors. We completed our first fundraising round in 2023, and we are preparing for another one soon. Today, Welinq is growing rapidly, with 28 collaborators and fast-developing technology.

Can you describe the technology developed by the company?
Our technology enables quantum processors to interconnect with each other. The quantum memories we develop play a central role in this interconnection. They ensure crucial synchronization between different elements within such a quantum data centre involving multiple quantum processors, increasing the efficiency of the operations involved in quantum communications and computing.
This same technology is also the foundation for quantum repeaters, which are essential for long-distance quantum communication networks. Thus, Welinq positions itself at the intersection of two strategic fields: interconnecting quantum processors in quantum data centers and enabling long-distance quantum networks using quantum memories as key components.

What is your technological roadmap?
We have just launched the commercialization of our first product, which is an industry-grade quantum memory. Our next step is to improve this product, particularly by working on the interfaces between different quantum processor technologies. We have established strategic partnerships with key players in several quantum processor platforms. This will help to further advance in the compatibility in terms, for instance, of bandwidth. Demonstrating multimode capacity for storing multiple qubits simultaneously, but also deploying our technology in long-distance quantum communication links will also be important milestones. The ultimate goal is to enable the emergence of a truly interconnected and operational quantum network.

What are the main objectives of your current research?
My primary objective remains to demonstrate a quantum advantage for real-world applications, particularly in quantum networks. This is becoming increasingly challenging as applied protocols themselves become more sophisticated. This also leads me to more fundamental topics, for example regarding the certification of quantum resources in quantum networks. How do we verify the quantum nature of our resources? To do this, we use concepts from quantum non-locality, a fundamental topic that, while possibly not having immediate applications, fascinates me deeply.
Moreover, through my involvement with Welinq, I am increasingly interested in distributed quantum computing. The goal is to create large-scale quantum networks, not just for long-distance quantum communication but also to build quantum data centers integrating modular quantum processors allowing for their scale up and ultimately revealing their full potential.
This is still a new field, but I find it very stimulating, and I would like to explore this interface between quantum communication and quantum computing. This represents a major scientific and technological challenge, and I hope to make a significant contribution in the coming years. ●

PHOTONICS – A KEY ENABLING TECHNOLOGY IN THE QUANTUM WORLD

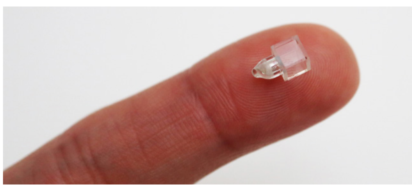
In recent years, quantum technologies have rapidly moved from research labs into industrial applications, supported by increased public funding, venture capital, and patent activity [1].

These technologies harness quantum phenomena like entanglement, tunneling, and superposition to achieve results that surpass classical limitations. Some compelling examples include:

- Quantum computers capable of solving complex problems beyond current supercomputers.
- High-precision time measurement for synchronizing communications.
- Compact sensors that detect minute magnetic fields—replacing room-sized systems.
- Secure communications that resist eavesdropping.

At the core of these innovations is a medium that behaves in a quantized manner. In neutral atom computing, this medium consists of a collection of trapped atoms; in ion computing, it comprises trapped ions; and in certain types of atomic clocks, it is a collection of alkali atoms in vapor phase. Photonics technology plays a crucial role in interacting with and manipulating these delicate quantum media while also exhibiting quantized behavior and acting as a reliable carrier of information for networks of quantum devices. In other instances, such as in photonic quantum computing or quantum communications, individual photons themselves act as the quantized medium. In addition, photons can transfer information over long distances with minimal losses compared to electrons and they are unaffected by electromagnetic fields. Simply put, photonics is foundational to the realization of many quantum technologies.

▼ A small form vapor cell from Hamamatsu



HAMAMATSU PHOTONICS: A TRUSTED PARTNER IN QUANTUM TECHNOLOGIES

Hamamatsu Photonics has long been a trusted partner to the scientific research community, developing some of the most advanced photonic technologies available. Alongside this, the company has deep experience in high-volume production for industrial, medical, and semiconductor applications. This unique combination of precision, scale, and reliability positions Hamamatsu as an ideal photonics partner for quantum technology development.

VAPOR CELL TECHNOLOGY: A FLAGSHIP INNOVATION

One standout contribution is Hamamatsu's vapor cell technology. Known for its expertise in photomultiplier tubes (PMTs), the company has adapted its vacuum technology capabilities to manufacture vapor cells in various shapes and sizes, featuring different coatings and filled with a variety of alkali vapors and buffer gases.

These vapor cells, when integrated with light sources, detectors, optics, and electronics, become the core of quantum sensors. A notable example is Hamamatsu's optically pumped magnetometer (OPM), unveiled at Photonics West 2025 [2]. This compact sensor (under 8.5 cm^3) achieves a magnetic field sensitivity of 20 fT/√Hz, making it well-suited for biomedical functional imaging [3].

▲ OPM detection heads for MEG application

A BROADER QUANTUM PORTFOLIO

Beyond vapor cells, Hamamatsu offers a wide range of products that support quantum research and applications, including:

- Liquid Crystal on Silicon Spatial Light Modulators (LCOS SLMs)[4]
- High-speed, low-noise cameras for qubit readout[5]
- Single-frequency lasers for precise quantum state control[6]

LET'S COLLABORATE

Our engineers welcome one-on-one discussions about quantum innovations and custom solutions. To explore collaboration or learn more, reach out at info@hamamatsu.eu or visit our booth at the Laser World of Photonics this June at Messe Munich.

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