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Pasqal

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Pasqal: building a quantum computing business through strategic IP management

Pasqal was founded in 2019 as a spin-off from the Institut d'Optique Graduate School and develops neutral-atom quantum processors, building on the Nobel Prize-winning research of Alain Aspect. The company combines hardware and software technological assets to deliver high-performance quantum processing units (QPUs) for on-premises and cloud use, serving clients in a range of application areas including optimisation, material discovery and other complex computational challenges.

Thanks to its technological edge, robust IP portfolio, strategic collaborations and acquisitions, Pasqal has transformed foundational quantum research into industrial scale viable technology, raising over €125 million in funding and setting standards for the future of quantum computing.

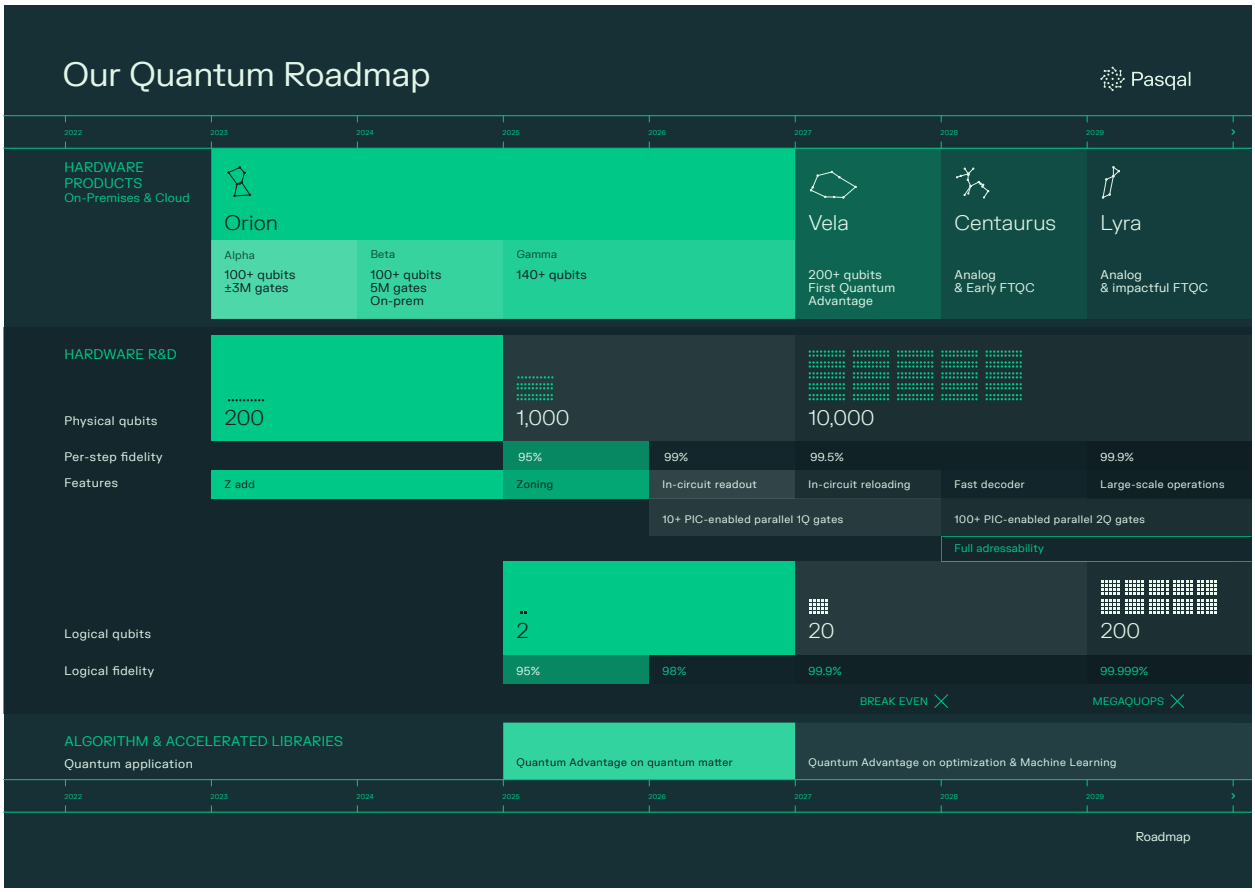


Figure 1: Pasqal's technology roadmap

Born out of decades of fundamental research into manipulating atoms with lasers, Pasqal's journey began in 2019 as a spin-off from the Institut d'Optique Graduate School of Paris-Saclay University. At the heart of the company's technology is the pioneering research of Alain Aspect, the 2022 Nobel laureate in physics for his experiments on quantum entanglement, who now serves as president of Pasqal's Scientific Advisory Board. Alongside co-founders Thierry Lahaye, Antoine Browaeys, Georges-Olivier Reymond and Christophe Jurczak, Aspect's work provides the scientific groundwork underlying the company's technology for quantum computing. Shortly after foundation the company was joined by its current CEO, quantum physicist Loïc Henriet, initially hired as head of quantum software and applications. With the support of the co-founders, he is now guiding the company from being a research-focused spin-off to a global quantum computing leader with headquarters in France, two fully-fledged manufacturing sites in Palaiseau (France) and Sherbrooke (Canada), and a presence in the USA, Middle East and Asia.

Pasqal develops quantum processors based on neutral atoms, using precisely controlled laser light to trap, manipulate and entangle them. These neutral atoms serve as qubits, the fundamental units of quantum information, allowing processors to perform computations that leverage quantum mechanical principles and achieve speeds and precision beyond the reach of classical computers. The company integrates both quantum computing hardware and software, enabling users to run algorithms efficiently on its quantum processing units (QPUs) and make the most of the hardware's capabilities.

"Breakthrough technologies require a forward-looking IP strategy. By protecting our core innovations, we ensure that Pasqal remains at the forefront of quantum computing and can translate cutting-edge research into impactful, commercial products."
Loïc Henriet, CEO of Pasqal

The transition from laboratory research to commercial technology was enabled through a transfer of the technology from the Institut d'Optique in exchange for financial compensation. Much of the underlying science was publicly available. The agreement between the two institutions ensured a proper transfer of all intellectual property assets related to the technology. This involved one very narrow and non-core patent, which nevertheless ensured access to trade secrets, know-how and, importantly, direct support from the original research teams at the Institut d'Optique.

TAKEAWAY

From lab to market
Technology transfer from university to industry can be the beginning of a journey for a deep tech startup, but only under the right contractual terms.

Monetising quantum through hardware and cloud access

Figure 2: Pasqal's quantum computer

Pasqal's business model is built on two main pillars. The first, and currently the largest, is the delivery of on-premises quantum computers to high performance computing centres (HPCs) and industrial sectors, making Pasqal one of the world's main suppliers of such systems. The company builds its machines and assembles systems in-house in its manufacturing facilities in France and Canada. Since 2024 it has already delivered three 100-qubit machines in France, Germany and Canada, and one 200-qubit machine in Saudi Arabia, with another installation planned in Italy in 2026. Each machine delivered includes maintenance services as part of the company's overall offering.

The hardware is complemented by software solutions, including algorithms, emulators, compilers and programming tools like Pulser and Pulser Studio, which help users develop, test and optimise quantum algorithms and translate them into instructions that can be executed on the QPUs. Most of this software is open source, enabling anyone to use and contribute to it, a strategy that encourages market adoption in key sectors of the economy, helping Pasqal to maximise the deployment and utilisation of its hardware.

The second revenue stream provides users with cloud-based access to Pasqal's QPUs, allowing them to run quantum computations either through Pasqal's Cloud Computing Platform or through major cloud service providers such as Google Cloud, Microsoft Azure, OVH Cloud and Scaleway. While on-premises delivery dominates today, the company expects demand to gradually shift toward cloud access as the technology matures and more users become interested in accessing the compute capabilities remotely.

Pasqal stands out as a full-stack quantum computing company, offering hardware, software, and applications. Its neutral-atom processors can operate in both analogue and digital modes, allowing users to solve concrete quantum challenges today, while paving the way for fault-tolerant quantum computing (FTQC). By integrating every layer, from hardware to applications, Pasqal delivers market-ready quantum computing capabilities that few companies worldwide currently offer in real computing environments. Pasqal's customers come from a range of key economic sectors including energy, logistics, defense, finance, pharmaceuticals, material discovery and the public sector.

To gain access to customers and early adopters, Pasqal leverages public procurement programmes such as those from European High Performance Computing (EuroHPC) to deploy its quantum systems in high-performance computing centres and enable access for researchers, SMEs and public entities. These deployments not only expand user adoption, but also provide valuable operational feedback and contribute to building Europe's strategic capabilities in quantum computing while reinforcing its resilience in terms of digital supply chains.

TAKEAWAY:

Public procurement as catalyst

Public procurement can serve as a critical catalyst for breakthrough technologies, driving market uptake and industrial deployment at scale.

Box 1: Delivering quantum computers to the public sector via public procurement

Pasqal collaborates with several public customers, such as the EuroHPC Joint Undertaking, where its quantum devices are deployed in HPCs through public procurement processes. Currently, Pasqal provides three out of the eight quantum computing systems awarded by EuroHPC based on a competitive public procurement process. Having a state-of-the-art technology effectively shapes the requirements of these customers, as advanced capabilities become the technology baseline. With respect to IP, one key requirement in recent procurement procedures has been interoperability at the software level, notably the ability to integrate third-party tools to support an open ecosystem on top of the hardware. This aligns well with Pasqal's open-source strategy, making it easy to meet procurement requirements. Once deployed, the machines are owned and hosted by public entities that distribute computing time to researchers or SMEs, for example through project-based calls.

TAKEAWAY:

Market access through technological leadership

IIn cutting-edge technologies like quantum computing, maintaining technological excellence facilitates meeting procurement requirements and winning public contracts.

Converting know-how into a broad patent portfolio

Since its origins at the Institut d'Optique, Pasqal's quantum computer has evolved from a laboratory prototype into a fully-fledged commercial product. The initial portfolio of trade secrets and know-how has expanded significantly as the technology has developed. Pasqal currently holds a fully-fledged IP portfolio comprising patents, trade secrets, copyrights on software and trade marks to protect its brand. The patent portfolio includes close to 90 patent families covering both hardware and computer-implemented (software-based) inventions. Pasqal's IP strategy operates at two main levels. At the most basic, it protects the core hardware and system architecture to shield the company from copycats and support freedom to operate (FTO). Then it files patent applications on performance-enhancing innovations such as error correction to secure a strong IP position and competitive edge as next-generation quantum processors become more widespread. Patent applications and scientific publications also improve Pasqal's reputation, facilitate R&D co-operation and strengthen its position in negotiations.

Over the years the company has expanded its IP not only from its own developments, but also through strategic acquisitions. These have allowed it to secure patents, trade secrets and technological expertise in strategic areas. In 2025, for example, the company acquired Aeponyx, a Canadian startup specialising in photonic integrated circuits. This transaction enriched the patent portfolio of Pasqal by a number of patent families and brought in confidential know-how, tacit knowledge and technological expertise, maximising Pasqal's benefits from the access to a critical technology complementing its own.

Figure 3: Loïc Henriet, CEO of Pasqal

TAKEAWAY:

Growth through acquisition

Strategic acquisitions allow companies to expand and complement their IP portfolio, secure specialised know-how and integrate complementary technological expertise.

Next to patents, trade secrets are a key component of Pasqal's IP portfolio. These protect critical know-how that is difficult to reverse-engineer, including the expertise required to assemble all the technological building blocks needed to construct a quantum computer. Additionally, the company maintains a trade mark portfolio covering its name and various logo designs, enhancing brand recognition and helping differentiate its products in the market. The word mark Pasqal was secured early on, proving the company's foresight with respect to securing IP protection from the very start (see list of selected patent applications and trade marks in tables 2 and 3).

Balancing open source and patent protection for software

Although much of the software code is open source, the company sees strategic value in protecting inventions based on certain algorithms, such as methods that enable the optimisation of hybrid quantum-classical workflows; these produce technical effects that give a competitive edge. While the legal landscape for patenting quantum algorithms is still evolving, in Pasqal's experience the EPO has been treating such patent applications according to the principles and guidelines established for computer-implemented inventions. So far the company has been able to overcome early clarity issues in patent search reports and is progressing with its applications.

Box 2: Protecting computer-implemented inventions at the EPO

Computer-implemented inventions (CIIs) are inventions in which the essential features are realised by a computer, software or digital data processing. At the EPO, CIIs are not excluded from patentability if they possess technical character, meaning the invention provides a technical solution to a technical problem. In practice quantum-related CIIs often meet this requirement because quantum algorithms typically rely on technical means, such as manipulating physical qubits with quantum gates or performing hardware-dependent circuit optimisations. When the invention is implemented on quantum hardware or produces a measurable technical effect, it is generally considered to have technical character, which supports the assessment of patentability under the EPO's practice.

Because Pasqal combines open source software with an active patenting strategy, it avoids standard open source licenses that automatically grant users the right to use the patents. Instead, the company applies a tailored licensing approach that allows software to be shared openly while maintaining control over patented technologies and preventing any unintended loss of exclusion rights.

TAKEAWAY:

Balancing patents and open source

When combining open source with patent protection, use custom licences that avoid unintentionally giving away the exclusion right of patents

Enhancing scientific reputation while protecting IP

Even though the vast majority of Pasqal's employees work full time for the company, it remains highly active in scientific publishing. In the emerging and fast-paced field of quantum computing, the credibility of a startup is also linked to its scientific output. Publishing therefore supports both the company's reputation and long-term IP strategy.

Publishing and patenting are not seen as incompatible; however, Pasqal is aware of the importance of carefully balancing the two and has established clear processes to ensure scientific output does not compromise its creation of IP. All team managers receive dedicated IP training, enabling them to properly evaluate and approve scientific publications. All employees are also made aware that public disclosure before filing a patent application can jeopardise patentability. As part of the invention disclosure process, inventors must indicate whether they intend to publish their results. If publication is planned, team managers are involved in the discussion and the IP department checks whether patent filing is necessary before anything is made public. In some cases, patent drafting can be accelerated if there is a firm deadline for publication, e.g. due to a PhD defence or conference submission.

Research collaborations such as those with the Institut d'Optique and the CNRS are governed by strict confidentiality clauses. In these partnerships, either party wishing to publish must first notify the other, ensuring all involved can retain control over their IP. In some cases, Pasqal also publishes certain results strategically to enrich the knowledge base and contribute to the state of the art.

TAKEAWAY:

Strategic publishing

Leverage scientific publications as a tool for reputation building and strategic publishing. To avoid compromising IP assets, implement a clear corporate process that systematically assesses patenting potential and trade secret risks before release.

Systematic approach to IP creation

Figure 4: Inside a quantum computer - 3D view of an open quantum processing unit (QPU)

Pasqal has established a structured and proactive approach to managing its IP. When Pasqal's first IP manager joined in 2022, the company decided to set up a dedicated software platform to streamline the handling of invention disclosures and maintain a clear, centralised record of all IP-related developments.

There are two main pathways through which new inventions enter the system:

a) Spontaneous disclosures: inventors can submit ideas as invention disclosures directly via the dedicated corporate software tool.
b) Proactive identification: the IP team conducts regular meetings with inventors to identify emerging inventions. These sessions are guided by a technical roadmap that is continuously updated to reflect the evolution of Pasqal's technology and technical developments in the broader quantum computing field. This ensures that ongoing R&D efforts, the IP portfolio and the company's technological priorities remain aligned.

Once an invention has been identified, the IP department liaises with internal technical experts and performs a preliminary patentability check, including a basic prior-art search and evaluation of whether the concept can be sufficiently disclosed. Pasqal's IP committee then decides which inventions should be prioritised based on strategic relevance and alignment with the company's technology roadmap.

For inventions approved by the IP committee, Pasqal collaborates with specialised external patent attorneys, selected according to technical field. The IP corporate team and the inventors work closely with the attorneys to ensure each application is drafted accurately and correctly describes the technology, aiming for enforceable patent protection.

TAKEAWAY

Proactive invention capture
Capture inventions both spontaneously and proactively during regular reviews and ensure they are aligned with your strategic goals.

Patent filing choices

Pasqal's core markets are Europe, North America, the Middle East and Asia with production facilities in France and Canada. It therefore seeks broad geographical coverage for its patents, with the decision in each case depending on whether the technology is hardware- or software-based. Each type of technology covers regions of interest depending on the market of the concerned technology. Typically, a software-based solution can be deployed globally, warranting broader protection than a hardware-based solution. The company typically files for priority national or European patents with a subsequent PCT filing, which offers the highest flexibility and allows it to wait up to 30-31 months before deciding which markets to pursue.

Since patent filing tactics rely heavily on the PCT system, for each application the company evaluates whether it is worth pursuing through a PCT filing around the 12-month mark after the priority date. Around the 30-month mark it decides which national phases, if any, should be entered. In addition, Pasqal's IP committee conducts a regular portfolio review to evaluate the continued value of each patent. Non-core ones are typically allowed to lapse, helping the company maintain a focused and efficient portfolio and keep costs under control.

Like many others, Pasqal initially adopted a cautious wait-and-see approach toward the Unitary Patent system, choosing the traditional national validation route for European patents granted. However, given the company's increasing interest in covering more EU jurisdictions, after a positive cost-benefit analysis it has begun requesting unitary effect for more recently granted European patents. The perceived high quality of decisions taken by the Unified Patent Court and reduced administrative burden contributed to the decision to lean strongly towards the Unitary Patent system for future applications. Decisions will, however, continue to be taken on a case-by-case basis.

Securing IP in collaborations

Pasqal engages in co-development projects with a number of industrial partners. Each collaboration is governed by tailored agreements that define how intellectual property will be handled and which party retains ownership of the IP generated. When ownership cannot remain exclusively with Pasqal, such as in collaborations with French universities, which often prefer to retain ownership, the company may file joint patent applications, while agreeing on the use rights.

For instance, Pasqal may obtain exclusive rights within specific domains relevant to its activities, while partners may retain rights for applications outside Pasqal's core areas. This flexible approach allows the company to collaborate effectively while safeguarding its strategic interests.

TAKEAWAY

IP rights and collaboration agreements
If you cannot obtain all IP rights in collaboration agreements, customise the agreement to ensure each party can benefit from the results for its field of use while pragmatically defining the ownership regime upfront.

IP supporting the investment journey

In 2021 the company raised a €25 million Series A led by Quantonation and the Defence Innovation Fund, managed by Bpifrance on behalf of the Defense Innovation Agency (AID). This investment round included participation of Runa Capital, Daphni and Eni Next. Series B with a value of about €100 million followed in January 2023, led by the Singaporean investment company Temasek including several new (Wa'ed Ventures and Bpifrance, through its Large Venture Fund) and existing investors (Quantonation, the Defence Innovation Fund, Daphni and Eni Next), and the EIC Fund. Since then Pasqal has attracted additional strategic investors, notably the shipping and logistics company CMA CGM and LG Electronics, as well as an additional €30 million equity investment from the EIC Fund via the Step Scale Up scheme aiming at scaling up strategic technologies.

For Pasqal, the Series A and B funding rounds were largely driven by technology rather than commercial traction. IP was therefore critical for the success of both funding rounds. However, expectations regarding IP changed between the two series. While in Series A investors mainly needed reassurance that the technology was properly protected and there was FTO, by Series B expectations had become more detailed. Investors looked for a well-defined and well-explained IP strategy aligned with the technology roadmap and the company's business goals. At that stage the company was expected not only to have secured the ability to commercialise its technology, but also to show how its evolving IP portfolio would continue to reinforce and protect future developments.

TAKEAWAY

Investor confidence through IP

A document clearly explaining your IP strategy helps earn investor confidence.

In addition to equity investments, Pasqal has also attracted a number of public grants, for which their IP portfolio and strategy played an important role. In France the company received grants from Bpifrance and other national innovation programmes. At the European level it secured several grants from the Pathfinder and Accelerator programmes of the European Innovation Council (EIC). For the EIC in particular, IP strategy is one of the core elements of proposals and is expected even for very early-stage technologies. The more advanced the technology development, the stiffer the requirements of the EIC. For the EIC Accelerator an adequate IP protection of the technology, a well-articulated IP strategy and FTO are essential.

Investment rounds also often provide strategic input and feed into the IP strategy through investor recommendations. Such recommendations also played a role in the company's increased patent filing activity.

Table 1: Overview of major investments in the company

Type	Year	Lead investor/funding agency	Amount
Series A	2021	Quantonation	€25 million
Series B	2023	Temasek	€100 million
EIC STEP Scale Up	2025	EIC Fund	€30 million (investment not yet completed)

Shaping quantum computing standards for future compatibility

Pasqal actively participates in shaping quantum computing industrial standards and enjoys leadership position as the convenor of the Working Group 3 on Quantum Computing and Simulation of the Joint Technical Committee 22 (JTC22) of CEN-CENELEC, one of the EU law-recognized European standard development organizations for quantum technology standardization. Pasqal is also the French industrial representative at the international ISO/IEC Joint Technical Committee 3 (JTC-3), as well as the industry representative nominated by the French government at the G7 Joint Group on Quantum Technologies, created under the 2025 G7 Leaders' Summit in Canada. The company considers its involvement in quantum computing standard-setting activities as strategically important. Being an active industrial standard-setter with a leadership position in key European and international standardisation bodies is critical for the company for two reasons. Firstly, it ensures that the company will be able to keep building and delivering quantum computers that will accelerate market adoption through their integration with classical computing. Secondly, it enables Pasqal to avoid being locked out of the market because of industrial standards that may not fit the technical characteristics of the technology developed by it.

At this stage, the role of standard-essential patents (SEPs) for Pasqal is still uncertain. Some of its patents may eventually become essential, but the company does not currently file patents with the main expectation of the SEP status, mainly due to the current difficulty to predict which patents will eventually contribute to the standards in the quantum field.

TAKEAWAY

Influence through standards

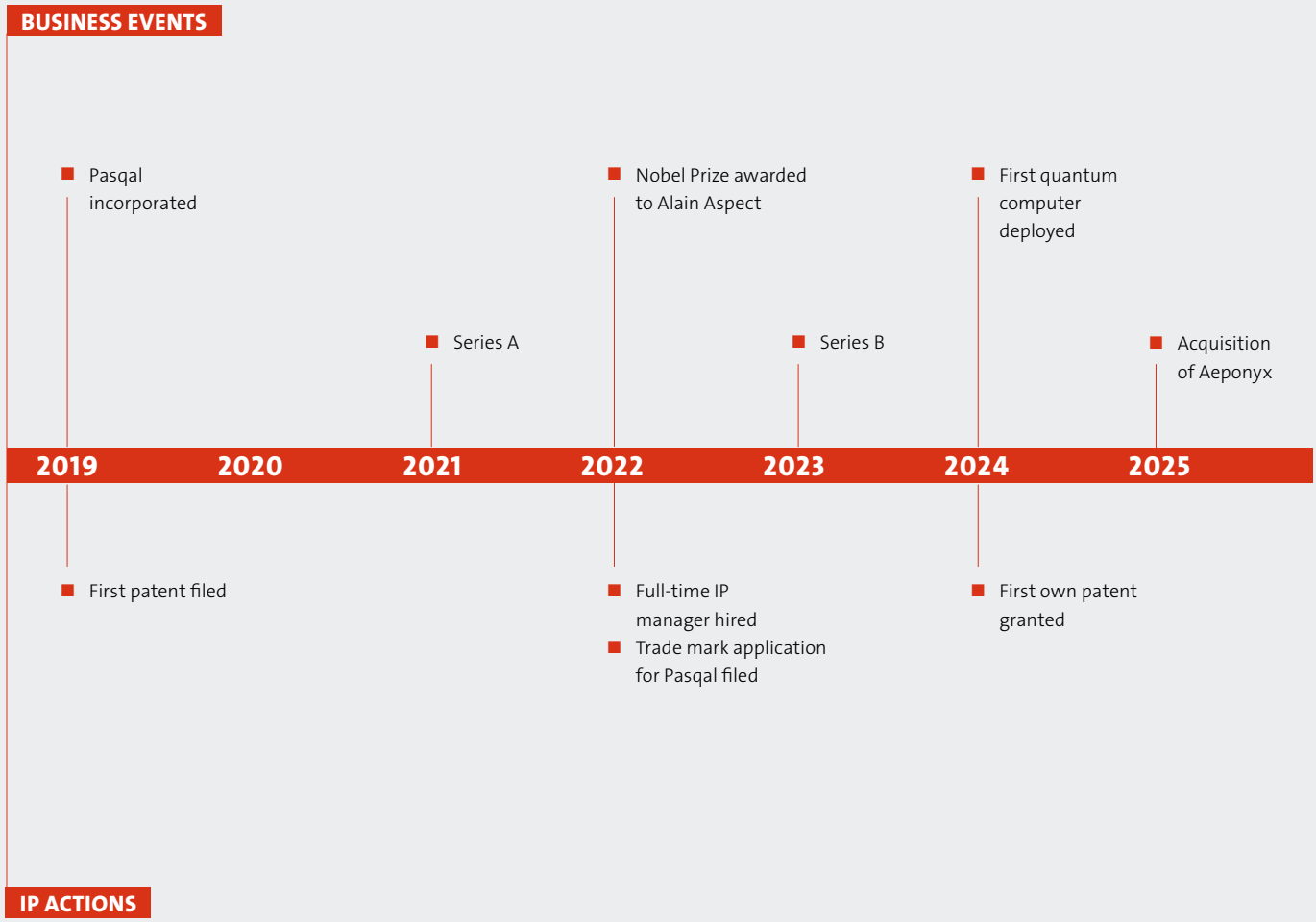
In developing technology fields like quantum computing, active engagement in standard-setting is essential to accelerate market adoption and ensure future technology compatibility.

"Participation in standard-setting activities enables Pasqal's technology to scale industrially by fostering interoperability and reducing the risk of market lock-in."
Loïc Henriet, CEO of Pasqal

Box 3: Standard-setting and Standard Essential Patents

Standards are agreed technical specifications or protocols that ensure compatibility, interoperability and quality across products, systems or services. They are developed by recognised standards organisations such as ISO, CEN/CENELEC or ETSI through a collaborative process involving industry participants, experts and stakeholders, often requiring consensus. A Standard Essential Patent (SEP) is a patent that claims technology necessary to implement a standard; because compliance with the standard requires using the patented technology, SEP holders are generally required to license them to anyone applying the standard on fair, reasonable, and non-discriminatory (FRAND) terms to allow broad adoption of the standard while protecting the patent holder's rights.

Timeline


BUSINESS EVENTS
Pasqal incorporated
Series A
Nobel Prize awarded to Alain Aspect
Series B
First quantum computer deployed
Acquisition of Aeponyx
2019
2020
2021
2022
2023
2024
2025
First patent filed
Full-time IP manager hired
Trade mark application for Pasqal filed
First own patent granted
IP ACTIONS

PROFILES

Pasqal

- Founded in 2019
- Employees in 2025: 287
- Number of active patent families in 2025: 86 (including from mergers & acquisitions)
- Core technology: neutral atoms trapped and controlled with lasers as qubits for scalable quantum processors
- Product portfolio: neutral atom quantum computers, application software and cloud services
- Business model: full stack, with the company building and operating the entire quantum computing system, including own assembly and deployment of quantum computers, development of application software made available via open source, and renting quantum computing time via cloud access

Loïc Henriet

- Key employee of Pasqal since its earliest days, formerly CTO and since 2024 CEO
- Completed PhD in theoretical quantum physics at the École Polytechnique in Paris

Alain Aspect

- French physicist and co-founder of Pasqal
- Awarded the Nobel Prize in Physics in 2022 (shared with John F. Clauser and Anton Zeilinger) for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science.

Institut d'Optique Graduate School

- Graduate engineering school of Paris-Saclay University, at the forefront of optics and photonics research
- Research from this institute played an instrumental role in advancing neutral atom quantum computing and laid the foundations of the technology subsequently developed by Pasqal

Quantonation

- Early-stage venture capital fund investing in breakthrough technologies based on advances in physics and computing, based in Paris (France) and B oston (USA)
- Participated in all investment rounds and led the Series A round

Temasek

- Investment company headquartered in Singapore, with a global portfolio spanning a broad spectrum of industries
- As of March 2025 the investment portfolio was worth $424 billion
- Led the Series B round

European Innovation Council (EIC)

- EU programme to support high-risk, high-impact innovation with grants and/or equity investment (the latter via the EIC Fund)
- Participated in Series B and provided financing as well as additional business support for scaling up

Overview of Pasqal's registered IP rights

Table 2: Trade marks

Title	Application date	Classes	EUTM number
Pasqal	21/06/2022	9, 37, 38, 42	1684671
	04/01/2024	9, 11, 37, 42	1783905
MyCryoFirm	04/01/2024	9, 11, 37, 42	1784501
	04/01/2024	9, 11, 37, 42	1784502
	25/01/2024	9, 37, 38, 42	1786768
	25/14/2024	9, 37, 38, 42	1786769
	25/09/2024	9, 37, 38, 42	1824909
	25/09/2024	9, 37, 38, 42	1824911

Table 3: Selected patent applications

Title	Priority date	Patent number
Methods for allocating logical qubits of a quantum algorithm in a quantum processor	24.07.2020	EP4186009B1
Methods and systems for measuring a similarity between two graphs	07.07.2021	EP4367607A1
Laser apparatus for excitation of rubidium atoms in a quantum processor	25.08.2021	EP4393037B1
Method for determining a configuration of a quantum processor to solve an optimization problem	03.12.2021	EP4441669A1
Method for generating one or more control signals for operating an analogue quantum computer	06.07.2022	EP4290423A1
Method and system for using a quantum computer to generate a graph neural network	20.09.2022	EP4343621A1

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