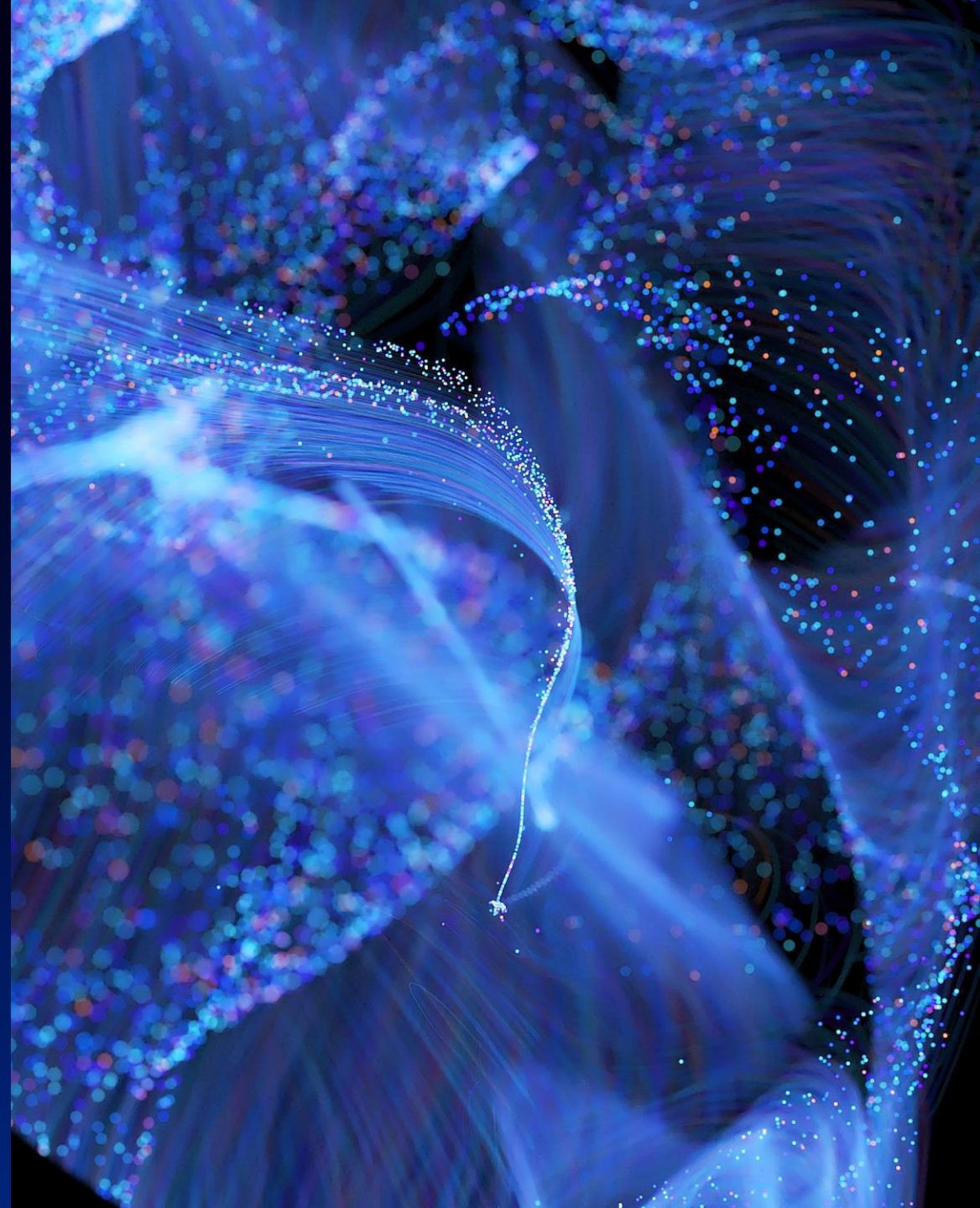




Quantum Technology Investment Update

2022 Review

February 2023



Executive Summary



- 🔒 This document provides an overview of investment in the quantum market in 2022, some of the key trends and players as well as an overview of relevant investors. Fundraising just failed to top the flood of money that poured into quantum companies in 2021 (with an estimated \$2.2 bn capital invested into quantum in 2022, 5% down from \$2.3 bn in the prior year).
- 🔒 This document does not cover [government funding](#) which is estimated to account for \$25-30 bn of commitments globally and represents an arguably more important driver in the current market environment.
- 🔒 Despite significant growth in quantum investment over the past few years, quantum technology still represents only a fraction of total VC funding (<1%), and notably has proven relatively more resilient to other tech sectors during the 2022 funding shortfalls.
- 🔒 The private quantum company market is still concentrated in North America (with US-based start-up's accounting for more than half total funding), though with increasing diversification. Notable 2022 transactions include the ~\$148m Series B of China-based Origin Quantum, the ~\$128m Series A2 of Finnish-headquartered IQM, or the \$75m Series A of the Swiss company Terra Quantum.
- 🔒 In addition to continued investment into existing quantum start-up's (with over 70 funding rounds announced in 2022), more than [40 new quantum companies were founded](#) over the course of the year.
- 🔒 Out of the quantum subsegments, Software had a stellar year with total investment growing year-on-year in 2022. This was partly driven by the \$500m financing of [SandboxAQ](#), following the company's spinoff from Alphabet.
- 🔒 In terms of industry news quantum had a banner year compared to other industries. In research, no Google Quantum Supremacy moment emerged (though Xanadu captured headlines with quantum computational advantage over the summer), but researchers made significant advances and quantum researchers were recognized by both the Breakthrough Prize and the Noble Prize committees. No small feat.

This document leverages data from [The Quantum Insider's proprietary market intelligence platform](#). This data is sourced from public announcements and directly from the underlying companies. Please contact The Quantum Insider's analyst team here for questions and corrections: <https://thequantuminsider.com/contact-us/>

Headline numbers

What we saw in 2022




\$2.2 bn

New private capital flowing into quantum technology companies in 2022¹



73

New disclosed private funding rounds in 2022



> 40

New quantum technology companies established in 2022

What we have in store

66%² believe that private investment into quantum technology companies in 2023 will surpass 2022 with only a 21% concerned we will see a decline.

n = 230



1. Excludes unknown raises so represents a low estimate

2. TQI followers on LinkedIn

Source: [The Quantum Insider Intelligence Platform](#)



“Deep Tech investments are widely acknowledged to have significant upside. What is under appreciated in the investor community is both the time horizon and risk. The winners we focus on in this space have already compressed both of those vectors.”



“Fault-tolerant quantum computing could be the single most important scientific breakthrough of our lifetime, and investing in quantum technology offers immense potential to revolutionize entire industries, from computing to communications and beyond. However, investors must remain realistic in their expectations and be aware of the challenges that lie ahead in this rapidly-evolving field.”



Mark Danchak
Managing Partner,
Aspirant

Early investor in several
Quantum companies

ASPIRANT VENTURES



Niels Nielsen
Founding Partner,
2xN

Entrepreneur and pioneer
investor in Quantum Computing





It has been a year of significant growth and traction since our spinout last March and wonderful to be working side-by-side with investors such as T. Rowe Price, Breyer Capital, USIT, Guggenheim, Marc Benioff's Time Ventures, Parkway, InQtel, QTI, Section 32, and many other leading funds.

With Eric Schmidt as our Chairman and many other accomplished individuals joining us in our braintrust, we have been able to engage with large enterprise customers to address their needs with our software.



Jack Hidary
CEO,
SandboxAQ



Key News & Market Developments in 2022

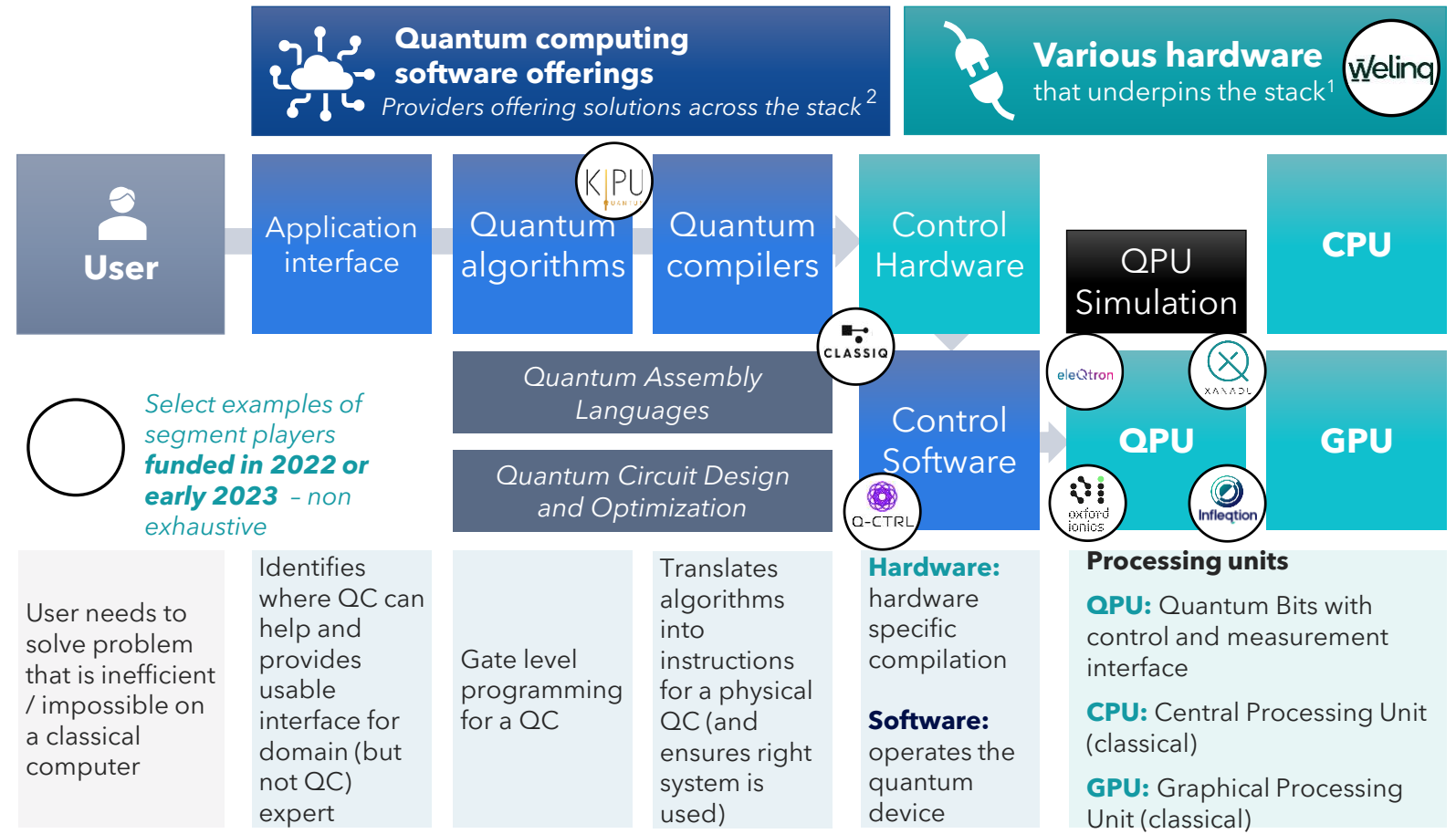


- 🕒 Nov-22 - IBM Unveils 400 Qubit-Plus Quantum Processor
- 🕒 Nov-22 - XANADU closes \$100 Million fund raise, \$1 billion valuation
- 🕒 Nov-22 - Cold Quanta - Now Inflection - raises \$110 Million Series B
- 🕒 Oct-22 - Nobel Prize in Physics goes to pioneering Quantum Entanglement researchers
- 🕒 Sept-22 - Four Quantum Pioneers share the Breakthrough Prize
- 🕒 Aug-22 - Quantinuum Study Shows Logical Qubits Can Outperform Physical Qubits
- 🕒 Jul-22 - China's Origin Quantum secures \$148 Million Series B Funding Round
- 🕒 Jul-22 - Finnish Startup IQM raises €128 Million in Series A2 funding
- 🕒 Jun-22 - XANADU'S Borealis demonstrates quantum advantage
- 🕒 Mar-22 - Terra Quantum AG extends Series A funding to \$75 Million
- 🕒 Jan-22 - Atom Computing raises \$60 Million Series B to build second-generation Quantum Computer

Quantum Technology Stack overview

The full stack for quantum computing technologies is relatively complex, with several steps sitting between end-user applications and QPUs.

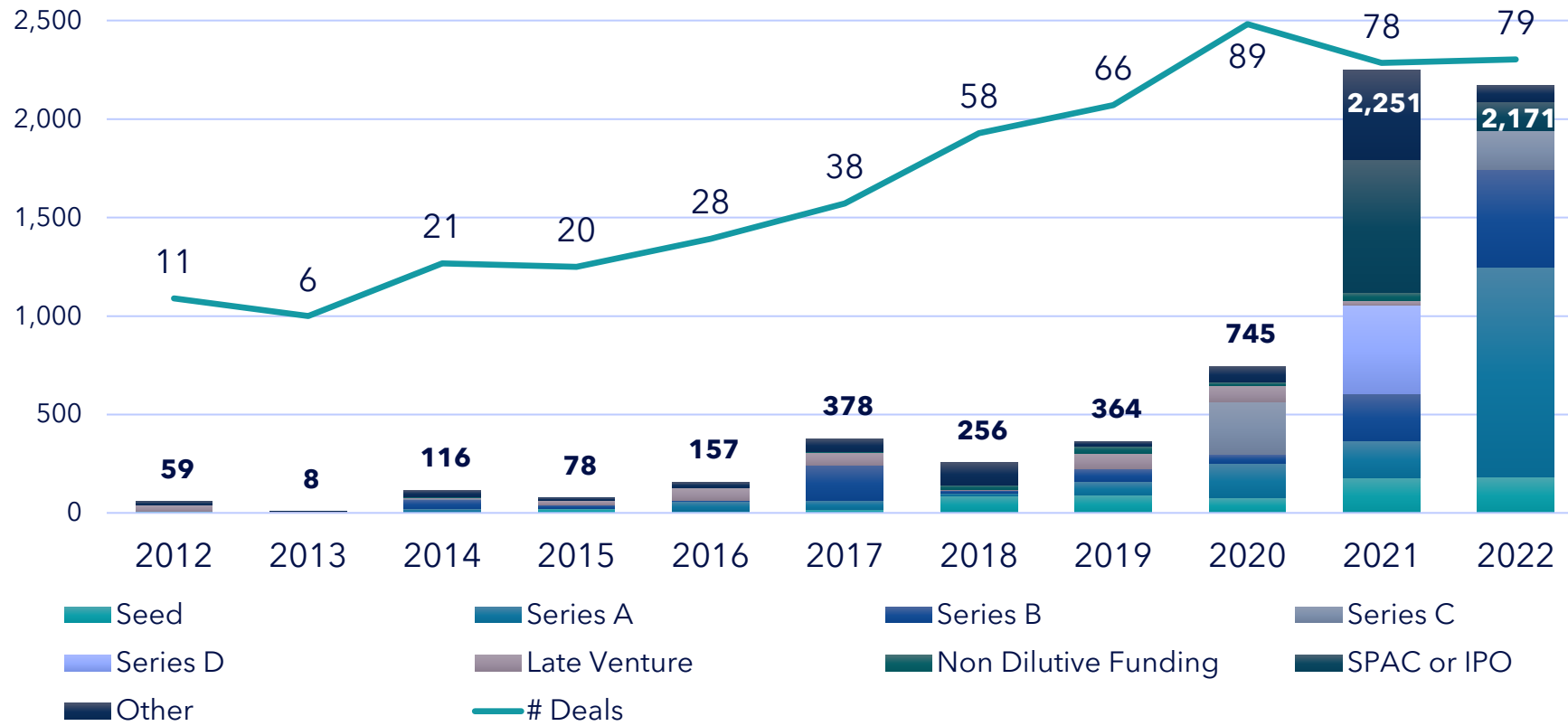
- This page shows a high-level schematic of how an end user accesses quantum devices and some of the key layers in the technology stack.
- This excludes another layer of complexity in each general segment. For example, within QPUs there are multiple qubit implementations; in the control hardware there are control systems for the control plane (e.g. heat management) and the quantum plane (e.g. quantum interconnects).
- The circled companies represent organizations that received private funding in 2022 or early 2023, representing the broad spectrum of investor interest across the stack.



1. e.g. Dilution refrigerators, vacuum chambers, coaxial cables, etc.
 2. Quantum software interfaces and QCaaS offerings provide access to CPU and GPU in addition to QPU
 Source: [The Quantum Insider Intelligence Platform](#)

Total private investment in Quantum Technology over the past 10 years

Total Quantum Investment by Stage; in \$ millions



Private investment into Quantum Technology has continued to increase over the past few years, with record high funding of \$2.3bn in 2021 and \$2.2bn in 2022.

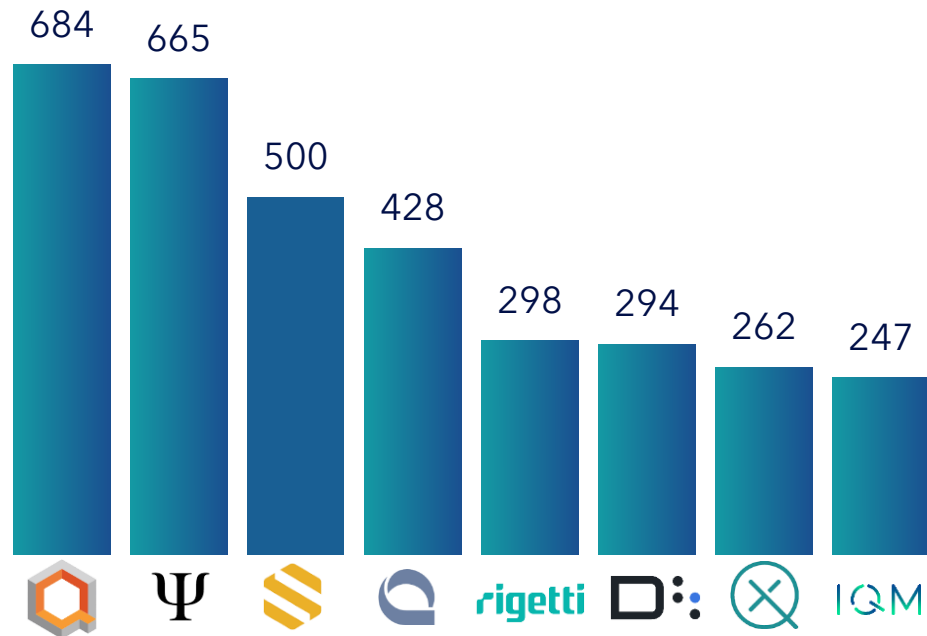
The spike in activity in 2021 was SPAC driven; 2022 was driven by growing Series A and B, as companies outside of the US received larger funding rounds.








These figures are expected to represent the lower bound of quantum investment as many companies do not disclose funding.

Source: [The Quantum Insider Intelligence Platform](#)

Top funded Quantum Technology companies globally by total private investment

Total Investment since Founding; in \$ millions



Company	Segment	Description	Founded
 IONQ SPAC ¹	Quantum Computers	Developer of a trapped ion quantum computer; spinout from University of Maryland.	2016
Ψ PsiQuantum	Quantum Computers	Company developing the first general purpose Quantum computer using silicon photonic qubits.	2016
 SANDBOXAQ™	Software	Enterprise SaaS company delivering solutions at the nexus of quantum tech and AI. Focus on sensing, security and optimization.	2022
 QUANTINUUM	Quantum Computers	Combination of UK-based quantum software ² & OS company and Honeywell Quantum Solutions, specialized in Ion Trap quantum computers.	2021
 rigetti SPAC ¹	Quantum Computers	California-based developer of hardware and software for quantum computers.	2013
 D:wave The Quantum Computing Company™ SPAC ¹	Quantum Computers	Full stack technology provider including cloud services, application development tools and other services.	1999
 XANADU	Quantum Computers	Full-stack developer of quantum photonic processors and an open-source quantum software platform.	2016
 IQM	Quantum Computers	Developer of scalable hardware for universal quantum computers, focusing on superconducting technology.	2018

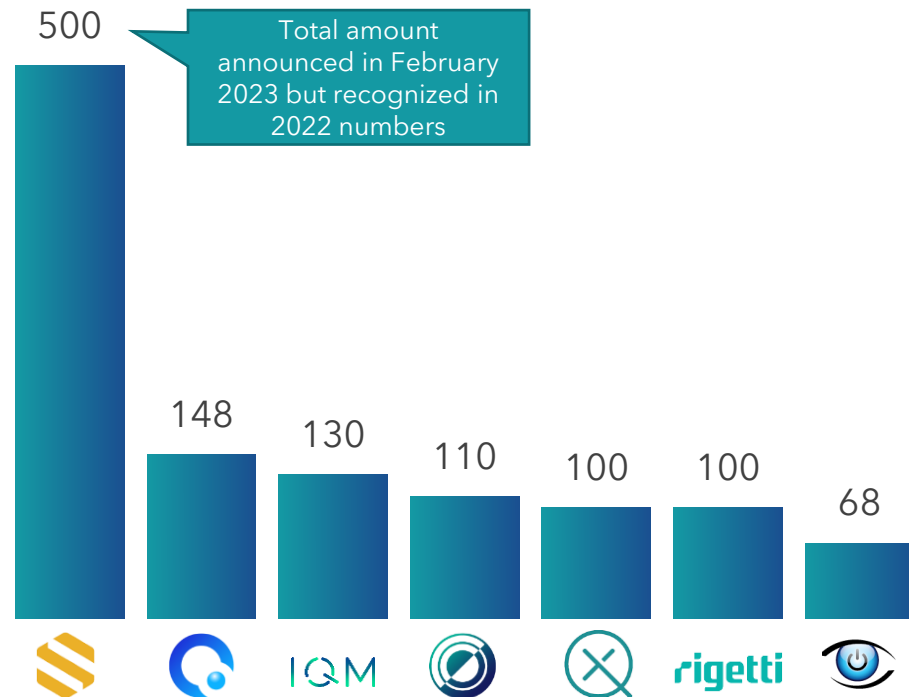
Source: [The Quantum Insider Intelligence Platform](#)








1. Funding net of SPAC redemptions

2. Quantinuum total funding includes est. \$158m of Cambridge Quantum funding prior to merger with Honeywell

Top funded Quantum Technology companies globally by private investment in 2022

Total Investment in 2022; in \$ millions

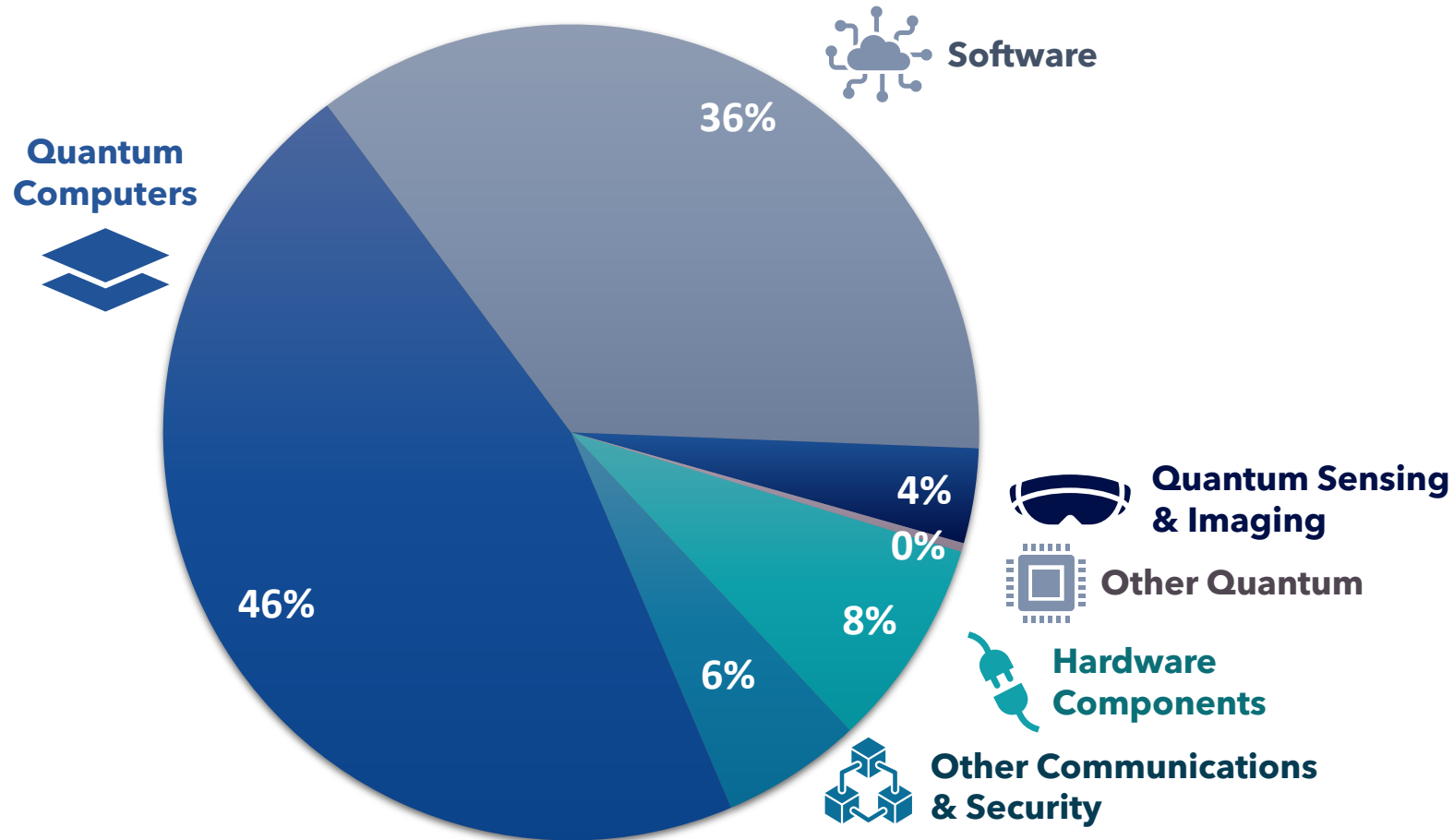


Company	Segment	Description	Founded
 SANDBOXAQ™	Software	Enterprise SaaS company delivering solutions at the nexus of quantum tech and AI. Focus on sensing, security and optimization.	2022
 本源量子 ORIGIN QUANTUM	Quantum Computers	Provider of multiple Quantum Computing solutions.	2017
 IQM	Quantum Computers	Developer of scalable hardware for universal quantum computers, focusing on superconducting technology.	2018
 Infleqtion	Quantum Computers	Holding company for ColdQuanta (sell laser-cooled and ultra-cold atom enabled quantum technologies) and Super.Tech	2007
 XANADU	Quantum Computers	Full-stack developer of quantum photonic processors and an open-source quantum software platform.	2016
 rigetti SPAC ¹	Quantum Computers	California-based developer of hardware and software for quantum computers.	2007
 CORNAMI™ Intelligent Computing	Quantum Comms & Security	Fabless semiconductor company developing quantum computing and Fully Homomorphic Encryption (FHE) solutions.	2012

Source: [The Quantum Insider Intelligence Platform](#)

1. Funding net of SPAC redemptions

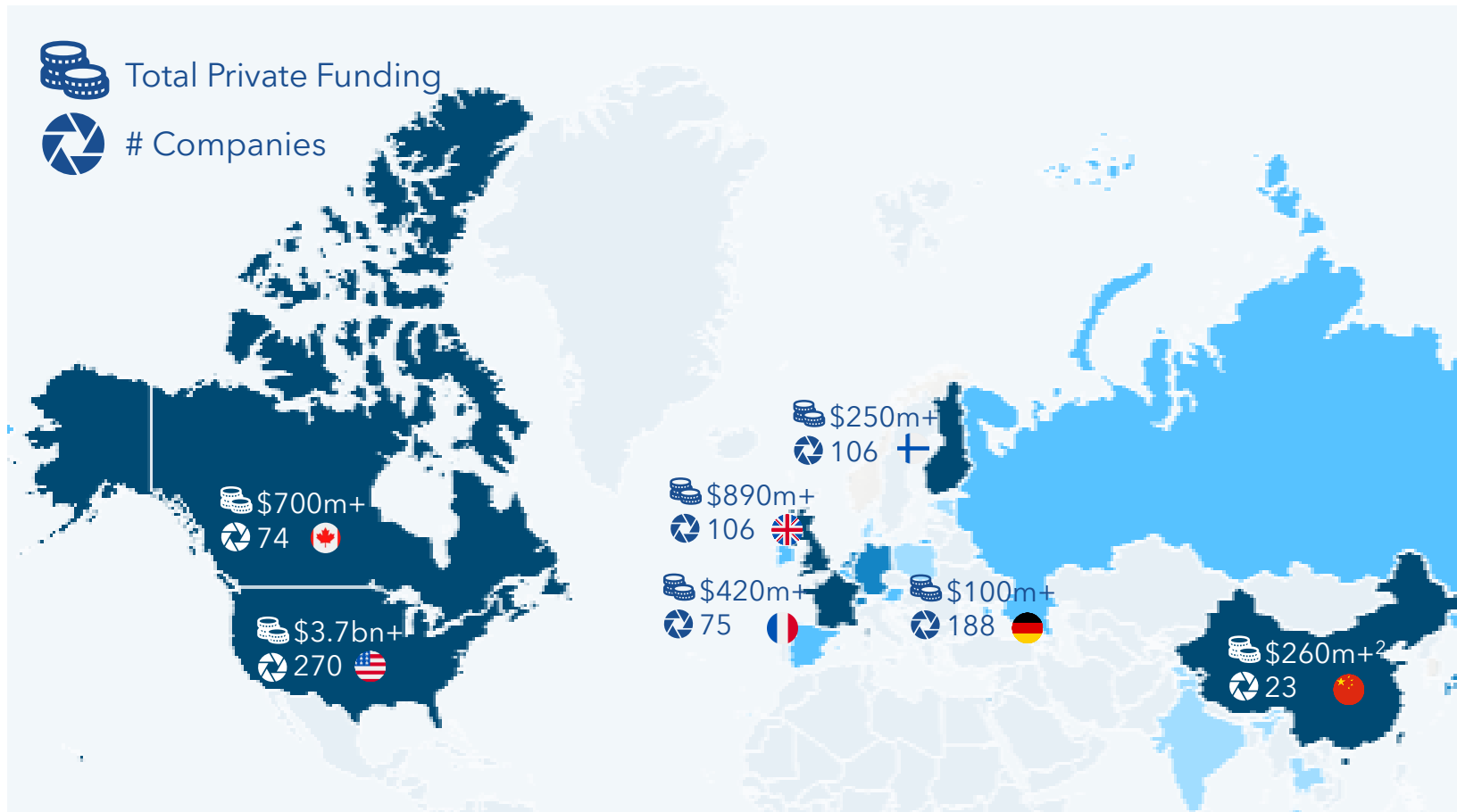
Quantum Technology 2022 Investment by Sector



Private investment into Quantum Technology reached over \$2 billion in 2022, with the strongest momentum in Quantum Computers and Software segments.

- Notable Quantum Computers transactions include the ¥1bn (~\$148m) Series B financing of Origin Quantum, a China-based developer of full-stack QC solutions led by the government backed Shenzhen Capital Group's Hotland Investment Asset Management.
- Quantum Software investment has grown in 2022, largely driven by the financing of SandboxAQ, following the company's spinoff from Alphabet. SandboxAQ is an enterprise SaaS company delivering solutions at the nexus of quantum tech and AI, focusing on sensing, security and optimization.

Quantum Technology 2022 Investment Hotspots



Global private investment into Quantum Technology has topped \$7bn¹ since 2012.

- **North America** remains the largest Quantum market, with more than half of total Quantum investment (\$3.7bn) into US-based players. Canada has also seen significant activity, with over \$700 million allocated to Quantum companies.
- Quantum technology businesses based in **Europe** have received total investments of over \$1.7bn since founding. The most active European markets from a private capital perspective include the UK, France, Finland and Germany.
- While quantum investment in **APAC** has historically been behind Western markets, there has been a number of large investments in the region in 2022 as interest in quantum technology and number of emerging players continue to grow. China represents an interesting case where the lower private investment belies significant state involvement.

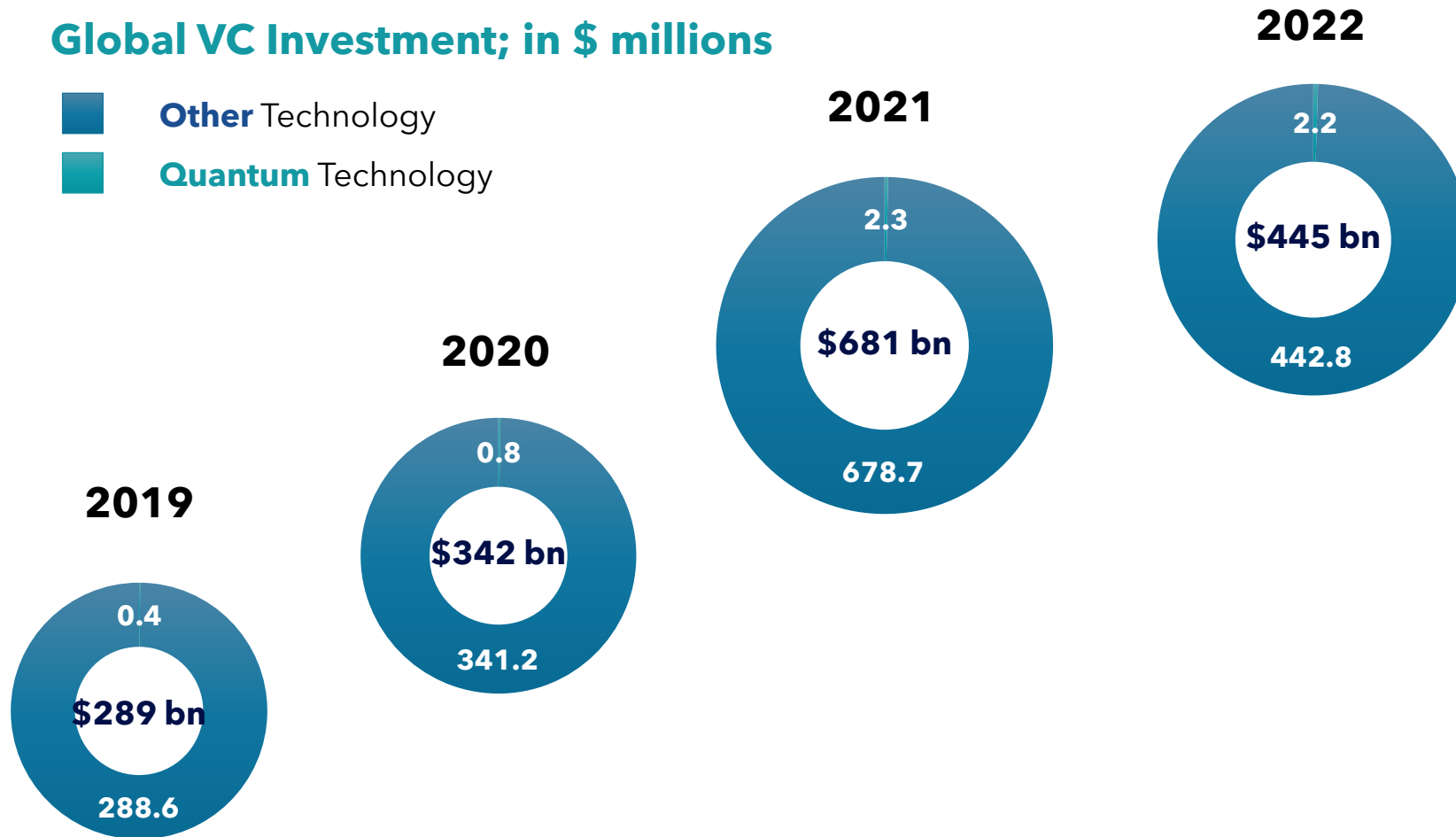
Source: [The Quantum Insider Intelligence Platform](#)

1. Cumulative total investment
2. There has been limited disclosure in China, but we expect most of the funding has state involvement

Quantum still represents only a fraction of total VC Investment

Global VC Investment; in \$ millions

- Other Technology
- Quantum Technology



Despite significant increase in activity over the past few years, quantum technology still represents under 1% of global Venture Capital investment.

- 2021 was a record year for VC globally according to Crunchbase, with over \$680 bn capital invested into early-stage companies (representing a 100% year-on-year increase).
- Quantum Technology start-ups also saw an all-time-high funding of over \$2.3bn.
- Activity in 2022 has remained significant though below prior year levels at \$445bn total VC funding and \$2.2bn quantum technology funding (representing a 35% and a 5% drop y-o-y, respectively).

Key Players in Quantum Investment since 2012



EMEA

Venture Capital

Corporate VC

Government Office

Network / Diversified

Other

Americas

Venture Capital

Corporate VC

Government Office

Network / Diversified

Other

APAC¹

Venture Capital

Corporate VC

Government Office

Network / Diversified

Other

Source: [The Quantum Insider Intelligence Platform](#)

1. Many Chinese VC investors are government-backed or led

Quantum Technology Newcomer Case Studies



TQI Category

Quantum Computers / Trapped Ion

Hardware Components/ Other Hardware

Quantum Computers / Photonics

Quantum Computers / Electrons on Helium

Business Description

Developer of high-performance quantum computers through combining trapped ions qubits with proprietary noiseless electronic qubit control technology (EQC) which aims to reduce quantum noise.

Provider of solutions connecting quantum computers at a distance, enabling storage and release of quantum information without altering its properties. Welinq's solutions might allow to build much larger quantum systems in the future.

Full-stack developer of quantum photonic processors and an OS quantum software. Xanadu developed Borealis, a programmable photonic quantum computer that outperforms the best classical supercomputers, available to the public via cloud.

EeroQ uses pools of superfluid helium to trap and control individually floating electrons. These capabilities are expected to help EeroQ in building a large-scale quantum computer based on electron's magnetic spin.

\$m raised

 **\$40m**

 **\$5.5m**

 **\$262m**

 **\$7.3m**

Year Founded

2019

2022

2016

2016

HQ

 **Oxford, UK**

 **Paris, France**

 **Toronto, Canada**

 **Chicago, US**

Quantum Technology Investor Case Studies

TQI Category	 Venture Capital	 Venture Capital	 Corporate VC	 Government Office	 Accelerator
Investor Overview	<p>Quantonation is an Early Stage Venture Fund dedicated to Deep Physics startups with a focus on the emerging and disruptive field of Quantum Technologies.</p>	<p>Runa Capital is a global VC firm HQ'd in Palo Alto, US, investing in deep tech, cloud business software, fintech, edutech and digital health startups on early stages.</p>	<p>Early to growth-stage VC firm independently supporting companies that are set to shift the future of aerospace.</p>	<p>French public investment bank; joint venture of two public entities: the Caisse des dépôts et consignations and EPIC BPI-Groupe, formerly EPIC OSEO.</p>	<p>Seed-stage program for scalable, science-based ventures. The program employs an objectives-based mentoring process with the goal of maximizing equity value creation.</p>
Quantum Portfolio ¹					
HQ	Paris, France	Palo Alto, US	Menlo Park, US	Paris, France	Toronto, Canada

Source: [The Quantum Insider Intelligence Platform](#)
 1. Non exhaustive

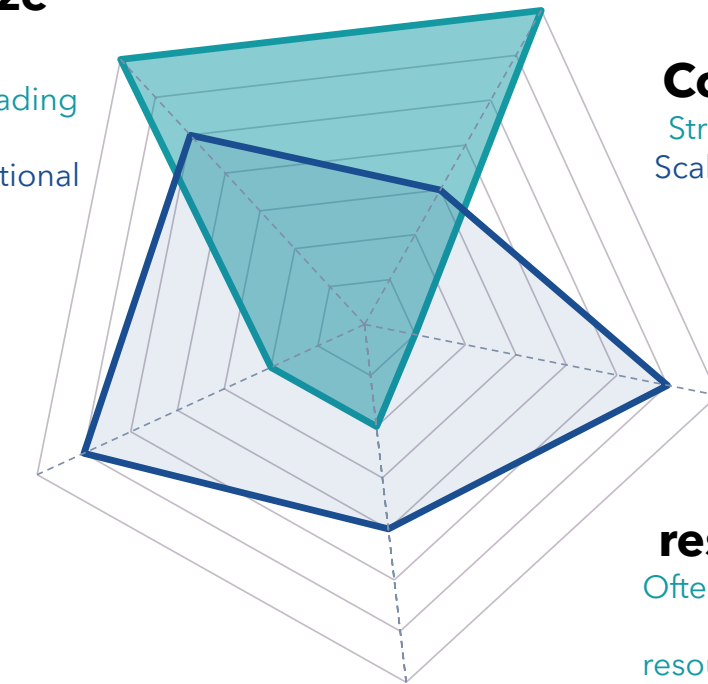
Typical Quantum Technology Start-up Investment Characteristics

Potential for outside returns

Potential to back category leading companies
Outside returns in more traditional markets may be challenging

Capital Efficiency

Many QC startups require significant capex (though exceptions within software)
Often less capital intensive



Speed to Market

Typically long development timelines
Often a few months time to market

Differentiation & Competitive Position

Strong technology differentiation
Scale and first-mover often key for competitive advantage

Due diligence resource availability

Often novel technologies with no existing peers and limited resources or industry intelligence
Typically playing in proven segments with clear comparables and industry intelligence

Quantum Technology Companies will typically have significantly different risk profiles to other Technology start-ups, with longer and more cost-intensive development timelines, more novel breakthrough technologies and a significant competitive edge. **Not all quantum companies are the same.**



Quantum Technology



Other Technology

2022 Select News



IBM Unveils 400 Qubit-Plus Quantum Processor



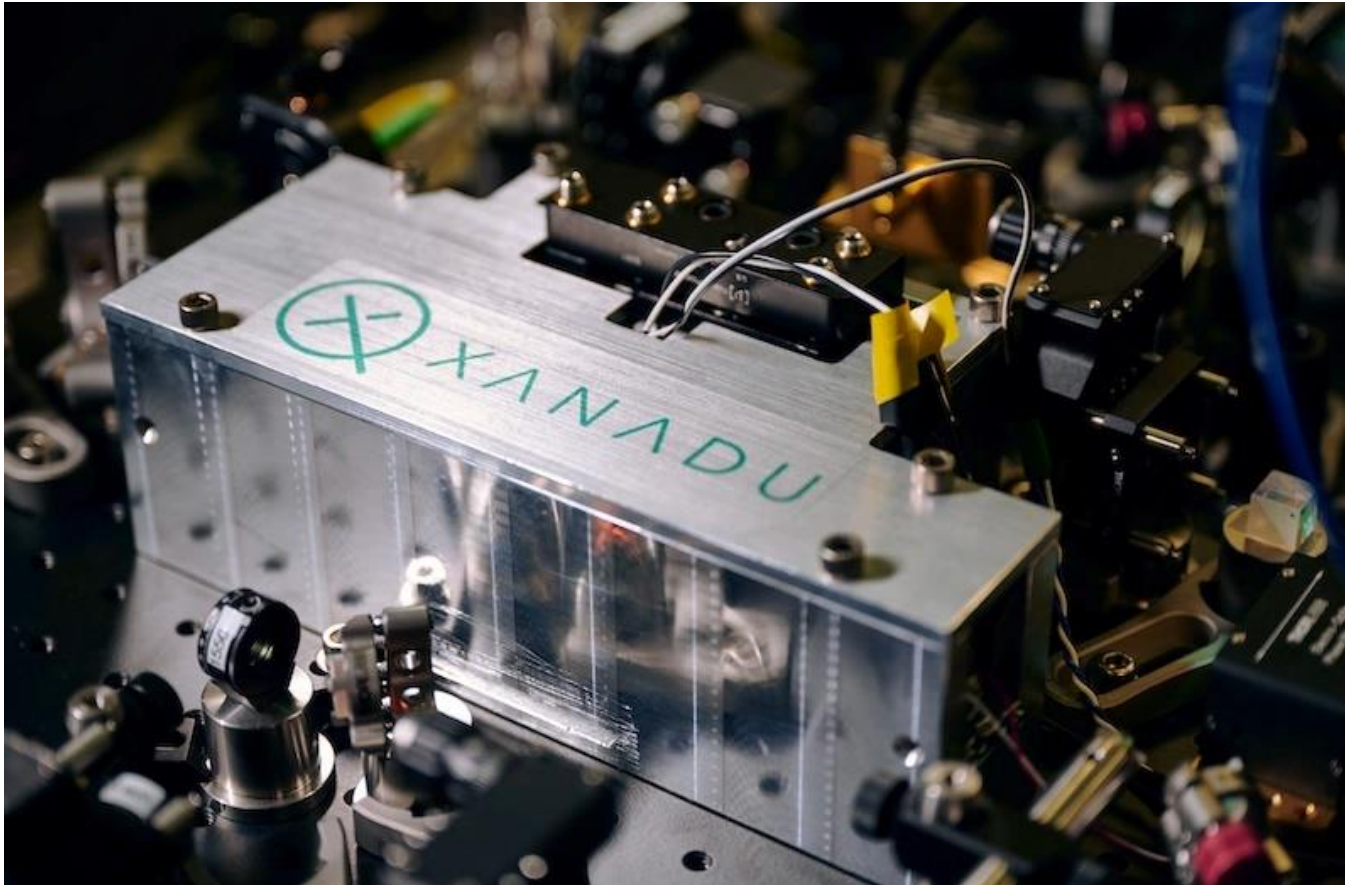
Source: [The Quantum Insider Intelligence Platform](#)

IBM announced new advances in quantum hardware and software and outlining its pioneering vision for quantum-centric supercomputing.

The annual IBM Quantum Summit showcases the company's broad quantum ecosystem of clients, partners and developers and their continued progress to bring useful quantum computing to the world.



XANADU closes \$100 Million fund raise, \$1 billion valuation



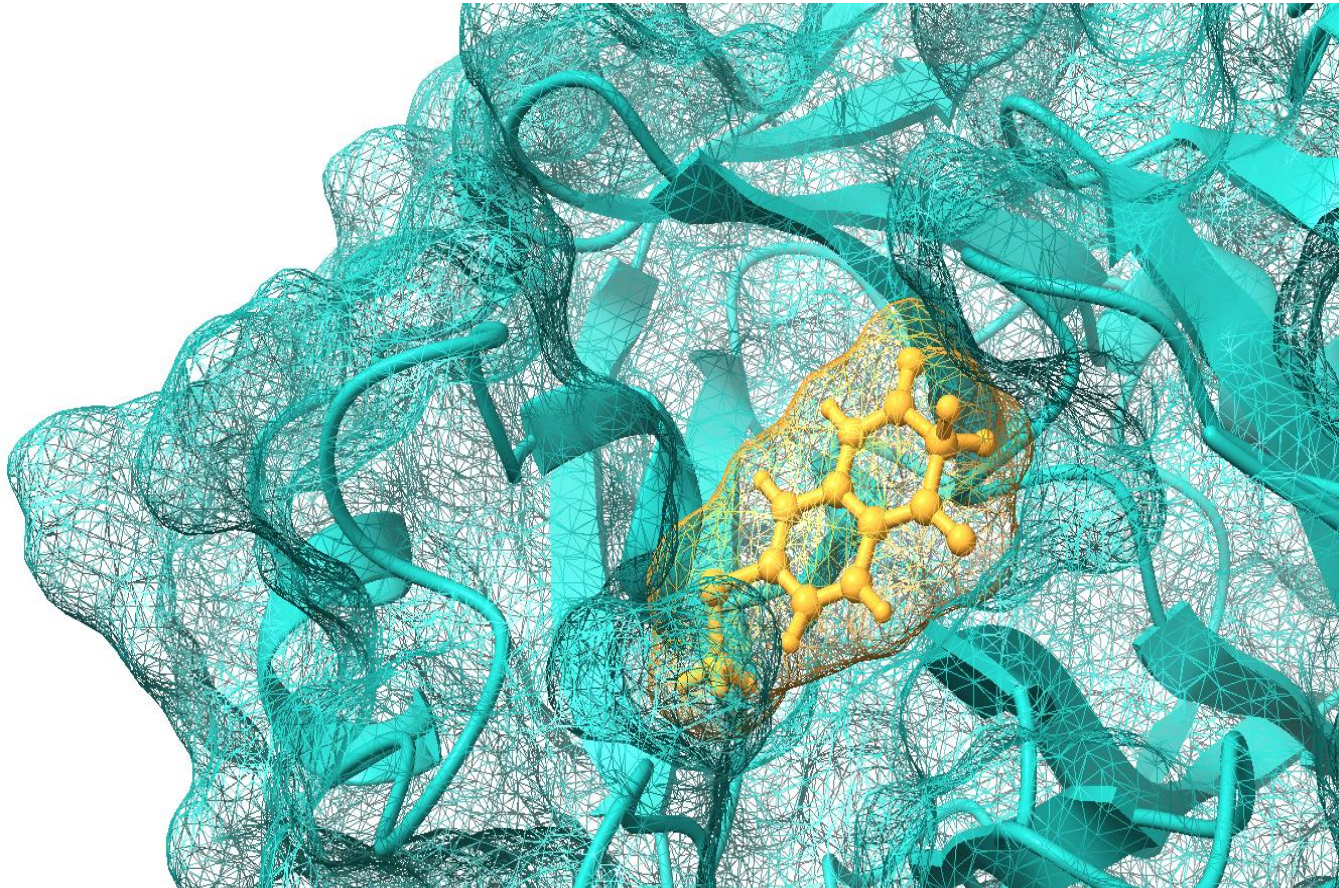
Source: [The Quantum Insider Intelligence Platform](#)

Xanadu announced it raised \$100 million USD in Series C financing.

Georgian led the round with participation from Porsche Automobil Holding SE, Forward Ventures, Alumni Ventures, Pegasus Tech Ventures, Silicon Valley Bank, along with previous investors Bessemer Venture Partners, Capricorn, BDC Capital, and Tim Draper. To date, Xanadu has raised \$250M USD, bringing the company valuation to \$1 billion USD



Cold Quanta - Now Inflection - raises \$110 Million Series B



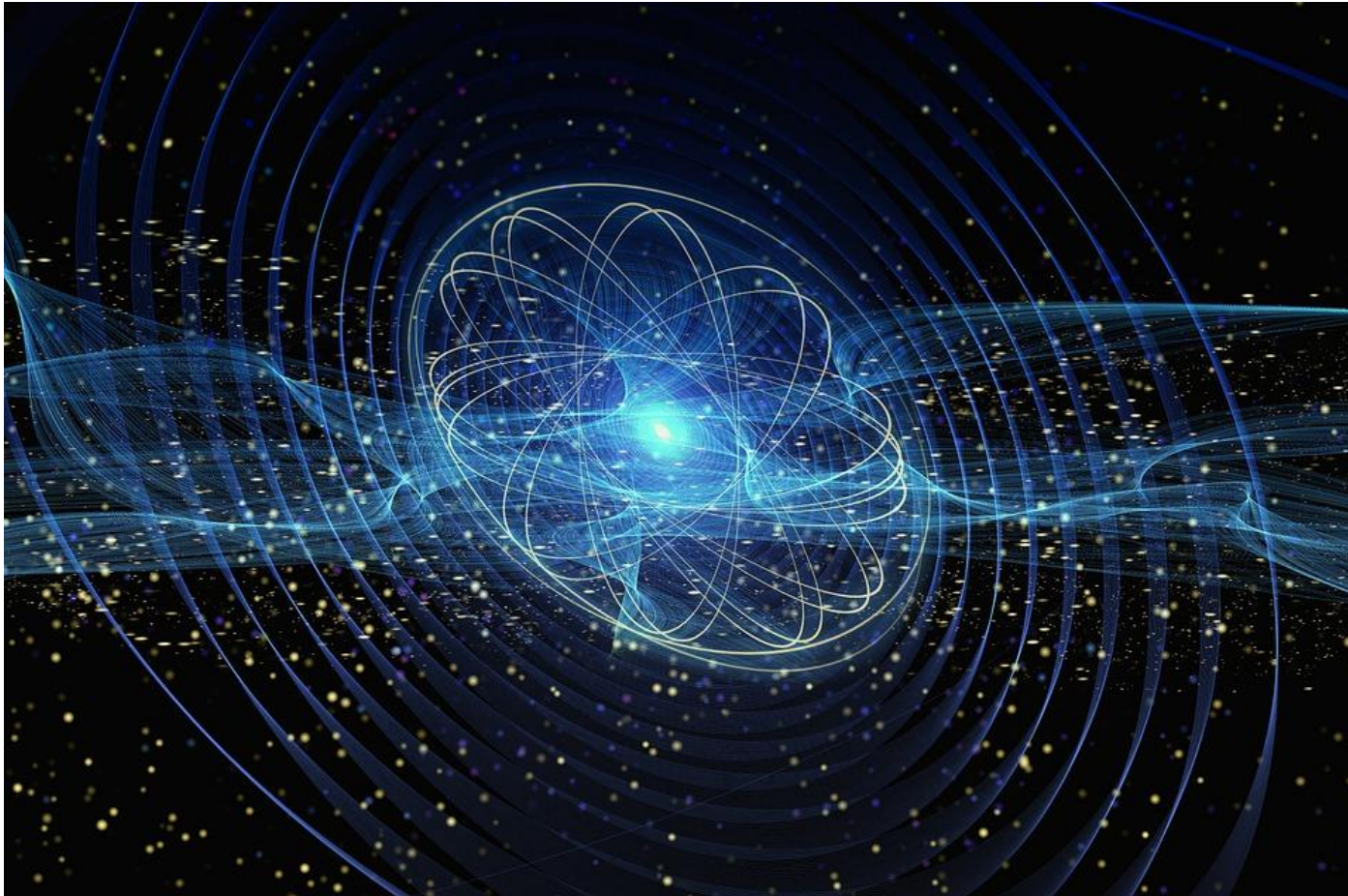
Source: [The Quantum Insider Intelligence Platform](#)

ColdQuanta (Inflection) announced a \$110 million Series B round of funding to continue commercializing the company's product portfolio, including quantum computing, quantum algorithms and applications, atomic clocks, sensors, and components.

Christopher Galvin, former Motorola chairman and CEO, joined the company's board of directors, and is also now an investor in ColdQuanta.



Nobel Prize in Physics goes to pioneering Quantum Entanglement researchers



Source: [The Quantum Insider Intelligence Platform](#)

The 2022 Noble Prize in Physics was awarded to Alain Aspect, John F. Clauser and Anton Zeilinger, three pioneers who conducted experiments on quantum entanglement.

The prize also recognizes that this once esoteric-sounding – and acting – quantum phenomena is becoming the backbone of a rapidly emerging quantum industry.



Four Quantum Pioneers share the breakthrough prize



Source: [The Quantum Insider Intelligence Platform](#)

Four pioneers in the field of quantum information were among the list of the 2023 Breakthrough Prize laureates

David Deutsch, Peter Shor, Charles H. Bennett and Gilles Brassard were listed as this year's winner in the fundamental physics category. Each winner will receive about \$3 million.



Quantinuum Study Shows Logical Qubits Can Outperform Physical Qubits



A team of Quantinuum scientists report that logical qubits can outperform physical qubits, a key step toward quantum computers that can be used to solve practical problems.

It's also an achievement that only recently was thought to be years away. The demonstration offers a path toward scalability, qubit efficiency and less circuitry needed for fault-tolerance, the team added.



Finnish Startup IQM raises €128 Million in Series A2 funding



Source: [The Quantum Insider Intelligence Platform](#)

IQM Quantum Computers (IQM), a Finland-based company that provides on-premises quantum computers for supercomputing data centres and research labs, announced it raised €128 million (\$128 million) in Series A2 funding,

led by World Fund to expand its international business and accelerate product development to tackle the world's most pressing problems, especially in the climate crisis.



China's Origin Quantum secures \$148 Million Series B Funding Round



Origin Quantum, a quantum computing startup based in Hefei, China and founded in 2017 by Professor Guo Guoping and a team from the quantum information laboratory at the Chinese Academy of Sciences closed a \$148-million Series B (1 Billion Yuan) funding round.



XANADU'S Borealis demonstrates quantum advantage



Source: [The Quantum Insider Intelligence Platform](#)

Xanadu demonstrated quantum computational advantage using Borealis, the company's newest photonic quantum computer.

Borealis synthesizes a quantum state of 216 squeezed-state qubits, entangled in three dimensions according to the user's specified program. It then generates samples from this state at a rate exceeding the capabilities of any existing classical supercomputer. Using direct simulation, the fastest supercomputer in the world would take approximately 9,000 years to generate a single such sample, compared to 36 microseconds for Borealis.



Atom Computing raises \$60 Million Series B to build second-generation Quantum Computer



Atom Computing, the creators of the first quantum computer made of nuclear-spin qubits from optically-trapped neutral atoms, announced closure of a \$60M Series B round.

Third Point Ventures led the round, followed by Primer Movers Lab and insiders including Innovation Endeavors, Venrock and Prelude Ventures. Following the completion of their first 100-qubit quantum computing system with world-record 40 second coherence times.



Terra Quantum AG extends Series A funding to \$75 Million



Source: [The Quantum Insider Intelligence Platform](#)

Terra Quantum AG, a globally leading quantum technology company, announced it had extended its Series A funding round to \$75 million, as well as research offering a groundbreaking solution to the longstanding challenge of efficient power devices for nanoelectronics.

Terra Quantum is the first company to reveal the underlying mechanism of ferroelectric-based negative capacitance while also sharing methods for its practical realization.



About Us



About the Platform



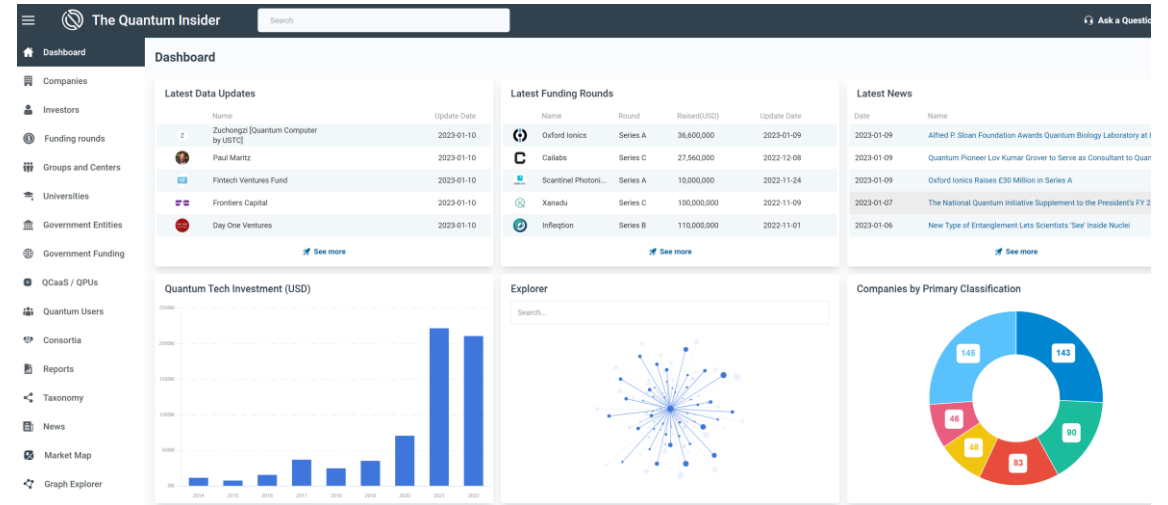
THE QUANTUM INTELLIGENCE PLATFORM

The leading provider of information, data, and insights on Quantum Technologies

OUR PLATFORM

The Quantum Insider collects and structures global data on quantum technologies and delivers this in a user-friendly platform.

Our platform helps investors, startups, corporations, accelerators, policy makers and governments gain a holistic overview of the quantum technology landscape.



Detailed data on companies, investors, academic groups, government institutions and more.



Proprietary taxonomy and customizable metadata.



Robust funding information that can be filtered by subsector and technology type.



Powerful visualization tools including our unique graph explorer and market mapping.

About the Platform

OUR FEATURES



CUSTOM TAXONOMY

We have applied our deep expertise in quantum technologies to carefully classify and segment all stakeholders across the ecosystem



ADVISORY

Our multidisciplinary team of experts help Start-ups, Multinational Corporations and Governments answer material questions and produce measurable value that is all underpinned by robust data



DUE DILIGENCE

Analyzing rapidly emerging technologies requires access to the latest and deepest information. Our platform provides you with myriad data points whether you need to source and evaluate investments, uncover competitive intelligence, or support your own products and services



MARKET INTELLIGENCE

The landscape of emerging technologies is constantly shifting. Our platform delivers deep analysis and reports, helping you to keep track of a complex, emerging industry and gain an edge over competitors



ECOSYSTEM

Our data covers more than companies and investors. We provide information on the wider quantum technology ecosystem including academic institutions, national labs and corporate end users



NEWS & MEDIA

News moves markets and changes industries. Get the latest industry news, reports and updates all powered by The Quantum Insider

OUR DATA



COMPANIES

900+ quantum technology companies (including computing, security, sensing, etc.)



INVESTORS

700+ investors who have been involved in quantum technology fundraises



FUNDING

500+ funding rounds since 2012



GROUPS & CENTRES

More than 400 groups / centres involved in quantum technology research



UNIVERSITIES

All universities involved in quantum technologies



GOV. ENTITIES

Over 30 national labs and list of government agencies



END USERS

200+ end users of Quantum technology

TQI is the leading platform owned and operated by Resonance

