QUANTO NATION

HPC User Forum – Oct, 4th 2022
Quantum Ecosystem

Olivier Tonneau, Partner

Agenda

1. Presentation of Quantonation (Team, investments, ecosystem)
2. Quantum race: where do we stand?
3. Example of Pasqal: HPC / Cloud will play a key role in the development of Quantum Computing
4. Global context (deals / Europe Competitiveness)
5. Challenges
6. Q&A

Quantonation 1 in a nutshell

Quantum Investors since 2018

€ 91m under management, **€ 44m** invested

X1,8 TVPI

1/3 strategic LPs, 16 countries

20 companies in 7 countries Europe / Canada / USA

2 exits

Portfolio:

300+ employees
72 patents
150 m€ equity+public funds raised

Portfolio: balancing short and long-term opportunities

As of July 2022

QUANTUM COMPUTING

QUANTUM NETWORKS

QUANTUM SENSING

DEEP PHYSICS

Building long term partnerships / ecosystem approach is key

NOT FOR PROFIT

le lab quantique

P33

QUANTUM INDUSTRY CONSORTIUM

Unitary Fund

QuantX

QUANTO NATION

ACADEMIC PARTNERS

cea

TU Delft Delft University of Technology

C2N Centre de Nanosciences & de Nanotechnologies

PADERBORN UNIVERSITY

SORBONNE UNIVERSITÉ CRÉATEURS DE FUTURS DEPUIS 1257

QuTech

CHICAGO QUANTUM EXCHANGE

INSTITUT d'OPTIQUE GRADUATE SCHOOL ParisTech

Berkeley UNIVERSITY OF CALIFORNIA

cnrs

UNIVERSITY OF OXFORD

INSTITUT QUANTIQUE UNIVERSITÉ DE SHERBROOKE

CORPORATE PARTNERS

BASF We create chemistry

CRÉDIT AGRICOLE

aws

eni

THALES

sopra steria

NVIDIA

GENCI

EDF

BCG

bpifrance

INITIATORS

CREATIVE DESTRUCTION LAB

QUANTUM CATALYZER

Quantum Delta Nederland

QUÉBEC INNOVATION ZONES QUANTUM SHERBROOKE

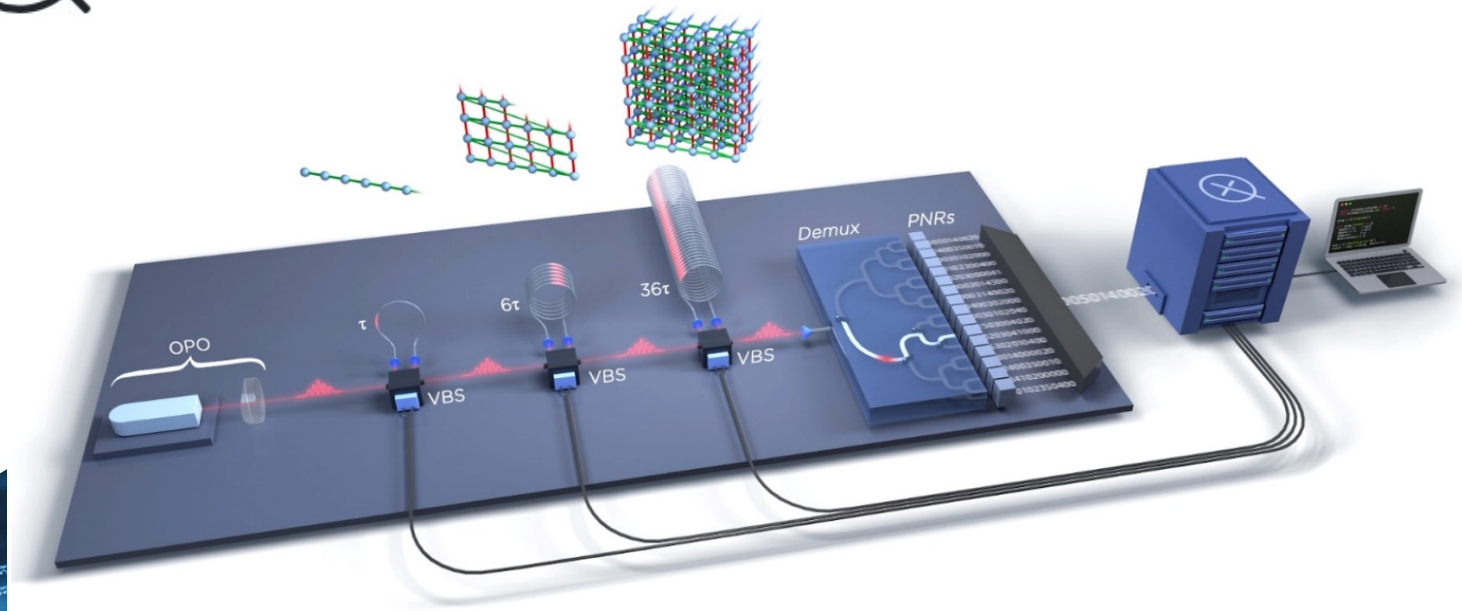
<DUALITY>
Accelerating Quantum Startups

The Quantum Race Continues

Beating classical computers with Borealis

XANADU

June 1, 2022



nature

Article

Quantum computational advantage with a programmable photonic processor

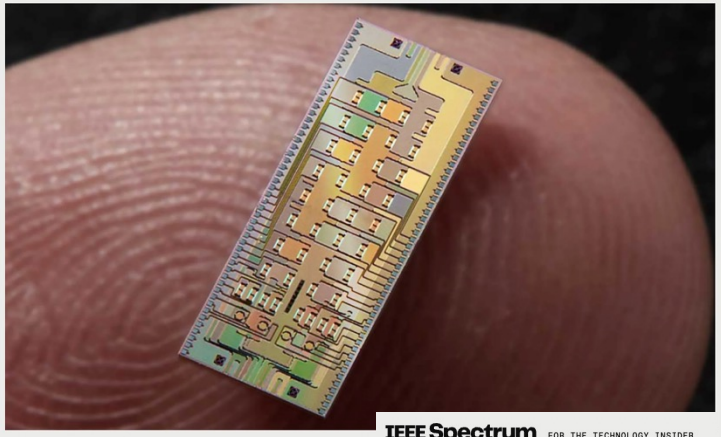
https://doi.org/10.1038/s41586-022-04725-x
Received: 12 November 2021
Accepted: 5 April 2022
Published online: 1 June 2022

Lars S. Madsen[1,3], Fabian Laudenbach[1,3], Mohsen Falamarzi. Askarani[1,3], Fabien Rortais[1], Trevor Vincent[1], Jacob F. F. Bulmer[1], Filippo M. Miatto[1], Leonhard Neuhaus[1], Lukas G. Helt[1], Matthew J. Collins[1], Adriana E. Lita[2], Thomas Gerrits[2], Sae Woo Nam[2], Varun D. Vaidya[1], Matteo Menotti[1], Ish Dhand[1], Zachary Vernon[1], Nicolás Quesada[1]✉ & Jonathan Lavoie[1]✉

In the Race to Hundreds of Qubits, Photons May Have "Quantum Advantage" ›Canadian startup

Xanadu says their quantum computer is cloud-accessible, Python programmable, and ready to scale

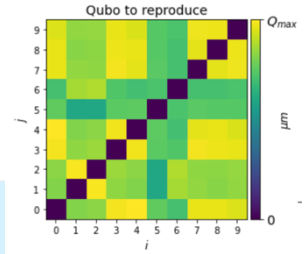
BY CHARLES Q. CHOI | 05 MAR 2021 | 4 MIN READ |



Xanadu's X8 photonic quantum computing chip. PHOTO: XANADU

IEEE Spectrum FOR THE TECHNOLOGY INSIDER

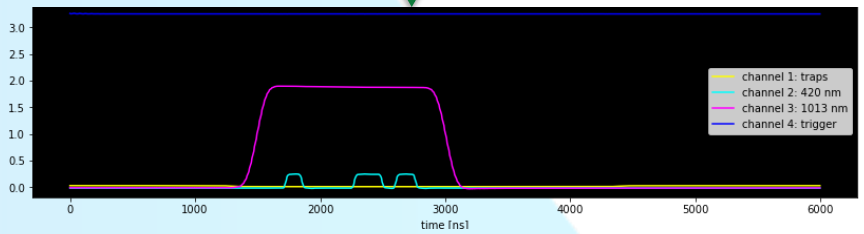
Starting to Solve Real World Problems

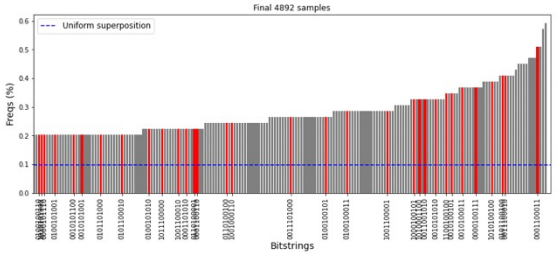


Embedding

Quantum Approximate Optimisation Algorithm (QAOA)

Optimized sequence





Bitstring Distributions

Hardware implementations for CACIB for 26 hours of continuous hardware runtime
Red bars in Bitstring Distributions histogram indicate 'good enough' optimization solutions; typically requires a few hundred shots on the hardware to find such a solution

"We see an advantage now. It is on the screen, here – the Pasqal device works and it outperforms random search"

Didier M'TAMON, Head Of Portfolio Models and Quantum Computing Lead at EuroHPC Summit Week 2022

CRÉDIT AGRICOLE
CORPORATE & INVESTMENT BANK

Addressing Grand challenges in Healthcare …

Chemical Science

ROYAL SOCIETY OF CHEMISTRY

EDGE ARTICLE

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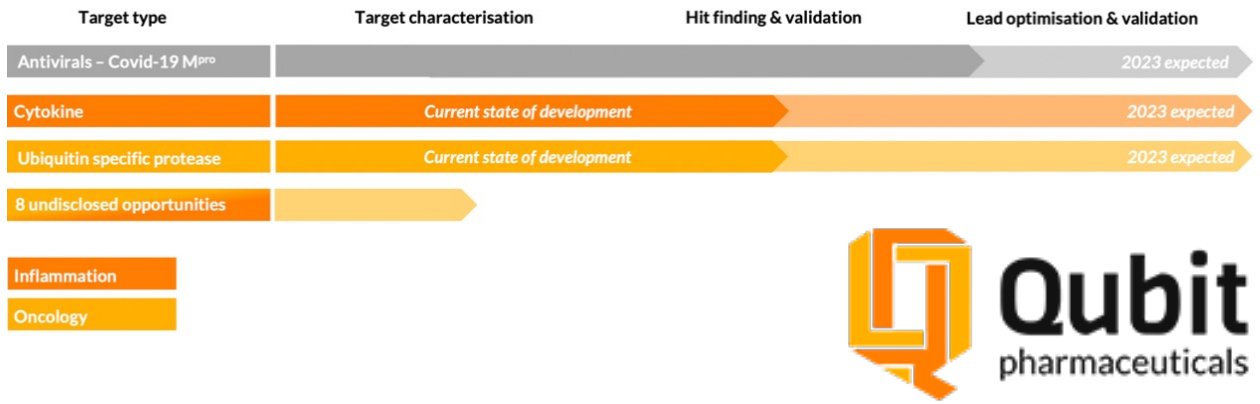
Cite this: *Chem. Sci.*, 2022, 13, 3674

All publication charges for this article have been paid for by the Royal Society of Chemistry

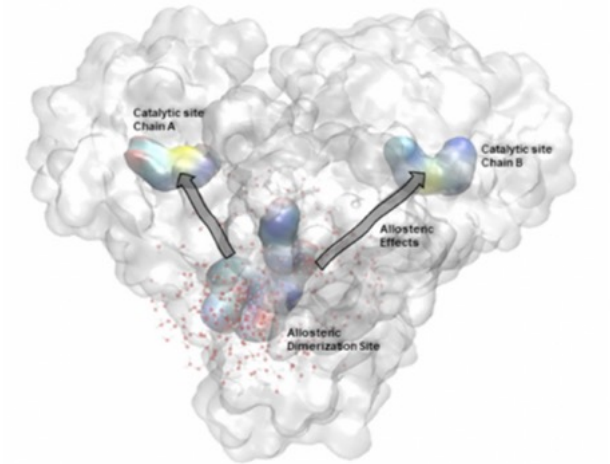
Computationally driven discovery of SARS-CoV-2 M^{pro} inhibitors: from design to experimental validation†‡

Léa El Khoury, §[a] Zhifeng Jing, §[a] Alberto Cuzzolin,[b] Alessandro Deplano,[c] Daniele Loco,[a] Boris Sattarov,[a] Florent Hédin, [a] Sebastian Wendeborn,[d] Chris Ho,[a] Dina El Ahdab, [n] Theo Jaffrelot Inizan,[n] Mattia Sturlese,[g] Alice Sosic,[e] Martina Volpiana,[e] Angela Lugato,[e] Marco Barone,[e] Barbara Gatto,[e] Maria Ludovica Macchia,[e] Massimo Bellanda,[f] Roberto Battistutta,[f] Cristiano Salata, [h] Ivan Kondratov,[i] Rustam Iminov,[i] Andrii Khairulin,[i] Yaroslav Mykhalonok,[i] Anton Pochepko,[i] Volodymyr Chashka-Ratushnyi,[i] Iaroslava Kos,[i] Stefano Moro, [g] Matthieu Montes,[j] Pengyu Ren,[k] Jay W. Ponder, [lm] Louis Lagardère,[n] Jean-Philip Piquemal [*no] and Davide Sabbadin*[a]



Target characterization

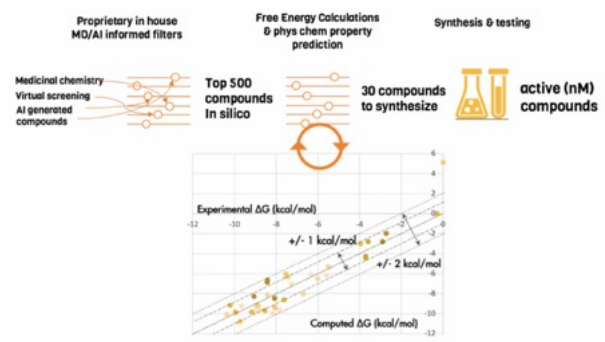
3 months



Journal of Physical Chemistry Letters, **12**, 6218-6226 (2021)

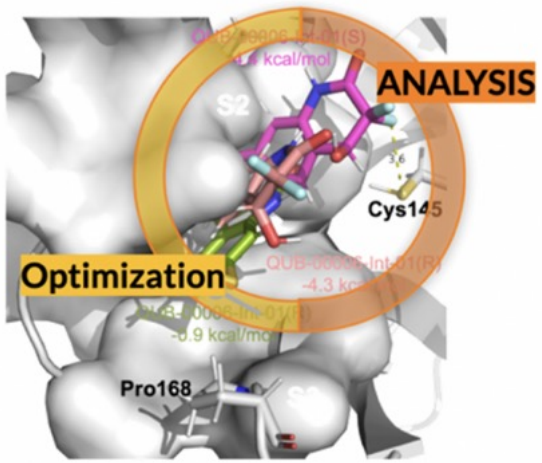
Hit screening & validation

3-6 months



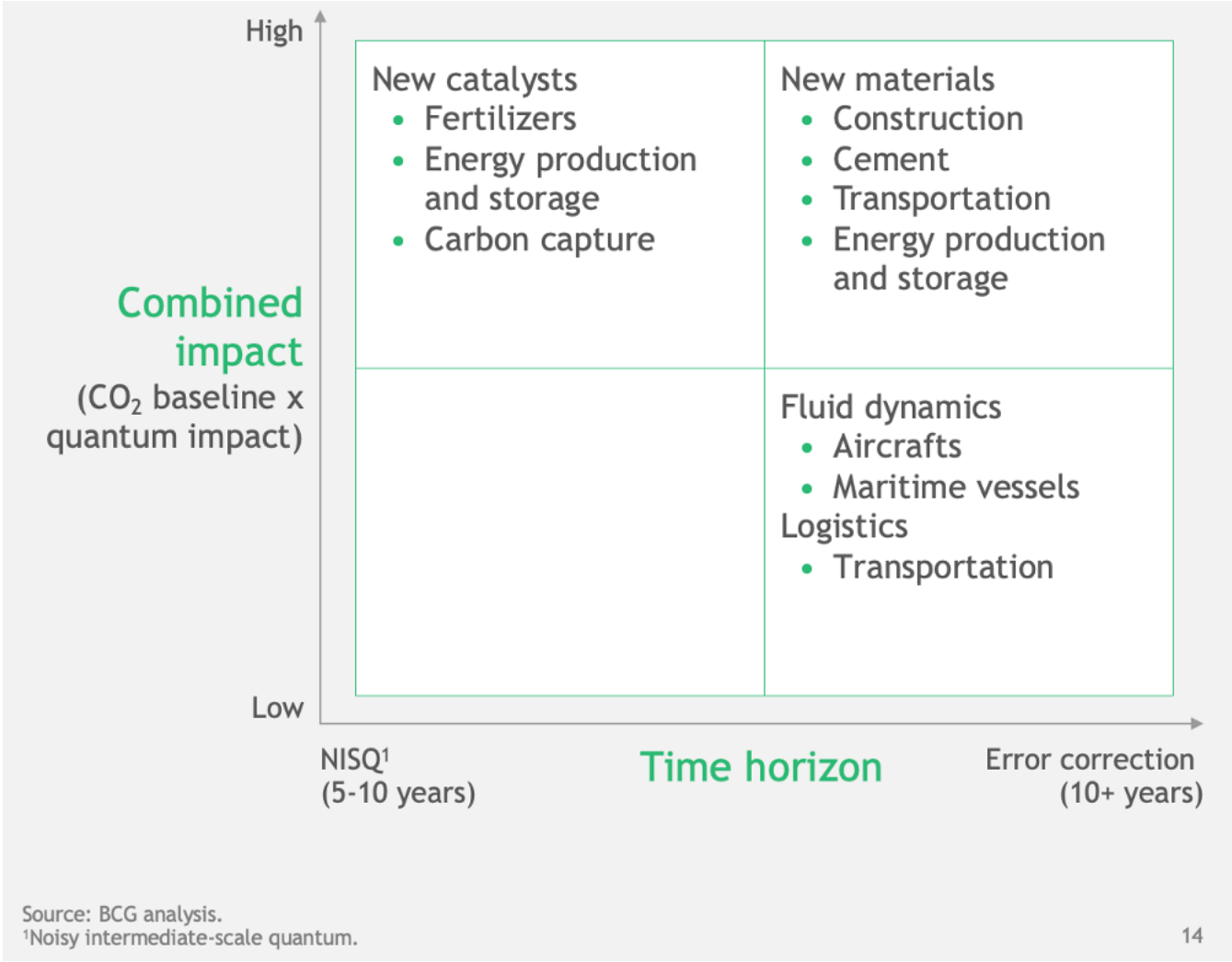
Lead optimisation

12 months



… and Sustainability

Quantum Computing use cases to fight Climate Change



Source: BCG analysis.
[1]Noisy intermediate-scale quantum.

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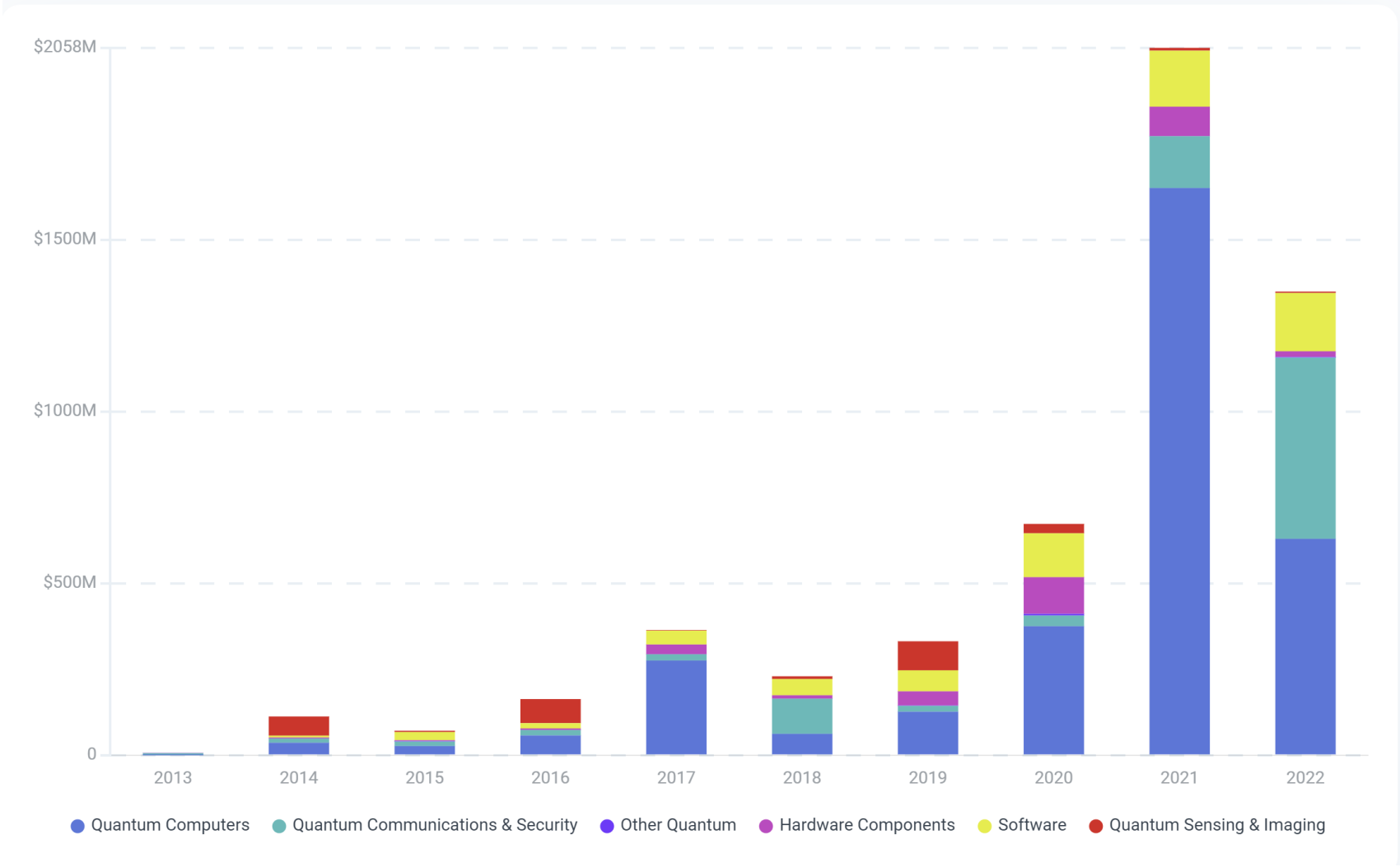
Example of QC startup ecosystem

HPC / Cloud expected to be the preferred access to Quantum Computers

Partnership	Commentary	Partners
Programming Environment (QC Framework)	Pasqal's QPUs can be programmed using major languages and frameworks	Atos, CQC Cambridge Quantum Computing Limited, Google
Cloud Access & Remote HPC	Pasqal's QPUs will be in public HPC centers offering remote access, and accessible via major commercial cloud platforms as well as its own cloud	aws, CINECA, GENCI, JÜLICH Forschungszentrum, Microsoft, TGCC
Development of Application Portfolio & Software Stack	Quantum application providers are using Pasqal's processors to serve their customers' needs	Multiverse, NVIDIA, ParityQC, Qubit pharmaceuticals, rahko, SCHRÖDINGER, SIEMENS, Unitary Fund, University of Notre Dame, universität innsbruck
End-User Pool (Public & Private) Generating IP	The end-user pool is comprised of academic research groups and industrial companies both developing direct partnerships with Pasqal for scientific discovery and commercial applications	ارامكو السعودية Saudi Aramco, BMW, CIB, EDF, Johnson & Johnson, LG, université PARIS-SACLAY

2021 and 2022 Record Years for Investment in Quantum



$1350M YTD 2022

Including $625M SPAC PIPE in 2021 and $100M in 2022 : Rigetti, IonQ, Arqit

M&A : CQC + Honeywell, Pasqal + Qu&Co, Cold Quanta + Super.tech, NKT Photonics + Hamamatsu

THE QUANTUM INSIDER

As of 06/16/2022

European leaders will need to raise significant amounts to keep up with US leaders

Leading US & Canadian QC hardware Startups

	Qubit Technology	Total funding	Creation date
IONQ	Ion traps	$432M	2015
D-Wave The Quantum Computing Company	Annealing	$296M	1999
rigetti	Superconducting	$300M	2013
PsiQuantum	Photons	$665M	2015
XANADU	Photons	$136M	2016
atom computing	Cold atoms	$81M	2018
ColdQuanta	Cold atoms	$75M	2017

Leading European & UK QC hardware Startups

	Qubit Technology	Total funding	Creation date
IQM	Superconducting	$105M	2018
PASQAL	Cold atom	$30M	2018
ALICE & BOB	Self corrected	$33M	2020
OQC	Superconducting	$45M	2017

+ Leading Corporates

Google aws QUANTINUUM intel IBM

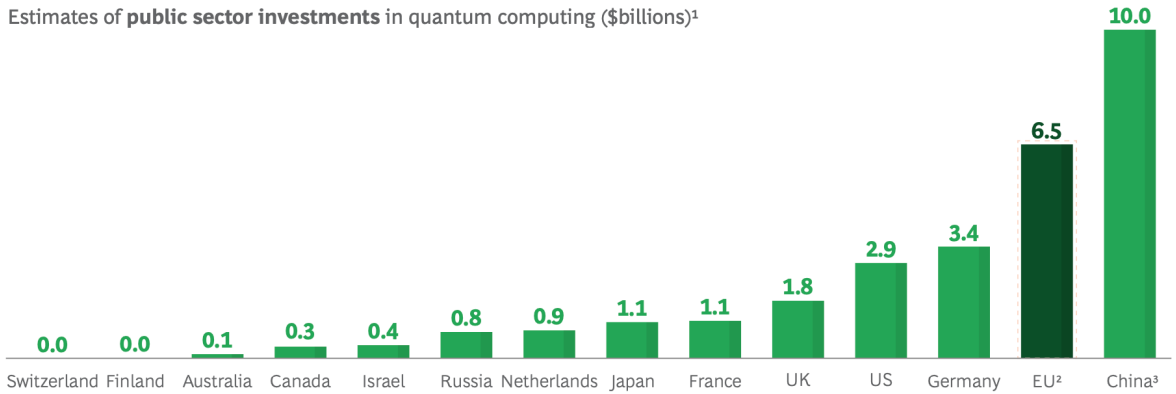
+ other QC companies that have raised 15 M€ or less (Orca Computing, Quandela, Quantum Motion, C12,…)

Europe is in the race for startups and government funding

+€10Bn invested by European Initiatives

EuroQCI · EuroHPC Joint Undertaking · QUANTUM FLAGSHIP · EIC Accelerator · EIC Pathfinder · EIC ScalingUp

Estimates of **public sector investments** in quantum computing ($billions)[1]



Sources: Literature search; BCG analysis.

[1]The data in this exhibit represents public announcements made after 2013; investments may be made for different time horizons.

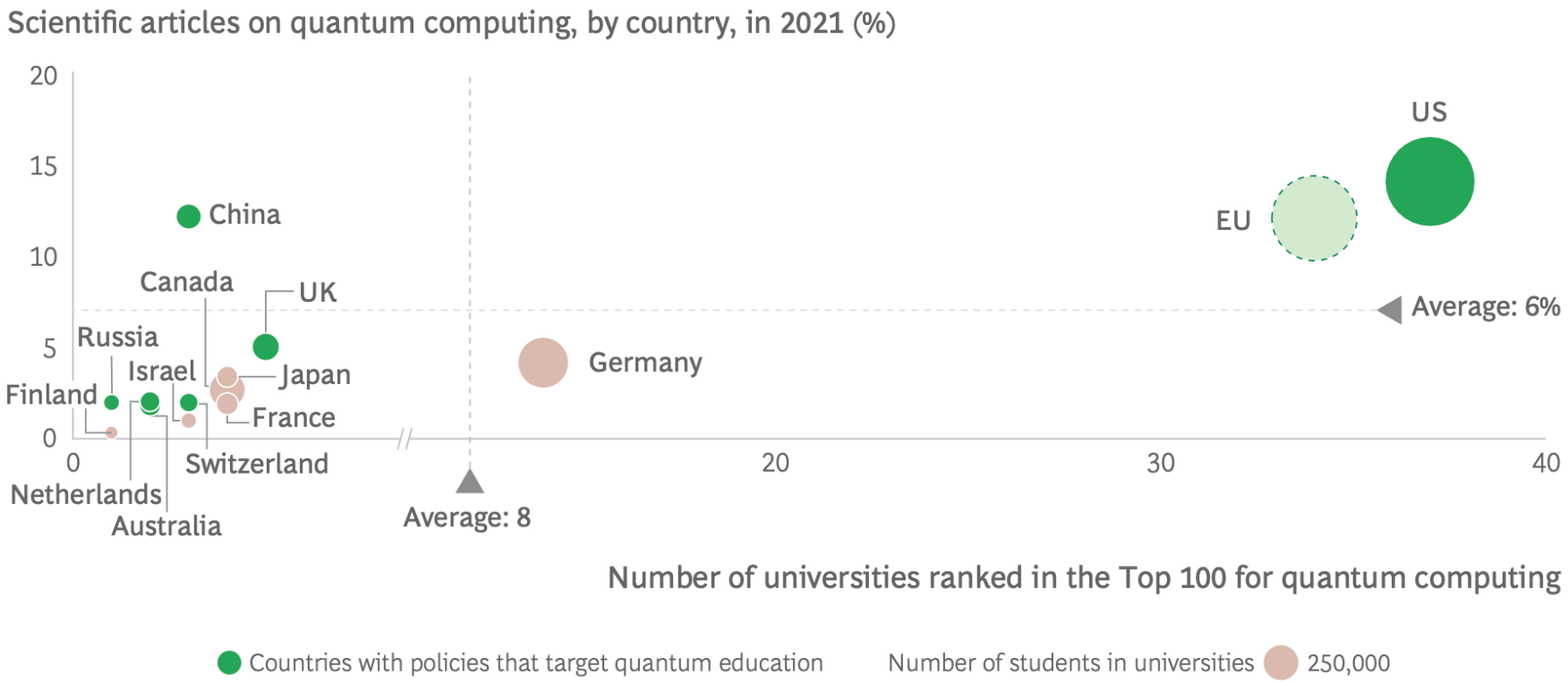
[2]Investments made centrally by the EU (~$1.1 billion) as well as those made by Germany, France, the Netherlands, and Finland.

[3]Public investment figures for China are non-official estimations based on experts and media sources.

Europe can compete with China and the US, but will need a supranational approach

€1.8Bn : Country and amount of public support for Quantum Technologies

Academic Leadership: Europe close to the US



Sources: EduRank; Web of Science; Literature search; BCG analysis.

Note: The number of articles and universities for the EU represents the sum of the individual totals for each EU country.

Challenges for European Quantum Industry

- **Well Structured Ecosystem:**
  - ✓ Strong research hubs
  - ✓ EC / QUIC
  - ✓ National plans
  - ✓ Vivid Startup ecosystem
  - ✓ Large Corporate gearing up for Quantum and collaboration with Startups (ENI, BMW, Total, Crédit Agricole, Siemens, Bosch, BASF,…)
  - ✓ Early-stage VC engaged on Quantum Tech
  - ✓ Efficient Non dilutive financing schemes (EIC, Local or regional initiatives)
  - ✓ Access to HPC Centers (GENCI, OVH, Cineca, Jülich,…)
- **But…**
  - ✓ Need to show reasonable timeline for industrial applications
  - ✓ More agility required in large infrastructure projects (communications / HPC)
  - ✓ Need to raise large financing rounds to keep the pace vs US startups