The Amsterdam Quantum Ecosystem
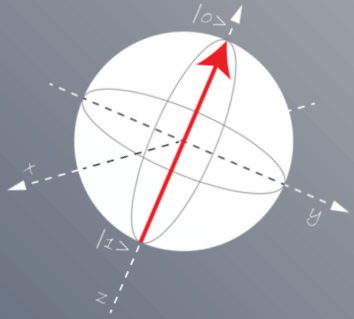
Christian Schaffner

Group leader TCS
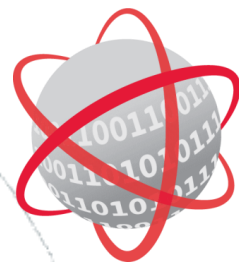Theory of Computer Science

Director

Research Center for Quantum Software

IvI All Hands meeting – 25 September 2024

Amsterdam Quantum Ecosystem

The Present of

Research Center for Quantum Software

Collaboration between University of Amsterdam and CWI, founded in 2015 by Harry Buhrman and Kareljan Schoutens

~100 People: 37 senior researchers, 13 PDs, 37 PhDs, 9 support staff, 56% non-Dutch

IvI: Christian Schaffner, Florian Speelman, John van de Wetering
ILLC: Harry Buhrman, Maris Ozols
IoP: Philippe Bouyer, Philippe Corboz, Arghavan Safavi, Florian Schreck, Kareljan Schoutens
KdVI: Krystal Guo, Ludovico Lami, Michael Walter, Jeroen Zuiddam
HIMS: Wybren Jan Buma
CWI: Jop Briët, Stacey Jeffery, Jonas Helsen, Ronald de Wolf

Selected highlights 2022-2024

- Number of QuSoft-affiliated accepted articles at annual flagship workshop Quantum Information Processing (QIP): 12 (of 114) in 2023, 10 (of 112) in 2024.

- 3-4 PhD graduates per year

- Personal grants: ERCs, VENI, VIDI

- STOC 10-year test of time reward for Ronald de Wolf, June 2022
- Gödel Prize for Ronald de Wolf, May 2023

- QuSoft Turing Chair: Prof Gilles Brassard 2022, Prof Matthias Christandl 2024
- 2023 Breakthrough Prize in Fundamental Physics, Gilles Brassard

- Launch of European Quantum Software Institute (EQSI), Nov 2022

- Yearly QuSoft scientific retreats since 2022, with international guests Gilles Brassard, Robert König, Mario Szegedy
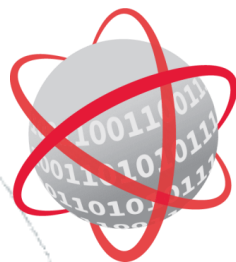
Collaborations with industry

ABN·AMRO

Atos

BOSCH

Quantum Gateway Foundation

QuiX QUANTUM

TOYOTA EUROPE

fermioniq

12 April 2023:
UvA Quantum Lab visit by French President Macron and the Dutch King

Amsterdam Quantum Ecosystem

Core activities

Bring the ecosystem together

Education and Inspiration

R&D Collaborations

Outreach

Workshops

Set up PhD/PD projects

Networking events

Q.A Experience

Liaison to QuantumDelta NL

Bring companies to Amsterdam

Q Talent & Learning Center

Quantum Application Lab

Founded 2022, joint initiative of:

Current focus on:

how can current quantum computer help companies?

With industry partners:

European Quantum Software Institute

Launched in 2022, EQSI unites these 6 leading research institutions:

- **Centre for the Mathematics of Quantum Theory** in Copenhagen, DK (Matthias Christandl)

- **Quantum Information Theory at TU Munich**, Germany (Robert König)

- **Paris Centre for Quantum Technologies** (Iordanis Kerenidis)

- **QuSoft**

- **Portuguese Quantum Institute,** Lisbon (Yasser Omar)

- **Center for Quantum Computing Science** in Riga, Latvia (Andris Ambainis)

- initiative for quantum software research, education and outreach in Europe

- collaboration with providers of quantum computing infrastructure and industry partners interested in developing quantum algorithms.

Education

Quantum education efforts on all levels, such as:

- UvA courses on BSc and MSc level
- Quantum Quest (Maris, Michael, Koen, Doutzen)
- Professional's Guide to Quantum Technology (by Koen Groenland)
- HvA: Quantum Talent & Learning Center

Quantum Education Matrix

Audience ↓	Basic introduction	Technical 🌶	Technical 🌶🌶	Technical 🌶🌶🌶	Programming	Business Impact
Bright high-school students	Q.A Experience	[AUAS + LEI] Quantum Experiment Havo	[UvA] Masterclass	Quantum Quest		
University: Bachelor		[AUAS] Summer school (2023)	[AUAS] Minor Applied QC / [AUAS] Theme Semester Quantum enabling tech.	[AUAS] Internship program	[AUAS] Introduction into Quantum Computing (Coming Q2 2024)	
University: Master	National Quantum Course (coming 14.4-2024)		[UvA] Recommended courses [BSc + MSc] / [UvA] Master Quantum Computer Science (2024) / [NL+FR+DU] Quantum Summer School (2024) / [AUAS+THUAS+Saxion+Fontys] Professional Master AQT (2025)			[UvA] Quantum in Business and Society
Current Workforce		Intoduction into Quantum Computing (ABS)	In-house workshops		Programming workshops ↓	Workshop General Awareness Quantum Computing ↓ / Masterclass Intro to Quantum Technology ↓
Anyone (general outreach)			Quantum talks			Professional's Guide to Quantum Technology

UNIVERSITEIT VAN AMSTERDAM
Faculteit der Natuurwetenschappen,
Wiskunde en Informatica
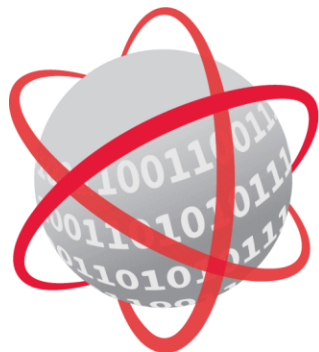
New MSc in QUANTUM COMPUTER SCIENCE

John van de Wetering
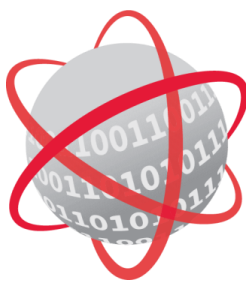Program director

Lisa van Pappelendam

Dewi Lepelaar
Program Coordinator

Daan Schoneveld
Junior teacher

UvA Master

QUANTUM COMPUTER SCIENCE
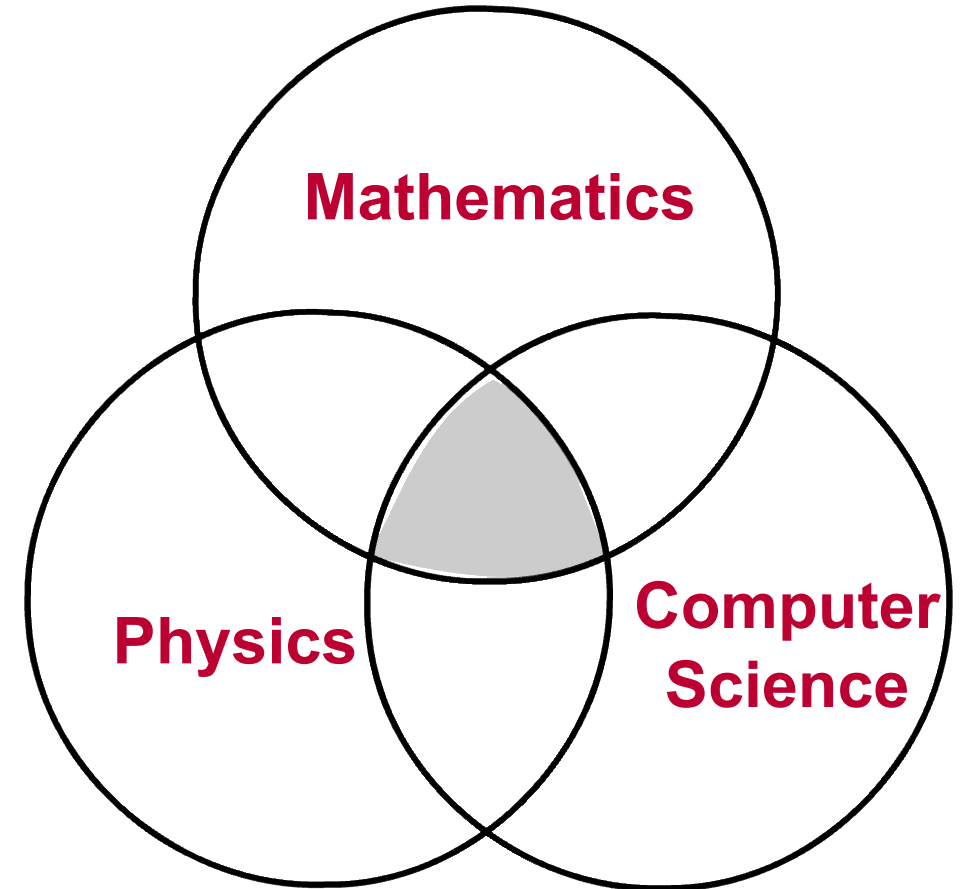
Research-based programme

- Strongly connected to **active research** in QuSoft, all lecturers are QuSoft members!
- Much of industry is research based as well

Interdisciplinary

Focus on Theoretical Aspects

- **Not** an engineering programme
- Focus on theoretical physics, mathematics, algorithms and programming
- Internships at companies

Industrial Advisory Board

Mathematics
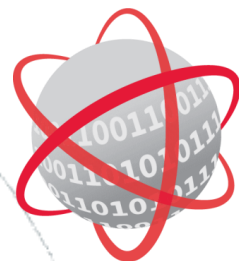
Physics

Computer Science

2028: LabQ building

2028: LabQ & Amsterdam Science Park

- Quantum Research, Education and Valorisation under one roof in LabQ
- Co-hosting HPC and quantum computing infrastructure
- EU Quantum Excellence center

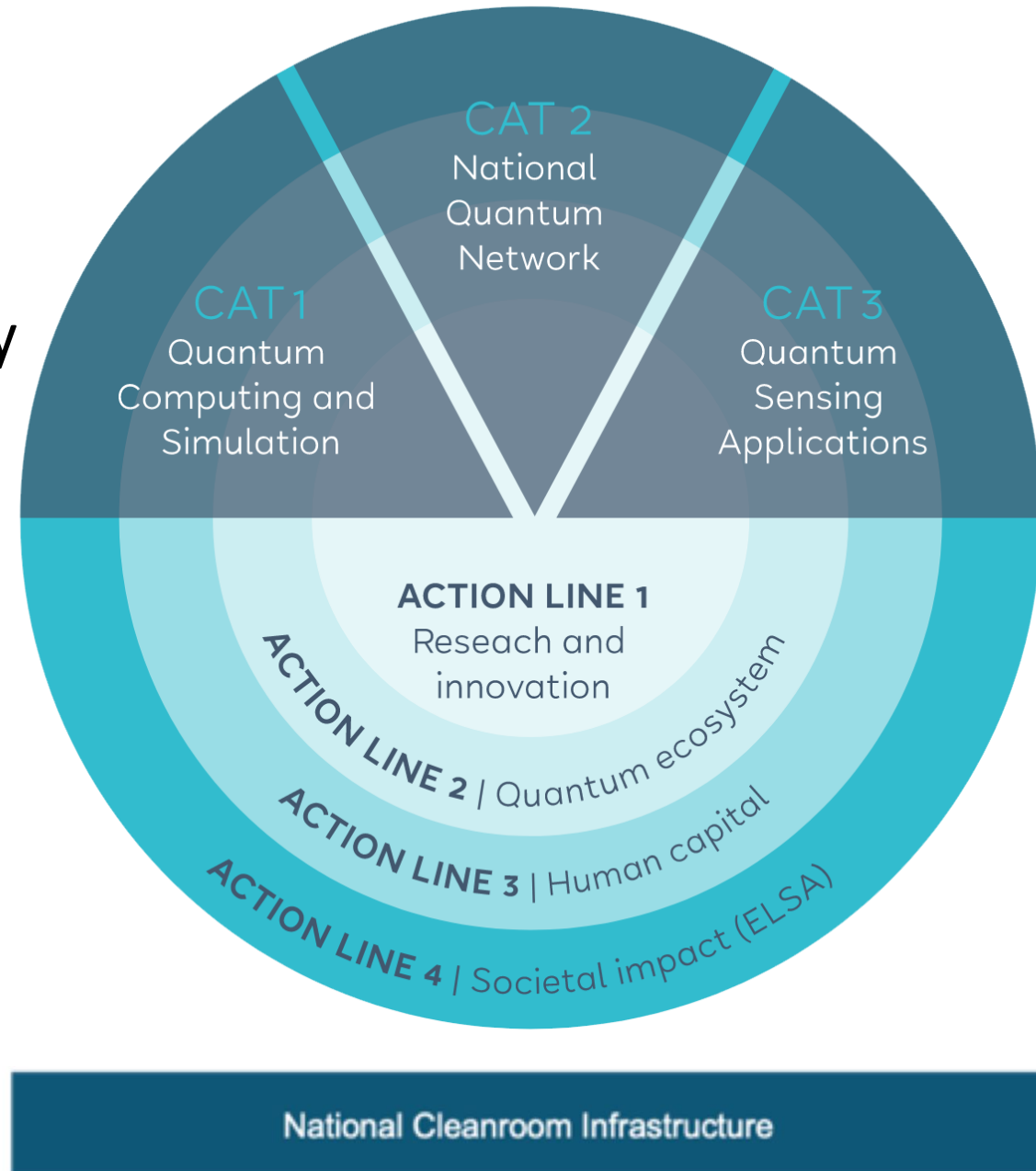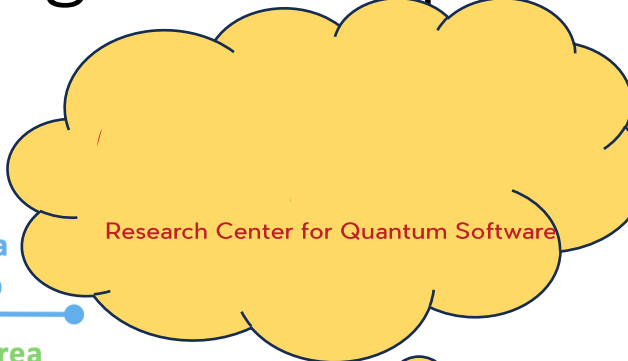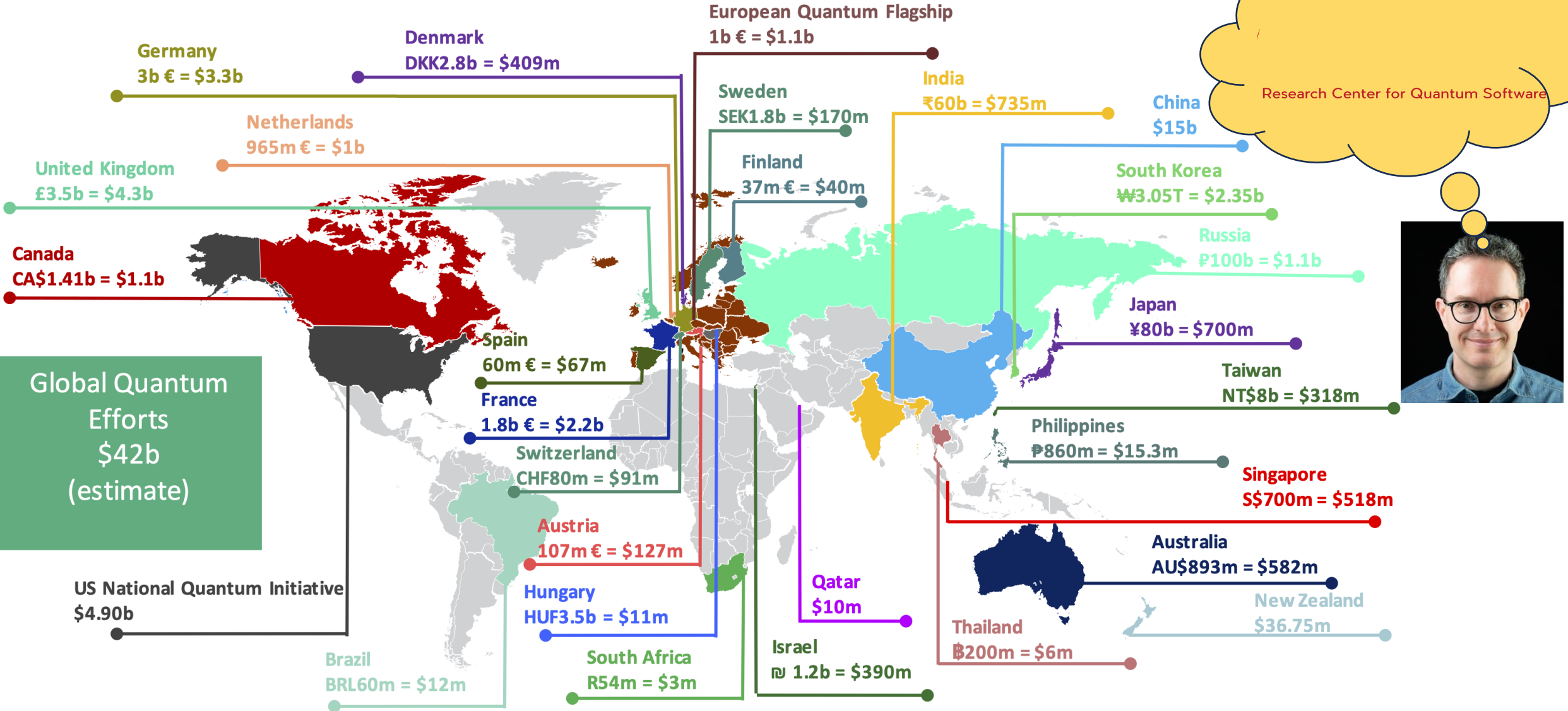# Amsterdam Quantum Ecosystem

Quantum Delta NL

- Organization to manage the 615M€ growth fund investment by Dutch ministry of economic affairs

- Amsterdam is one of the 5 national hubs

- Involved in all CATs and ALs

- Currently half way:
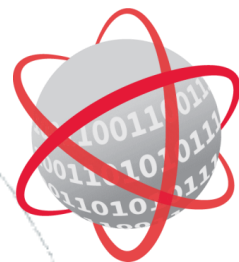 starting phase 3, lasting until 2028

Quantum Software Research in a Complex Funding Landscape

Research Center for Quantum Software

European Quantum Flagship
1b € = $1.1b

Germany
3b € = $3.3b

Denmark
DKK2.8b = $409m

India
₹60b = $735m

China
$15b

Netherlands
965m € = $1b

Sweden
SEK1.8b = $170m

South Korea
₩3.05T = $2.35b

United Kingdom
£3.5b = $4.3b

Finland
37m € = $40m

Russia
₽100b = $1.1b

Canada
CA$1.41b = $1.1b

Japan
¥80b = $700m

Spain
60m € = $67m

Taiwan
NT$8b = $318m

France
1.8b € = $2.2b

Philippines
₱860m = $15.3m

Switzerland
CHF80m = $91m

Singapore
S$700m = $518m

Global Quantum Efforts $42b (estimate)

Austria
107m € = $127m

Australia
AU$893m = $582m

US National Quantum Initiative
$4.90b

Hungary
HUF3.5b = $11m

Qatar
$10m

New Zealand
$36.75m

Brazil
BRL60m = $12m

South Africa
R54m = $3m

Israel
₪ 1.2b = $390m

Thailand
฿200m = $6m

https://www.qureca.com/quantum-initiatives-worldwide/

Amsterdam Quantum Ecosystem

Research Center for Quantum Software