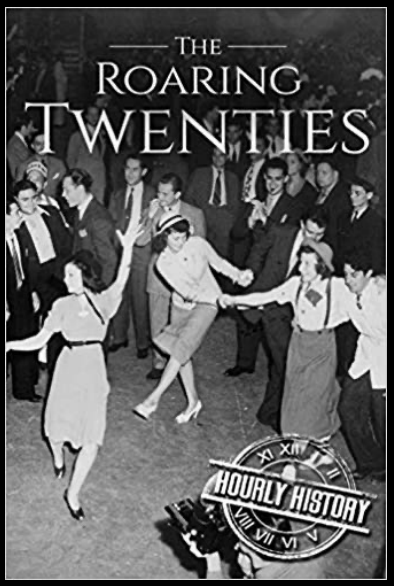
ICT to support Science & Society in the Roaring Twenties

Cees de Laat

Systems and Networking Laboratory
Complex Cyber Infrastrure group
University of Amsterdam

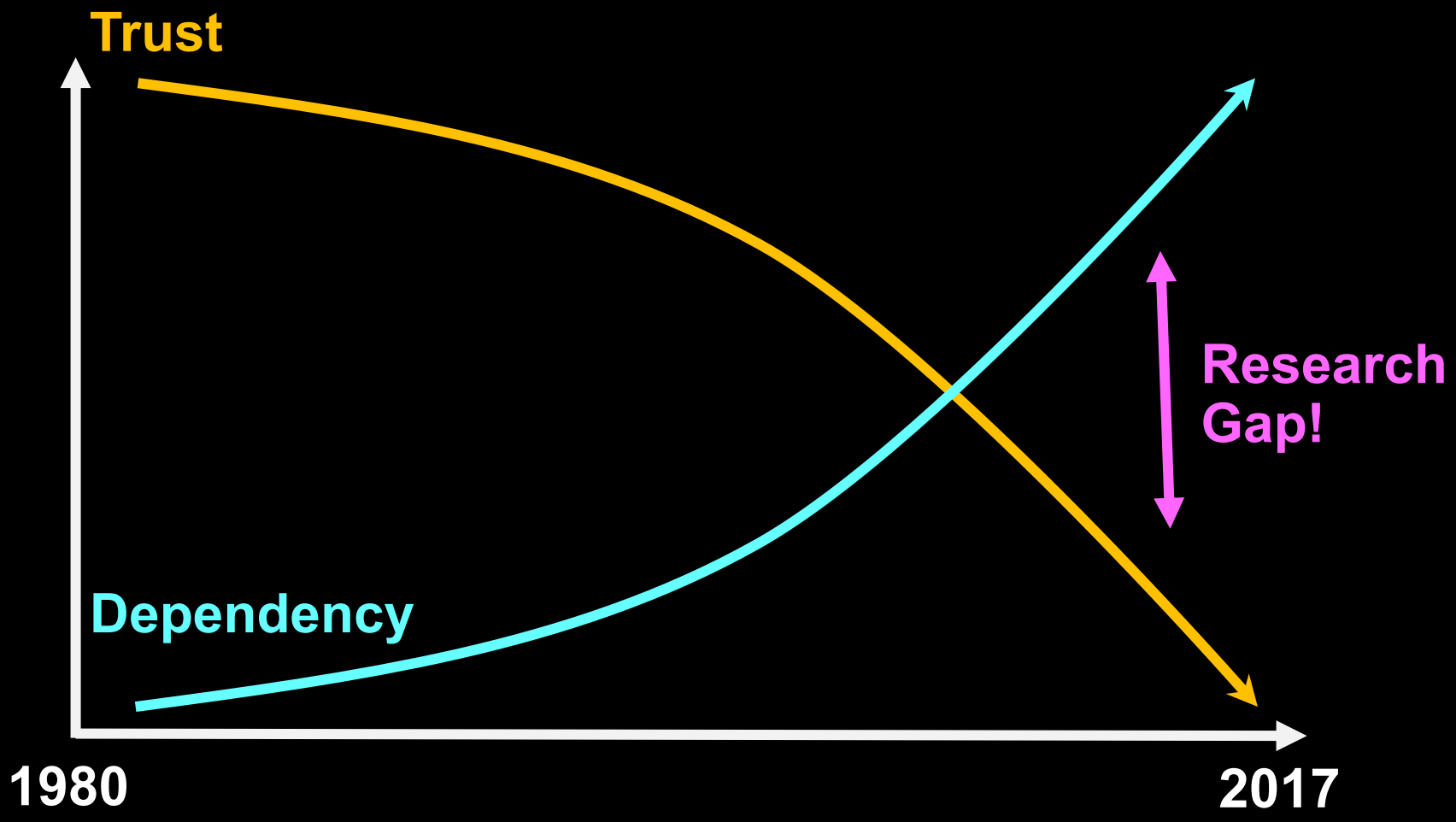
ICT to support the transformation of Science in the Roaring Twenties



From Wikipedia: The Roaring Twenties refers to the decade of the 1920s in Western society and Western culture. It was a period of economic prosperity with a distinctive cultural edge in the United States and Western Europe, particularly in major cities such as Berlin, Chicago, London, Los Angeles, New York City, Paris, and Sydney. In France, the decade was known as the "années folles" ('crazy years'), emphasizing the era's social, artistic and cultural dynamism. Jazz blossomed, the flapper redefined the modern look for British and American women, and Art Deco peaked….

This period saw the large-scale development and use of automobiles, telephones, movies, radio, and electrical appliances being installed in the lives of thousands of Westerners. Aviation soon became a business. Nations saw rapid industrial and economic growth, accelerated consumer demand, and introduced significantly new changes in lifestyle and culture. The media focused on celebrities, especially sports heroes and movie stars, as cities rooted for their home teams and filled the new palatial cinemas and gigantic sports stadiums. In most major democratic states, women won the right to vote. The right to vote made a huge impact on society.

Fading Trust in Internet

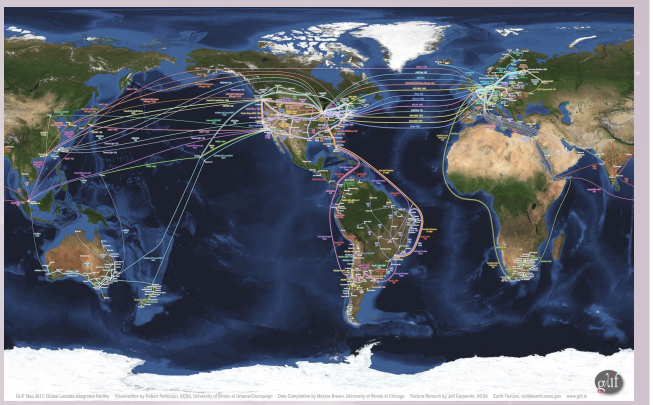


Mission

- The Systems and Networking Lab conducts research on leading-edge computer systems of all scales, ranging from global-scale systems and networks to embedded devices.

- Across these multiple scales our particular interest is on extra-functional properties of systems, such as performance, programmability, productivity, security, trust, sustainability and, last but not least, the societal impact of emerging systems-related technologies.

Broad spectrum of research



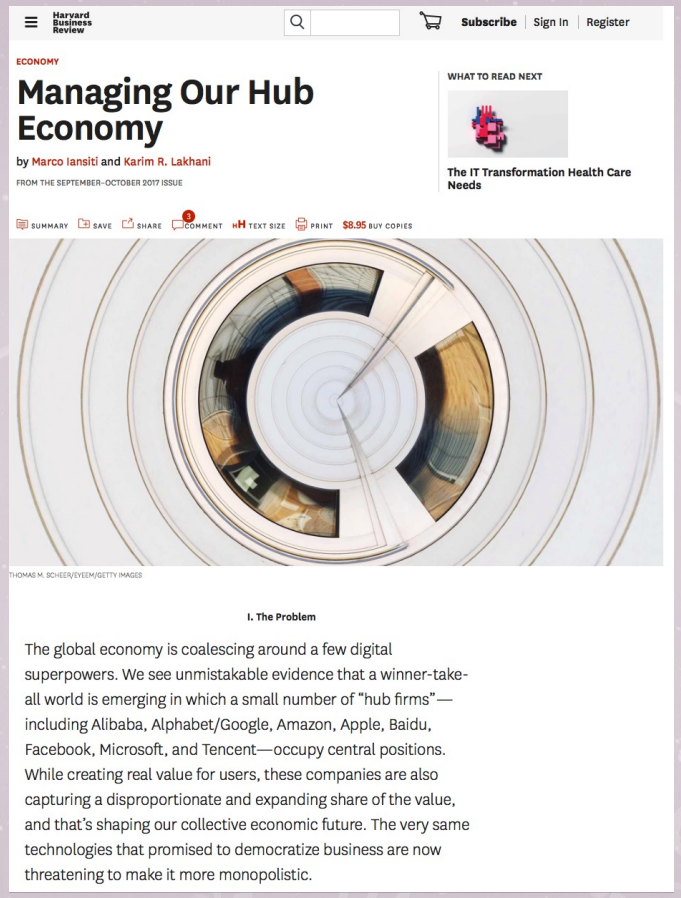
- Advanced networks / Internet architecture
- Network programmabillity / Overlays / Virtualisation
- Authorisation of Internet resources
- Quality of service for apps on Clouds
- Systems: Embedded / real time / parallel / design
- Performance & Compilers & ExaScale
- Safe Secure Data Sharing / Processing
- Data Sovereignty & Normative Agents & Trust ➔ AmDEX

- **Well funded accross the theme ➔ ~ 8,5 Meuro in last 3 years, mostly from NWO / EU and smaller portion from SURF and Industry**

Data Hub Firms

- Leading to monopolies
- **Open Data Markets**
- **➔ AmDEX**

Harvard Business Review



Harvard Business Review

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ECONOMY

Managing Our Hub Economy

by Marco Iansiti and Karim R. Lakhani

FROM THE SEPTEMBER–OCTOBER 2017 ISSUE

WHAT TO READ NEXT

The IT Transformation Health Care Needs

SUMMARY SAVE SHARE COMMENT TEXT SIZE PRINT $8.95 BUY COPIES

THOMAS M. SCHEER/EYEEM/GETTY IMAGES

I. The Problem

The global economy is coalescing around a few digital superpowers. We see unmistakable evidence that a winner-take-all world is emerging in which a small number of "hub firms"—including Alibaba, Alphabet/Google, Amazon, Apple, Baidu, Facebook, Microsoft, and Tencent—occupy central positions. While creating real value for users, these companies are also capturing a disproportionate and expanding share of the value, and that's shaping our collective economic future. The very same technologies that promised to democratize business are now threatening to make it more monopolistic.

https://hbr.org/2017/09/managing-our-hub-economy

Data value creation monopolies

➔

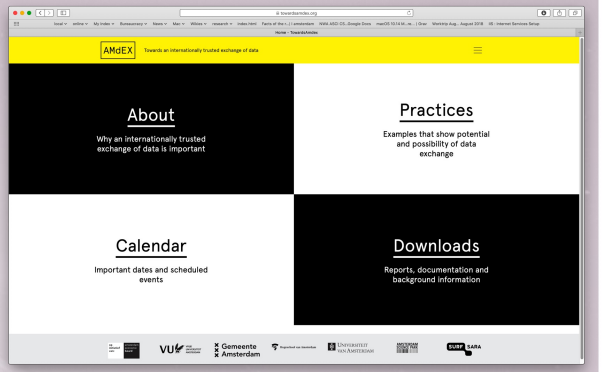
Create an equal playing field

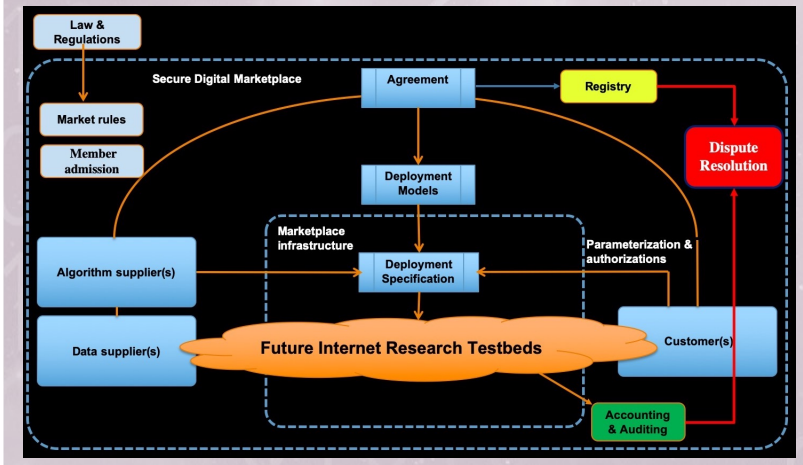
➔

Sound Market principles

AMdEX.eu

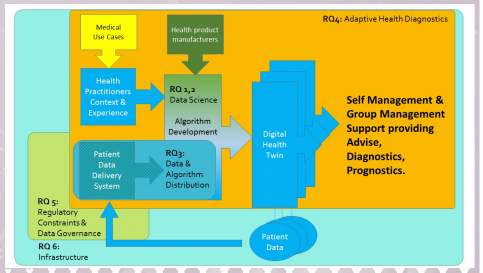
- Competing organisations, share data for common benefit
- Trust, Risk, data ownership & control
  - Industry: AF-KLM, Health, etc
  - Science: European Open Science Cloud
  - Society: Amsterdam Economic Board





Aircraft Maintenance AF-KLM

Health: Enabling Personal Interventions



Position

- Nationally
  - ASCI research School
  - Close cooperation with VU, eScience center, SURF, TU-Delft, TNO-ICT
  - KPMG, KLM, ASML, TNO-ESI, THALES, PHILIPS
- Internationally
  - Lawrence Berkeley National Lab, Dept of Energy, NSF, UC San Diego
  - SuperComputing / SCinet
  - Internet2, GEANT
  - Environmental e-Infrastructures, LifeWatch
  - Frauenhofer, IDSA
  - Equinix, CIENA

Future

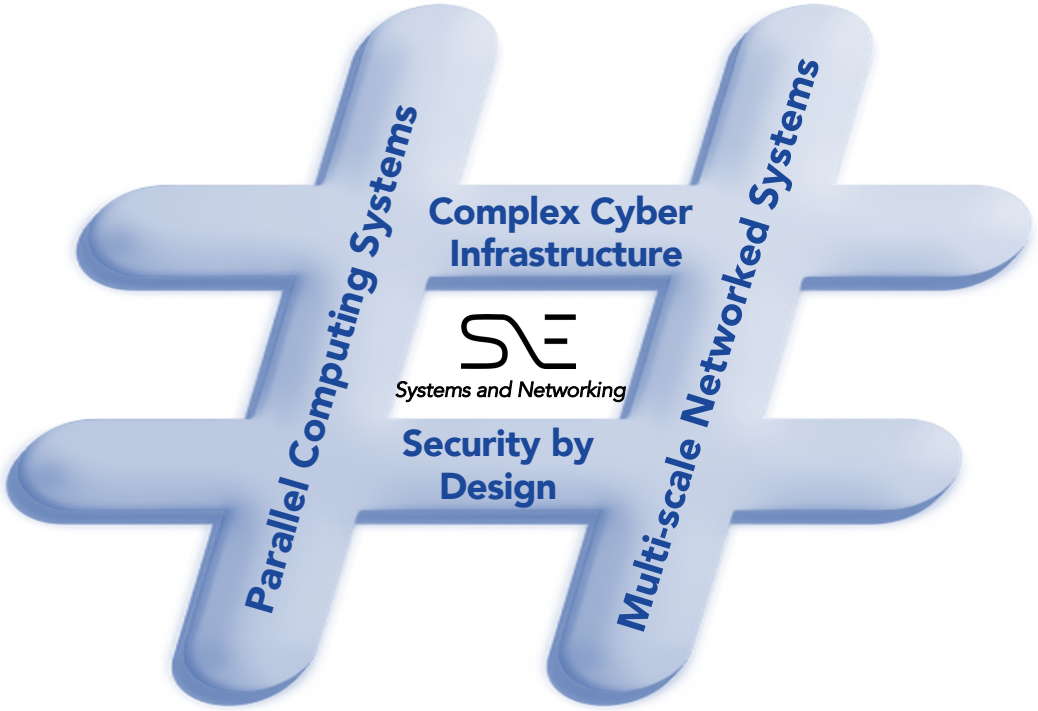
- Split the “old” group
- Add security by design
- Quantum node in national network
- Ethics
- Open Science

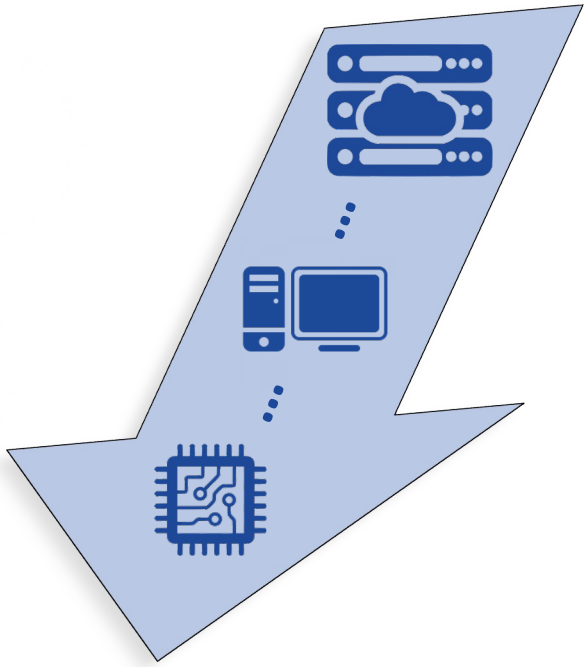
The constant factor in our field is CHANGE!

The fate of SNE

- System and Networking group
  - ~70 persons, ~45 fte in 2019
  - Stepped down and suggested split the original group
  - Multiscale Networked Systems (MNS)
    - Prof.dr. Paola Grosso
    - https://mns-research.nl/
  - Complex Cyber Infrastructure (CCI)
    - Dr. Zoltan Mann
    - https://cci-research.nl/
  - Parallel Computing Systems (PCS)
    - Prof.dr. Andy Pimentel
    - https://pcs-research.nl/

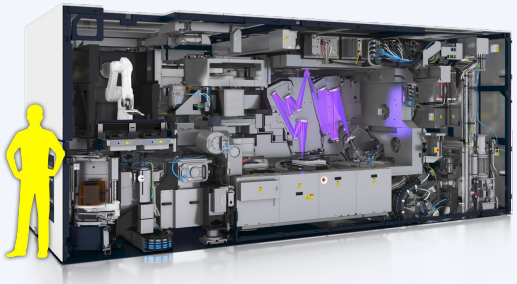
Now over 100 persons, well funded with projects and strong education programs.





- We conduct research on leading-edge computer systems of all scales, ranging from global-scale systems and networks to embedded and on-chip devices
- Our particular interest is on the extra-functional properties of these systems, such as performance, programmability, productivity, security, trust, sustainability and, last but not least, the societal impact of emerging systems-related technologies

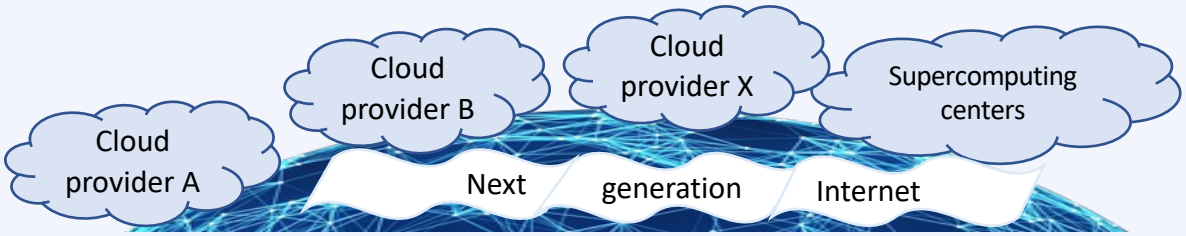
Systems and Networking research with great impact



Analysis and Optimization of Cyber-Physical Systems

In collaboration with:

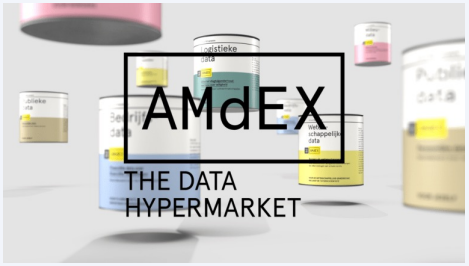
ASML ESI THALES



Programmability, automaticity and performance of Multiscale Networked Systems

In collaboration with:

netherlands eScience center | QuSoft Research Center for Quantum Software | SURF



In collaboration with:

KPMG PHILIPS TNO ciena AIR FRANCE KLM EQUINIX

Security by Design: Amsterdam Cyber Security Center

In collaboration with:

VU VRIJE UNIVERSITEIT AMSTERDAM | CWI Centrum Wiskunde & Informatica

Challenges ahead

- Knowledge safety (“kennisveiligheid”)
- Security – the attacks on our CI
- Cyber Infrastructure is not resilient wrt geopolitical changes
- The transformation of Science in the digital age
- Reinventing Libraries
- The (in)dependence on big tech, plan a-b, exit strategies, etc.
- Sovereignty: Be yourself in a digital world!

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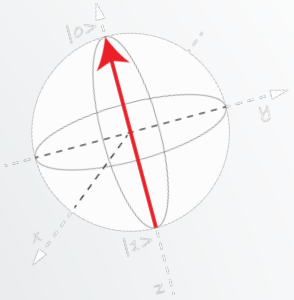
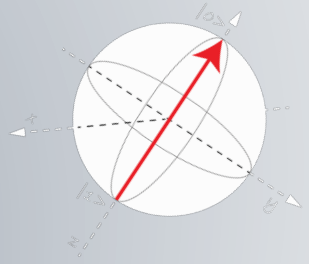
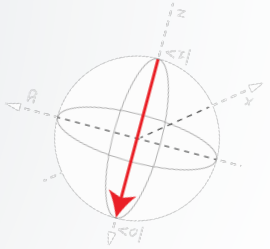
Research Center for Quantum Software







Christian Schaffner

Director

QuSoft

Research Center for Quantum Software

Collaboration between University of Amsterdam and CWI, founded 8 years ago

5 Research Lines: Q Simulations; Q Information Science; Cryptography in a Q world; Q Algorithms & Complexity; Q for Society and Business

74 People: 32 senior researchers, 13 PDs, 24 PhDs, 5 support staff, 50% internationals

Top scientific contributions: e.g. to Quantum Information Processing (QIP) workshop, conferences, journals, personal grants etc.

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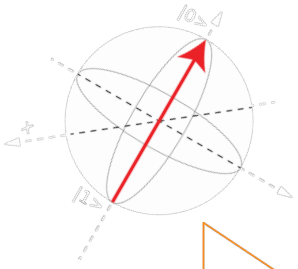
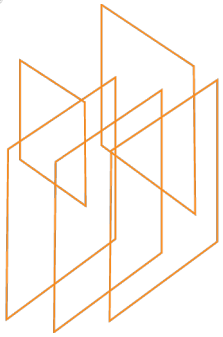
Research Center for Quantum Software

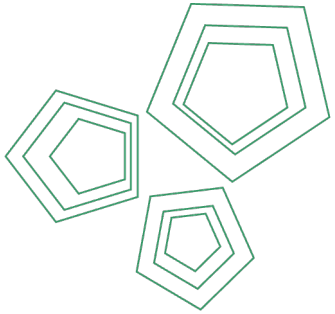
Research Lines

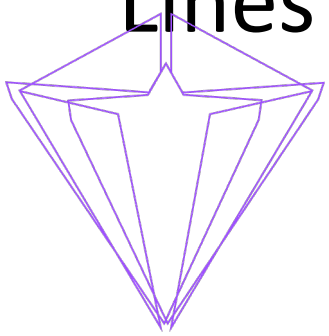


- Quantum Simulation and Few-Qubit Applications
- Physics behind near-term quantum devices

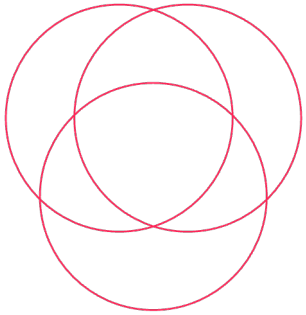


- Quantum Information Science
- Exploring the mathematical foundations

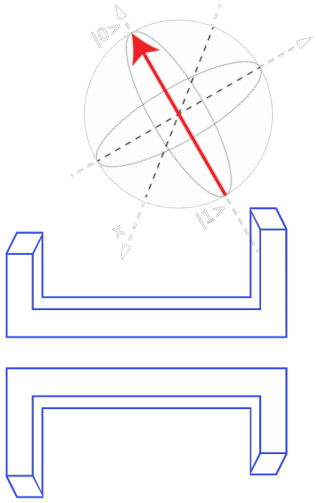




- Cryptography in a Quantum World
- Post-quantum security
- Quantum internet

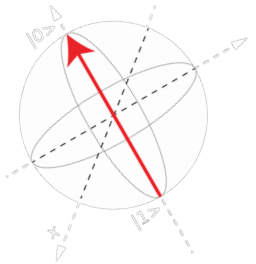


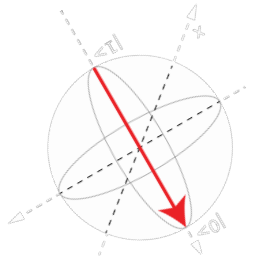
- Quantum Algorithms and Complexity
- Designing for quantum speed-ups
- What are the limits?



- Quantum for Society and Business
- Connections with business
- Societal impact

Population





UNIVERSITEIT VAN AMSTERDAM

CWI

Centrum Wiskunde & Informatica

25%

75%

QUIX QUANTUM

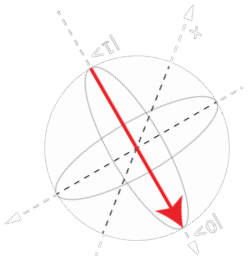
TNO

VU

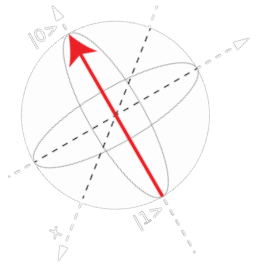
5%

QuSoft

Research Center for Quantum Software



People involved: 74



Senior researchers: 32

Postdoctoral researchers: 13

PhD researchers: 24

Support staff: 5

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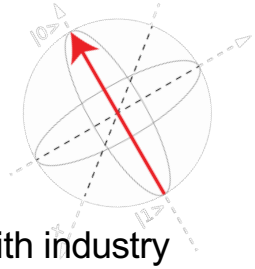
Research Center for Quantum Software

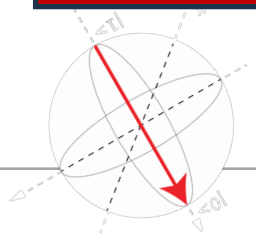
Vibrant and dynamic organization



Very international community

International origin: 49%

Dutch origin: 51%



PhD graduates:
3-4 graduates per year

Collaborations with industry

ABN·AMRO

Atos

BOSCH

Quantum Gateway Foundation

QUIX QUANTUM

TOYOTA EUROPE

QuSoft
Research Center for Quantum Software

Selected Highlights 2022 / 2023

- ERC Starting Grant Stacey Jeffery, January 2023

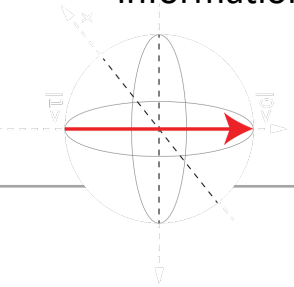
- First QuSoft Retreat, June 7-9 2022 [with guests Gilles Brassard and Robert König]
- Second QuSoft retreat 2023

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

- Prof Gilles Brassard visiting professor on Turing Chair: June 2022 – December 2022
- 2023 Breakthrough Prize in Fundamental Physics, Gilles Brassard

- Launch of European Quantum Software Institute (EQSI), Paris, Nov 8 2022

- Number of QuSoft-affiliated accepted articles at annual flagship workshop Quantum Information Processing (QIP): 12 in 2022, 10 in 2023.



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Entangled ecosystem

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Research Center for Quantum Software

- Core activities

Quantum.Amsterdam

Bring the ecosystem together

Outreach

Networking events

Acquire companies @ ASP

Education and Inspiration

Workshops

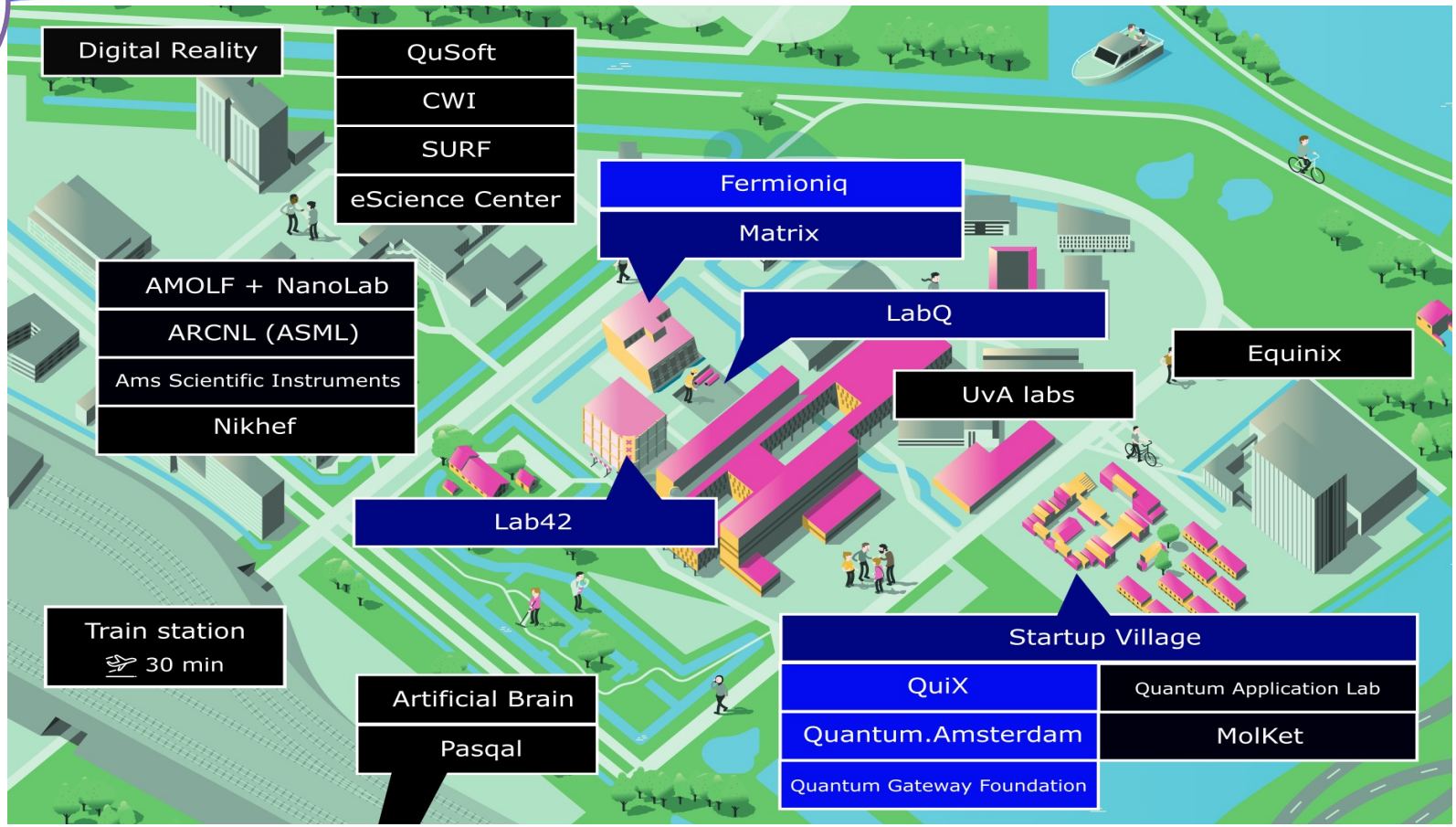
Q.A Experience

Talent & Learning Center

R&D Collaborations

Set up PhD/PD projects

Liaison to Growth Fund


Digital Reality
QuSoft
CWI
SURF
eScience Center
Fermioniq
Matrix
AMOLF + NanoLab
ARCNL (ASML)
Ams Scientific Instruments
Nikhef
LabQ
Equinix
UvA labs
Lab42
Train station
30 min
Artificial Brain
Pasqal
Startup Village
QuiX
Quantum Application Lab
Quantum.Amsterdam
MolKet
Quantum Gateway Foundation

Quantum Education Matrix

QuSoft Research Center for Quantum Software

Quantum.Amsterdam

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

Universiteit van Amsterdam
Faculteit der Natuurwetenschappen,
Wiskunde en Informatica

MSc in Quantum Computer Science (QuCS)


John van de Wetering
Lisa van Pappelenda

Quantum Computer Science

•About the programme

QUANTUM COMPUTER SCIENCE

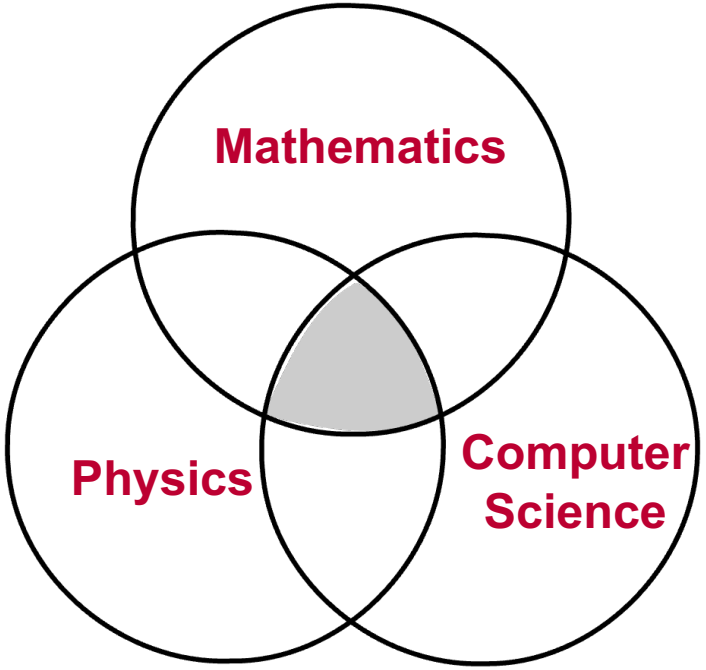
Research-based programme

- Very strong connection with **active research** in QuSoft
  - All lecturers are QuSoft members!
- Much of industry is research based as well

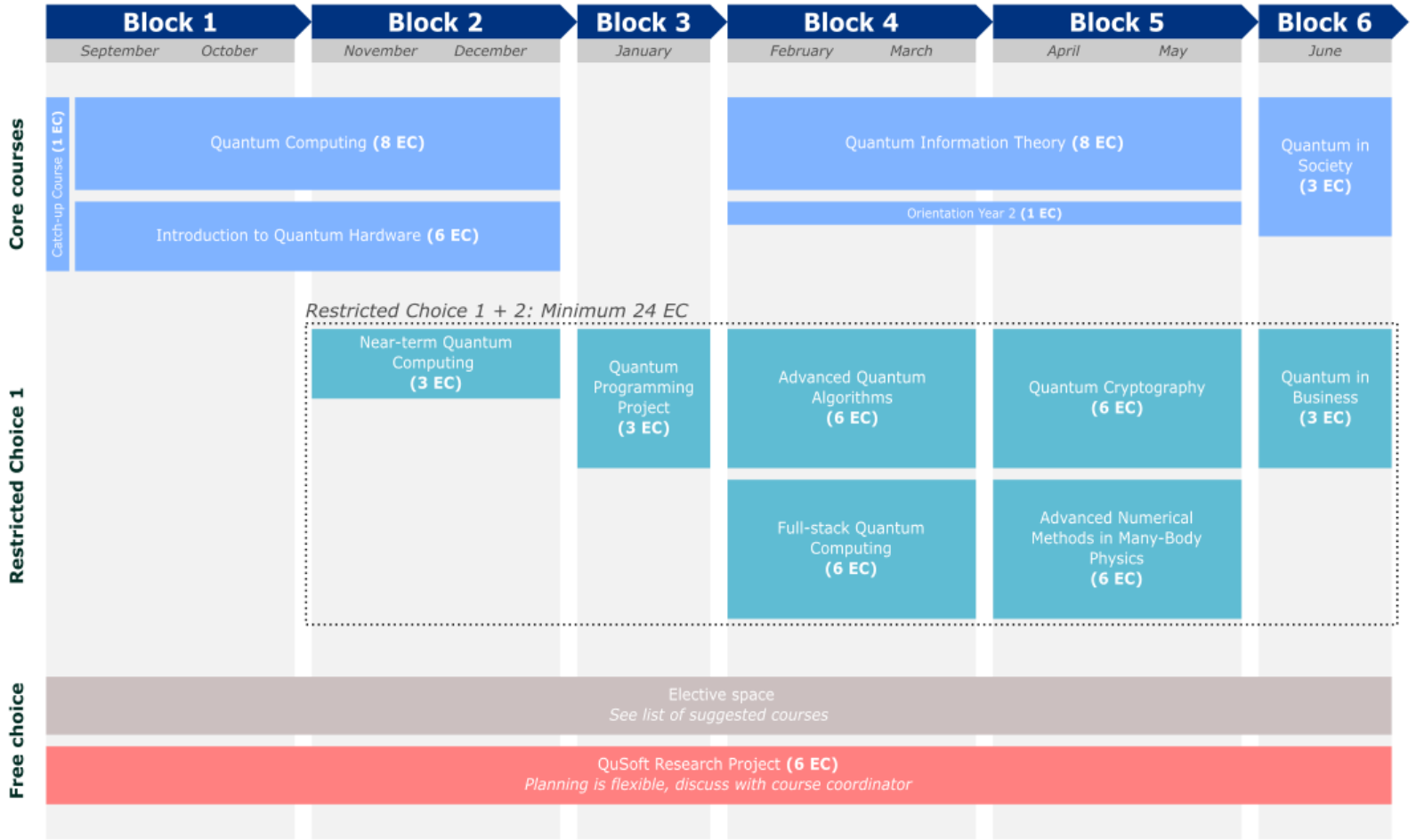
Focus on Theoretical Aspects

- **Not** an engineering programme!
- No practical lab sessions
- Focus on theoretical physics, mathematics, algorithms and programming

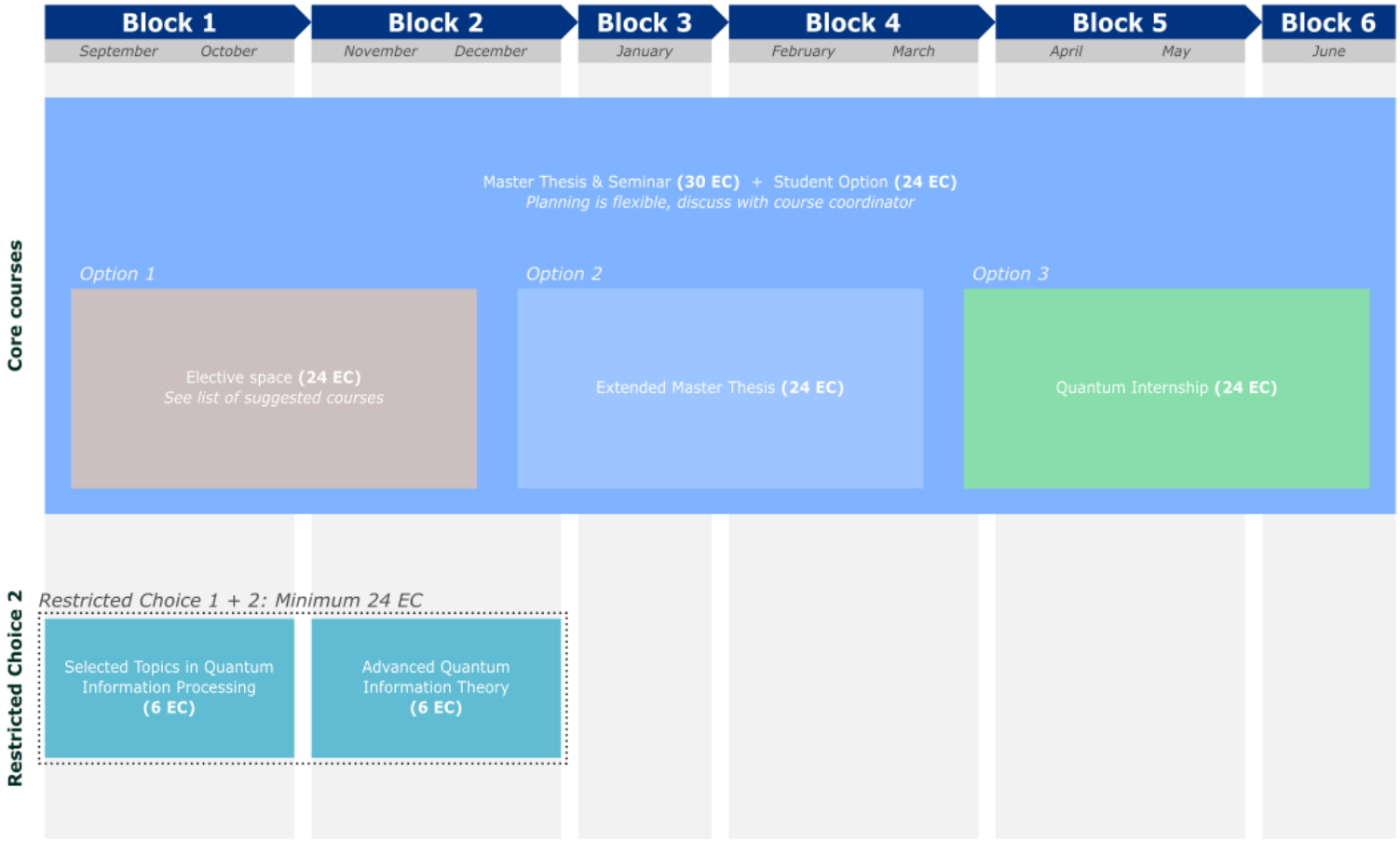
Interdisciplinary



First year – Curriculum



Second year – Curriculum



Quantum Delta NL

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Quantum Computer Science