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European Quantum Technology FET Flagship

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QUANTUM

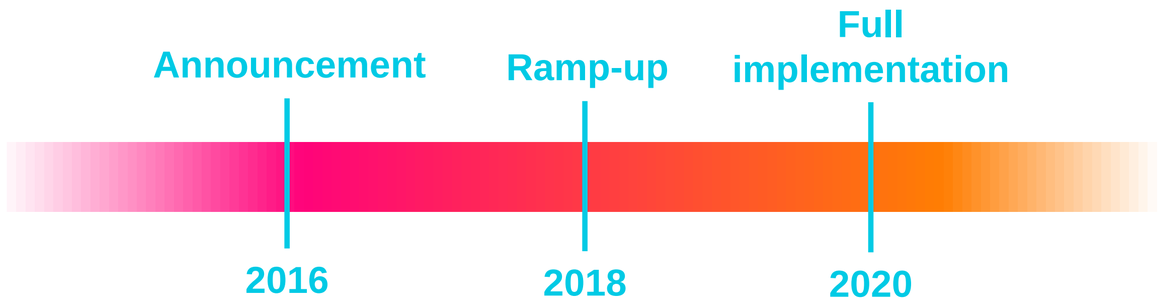
The QT-Flagship

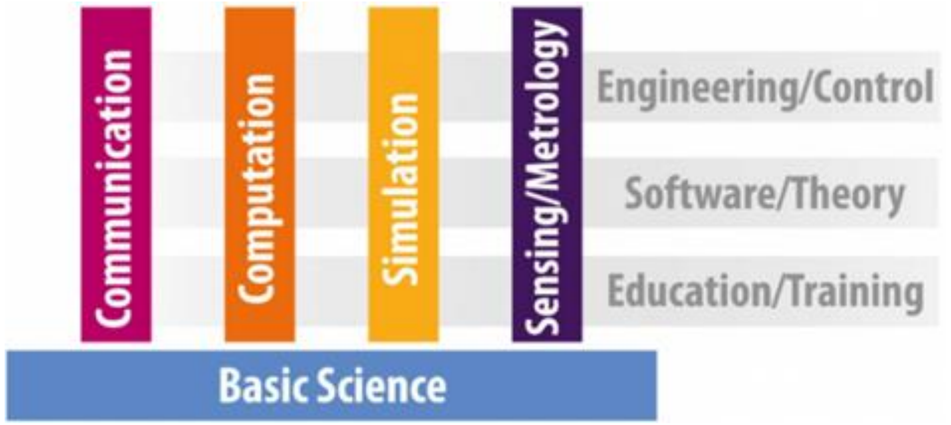
The basics

"*A research and innovation initiative pursuing grand scientific and technological challenges*"

Quantum Technology FET Flagship:

- 1 billion euros
- 10 years duration
- Focus on technological progress
- Large & long term research investment
- Coordination of national & EU efforts





Ramp up phase (2018-2021)

20 projects funded

- 4 Quantum communication projects for 33M€
- 2 Quantum computing projects for 20M€
- 2 Quantum simulation projects for 19M€
- 4 Quantum sensing projects for 37M€
- 7 Basic science projects for 20M€

Quantum Flagship, 2019

The QT-Flagship

The mission objectives

- Translate S&T excellence into industrial success
- Stimulate industrial involvement & innovation
- Move advanced QT from laboratory to industry with concrete prototype applications and marketable products
- Accelerate transition from science to technology
- Focus funding on application areas rather than on fundamental science
- Complemented by fundamental science on emerging topics
- Create value in Europe and retain know-how

Quantum Technology Eco System

Academic groups

SMEs

Large industries

Fabs

Research and Technology Organisations

National agencies

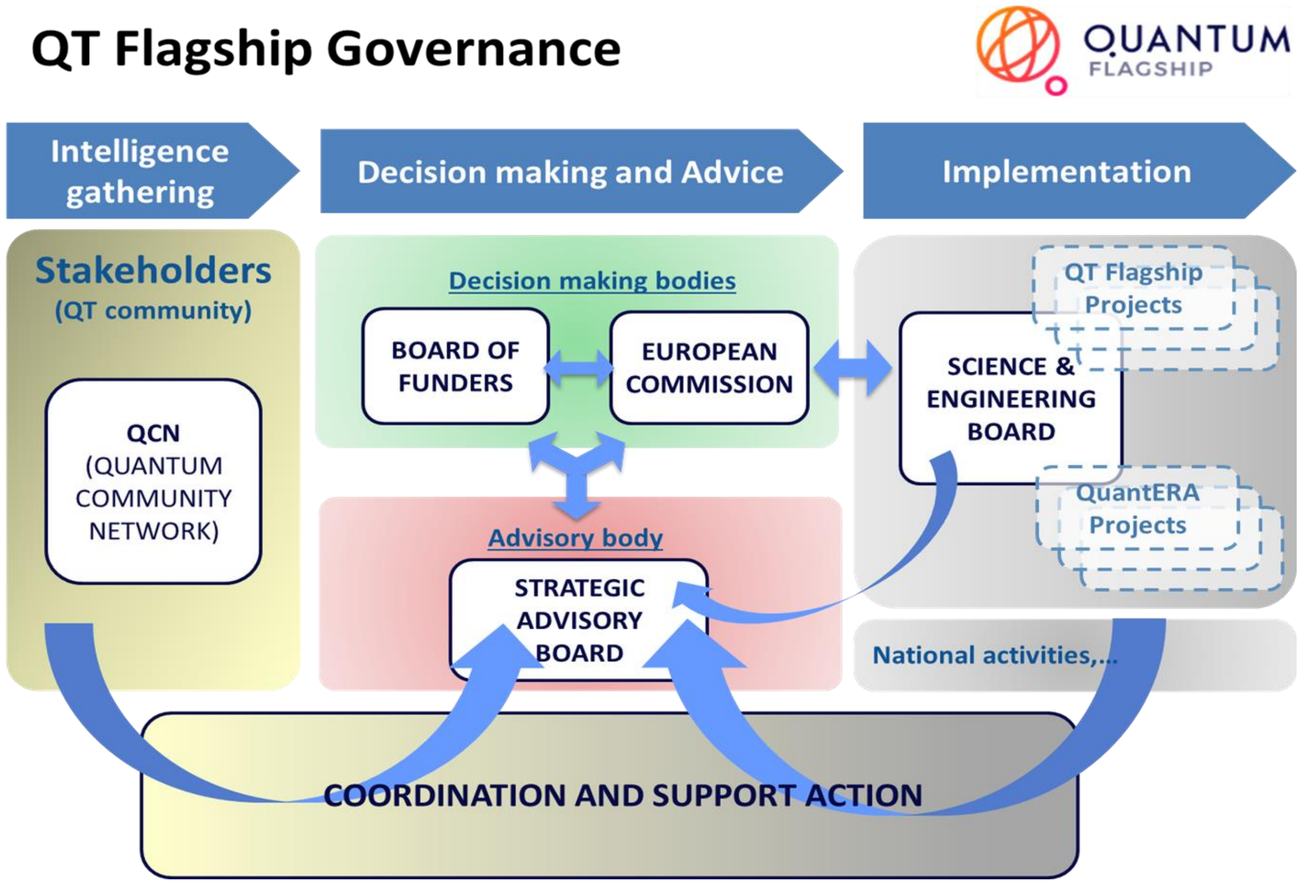
Network Operators

End-users

Manufacturers & Suppliers

The QT-Flagship

The Structure



QCN (national representatives)

- Stakeholders
- Roadmapping
- National initiatives

SAB

- Advice to BoF
- Strategic agenda
- Information flow between boards

SEB

- Projects progress
- Collaboration
- KPIs

CSA

- Certification & Standardisation
- Enabling technology access
- Innovation group
- IPR training
- International cooperation in QT
- Skills, Training & Education
- Annual QT event
- Societal involvement

Quantum Computing

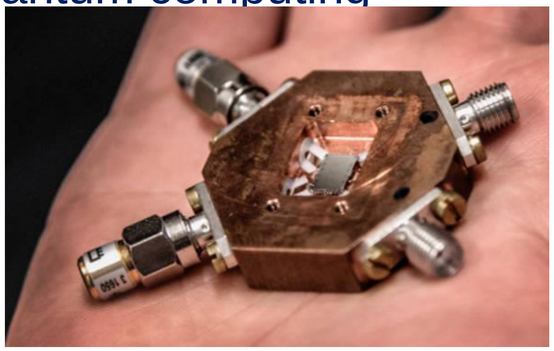
The projects

OpenSuperQ

Saarland University, Germany

OpenSuperQ - An Open Superconducting Quantum Computer

- 50-100 qubits (outperform classical computers)
- Hardware (chip fabs, packaging, Rf electronics)
- Software stack, optimisation tools
- Build value chain in quantum computing



AQTION

University of Innsbruck, Austria

AQTION - Advanced quantum computing with trapped ions

- Scalable ion trap approach
- Modular trap design
- Multi-laser & control system
- Fully-automated ion-trap quantum computer

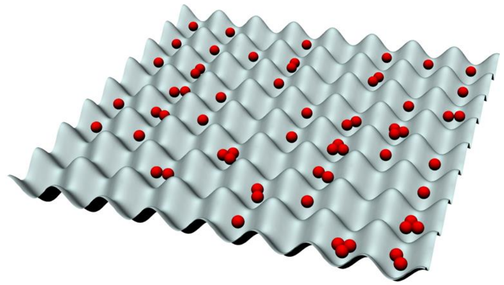
Quantum Simulation

The projects

MPG, Germany

Programmable Atomic Large-Scale Quantum Simulation

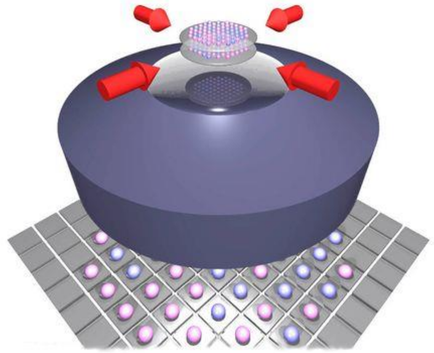
- Large scale quantum simulator (500 atoms)
- Neutral atoms and ions simulators
- Quantum annealing or optimization problems



CNR, Italy

Optimised quantum cascade laser frequency combs

- Investigation in carrier transport quantum dynamics
- Quantum simulator platform made of ultracold atoms in optical lattices
- Quantum communication & quantum sensing



Quantum Communication

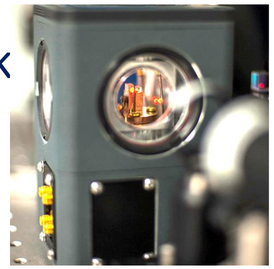
The projects

Full quantum internet functionality – over long distances

QIA

TU Delft, Netherlands

- Quantum repeater network
- Quantum network stack
- Interfaces to matter qubits

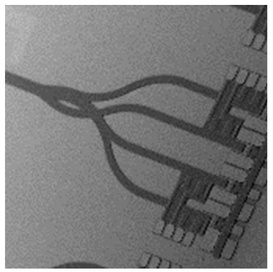


Continuous Variable QKD based on coherent detection

CiViQ

ICFO, Spain

- QKD on photonic integrated circuits
- Network-aware QKD
- Deployment tests for telco operators

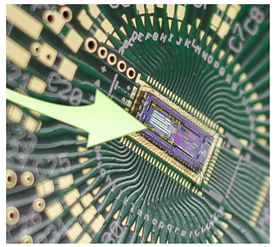


Affordable quantum communication for everyone

UNIQORN

Affordable Quantum Communication for Everyone

AIT, Austria



- InP and ploymer integration platforms
- Quantum system-on-chips: Entanglement, squeezed light, single photons
- Applications: QKD, one-time programs, Quantum OT

QRNG – cheaper, faster, more secure

QRANGE

University of Geneva, Switzerland

- Integrated CMOS SPADs
- QRNG generation >10Gbit/s
- Self-testing QRNGs

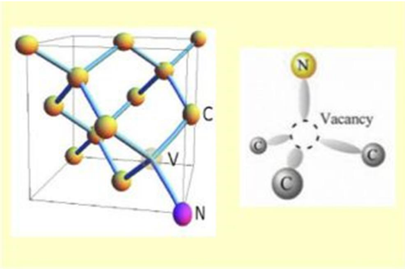
Quantum Sensing

The projects

ASTERIQS

Thales Research, France

Nitrogen-Vacancy centres for sensing

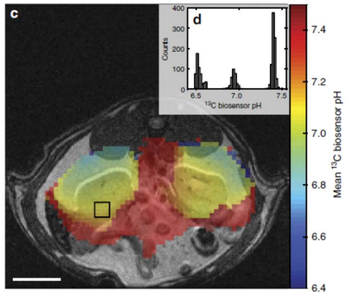


- Solid-state spins
- Multi purpose sensor (E, B, T, P)
- High dynamic range

metabolics

Fraunhofer IAF, Germany

Medical imaging enhanced by N/V centres

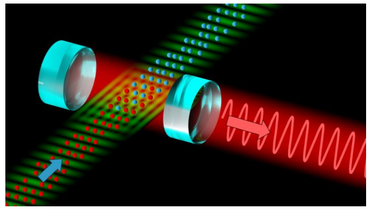


- Hyperpolarized magnetic resonance imaging (MRI)
- Nitrogen-vacancy (NV)-doped diamond as “polarizer”

iqClock

Integrated Quantum Clock

University of Amsterdam, Netherlands



- Integrated optical lattice clock
- Compact and transportable Sr clock
- Superradiant clock

macQsimal

CSEM SA, Switzerland

Miniature MEMS atomic vapor cell

- Integrated atomic vapor cell
- Compact atomic gyroscope, miniature atomic clock, compact optically pumped magnetometers, gas sensor

Basic Science

The projects

MicroQC

Microwave driven ion trap quantum computing

University of Sofia, Bulgaria

PhoQuS
Photons for Quantum Simulation

Photons for Quantum Simulation

Sorbonne University, France

SQUARE
Scalable Rare Earth Ion QUAntum Computing Nodes

Scalable Rare Earth Ion Quantum Computing Nodes

KIT, Germany

PhoG

Sub-Poissonian Photon Gun by Coherent Diffusive Photonics

University of St. Andrews, UK

QMiCS Quantum Microwave Communication and Sensing (**QMiCS**)

Quantum Microwave Communication and Sensing

WMI, Germany

2D-SIPC

Two-dimensional quantum materials and devices for scalable integrated photonic circuits

ICFO, Spain

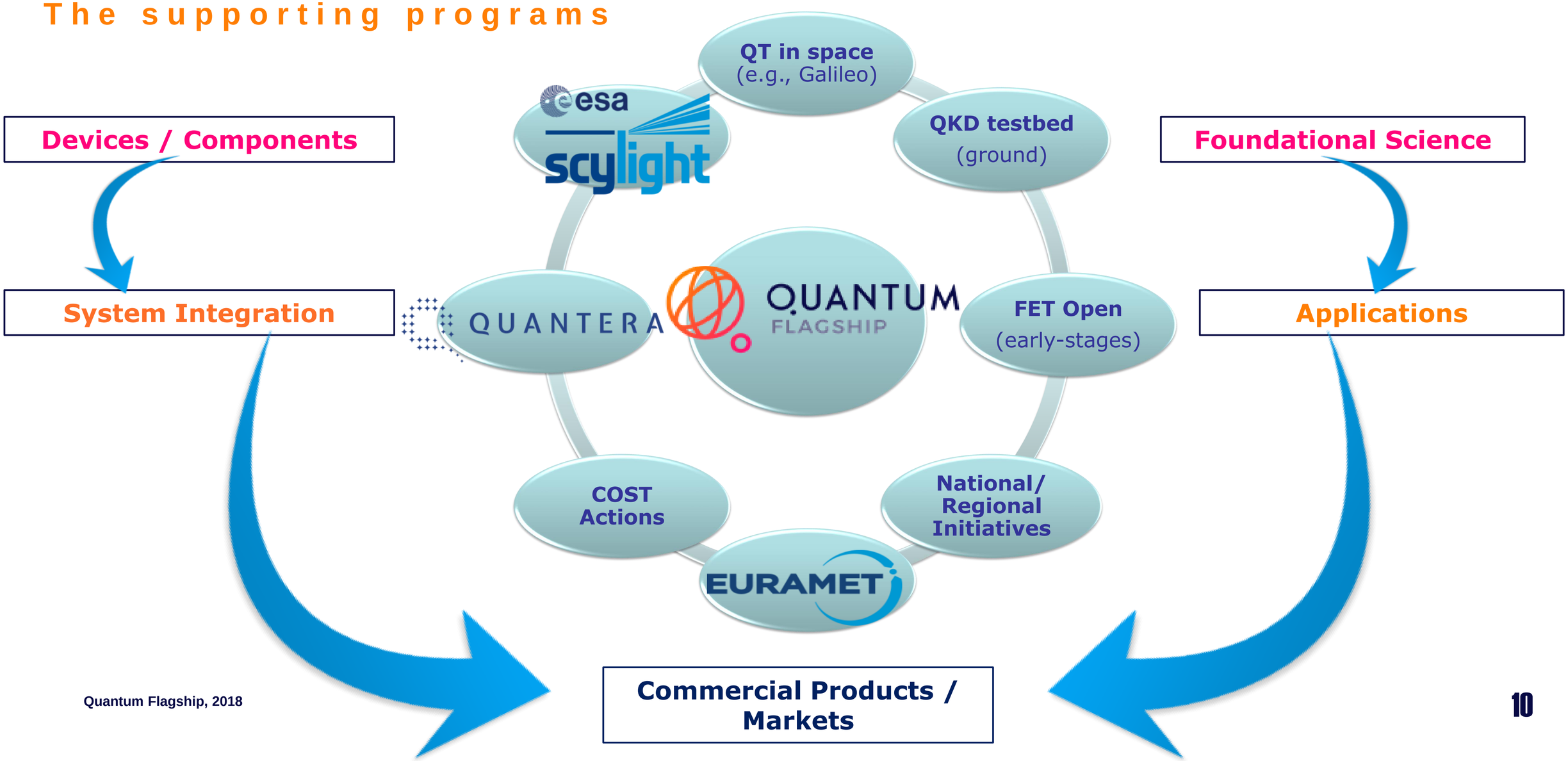
S2QUIP

Scalable Two-Dimensional Quantum Integrated Photonics

KTH, Sweden

Towards an European QT-ecosystem

The supporting programs



Challenges and Outlook

Upcoming programs 2012-2028

Issues to be addressed

- Right structure of Flagship
- Governance model
- Financial instruments
- Continuity versus openness and
- Complementarity in other (national) programs
- European autonomy in QT
- Skills & Training
- Stakeholder and user base involvement

Digital Europe Programme (DEP):

- Experimental Q.Computing
- QT/HPC hybrid
- QKD network infrastructure

Under Negotiation

Horizon Europe (HE): QT FLAGSHIP

- Technology supply
- Fundamental R&D

The future is bright
the future is

QUANTUM

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