Quantum Chips

Overview of the co-creation process

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Enabling and Emerging Technologies

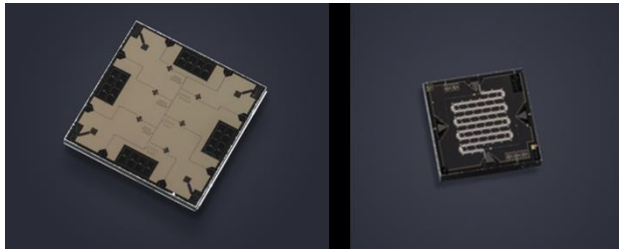
High diversity of quantum chips

And diversity and synergies of different quantum pillars →

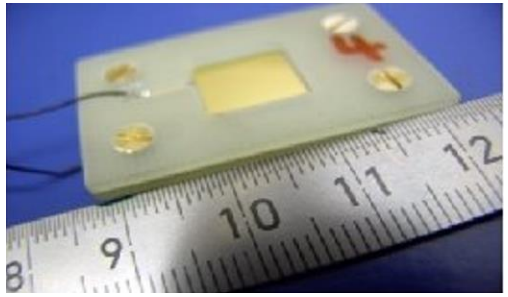
QUANTUM SENSING | QUANTUM COMMUNICATION | QUANTUM COMPUTING

quantum chip technology **tailored to meet the specific qubit requirements** for computing, sensing, and communication, ensuring optimal performance for each application.

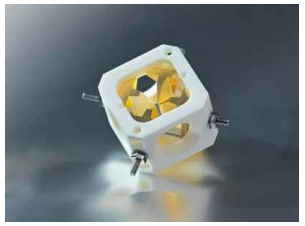
Examples of EU expertise, capability and products

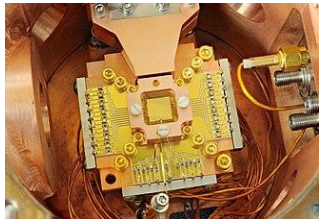


Computing: **Superconducting qubits** and parametric amplifier (for control and readout of qubits)

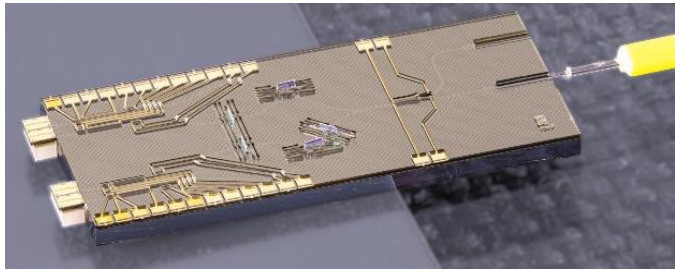


Sensing/Communication/Computing: Diamond growth, defect implantation (**NV-Center**), characterization

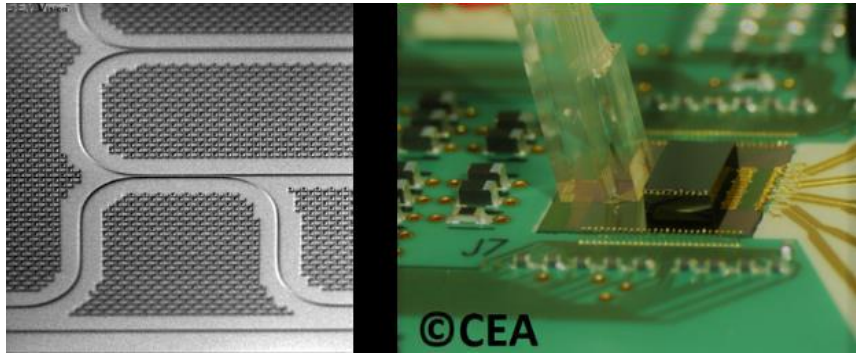




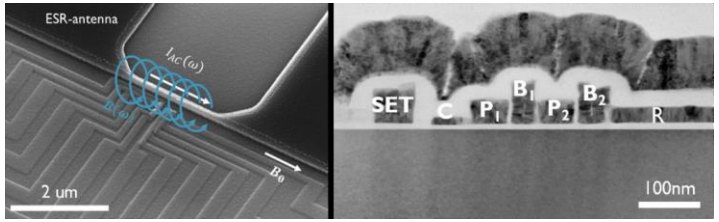
Computing/Sensing: (Left) **Trapped ions Paul trap**, (Right) **Chip ion trap**



Communication: Polarization coding **BB84 transmitter PIC**



Communication/Computing: (Left) SEM view of a **silicon photonic circuit** for entangled photon generation (Right) Packaging of **photonic integrated circuits** with fiber array and electronic chip on top



Computing: **Silicon spin qubit** cell with ESR manipulation unit: top view (left) and cross-section (right)

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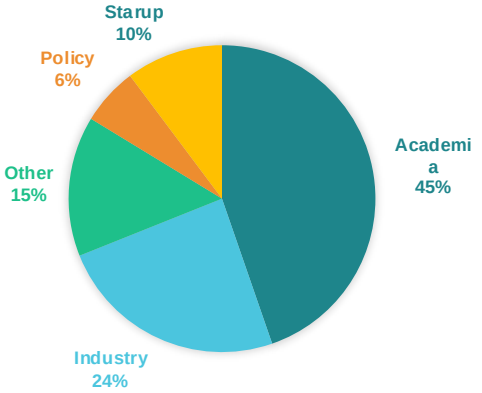
Co-creation process

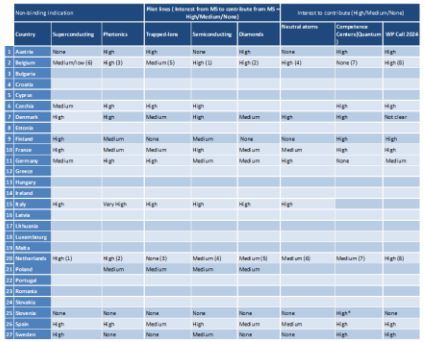
Phase 1

- Quantum Flagship SAB & QUIC
  - Provided technical input for roadmap (SRIA)
- Technical Workshops and feedback from Experts



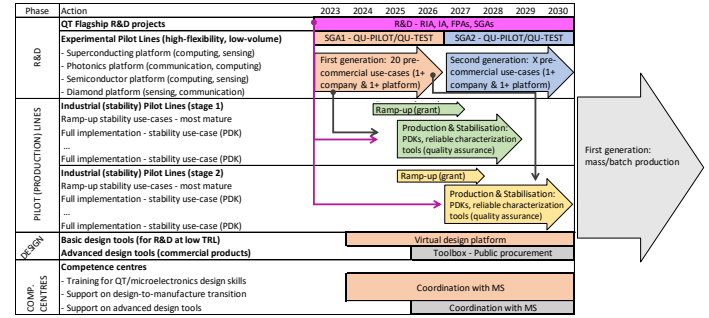
Phase 2

- National Quantum Initiative representatives
  - Informal group for MS consultation
  - Creation of interest groups per technology



Phase 3

- GB chips JU (Concept mature to review with GB)
  - Provide feedback to Roadmap and calls
  - Approval of the Work Programme



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Quantum community consultation

Consulted 1000+ key figures from science, industry, policy, startups and emerging talents
10+ workshops, conferences, thematic working groups, surveys, SRIA

Technology Platform	Communications	Computing/Simulation	Sensing & Metrology
Superconducting	Cryogenic temperature	Leading in quantum processors and annealers	metrology and magnetic field sensors
Photonics	Room temperature, QKD over long distances	Room temperature, challenges in noise reduction	research for applications like LIDAR
Trapped Ions	Room temperature, main focus on computing	high-fidelity qubits with long coherence times	precision measurements but require complex setups
Semiconducting	Potential in integrated quantum circuits	Spin qubits are promising for scalable quantum computers	Used in high-resolution and sensitive detectors
Diamond	Main focus is on sensing applications	Studied for use as robust qubits	High-precision sensors at the nanoscale
Neutral Atoms	Experimental stage for secure communication	Promising results, challenges in scalability and error correction	Mature applications, e.g. atomic clocks, interferometers

Maturity for Chips Fabrication: **Low**, **Medium**, **High**

Network of Quantum Initiatives (NQI) consultation

	Non-binding indication	Pilot lines (Interest from MS to contribute from MS – High/Medium/None)					
	Country	Superconducting	Photonics	Trapped-Ions	Semiconducting	Diamonds	Neutral atoms
1	Austria	High	High	High	None	High	None
2	Belgium	Medium/low (6)	High (3)	Medium (5)	High (1)	High (2)	High (4)
3	Bulgaria						
4	Croatia						
5	Cyprus						
6	Czechia	Medium	High	High	High		
7	Denmark	High	High	Medium	High	Medium	High
8	Estonia						
9	Finland	High	High	Medium	High	Medium	Medium
10	France	High	Medium	Medium	High	Medium	Medium
11	Germany	Medium	High	High	Medium	Medium	High
12	Greece						
13	Hungary						
14	Ireland						
15	Italy	High	Very High	High	High	High	High
16	Latvia						
17	Lithuania						
18	Luxembourg						
19	Malta						
20	Netherlands	High (1)	High (2)	None (3)	Medium (4)	Medium (5)	Medium (6)
21	Poland					Medium	
22	Portugal	Medium	High	High	High	High	Medium
23	Romania						
24	Slovakia						
25	Slovenia	None	None	None	None	None	None
26	Spain	High	High	Medium	High	Medium	Medium
27	Sweden	High	None	None	Medium	None	None

NQI: Informal expert group

- All 27 Member States (MS) represented
- **Included Chips JU representatives**
- Coordinate with MS governments/ministry, for quantum

Governments/ministries appointed experts

Established 6 Interest Groups

Report to MS and EC

European Commission

Thank you

European Commission