From Quantum Flagship to Quantum Fleet: the EU Programmes in Quantum Technologies

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The Nobel Prize in Physics 2022

Alain Aspect

John F. Clauser

Anton Zeilinger

John Bell
LAUREATES

Breakthrough Prize  Special Breakthrough Prize  New Horizons Prize  Physics Frontiers Prize


Charles H. Bennett  Gilles Brassard  David Deutsch  Peter W. Shor

For foundational work in the field of quantum information.
A much deserved recognition to the pioneers of Quantum Information Science and Technology!
From Quantum Flagship to Quantum Fleet: the EU Programmes in Quantum Technologies

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The programme

QuantERA ERA-NET Cofund in Quantum Technologies

The QuantERA Programme is a leading European network of 39 Research Funding Organisations from 31 countries.

QuantERA supports excellent Research and Innovation in Quantum Technologies.

The Programme's goals are:

- successfully providing the European quantum community with Calls for Proposals in QT
- promoting excellent research in QT
- encouraging transnational collaborations in QT
- networking research funders in QT
- mapping national, regional & European public policies in QT
- spreading research excellence across the European Research Area (ERA).
The future is Quantum.

The Second Quantum Revolution is unfolding now, exploiting the enormous advancements in our ability to detect and manipulate single quantum objects. The Quantum Flagship is driving this revolution in Europe.
APPLICATION AREAS

COMMUNICATION

COMPUTING

SIMULATION

SENSING & METROLOGY

CROSS-CUTTING ACTIVITIES

ENGINEERING/CONTROL

EDUCATION/TRAINING

SOFTWARE/THEORY

BASIC SCIENCE

Key areas and activities of the Quantum Flagship
Ramp-up phase: 2018-2021

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Key areas and activities of the Quantum Flagship
A community-driven research and innovation vision

Key Performance Indicators for Quantum Technologies in Europe

October 2022
## KPI Scorecard

### KPI Ecosystem

<table>
<thead>
<tr>
<th>KPI</th>
<th>2021 value</th>
<th>2030 target</th>
<th>progress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment (b€)</td>
<td>n.a.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lab-to-market</td>
<td>79</td>
<td>250</td>
<td>31.6</td>
</tr>
<tr>
<td>Lab-to-fab</td>
<td>1</td>
<td>10</td>
<td>10.0</td>
</tr>
<tr>
<td>Job Creation</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Patent Creation/IP Retention (rank)</td>
<td>n.a.</td>
<td>top 2</td>
<td></td>
</tr>
<tr>
<td>Supply Chain &amp; Strategic autonomy</td>
<td>0</td>
<td>10</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### KPI Quantum Communication

<table>
<thead>
<tr>
<th>KPI</th>
<th>2021 value</th>
<th>2030 target</th>
<th>progress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>2</td>
<td>20</td>
<td>10.0</td>
</tr>
<tr>
<td>European Technical Leadership (km)</td>
<td>1.3</td>
<td>500</td>
<td>0.3</td>
</tr>
<tr>
<td>Deployment (areas; nodes)</td>
<td>1.8</td>
<td>10; 50</td>
<td>10.0</td>
</tr>
<tr>
<td>Adoption</td>
<td>5</td>
<td>30</td>
<td>16.7</td>
</tr>
</tbody>
</table>

### KPI Quantum Computing

<table>
<thead>
<tr>
<th>KPI</th>
<th>2021 value</th>
<th>2030 target</th>
<th>progress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>0</td>
<td>3</td>
<td>0.0</td>
</tr>
<tr>
<td>European Technical Leadership (q volume)</td>
<td>32</td>
<td>655</td>
<td>4.9</td>
</tr>
<tr>
<td>European Impact Leadership</td>
<td>70</td>
<td>500</td>
<td>14.0</td>
</tr>
<tr>
<td>Accessibility</td>
<td>0</td>
<td>10</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**KEY**

- Green: Ahead of schedule | >>10%
- Light Green: On schedule | -10%
- Yellow: Needs progress | <10%
- Red: Behind schedule | <<10%
<table>
<thead>
<tr>
<th>KPI Quantum Simulation</th>
<th>2021 value</th>
<th>2030 target</th>
<th>progress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>0</td>
<td>8</td>
<td>0.0</td>
</tr>
<tr>
<td>Market Readiness</td>
<td>0</td>
<td>12</td>
<td>0.0</td>
</tr>
<tr>
<td>European Technical Leadership</td>
<td>200</td>
<td>200</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KPI Quantum Sensing and Metrology</th>
<th>2021 value</th>
<th>2030 target</th>
<th>progress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Readiness</td>
<td>3</td>
<td>20</td>
<td>15.0</td>
</tr>
<tr>
<td>Next-generation Technologies</td>
<td>0</td>
<td>7</td>
<td>0.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KPI Education</th>
<th>2021 value</th>
<th>2030 target</th>
<th>progress (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outreach</td>
<td>7</td>
<td>100</td>
<td>7.0</td>
</tr>
<tr>
<td>Education</td>
<td>0</td>
<td>180</td>
<td>0.0</td>
</tr>
<tr>
<td>Adopting</td>
<td>1</td>
<td>225</td>
<td>0.4</td>
</tr>
<tr>
<td>Diversity and Equity</td>
<td>0</td>
<td>90</td>
<td>0.0</td>
</tr>
</tbody>
</table>
FPAs: 2022-2029, RIAs: 2022-2025

APPLICATION AREAS

- COMMUNICATION
- COMPUTING
- SIMULATION
- SENSING & METROLOGY
- BASIC SCIENCE

CROSS-CUTTING ACTIVITIES
- ENGINEERING/CONTROL
- EDUCATION/TRAINING
- SOFTWARE/THEORY

Key areas and activities of the Quantum Flagship
EuroQCI: EU Quantum Communication Infrastructure

DECLARATION ON A QUANTUM COMMUNICATION INFRASTRUCTURE FOR THE EU

All 27 EU Member States have signed a declaration agreeing to work together to explore how to build a quantum communication infrastructure (QCI) across Europe, boosting European capabilities in quantum technologies, cybersecurity and industrial competitiveness.

@FutureTechEU #EuroQCI
EuroQCS

European Quantum Computing & Simulation Infrastructure

Authors: D. Binosi¹, ², T. Calarco²*, G. Colin de Verdière³, S. Corni⁴, A. Garcia-Saez⁵, M.P. Johansson⁶, V. Kannan⁷, N. Katz⁸, I. Kerendis⁹, J.I. Latorre⁵, Th. Lippert²*, R. Mengoni¹⁰, K. Michielsen²*, J.P. Nominé³, Y. Omar¹¹, P. Öster⁵, D. Ottaviani¹⁰, M. Schulz¹²,¹³, L. Tarruell¹⁴.

1. European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), Italy
2. Forschungszentrum Jülich (FZJ), Germany
3. Commissariat à l’énergie atomique et aux énergies alternatives (CEA), France
4. University of Padua and CNR Institute of Nanoscience, Modena, Italy
5. Barcelona Supercomputing Centre (BSC), Spain
6. CSC – IT Center for Science, Finland
7. Irish Centre for High-End Computing (ICHEC), Ireland
8. The Hebrew University of Jerusalem, Israel
9. Centre National de la Recherche Scientifique (CNRS), France
10. Consorzio Interuniversitario del Nord est Italiano Per il Calcolo Automatico (CINECA), Italy
11. University of Lisbon, Portugal
12. Leibniz Supercomputing Centre (LRZ), Germany
13. Technical University of Munich (TUM), Germany
14. Institute of Photonics Science (ICFO), Spain

EU deploys first quantum technology in six sites across Europe

The EuroHPC JU has selected six sites across the European Union to host and operate the first EuroHPC quantum computers in:

- Czechia
- France
- Germany
- Italy
- Poland
- Spain
European Quantum Industry Consortium

QuIC’s mission is to boost the European quantum-technology industry’s competitiveness and economic growth, and bolster value creation across the continent.
No digital without chips

The European Chips Act

#DigitalEU  #EUChipsAct
France and Germany line up for quantum leap

Emmanuel Macron lays out a €1.8B strategy to slingshot the country into becoming a quantum powerhouse, as Germany draws up a €2B programme of quantum research as part of its pandemic recovery plan

By Óanna Kelly
NQIs: National Quantum Initiatives

NQIs: Belgium, Bulgaria, Czech Republic, Finland, France, Greece, Hungary, Italy, Latvia, Netherlands, Slovakia, Switzerland, and the United Kingdom.

Private foundations: Denmark, Sweden.

Total: +5.7 billion Euro
From Quantum Flagship to Quantum Fleet
From Quantum Flagship to Quantum Fleet
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Chips Act
National Quantum Initiatives (NQIs)
How to integrate all these efforts and investment?
Bringing coherence to quantum initiatives in Europe

Chips Act
National Quantum Initiatives (NQIs)
QUCATS: GOALS & ACTIONS (2022-2025, ... AND BEYOND)

1. Strategy and growth
   1.1 Strategic roadmaps
   1.2 Ecosystem growth
   1.3 Synergies and funding

2. Outreach and cooperation
   2.1 Communication and Outreach
   2.2 International cooperation
   2.3 Trade & Export

3. Standardisation and benchmarks
   3.1 Intellectual Property
   3.2 Standardization
   3.3 Benchmarks & Use cases

4. Education and training
   4.1 Strategic educational infrastructures and services
   4.2 QT in secondary and higher education
   4.3 Professional trainings and mobility
   4.4 Wide access to quantum

5. Project management and transversal activities
   5.1 Project management
   5.2 Support to EU quantum activities
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   5.2 Support to EU quantum activities
200+ events covering Africa, the Americas, Asia, and Europe!
- Launched Quantum@School and Quantum@Museum projects.
- Join QuCATS in celebrating the World Quantum Day in 2023!
- 14 April: European Quantum Day?

Events celebrating quantum science and technology

- 200+ events
- 44+ countries
- 193+ cities
- 17+ languages

Tweet impressions > 43k
Weibo likes > 10M

worldquantumday.org   @WorldQuantumDay
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worldquantumday.org  @WorldQuantumDay
Making Europe autonomous in QT, open to IntCoop
Quantum Flagship
Find information online:

Feel free to contact me if I can be of help:
contact.yasser@pqi.pt
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