

Quantum Metrology: the present and the future

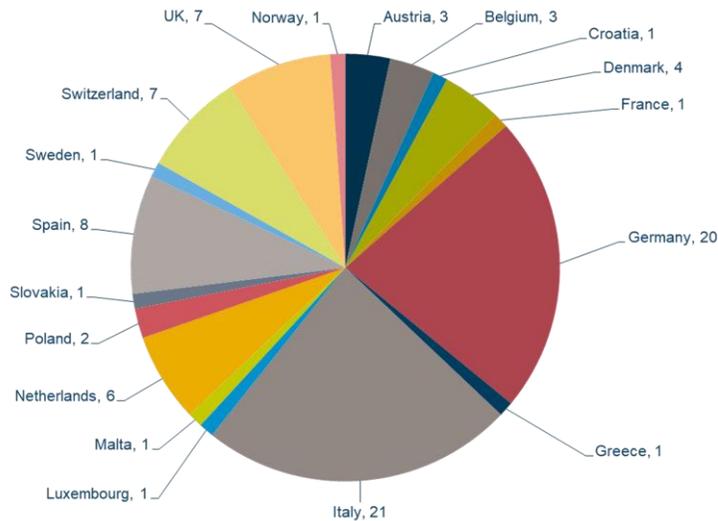


21st November 2022

Focus Group on Quantum Technologies (FGQT): activities and perspectives

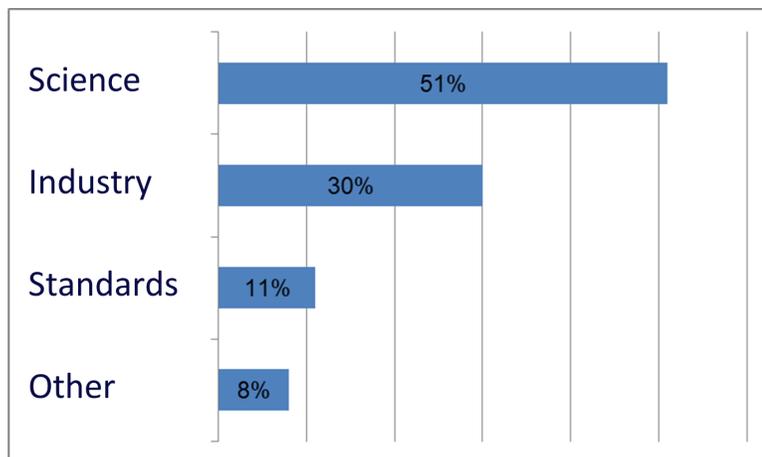
Dr. Nicolas Spethmann (PTB, vice-chair CEN-CENELEC FGQT)

Key Figures FGQT



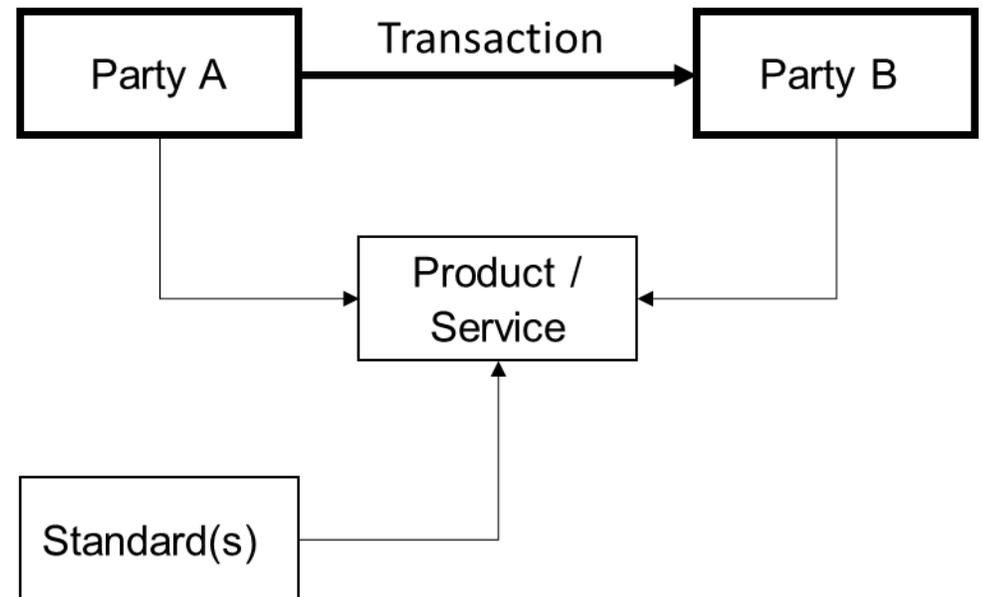
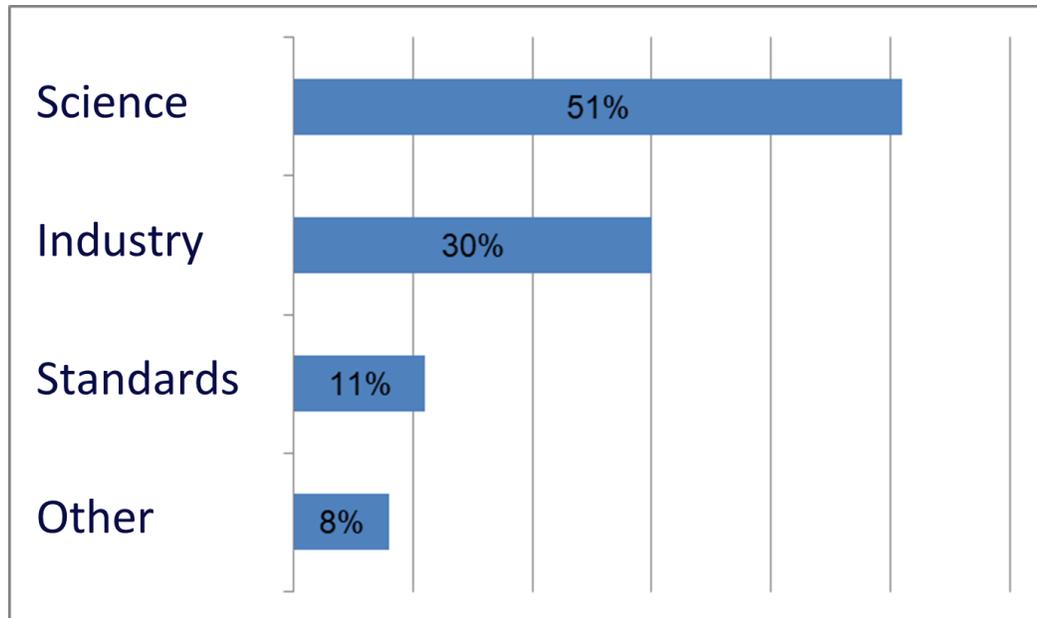
- Founded mid 2020, 150+ delegates, 18+ meetings, 150+ contributions
- **Developing roadmap**, 1st release probably in a few months
 - What to standardise (gaps), when, how and by whom
 - Coordinate with ISO/IEC, ETSI, ITU-T, EMN-Q, QUIC, EuroQCI, Qflag, Qu-Test, other ...
 - Spin-off standardisation activities: TC(s) for guidelines, reports, specifications;

Creation of CEN-CLC JTC 22 'Quantum Technologies'



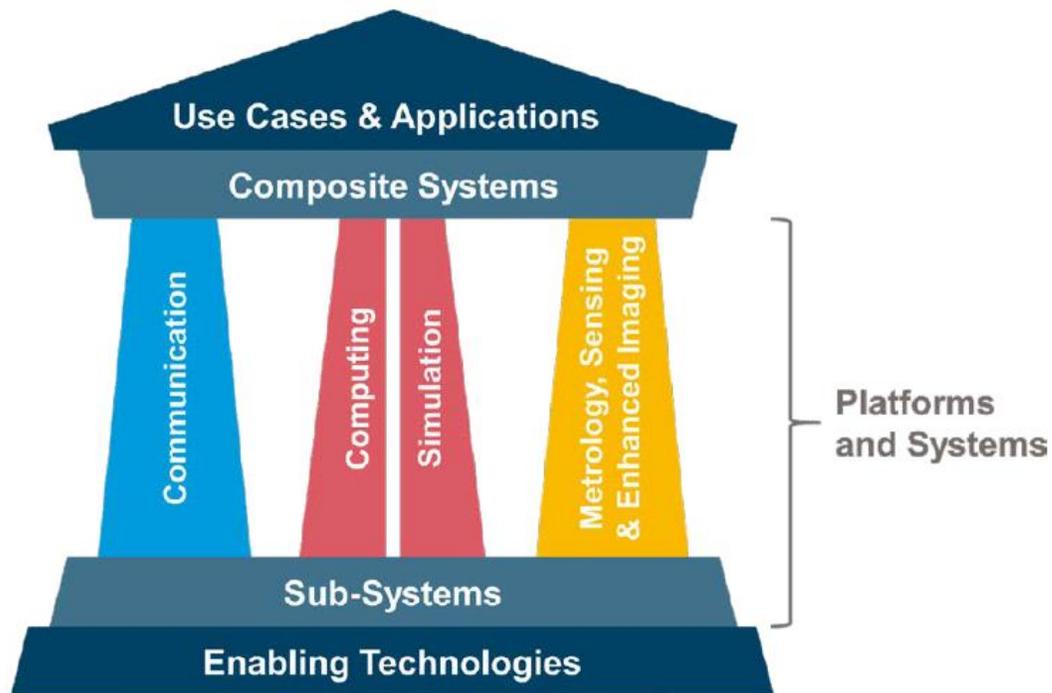
Forum to bring together complementary perspectives

- **FGQT as forum for academia, industry and standardization experts: establish a common language in order to be able to work together well, efficiently and quickly in the future**



Challenges and Chances

FGQT includes all QT-fields



This is a challenge:

- Domain experts from diverse, complementary fields
- There is a danger of addressing only a small portion of delegates at one time
- How to address a field as wide and diverse as “quantum technologies”?

And also a chance:

- Many QT components common across fields
- Horizontal layers connect fields
- FQGT can support development of coherent standardization and prevent double-development/work and prevent later adaptations
- **Framework for standardization**

Framework and Identification of Standardization Needs



Horizontal layer and cross cutting of QT components, sub systems, platforms

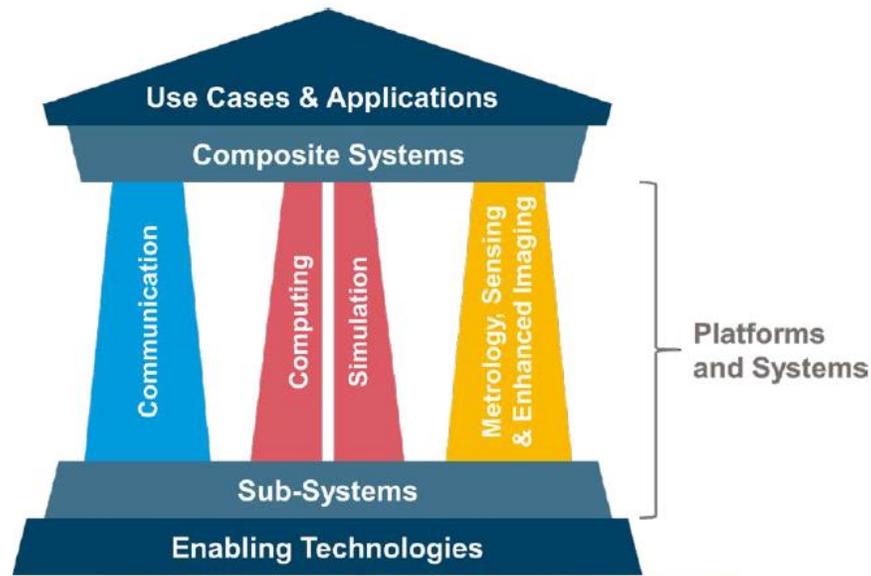
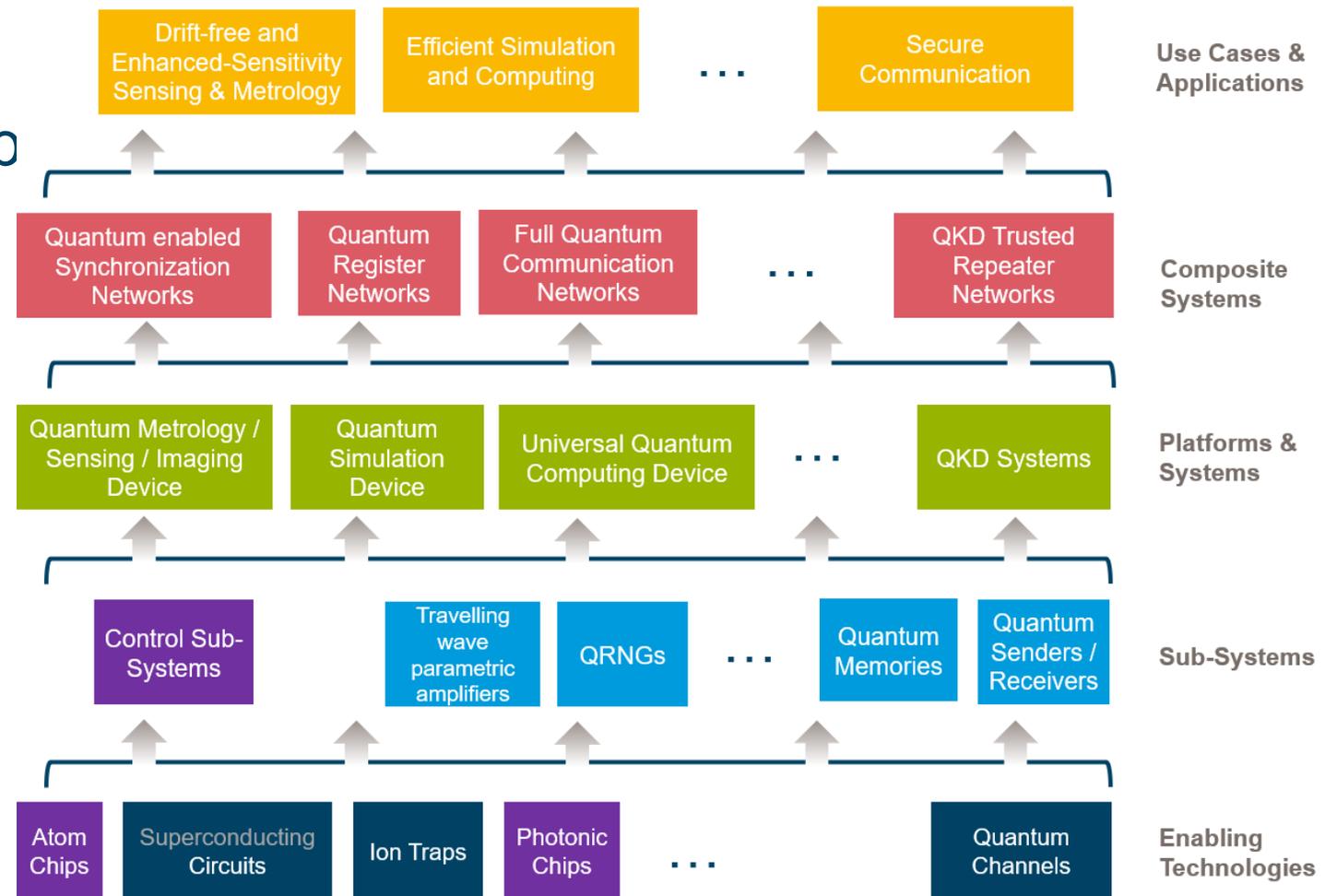
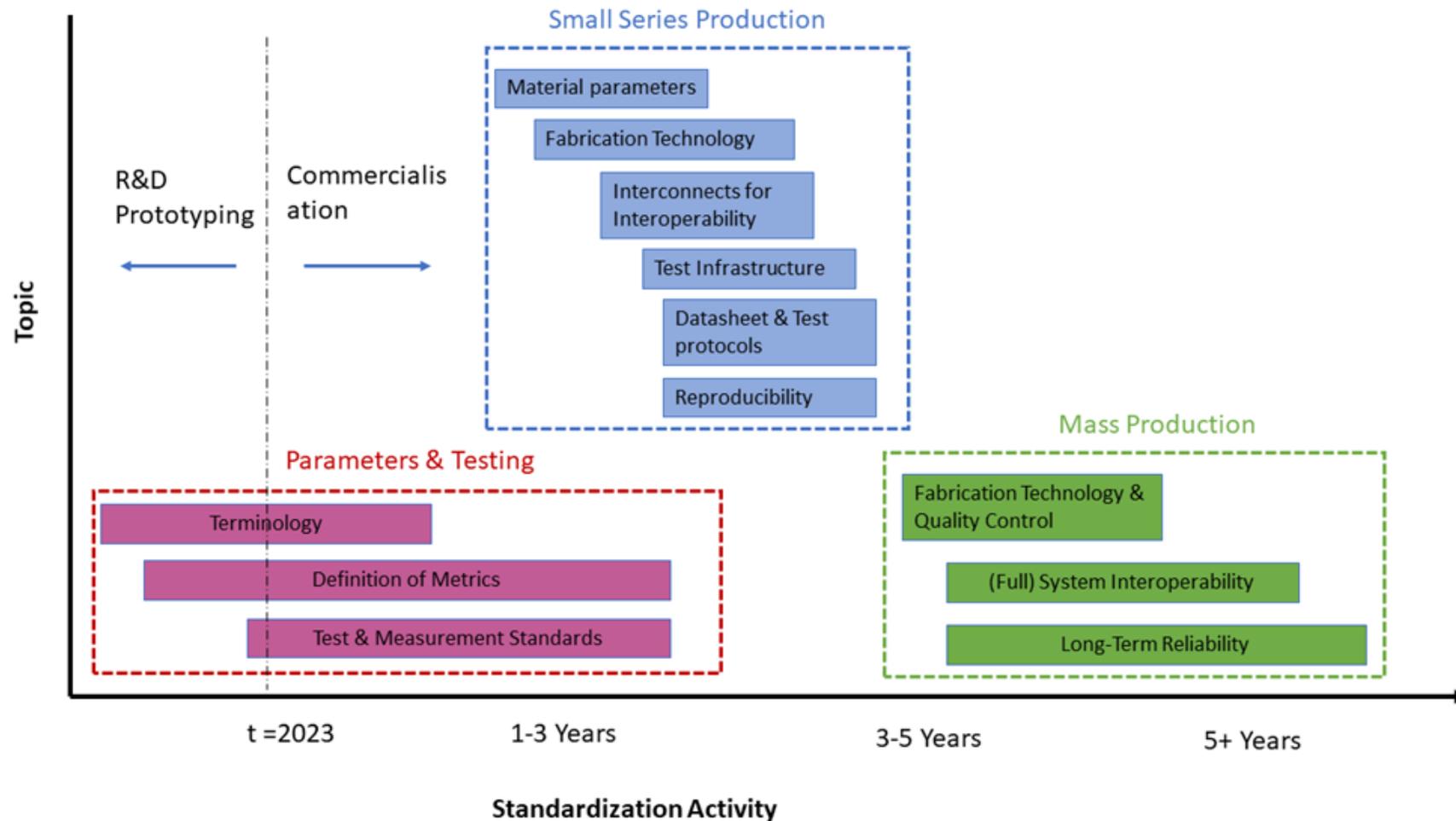


Figure 1: Quantum technology "temple" structure (Source: [57])



Timeline for Standardization of Enabling Technologies



“Supporting industry through testing and experimentation”

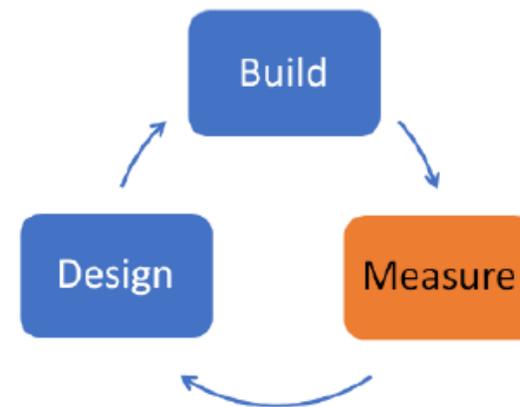
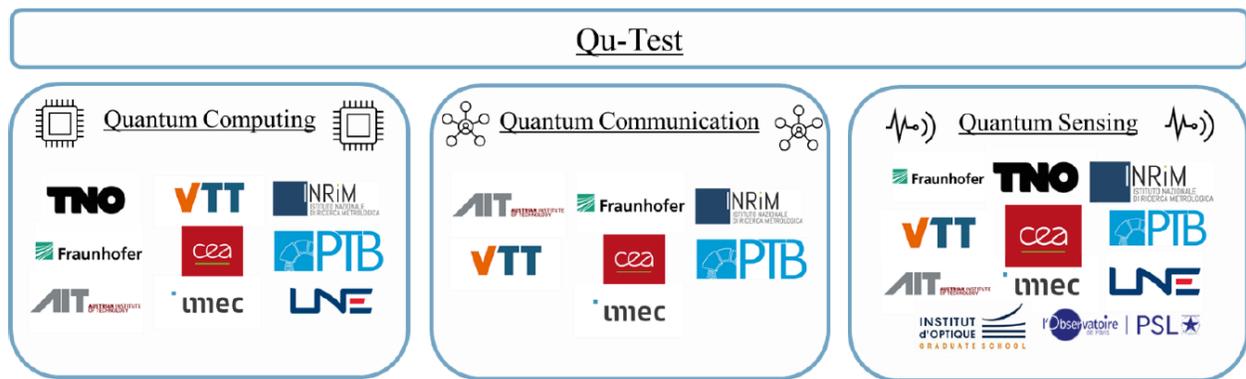


Figure 1 Engineering cycle of quantum devices

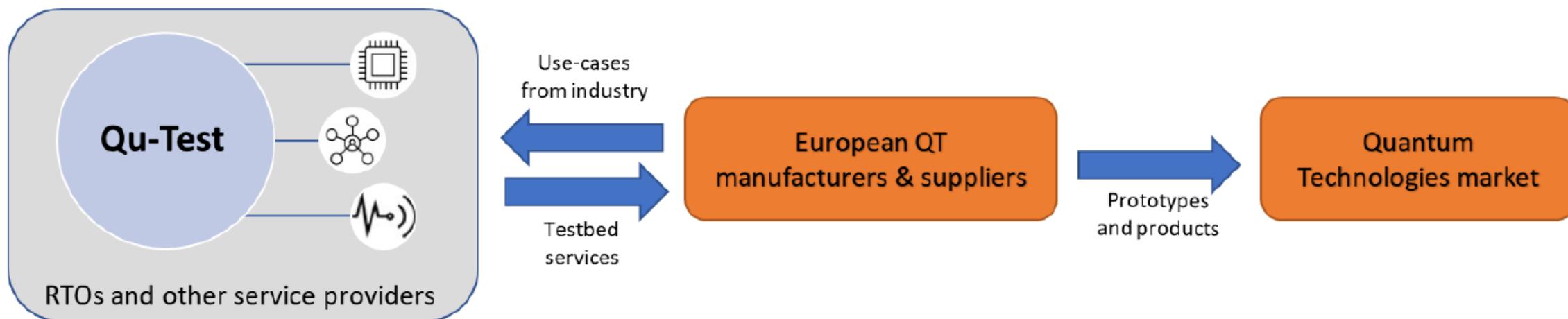


Figure 2 Schematic representation of how the testbed operates.

Scope, Conclusion & Perspective

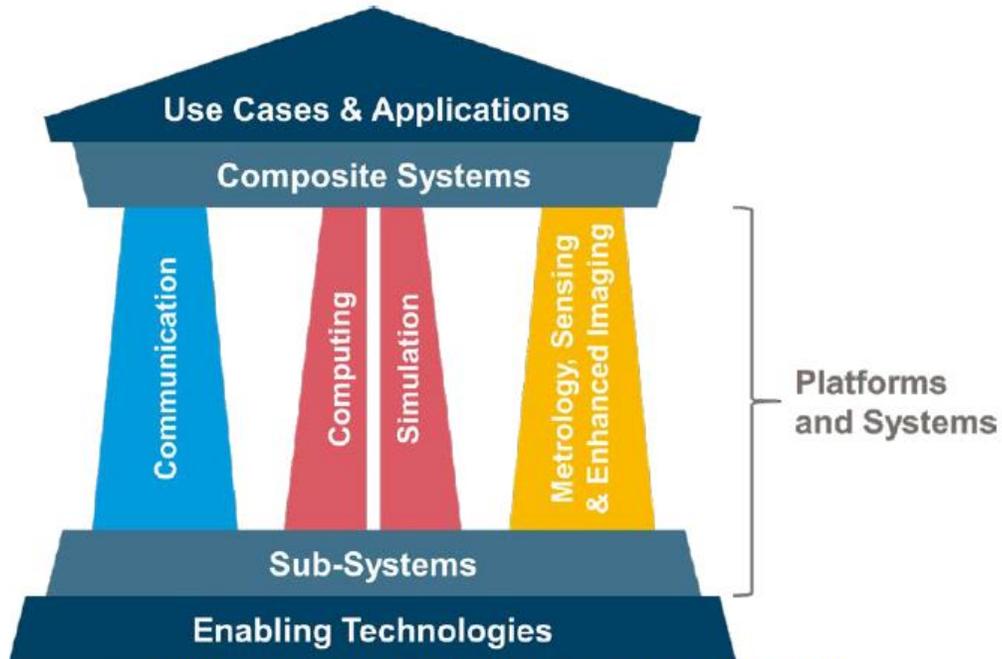


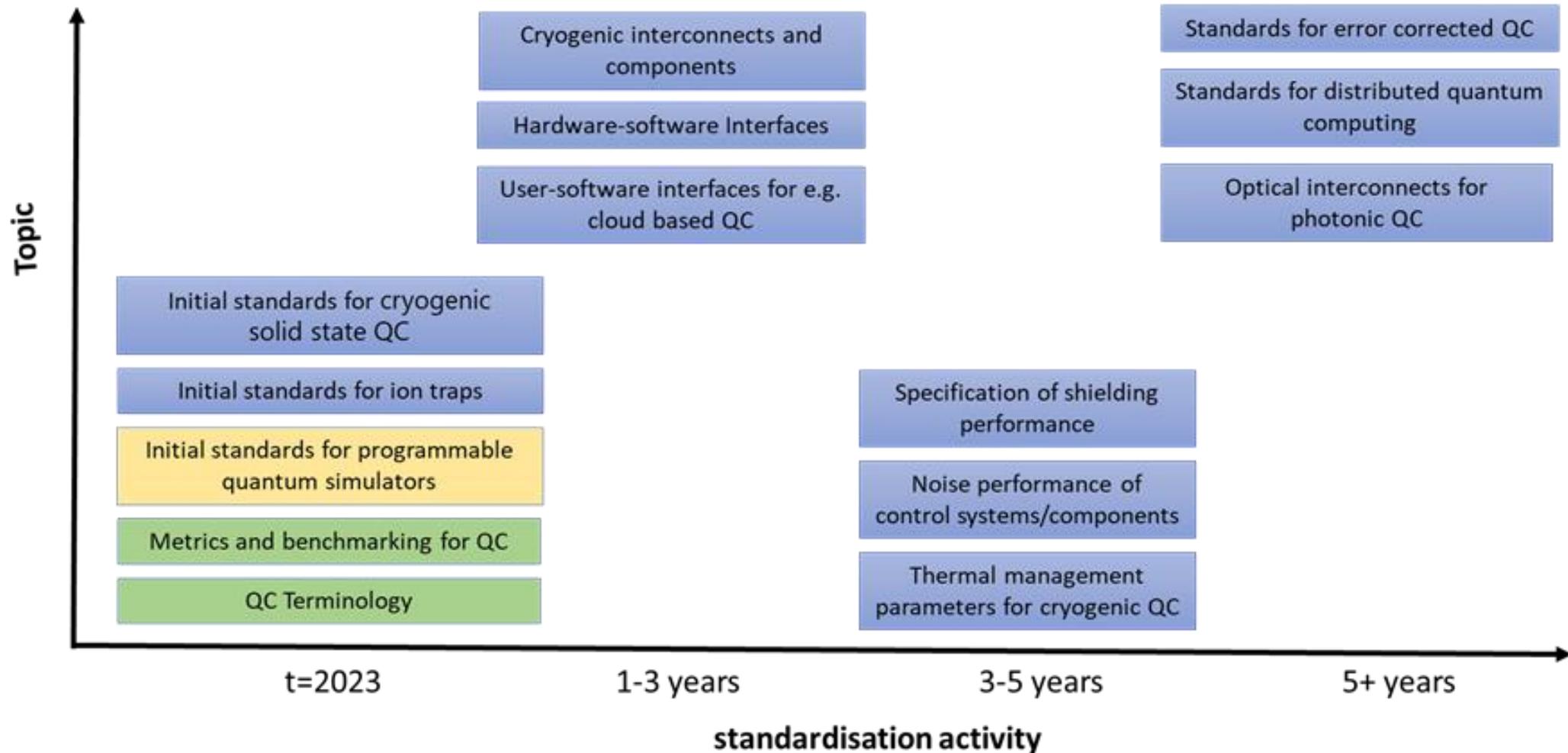
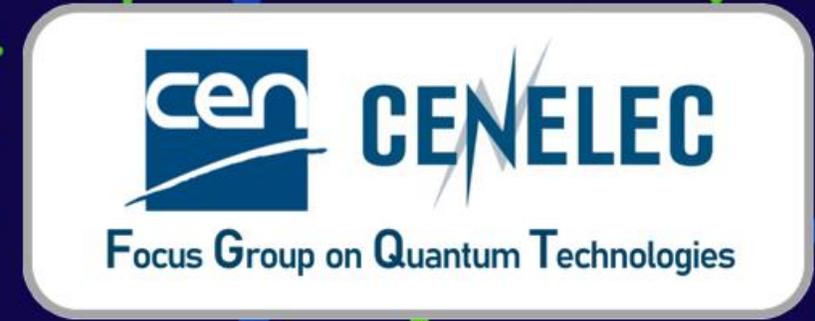
Figure 1: Quantum technology "temple" structure (Source: [57])

„Towards European Standards for Quantum Technologies“

<https://arxiv.org/abs/2203.01622>

- Roadmap: Standards How and When and by Whom?
- European voice in international/worldwide organizations
- **JTC 22 Quantum Technologies**
- A first important standardization activity: Which parameters have to be characterized for the quality assurance of QT components?
- **Provide overview and guidance: coherent framework for QT standardization**
- Help to connect and “streamline” current standardization efforts

Timeline for Standardization of Quantum Computing



The End

Since 2019:



New SI system

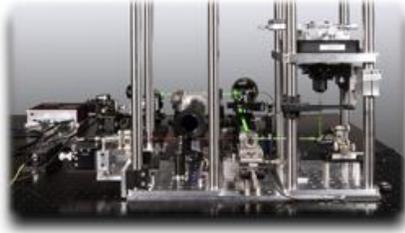
Germany's National Metrology Institute



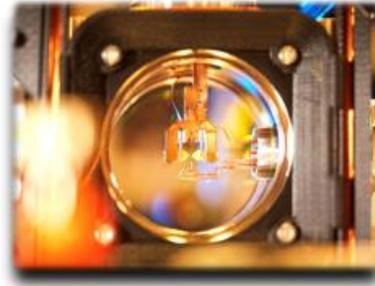
**Providing the national measurement infrastructure in
Germany on an internationally competitive level**

Physikalisch-Technische Bundesanstalt

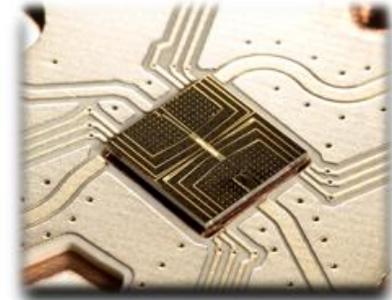
Single photon sources
and detectors



Clocks, resonators and
frequency dissemination

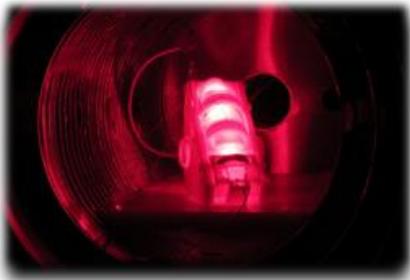


Ion traps for quantum simulation
and quantum computer

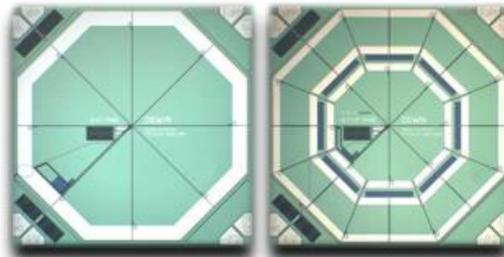


QT at PTB

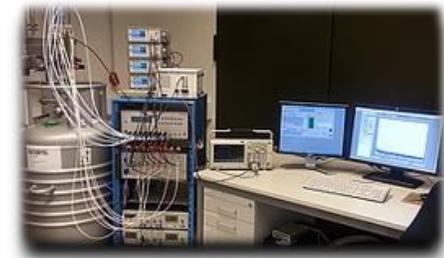
Metrology for ultralow
magnetic fields



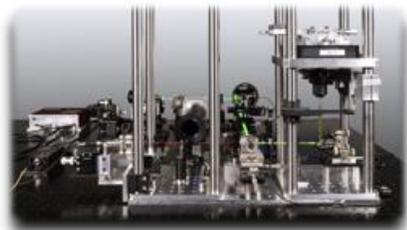
Cryosensors - SQUIDs



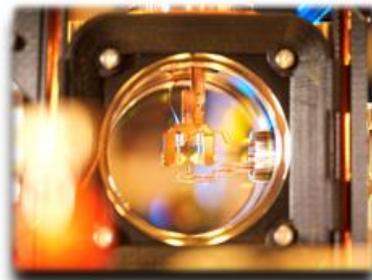
Electrical quantum
metrology



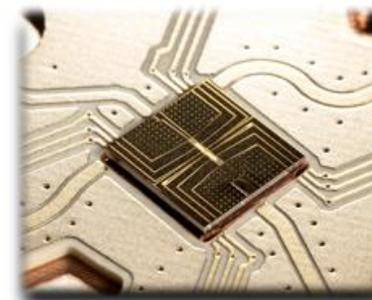
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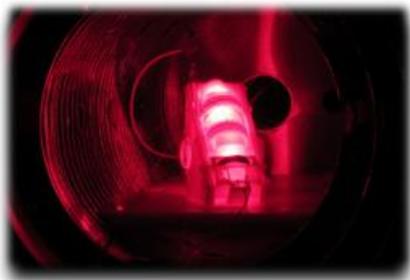


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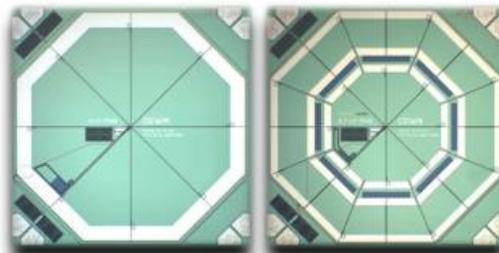


QTZ: transfer QT into application and into industry

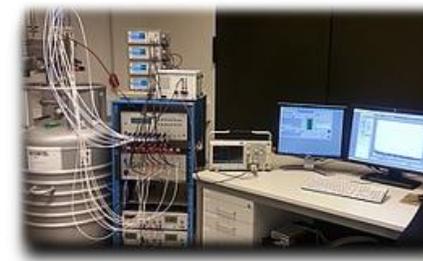
Metrology for ultralow
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Cryosensors - SQUIDs



Electrical quantum
metrology



- QTZ as PTB's hub for access to **QT expertise** and **infrastructure** for partners from industry and academia
- Support development of QT with **economic potential**

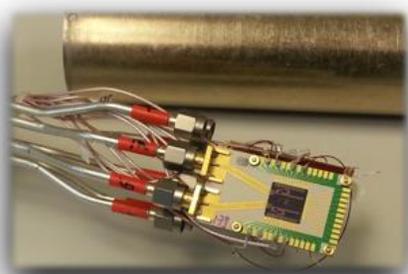
Fields of Activity of QTZ

Components
and
technology

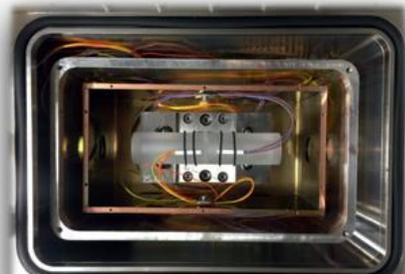
Calibration
and
services

User
facilities

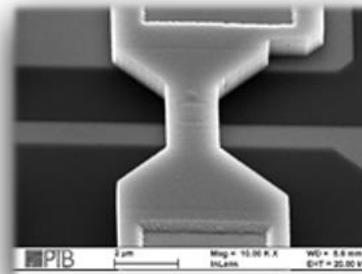
Hands-on
training,
support for
start-ups



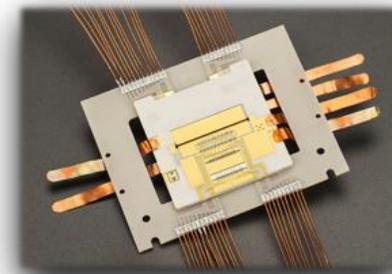
Electrical QT



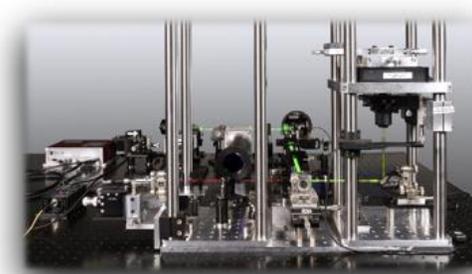
Optical QT



Mag. Sensors



Ion Traps



Single Photons