ACADÉMIE
DES SCIENCES
INSTITUT DE FRANCE

2025 February 5th meeting on the International Year of Quantum Science and Technology

Exploring the Quantum World

Société Française de Physique
Académie des Sciences

Exploring the Quantum World
Round table

Organizers : **Christophe Salomon** French Academy of Sciences
Elisabeth Giacobino French Physical Society

Participants :
William Phillips : Professor at the Joint Quantum Institute, University of Maryland, National Institute of Standards and Technology (NIST), USA
Gerd Leuchs : Professor at the Max Planck Institute of Light, (Nürnberg Erlangen), Germany, President of Optica
Luiz Davidovich : Professor at Universidade Federal do Rio de Janeiro, former President of the Brazilian Academy of Sciences, Brazil
Keith Burnett : former Vice-Chancellor of the University of Sheffield, Chair of the Institute of Physics (IOP), UK
Klaus Richter : Professor at the University of Regensburg, President of the Deutsche Physikalische Gesellschaft (DPG), Germany
Shoji Hashimoto, Japan Physical Society, Japan
Jean Dalibard : Professor at Collège de France, member of Académie des sciences, France
Jacqueline Bloch : CNRS Research Director, Center for Nanosciences and Nanotechnologies, member of Académie des sciences, France
Silvina Ponce Dawson : Professor at the University of Buenos Aires, Argentina, President of the International Union of Pure and Applied Physics (IUPAP)

William D. Phillips
Joint Quantum Institute
National Institute of Standards and Technology
University of Maryland
Laboratory for Physics Science

Technology, and especially quantum technology, has a global history, a global flavor, and a global connectivity.

Historically, half of the STEM jobs in the US are filled by people born elsewhere.

The first quantum revolution provided technology enabling connections between people in the most remote parts of the earth.

The challenges of making the 21st century technology of the second quantum revolution available globally are much the same as those for 20th century technology. Some features deserve special attention.

- Recruit young people into quantum-connected studies.
- Train AND Educate.
- Avoid Hype (the young people we want are not stupid).
- Use IYQ to share the excitement of quantum.

Importance of Quantum for society and for facing world challenges

Recent scientific results and applications

Gerd Leuchs

quantum → probabilistic, uncertain

how is it possible to get meaningful results ???

- true random number generation
- key distribution
- quantum internet

q-communication

- quantum entanglement - strict correlation

- biological sensing
- gravitational wave detection
- imaging

q-metrology

- quantum uncertainty reduction

- meaningful results
- massive parallel computing in one processor – in special cases
  - structure of large molecules
  - factoring large numbers
  - … & others, whenever the superposition survives the projection by measurement

q-computing & simulation

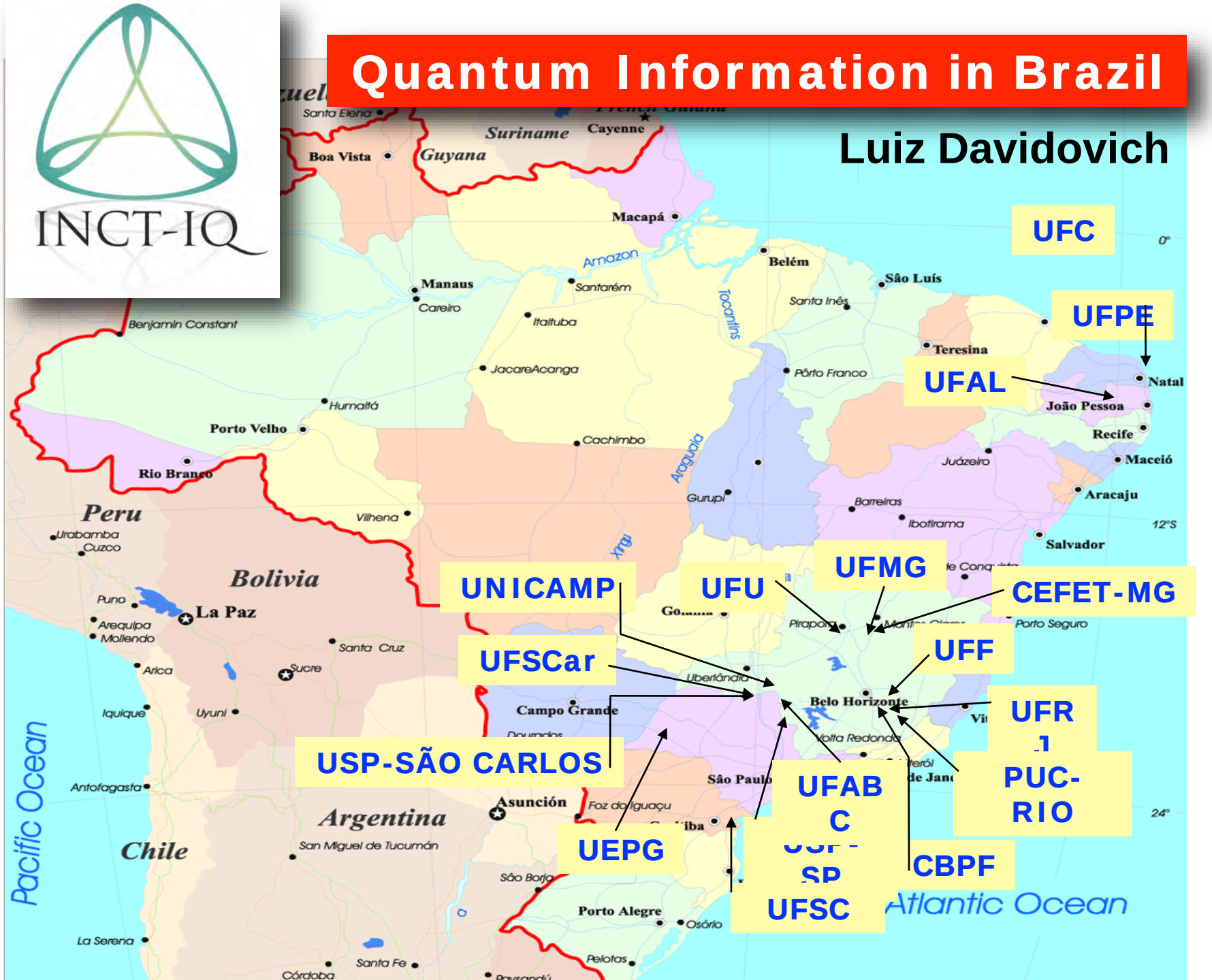
- massive superposition

many ideas in their infancy such as quantum battery

Quantum science and technologies around the world

Quantum Information in Brazil

INCT-IQ



120 PI's
20 higher-education institutions
1 research center
Strong collaboration

Quantum in undergraduate courses
Talks for the general public
Social media

Quantum initiatives: Federal government and State governments (FAPESP)

Problem: Growing international protectionism in this area

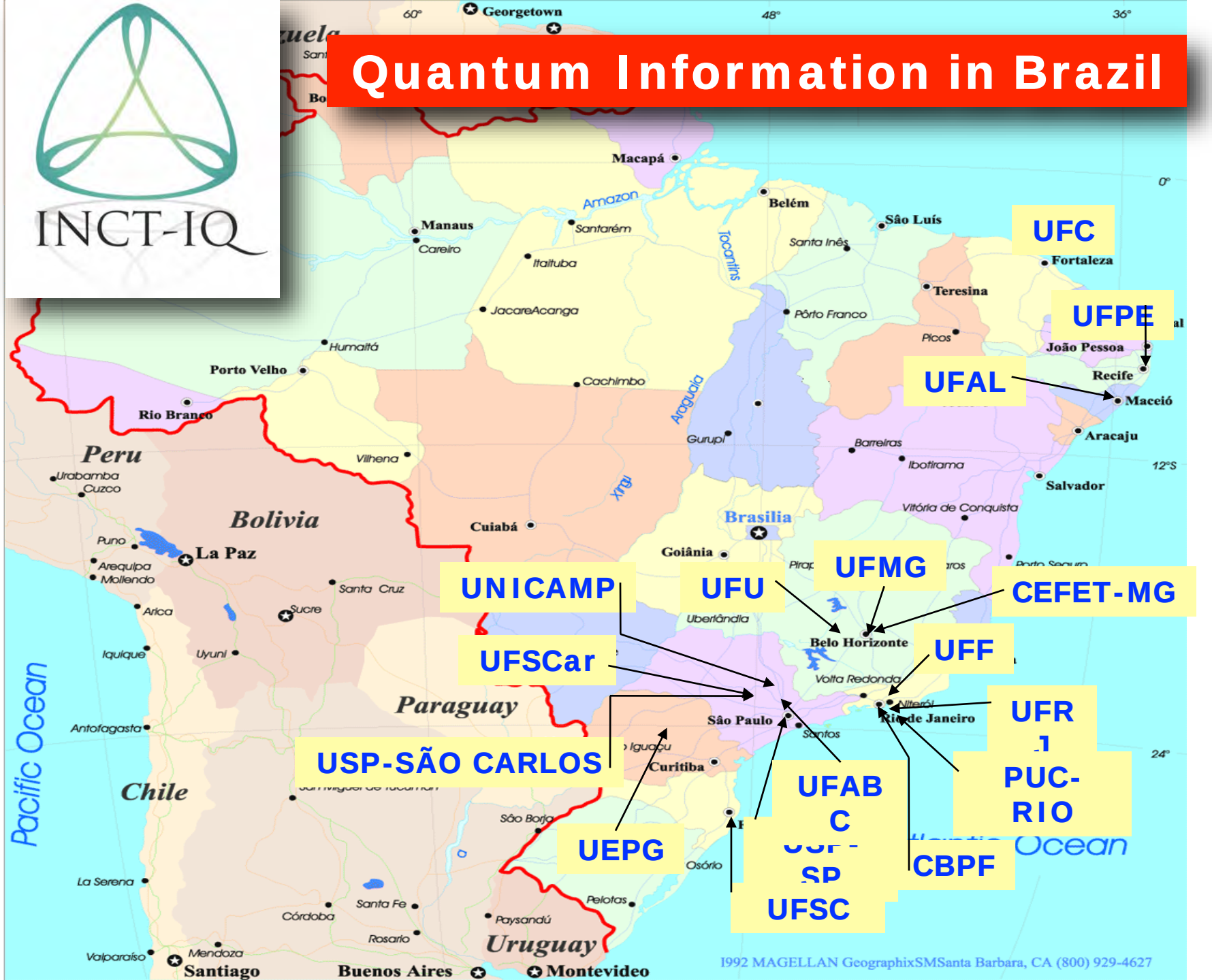
Why Constraints Are Good for Innovation

by Oguz A. Acar, Murat Tarakci and Daan van Knippenberg

November 22, 2019

Quantum Information in Brazil

INCT-IQ



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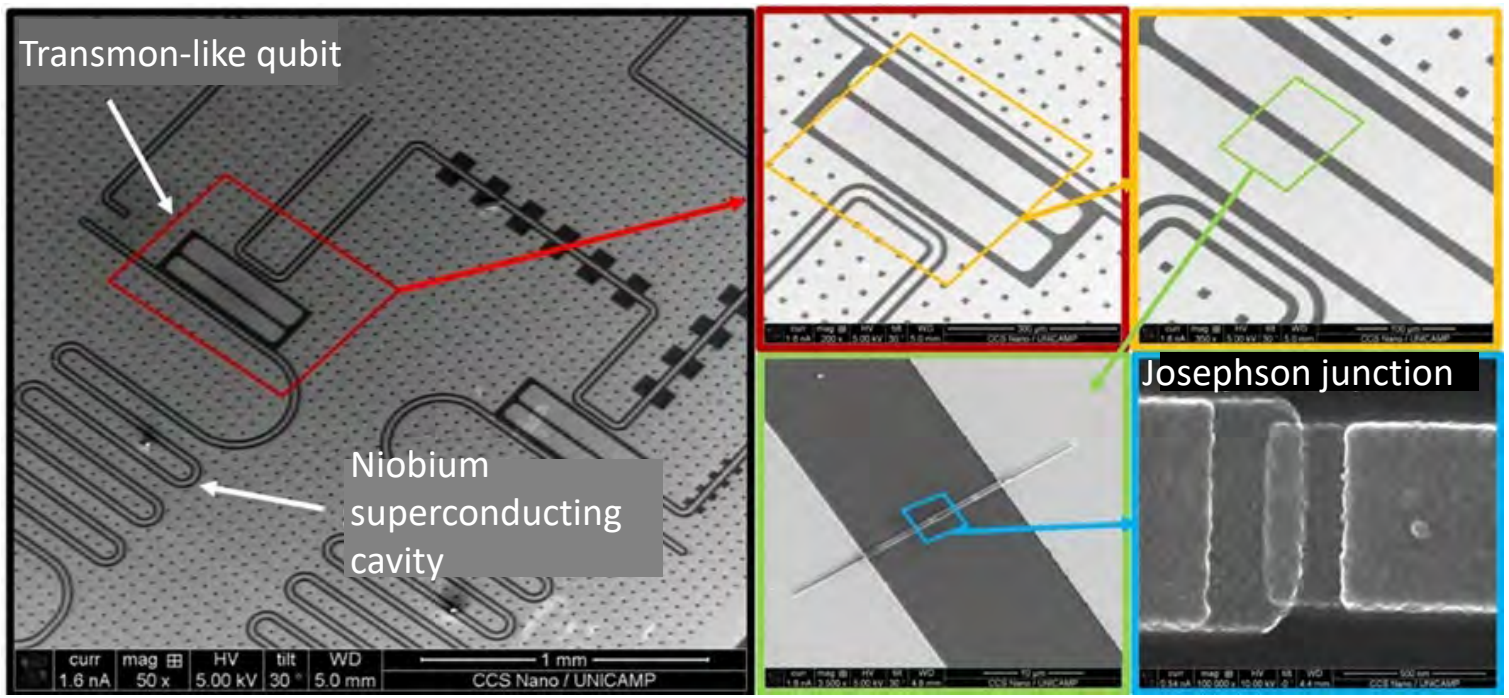
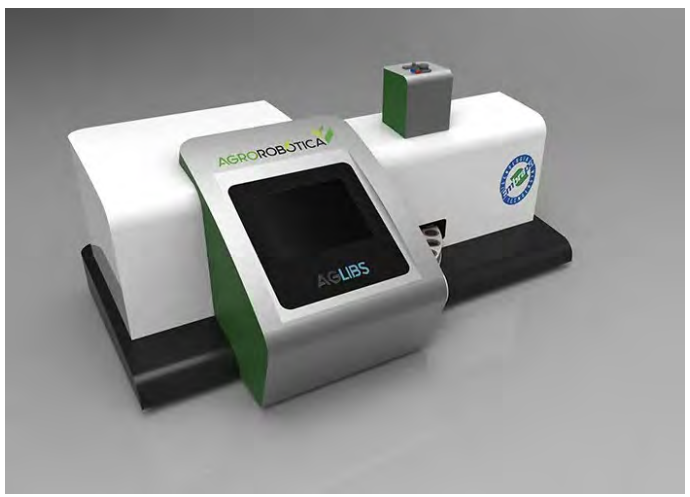
Ian Bremmer (President of Eurasia Group) at Davos (2025): "Constraints are not obstacles, they are catalysts for a new generation of innovation that could completely redraw the map of technological power." **Less than one week after this statement: DeepSeek**


Transmon-like qubit
Niobium superconducting cavity
Josephson junction
curr 1.6 nA
mag 50 x
HV 5.00 kV
tilt 30 °
WD 5.0 mm
1 mm
CCS Nano / UNICAMP


AGROROBÓTICA
AGLIBS

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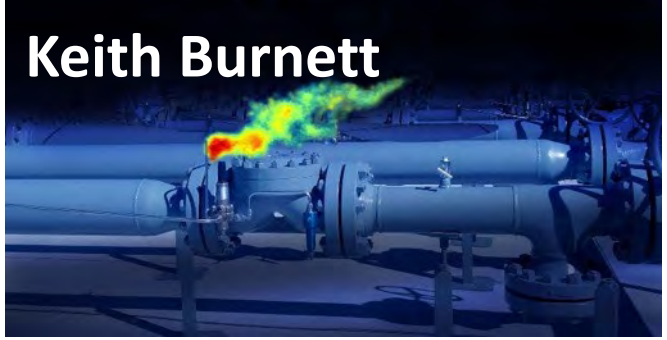
Real world UK and Ireland applications, tackling some of our greatest challenges

Measuring emissions and greenhouse gases more accurately than ever before

QLM Enabling Net Zero



University of BRISTOL

Wearable brain scanner with better sensitivity and lower cost

cerca Magnetics Limited

The University of Nottingham

Putting quantum technologies in space to secure future communications

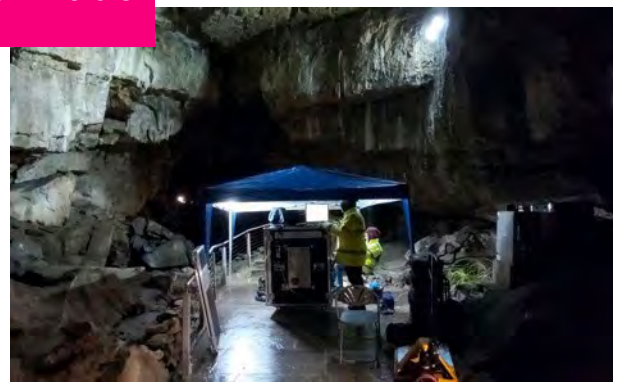
INNOVATIVE

UNIVERSITY of York

Gravity gradient sensor 'seeing' the invisible underground

RSK

UNIVERSITY OF BIRMINGHAM

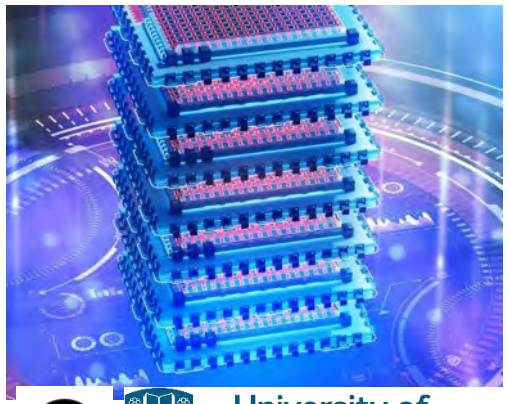


First commercial trial of a quantum secured communications network in the world

TOSHIBA

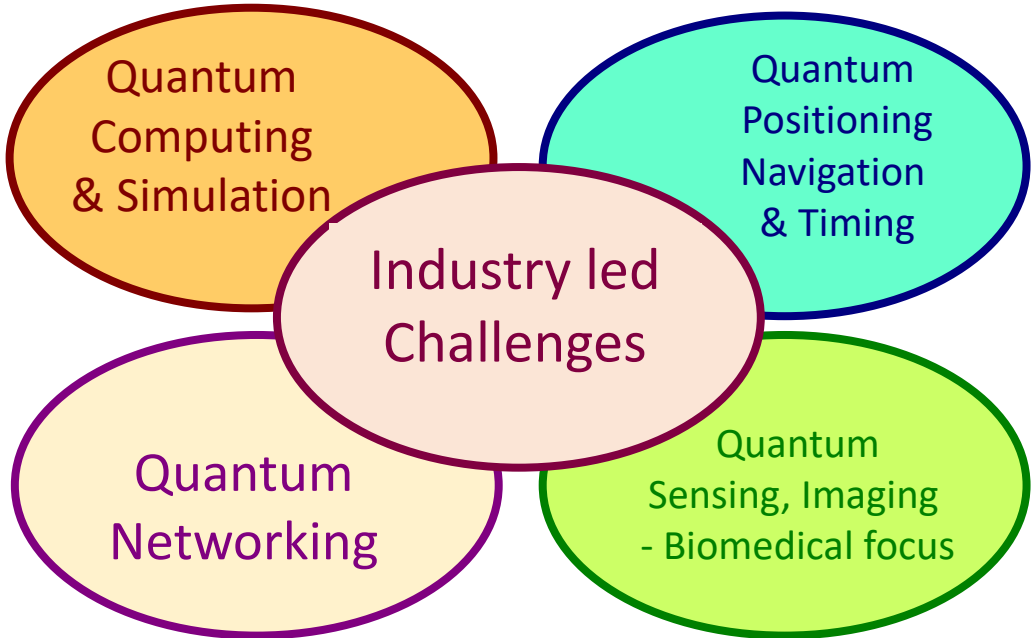
UK NATIONAL QUANTUM TECHNOLOGIES PROGRAMME

Creating the 'Data Centre of the Future', integrating quantum and classical systems



ORCA Computing

University of Southampton



The IYQ can build momentum!

INTERNATIONAL YEAR OF Quantum Science and Technology

That's why we are aiming to use the international year to:

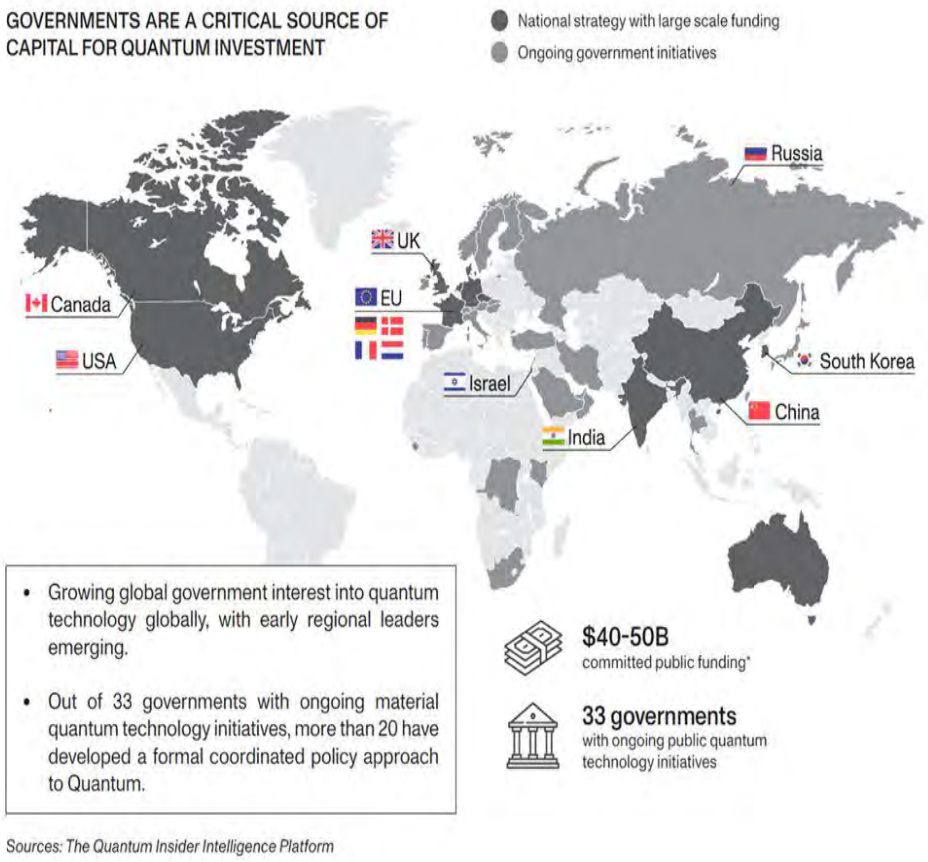
- **Energise the community through celebration**
- **Intrigue and excite more people from more backgrounds to join us**
- **Maintain political and policy momentum by raising awareness of the opportunities and risks**

As well as

- **Strengthening international partnerships to better explore this fast-developing science and technology.**

IOP Institute of Physics

World investment



German Physical Society (DPG)

Klaus Richter

I. Quantum science as basis of key technologies in the 21st century:

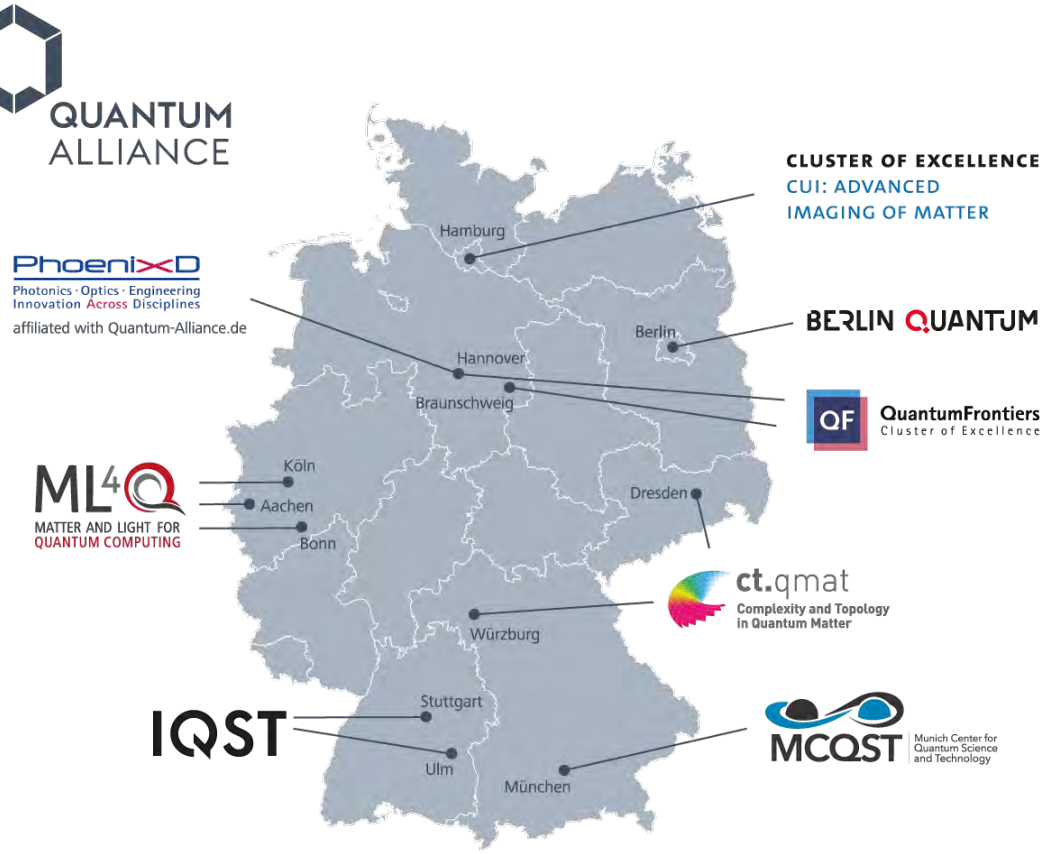
- 1st "quantum revolution": is still enabling others such as renewable energies, AI, …
- 2nd "quantum revolution": changes the way we think about information, computing, measurement and matter

II. Future quantum technologies presumably change our world once again:

- evolution instead of „revolution" …
- even after 100 years, quantum physics remains a field with untapped potential

III. Science is called upon to accompany new developments in quantum technologies responsibly

German Physical Society (DPG)



Quantum in research:

Germany: Quantum Alliance

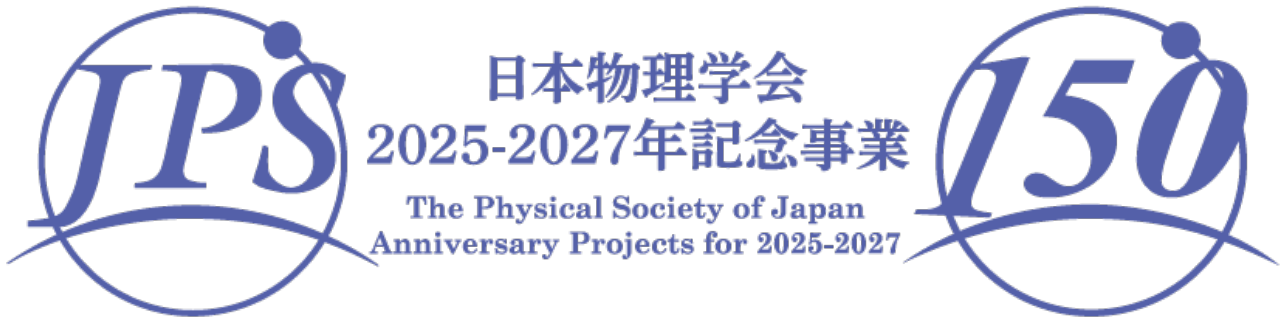
Consortium of *Clusters of Excellence* and research centers working in quantum science and technology

Quantum in education:

fascination with quantum physics as a trigger for interest in physics

Quantum activities in Germany:

www.quantum2025.de



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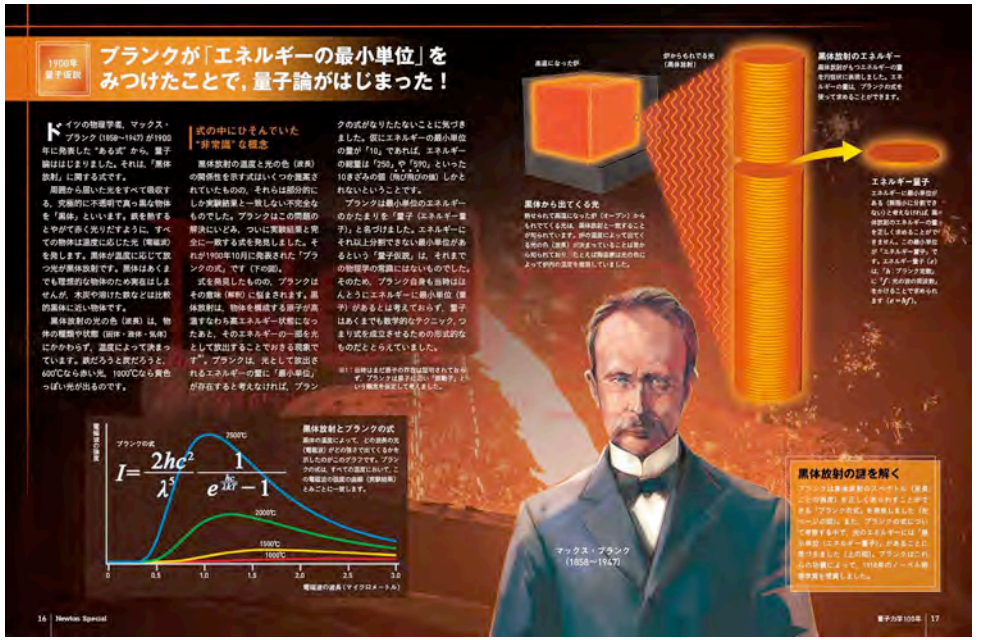
INTERNATIONAL YEAR OF
Quantum Science
and Technology

1877 ~ : 東京数学会社 (Tokyo Society of Mathematics)
1946 ~ : 日本物理学会 (Physical Society of Japan)

Shoji Hashimoto (KEK)
Vice president of JPS



Japanese science magazine editorial supervision by JPS

Symphony “Consciousness”
Conductor: Yannick Page, Orchestra: N’SO Kyoto
+ public lectures

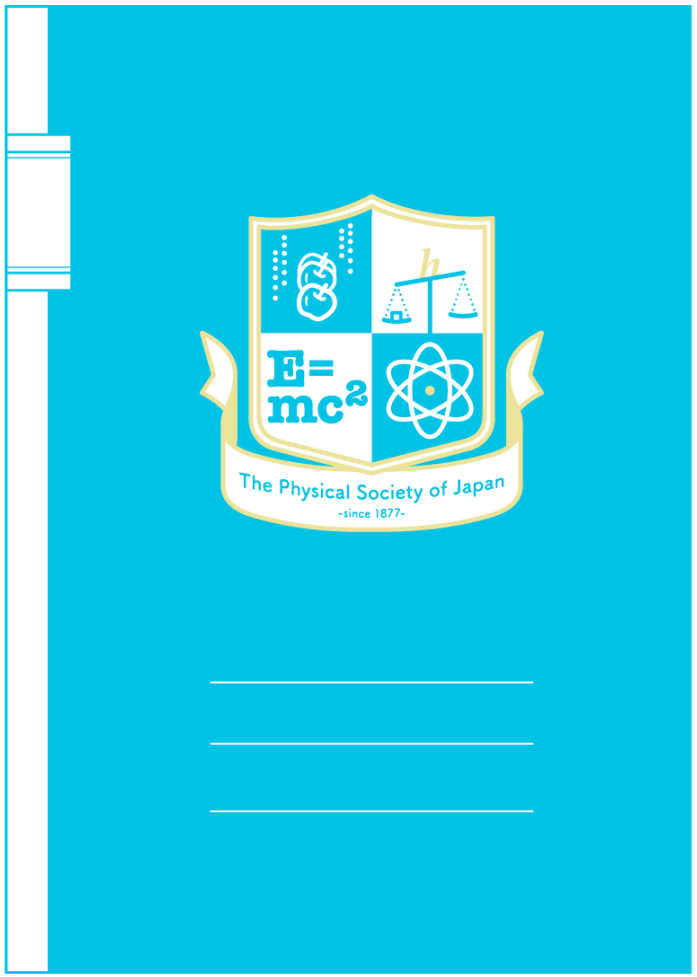
June 14-15, 2025
@ Miraikan

Sponsored by JPS

Also at Osaka EXPO 2025:
sponsored by MEXT

karuta (card game)

JPS notebook



JPS also initiating

- Peace declaration in collaboration with German Physics Society
- National “Physics Day” : now under voting
- National “Physics Heritage”
- Online “Physics Quiz”

JPS board members

Jean Dalibard, French Academy of Sciences

Three wishes

Demystifying Quantum Science for the general public

Immense intellectual adventure, enormous impact since 1950's

Revisiting the teaching of Quantum Science

Different publics, different expectations

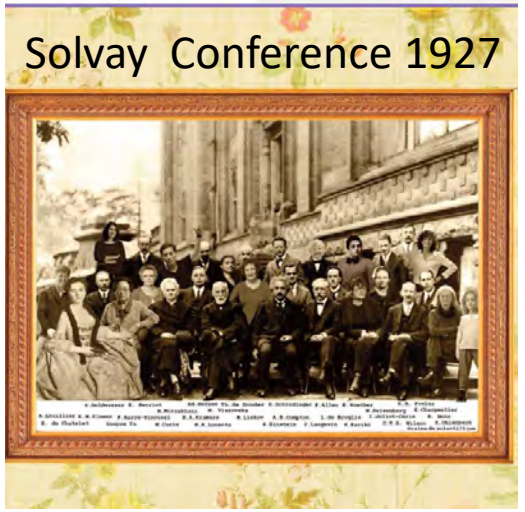
Distinguishing between promises, hopes and dreams

Ensure progress without overhyping speculative possibilities (leading to disillusionment)

The importance of quantum for the society and for facing world challenges

Jacqueline Bloch

- Quantum Mechanics is essential to understand electronic and optical properties of materials and conceive devices (transistors, solar cells, efficient light emitting diodes for lighting….)
  Importance for Novel sustainable materials and devices



- Explaining the impact of quantum mechanics for the ecological transition (not only via quantum computers) could trigger **vocations for physics** and quantum mechanics among the youngest generation, and in particular **female students**.

- Explaining modern physics provides citizens with tools for understanding the word, developing critical thinking when facing fake news

Quantum and society, some thoughts

Silvina Ponce Dawson, UBA & CONICET, Argentina

President, International Union of Pure and Applied Physics

The **quantum divide**: multiple interpretations (individuals engaged in QST development and those who are not; gap between quantum scientists and society; division between those with access to QST and those without)

Actions that can be taken to reduce this divide at various levels

Science education (middle-high school level): embed notions of quantum science in new curricula (including ethical aspects). Share experience worldwide (make tools widely available, translated into various languages).

Outreach (target: middle-high school students): collaborative projects, competitions, etc, that illustrate quantum concepts and/or highlight the impact of QST on daily lives

Departamento de Física .UBAexactas EXACTAS .UBA CONICET IUPAP

Outreach activities for the general public (rebuild trust, “fight” weird uses of the concept of quantum: not very easy).

Popularization of QST (literature, liaise with journalists, etc).

Contribute with capacity building in targeted areas of the world; create conditions to share equipment, computer facilities, etc; offer the possibility of having international collaborative projects, etc.

Best practices: clear code of conduct guaranteeing diversity, inclusion and equality.

Thank you!

Importance of Quantum
for society and for facing world challenges

- **Industry, Infrastructures and Economic Growth**

Developing **new materials** that drive technological innovation
Future infrastructures will be secured by **quantum information**.

- **Biology and Health**

Quantum photonics is advancing medical imaging and diagnosis.
Quantum chemistry is supporting the development of new vaccines and drugs.

- **Climate Action**

Quantum sensors for environmental monitoring; quantum computers to improve the long-term climate models.

- **Clean Energy**

More energy efficient **solar cells** and low emission LED **light sources**.

The future of Quantum Science and Technologies in the society

- Demystifying Quantum Science for the general public

Better education and outreach

- Reduced Inequalities

Open science and gender equity in education and research will ensure that quantum solutions are accessible to all.

- **Ensure progress without overselling speculative possibilities**

Expected progress for quantum communications and quantum computing