Orsay – 2/12/2019

Quantum & cea.fr

- Quantum flagship and beyond
- Quantum computing @ cea

Philippe CHOMAZ

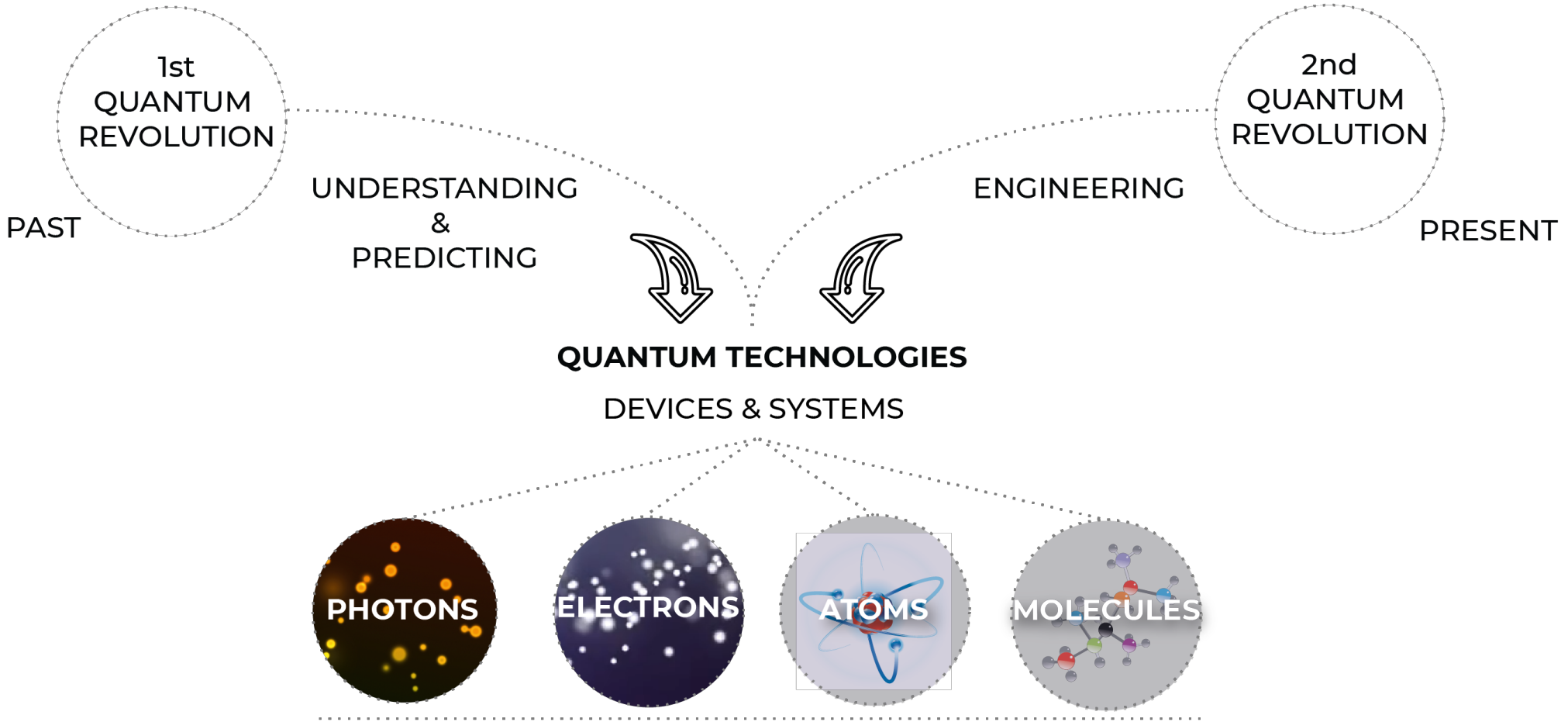
CEA

QUANTUM

CEA strongly involved in Quantum Flagship

CEA strongly involved in Quantum Flagship

What are Quantum Technologies?



Develop and engineer quantum resources

Superposition, Non-locality, Entanglement

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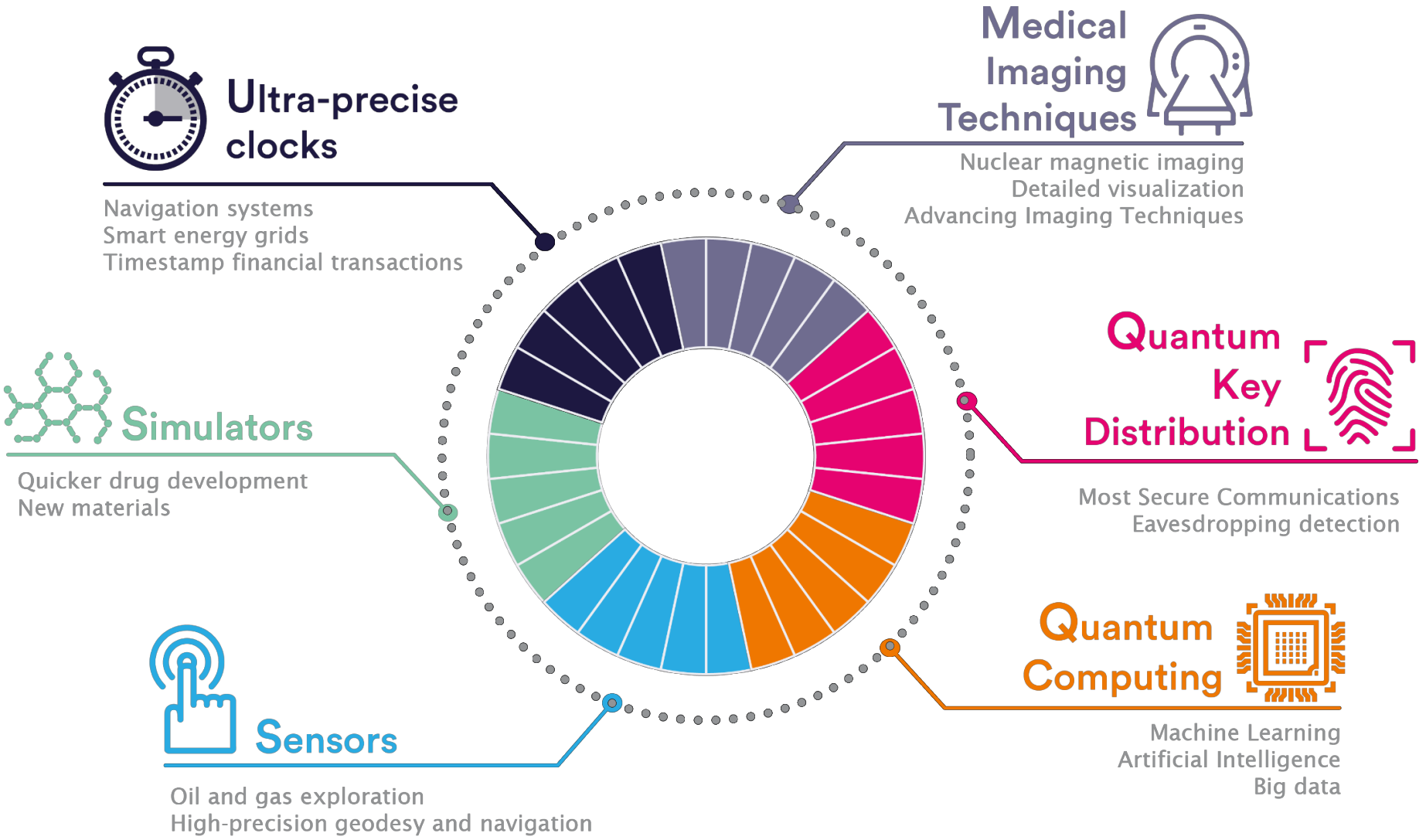
Quantum Technology applications



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European Quantum Fleet

RESEARCH BASED

HORIZON 2020
2014-2020

erc

MARIE CURIE ACTIONS

QUANTERA

Give **funding support** to **international research projects** in the field of Quantum Technologies

HORIZON EUROPE

HORIZON EUROPE
2021-2027

QUANTUM FLAGSHIP

Bring quantum **technologies** from the **lab** to the **market** and consolidate European scientific **leadership** in quantum research

INFRASTRUCTURES

EUROPEAN QUANTUM SENSING AND METROLOGY INFRASTRUCTURE (EuroQSM)

Build and **deploy** dedicated **measurement services** for quantum devices and support the creation of **globally accepted standards**

DIGITAL EUROPE

QUANTUM COMMUNICATION INFRASTRUCTURE (EuroQCI)

Build and **deploy** in the next decade a certified secure pan-European end-to-end QCI for **cyber-security services**

QUANTUM COMPUTING AND SIMULATION INFRASTRUCTURE (EuroQCS)

Build and **deploy** an infrastructure for big data, artificial intelligence, high performance computing, among others

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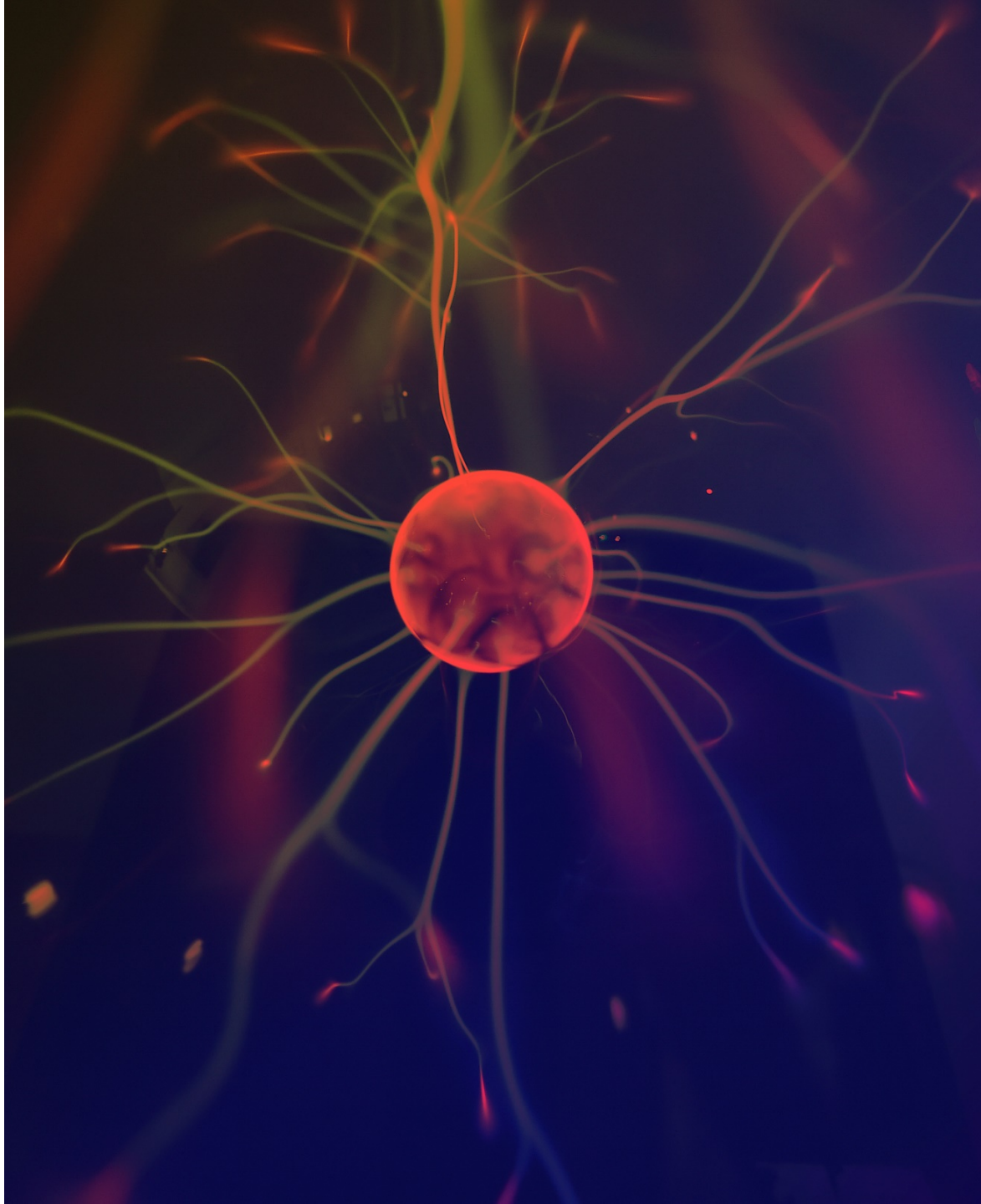
Quantum Flagship

- **Time**
  Decided in 2016, launched in 2018 for 10 years

- **Goal**
  Bring quantum technologies from the lab to the market by developing technologies and open research facilities in Europe

- **Method** Bring together academia, industry and policy makers, in a collaborative initiative on an unprecedented scale, flagship budget for 10 years: 1 B€



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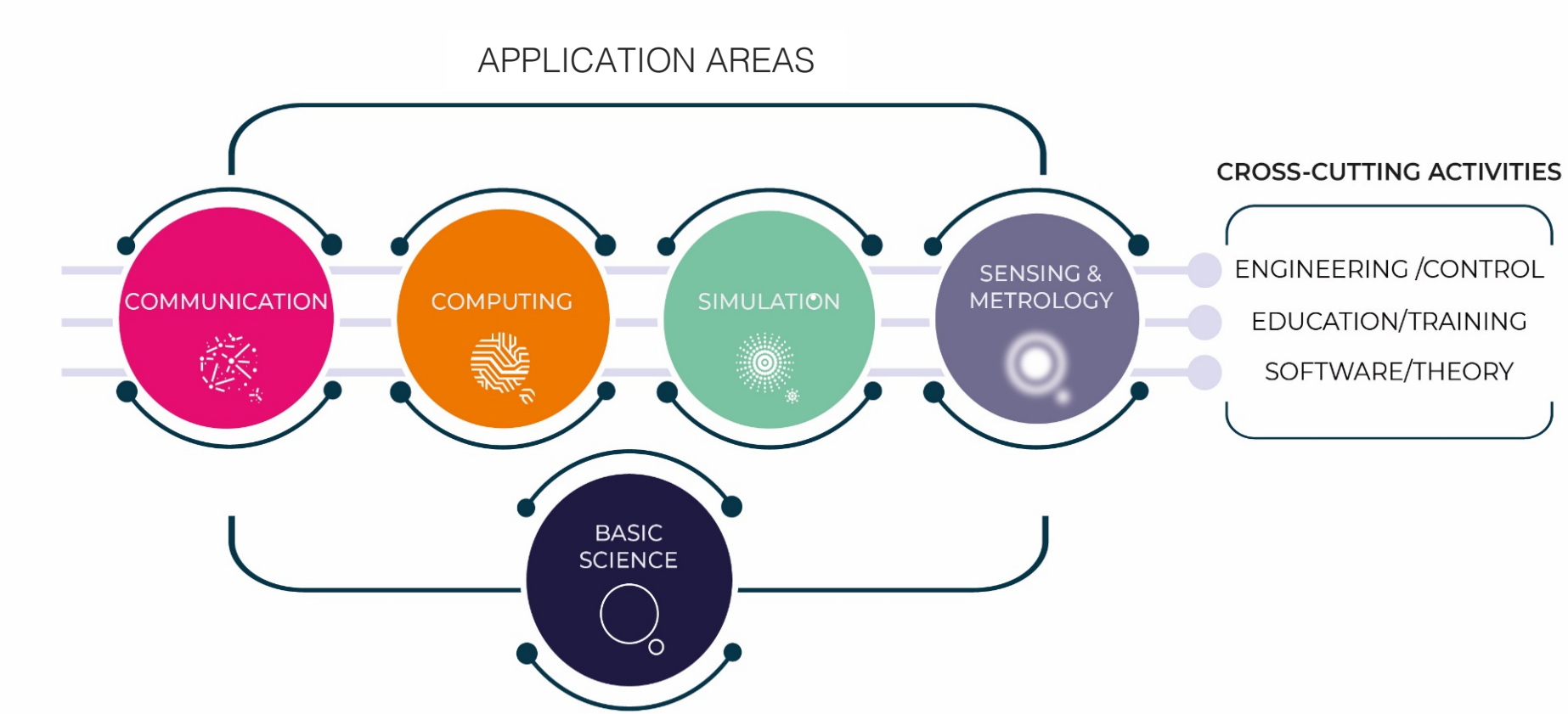
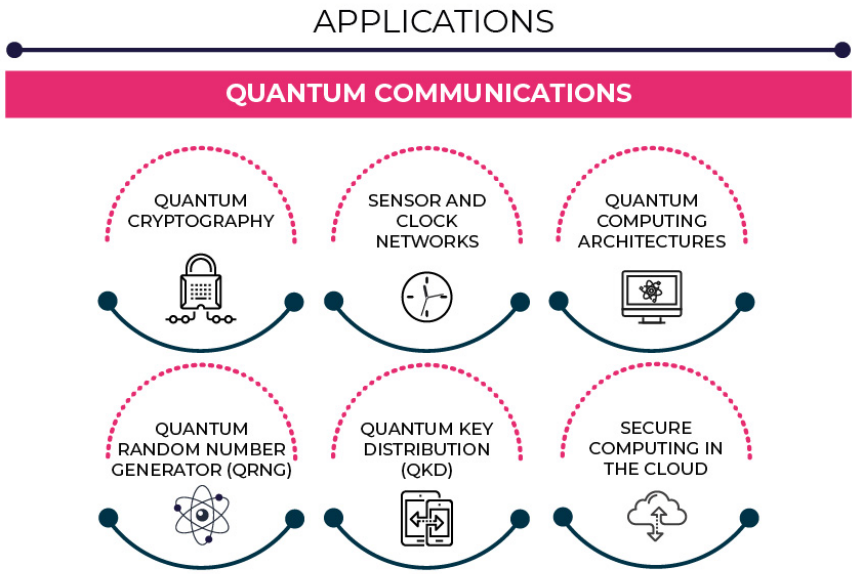
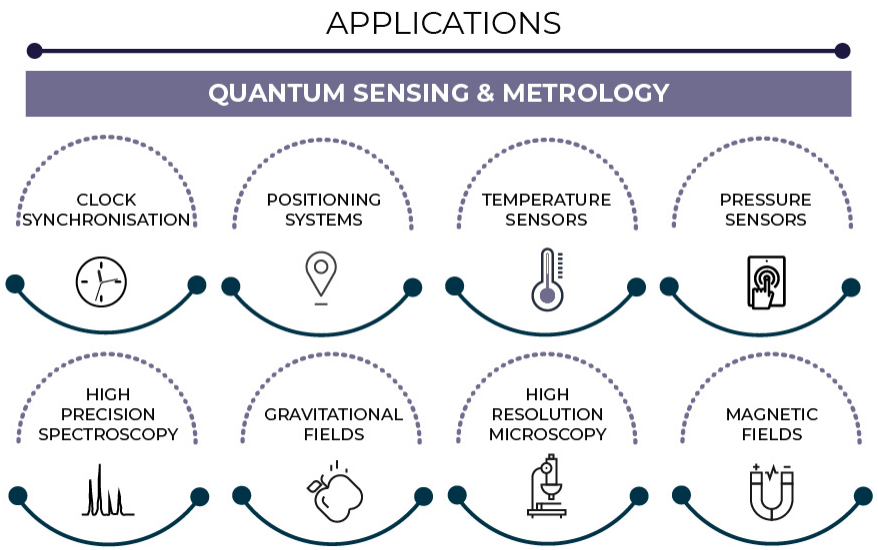
The Quantum Flagship
Structuring activities & efforts



Application Areas

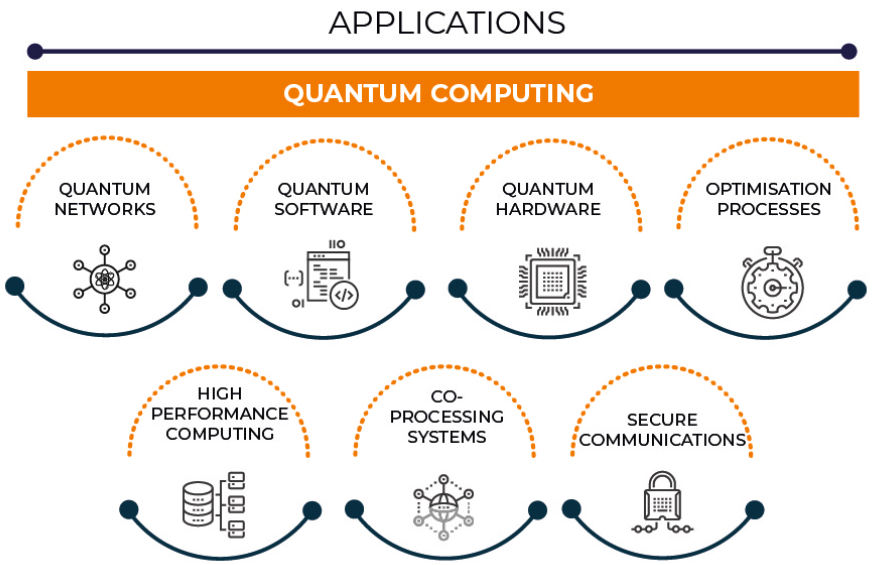


Quantum communication will build on the current digital infrastructurye to distribute and connect quantum resources for improved security and functionality. This will address challenges such as the long-term security of health records, to connected quantum clock networks and eventually enabling secure connection to quantum computers in the cloud.

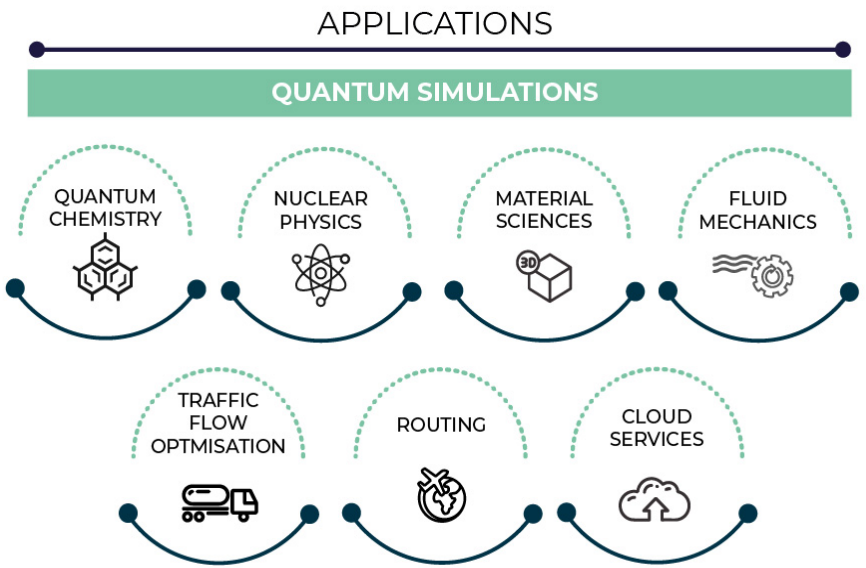


The second Quantum Revolution will result in quantum sensors that outperform existing sensors in many aspects, such as size, operating environment, sensitivity, specificity, statistical or systematic uncertainty, traceability, calibration intervals, lifetime, power consumption, reliability, or security, unleashing a wealth of novel applications.

Application Areas



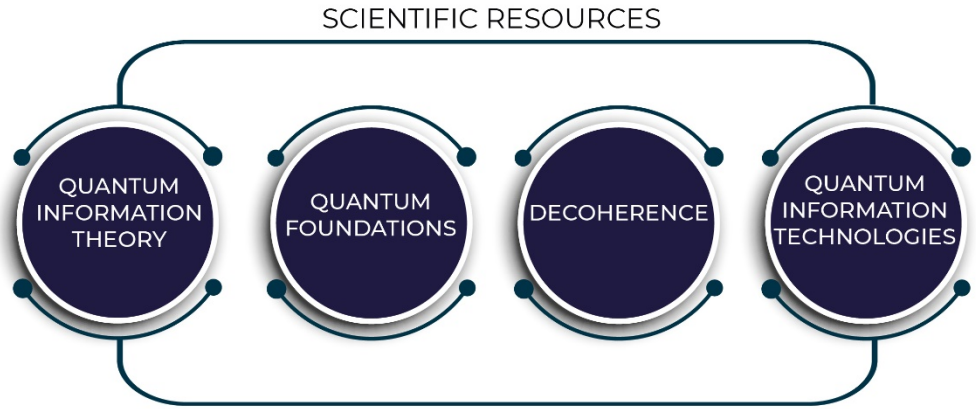
Quantum computers have the potential to solve tasks that we don't even dare dream of today and that classical computers can never solve. Completely new solutions for drug development, material design or areas such as financial services and transport will be possible.



Quantum simulators promise novel insights into strongly correlated quantum matter and at the same time offer near-term perspectives of tackling computational problems on quantum devices without quantum error correction.

Scientific & Technological Resources

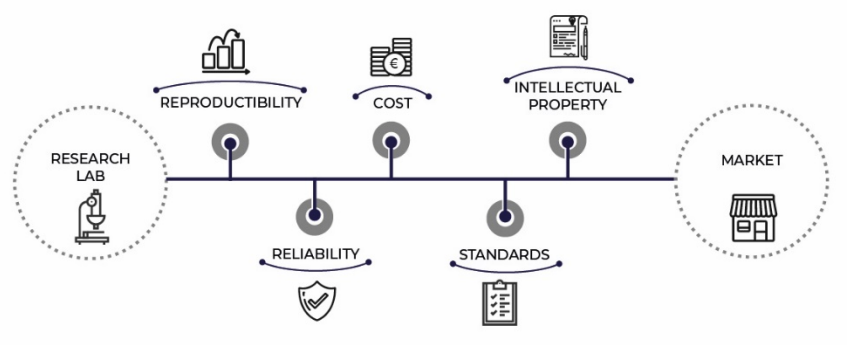
The Scientific and Technological Resources area can provide maximum flexibility for the attribution of scientific and technological resources: on the scientific side, it provides an “entrance door” for new ideas or themes, and on the technology side, it exploits synergies and sharing of resources.



Complimentary and Enabling Initiatives

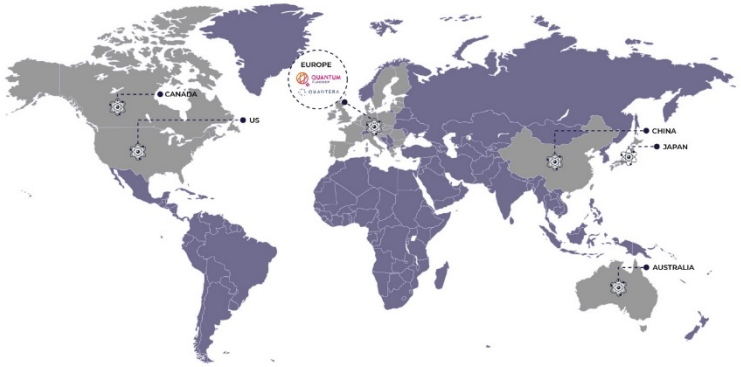
Innovation & Infrastructures

Addressing the challenges of scaling up from lab to products and services, raising awareness and bringing key stakeholders together, are all essential to develop the dynamic innovation ecosystem that will put Europe at the forefront of the emerging quantum technologies industry.



International Cooperation

Quantum technologies have a huge potential for innovation that may revolutionise the information economy. Europe can play a leading role through strategic international cooperation to develop competitive collaborations that represent a win-win for Europe and the field.

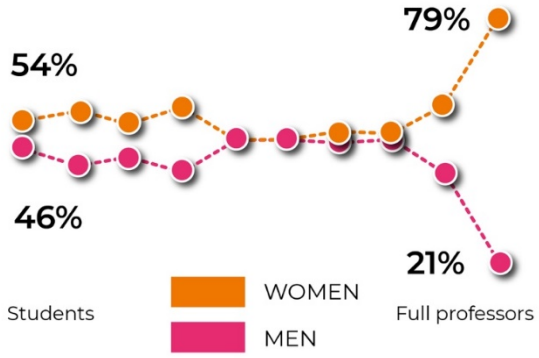


Education

The creation of a learning ecosystem embracing the concepts of quantum physics at all levels ranging from school up to the working environment is required, not just for a quantum-ready workforce to emerge, but for a well-informed society with knowledge and attitudes towards the acceptance of quantum technologies.

Gender Equality

Tackling the challenges of equality, equity and inclusion in the quantum technologies domain as we begin to structure this emerging industry represents a timely opportunity. In particular, the impact of the participation of women generally contributes to increasing the quality, societal relevance and competitiveness of research and innovation.



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US-EU cooperation on Quantum technologies

US-EU cooperation on Quantum technologies

1	First discussions (telCo) beginning of 2019
	First joint declaration of mutual will to increase QT collaborations
2	September 3rd and 4th US-EU Meeting in Washington
	Common strategic document about Opportunities for EU-US cooperation in quantum technologies

September 3rd and 4th US-EU Meeting in Washington

U S - E U P a r t i c i p a n t s

- Strong attendance
  - Many US agencies represented

EU Academic Attendees	
Philippe Chomaz	CEA Paris-Saclay
Rob Thew	University Geneva
Frank Wilhelm-Mauch	Saarland University
Lieven Vandersypen	QTech, TU-Delft
Thomas Monz	Innsbruck University
Andreas Wallraff	ETH, Zurich
Eugene Polzik	Niels Bohr Inst., University of Copenhagen
Vladimír Bužek	Inst. of Physics, Slovak Academy of Sciences
John Bagshaw	Independent Technology Consultant
Trevor Cross	Teledyne e2v (England)

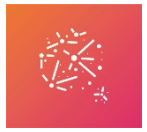
US Academic Attendees	
Ken Brown	Duke University
Margo Ginsberg	Duke University, QI Group
Christopher Monroe	University of Maryland
Paul Kwiat	Grainger College of Engineering, Illinois
Liang Jiang	University of Chicago
Margaret Martonosi	Princeton University
Mark A Eriksson	University of Wisconsin-Madison
Mark Saffman	Univeristy of Wisconsin-Madison
Mark Kasevich	Stanford University
Nathalie de Leon	Princeton University
Rob Schoelkopf	* Yale University

EC and EU Government Attendees	
Thomas Skordas	Dir. Digital Excel. & Science Infra, DG Connect, EU
Pascal Maillot	Deputy Head, HPC & QT Unit, EU
Tommaso Calarco	Dir., Inst. Quantum Ctrl, P. Grünberg Inst., DE
Freeke Heijman	Special QT Adv, Min. Eco. Aff. & Climate Pol., NL

US Organization Attendees	
Kent Rochford	CEO of SPIE
Ed White	Committee Chair of National Photonics Initiative
David Steuermann	Kavli Foundation
David Lang	OSA
Elizabeth Rogan	CEO of OSA

US Government Attendees	
Jake Taylor *	OSTP
Alexander Cronin	OSTP
Corey Stambaugh	OSTP
Merin Rajadurai	STATE
Tomasz Durakiewicz	NSF MPS
Denise Caldwell	NSF MPS/PHY
Claire Cramer	DOE ASCR
Nasser Barghouty	NASA SCaN
Gretchen Campbell	NIST
Barbara Goldstein *	NIST
Michael Hayduk	DOD AFRL
Thomas Walsh	FBI
Brad Blakestad	ODNI IARPA
Charles Tahan	UMD LPS
Michael Metcalfe	UMD LPS
Roberto Diener	DOD ONR
Grace Matcalfe	DOD AFOSR
TR Govindan	DOD ARO

Common strategy for EU-US cooperation in QT



Quantum Communication

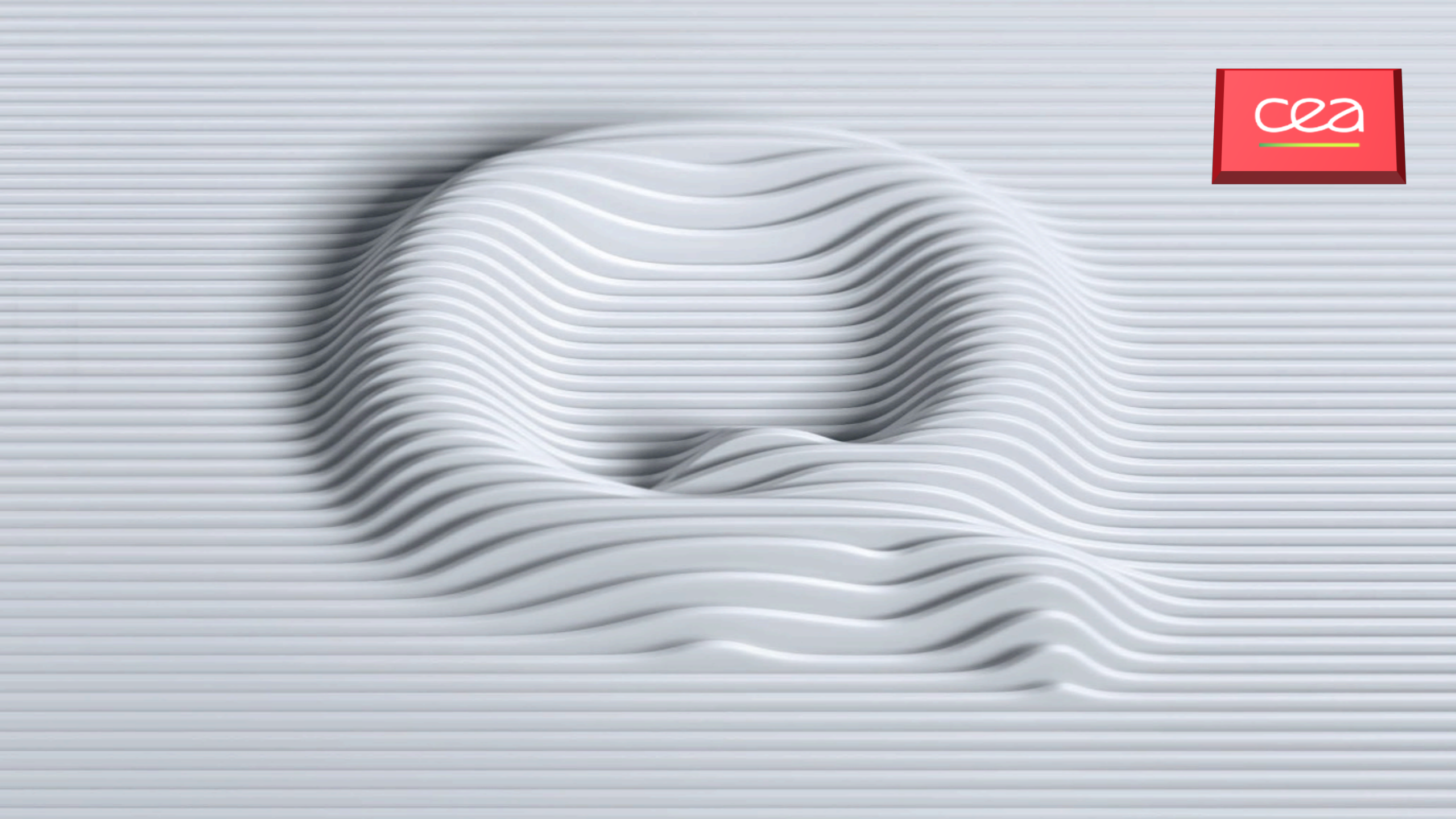
Enabling transatlantic quantum networking by a US-EU coordinated action on common **quantum protocols** to connect EU and US quantum networks and on constructing **quantum repeaters** to allow long-distance transmission of quantum resources

Quantum Computing & Simulation

Accelerating the development of quantum computers by sharing developments in enabling sciences and technologies on both ends of the value chain: on one side the **quantum hardware fabrication** and materials and on the other end the **quantum algorithms** and applications

Quantum Sensing & Metrology

Developing nanoscale devices and innovative sensors capable of achieving **ultimate performance** based on increasing quantum complexity such as entanglement and strengthening international collaboration to **use them in basic research in physics, chemistry, biology and medicine**



Ordinateur quantique : le CEA mise sur le silicium

SCIENCES. L'organisme public de recherche a présenté sa stratégie en matière d'informatique quantique. Il privilégie la compatibilité avec l'informatique classique.

DÉCOUVERTE INNOVATIONS

Un ordinateur quantique de 100 qubits sera conçu à Grenoble !

Le CEA de Grenoble associé au CNRS, ont reçu 14 millions de fonds européens pour concevoir l'ordinateur quantique le plus puissant du monde.

Publi-Rédactionnel - Publié le **27 novembre 2018** à 9:03 - *Mis à jour le 8 août 2019 à 23:50*

— SCIENCES —

Ordinateur quantique au silicium : des millions pour le projet QuCube à Grenoble

ACTUALITÉ

Classé sous : QUBIT , ORDINATEUR QUANTIQUE , DÉCOHÉRENCE

Laurent Sacco
Journaliste

Publié le 03/11/2018

Communiqué de presse | **Focus** | Informatique | Matériaux | Physique quantique | Technologies | Communications | Conception circuits intégrés | Nouveaux procédés de production industrielle

Un substrat en vue de la production en série de composants pour le calcul quantique

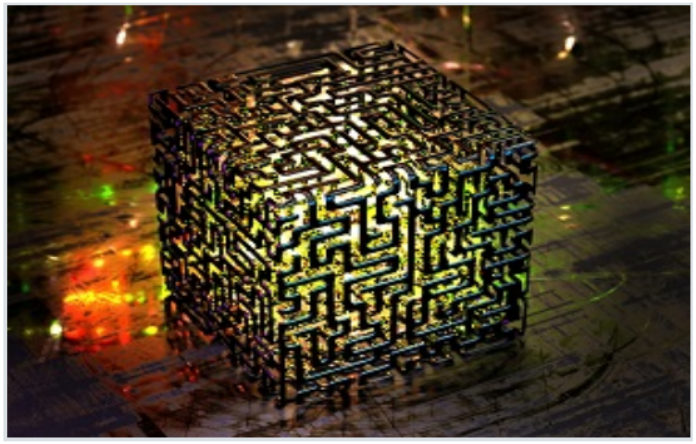
Jayet/CEA

Le CEA et ses partenaires ont mis au point un procédé pour obtenir des galettes de silicium enrichi en silicium 28 qui peuvent servir de support en vue de produire, en série, des milliers de boites quantiques. Cette étape esquisse un procédé compatible avec les chaînes de production industrielles aux normes CMOS.

Publié le 20 mars 2018

SCIENCE FONDAMENTALE POUR LES TECHNOLOGIES DE L'INFORMATION

Atos et le CEA lancent une chaire industrielle sur l'informatique quantique, avec le soutien de l'ANR



petit_NiPlot_iStock-841276142

Atos et le CEA inaugurent le 22 mai 2018 une chaire industrielle, co-financée par l'Agence nationale de la recherche (ANR), dans le but de développer la recherche et l'innovation en information quantique.

Publié le 22 mai 2018

Portée par Daniel Estève [1], la chaire industrielle, baptisée « Nasniq » (Nouvelle architecture de spins nucléaires pour l'information quantique),

Le CEA s'équipe d'un simulateur Atos au CCRT pour explorer le potentiel de l'informatique quantique pour l'industrie

(c) Atos

Le Centre de calcul recherche et technologie (CCRT), situé au centre CEA de Bruyères-le-Châtel, et Atos, leader international de la transformation digitale, collaborent pour mettre à disposition des utilisateurs industriels du CCRT un des simulateurs quantiques les plus performants au monde. La machine, construite par Atos, permettra à des partenaires comme EDF, Safran, l'IFPEN ou encore le CEA lui-même d'évaluer les potentialités des technologies quantiques pour leurs besoins.

Publié le 27 juin 2018

Quantum computing

Back to the ESNT page

June 12-14th
PROGRAM ProgramESNT_QC_NuclPhys_June19.pdf

Quantum computing and scientific research: state of the art and potential impact in nuclear physics

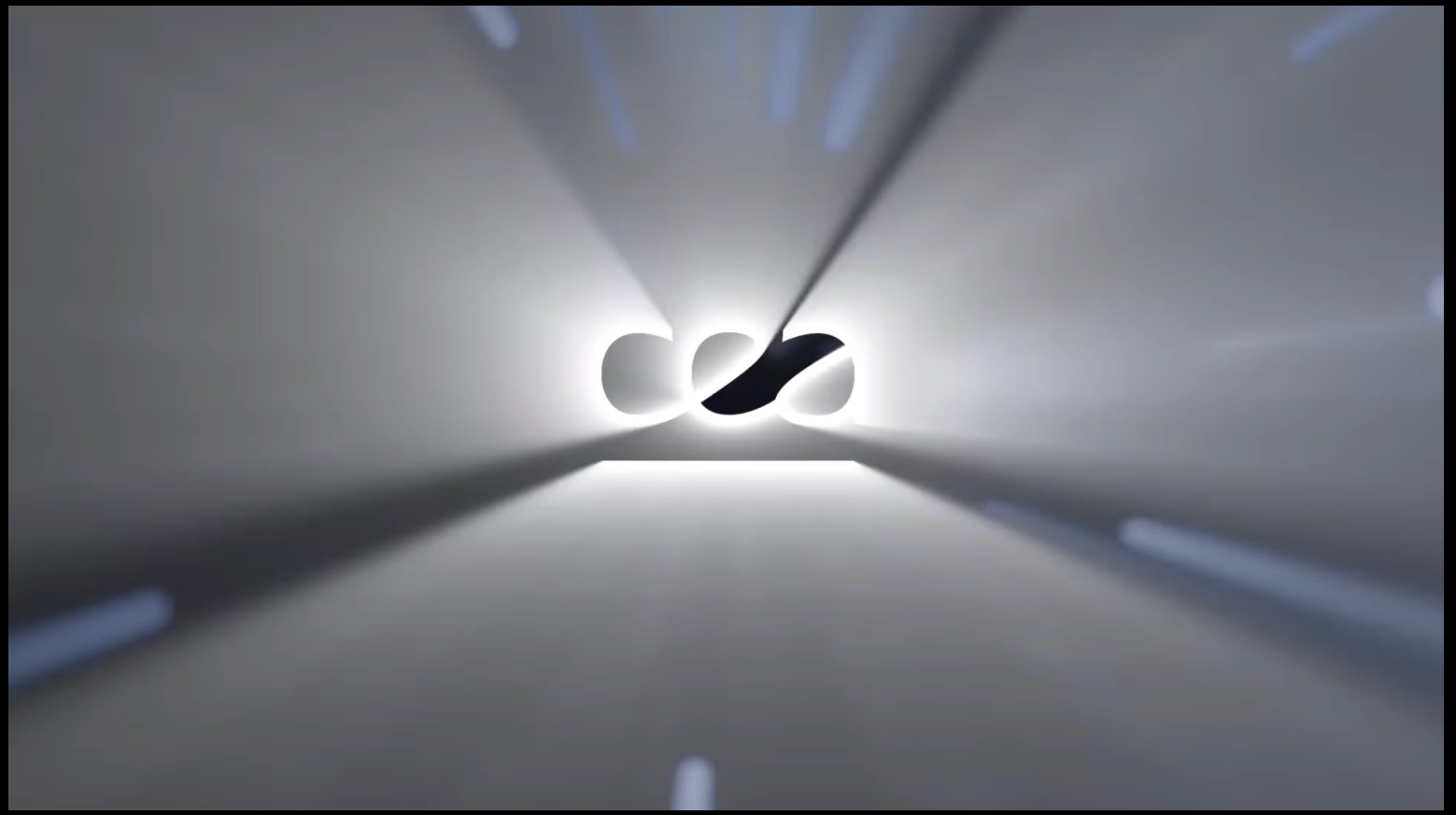
Organizers: T. Duguet (CEA-Saclay DPhN, contact), J.P. Ebran (CEA, DAM), D. Estève (CEA, SPEC; CNRS), V. Somà (DPhN, contact), A. Tichai (ESNT, contact)

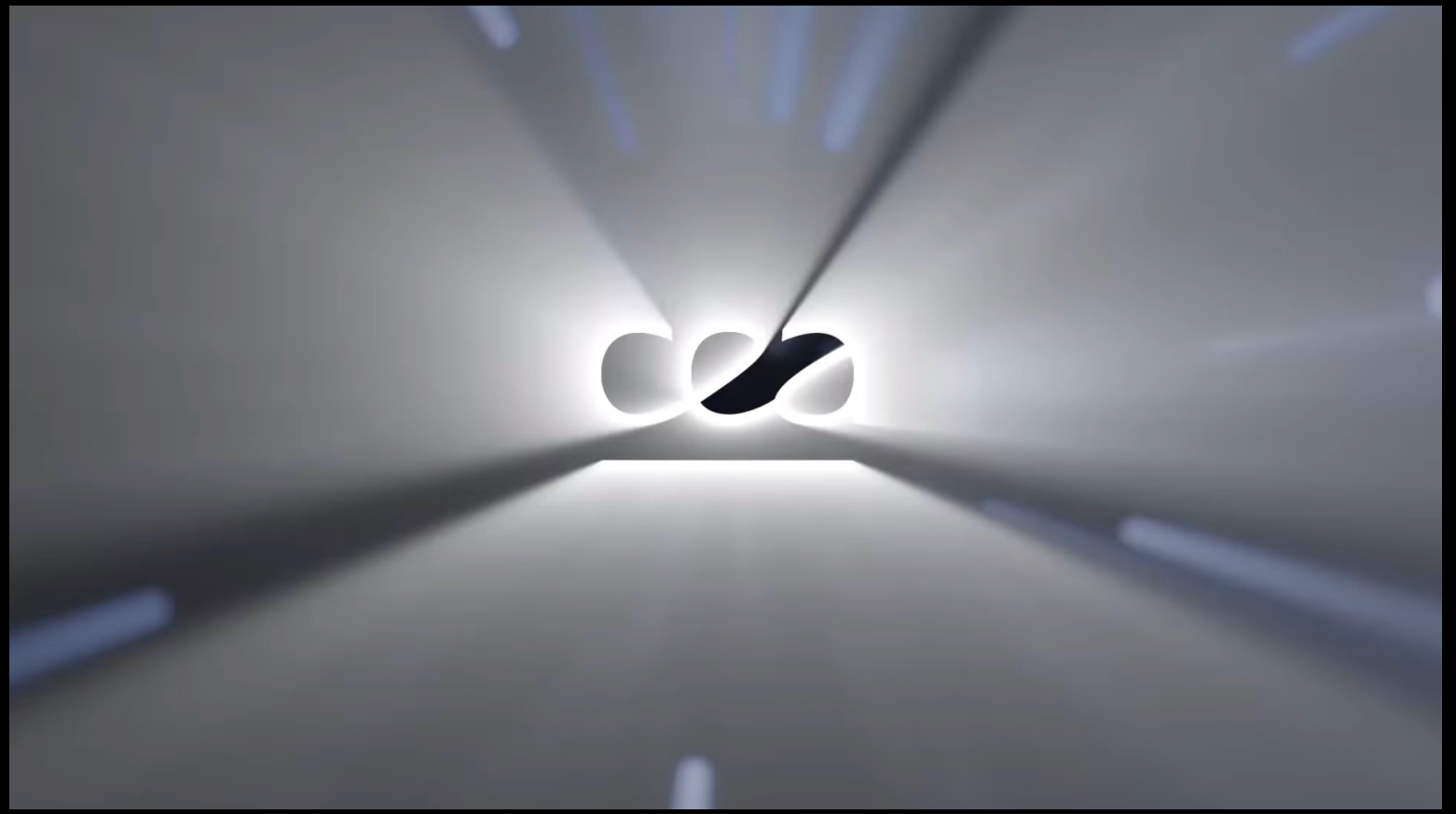
The main **goals of the workshop** are:
1. To inform/educate the local research community on the state of the art and near-future perspectives in quantum computing;
2. To examine the fields of scientific research where quantum simulations are expected to lead to important breakthroughs;
3. To review the progress in quantum algorithms and explore the potential interplay with quantum many-body formalisms;
4. To discuss potential impact of quantum simulations on nuclear physics research.

REFERENCES given during the workshop (and after): RefQuantumComputingESNTv2019v.pdf


JEU VIDEO
LE PRISONNIER QUANTIQUE
Une grande aventure au coeur des sciences et des technologies
cea


LE
PRISONNIER
QUANTIQUE
Vivez une
GRANDE
AVENTURE
au coeur des sciences
& des technologies
UN JEU VIDÉO GRATUIT
cea





Philippe CHOMAZ, 2019

QUANTUM
FLAGSHIP