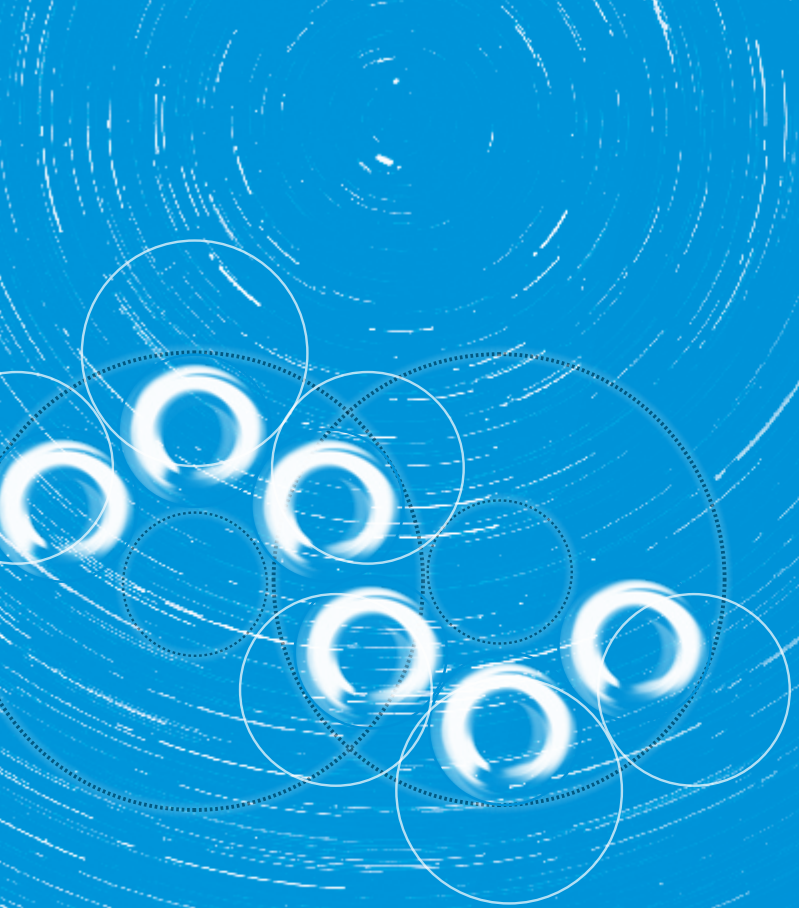


CO-SOCIETY#35

Enjoy Quantum!

What is the future impact in business?

MAY 14 2019

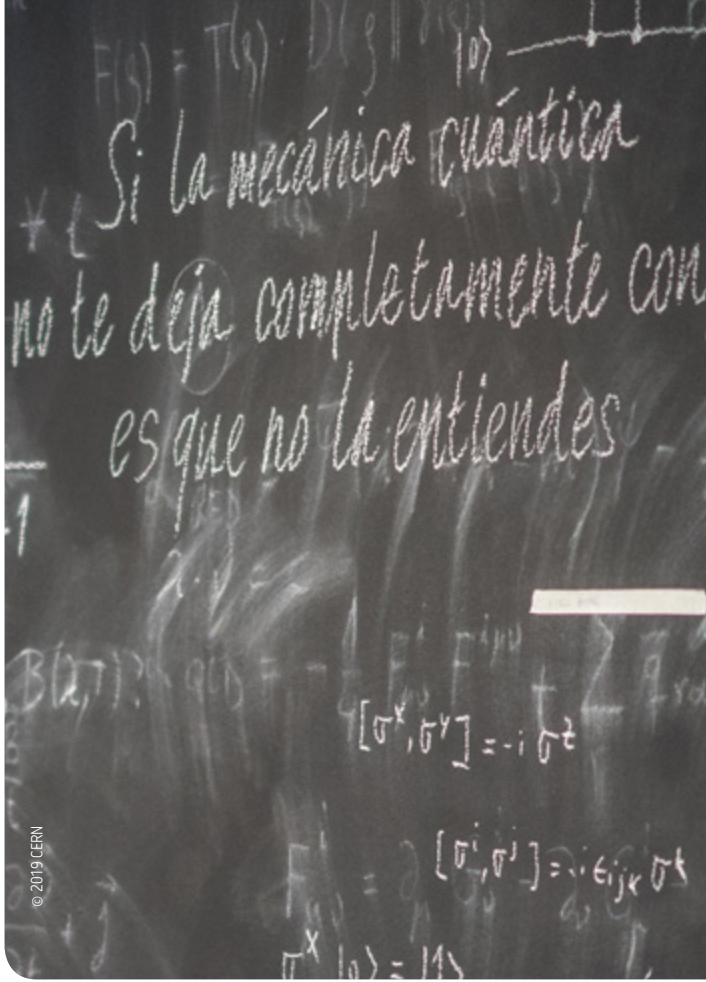
INSTITUTE OF NEXT
BARCELONA

Enjoy Quantum!
What is the future impact?

The Institute of Next, in collaboration with the Barcelona Contemporary Culture Centre (CCCB), invited restless professionals from different fields to reflect on how quantum will impact on their business models.

Quantum aims at understanding and questioning the physical world by inviting professionals to navigate, perceive, appraise and generate curiosity through the paradigms and shifting realities of modern science.

The Institute of Next's challenge is to become session curators so that the key concepts of quantum can be explained through guided visits, lectures and workshops to visualize scientific advances and future applications of quantum computing in different economic sectors.

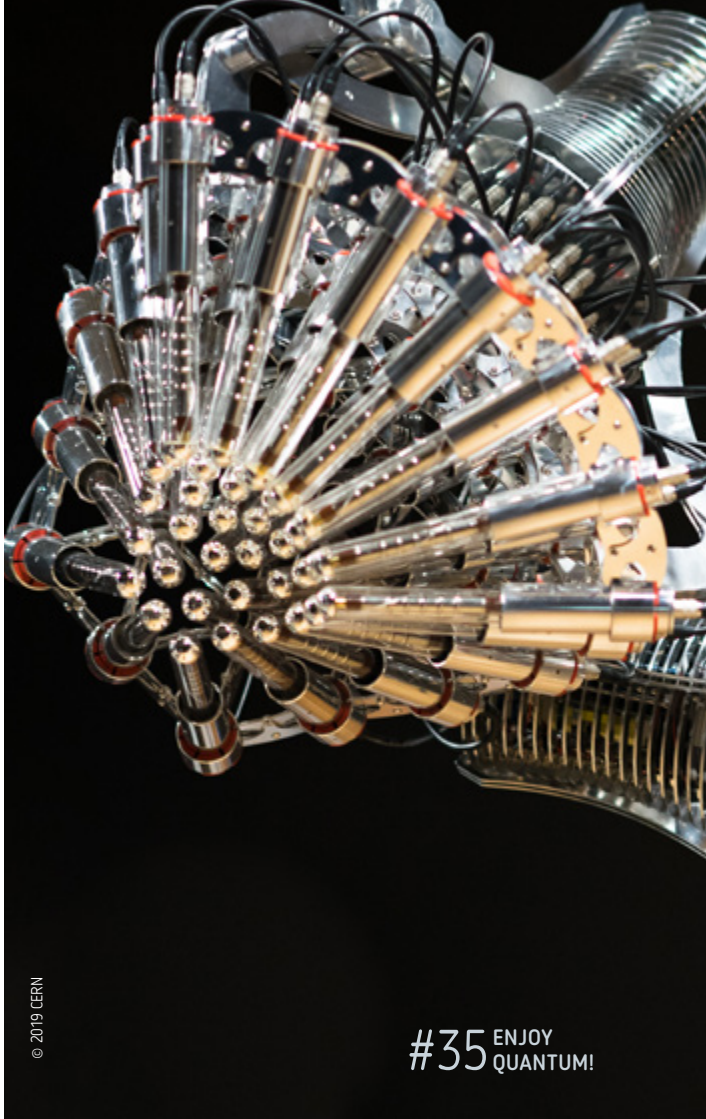


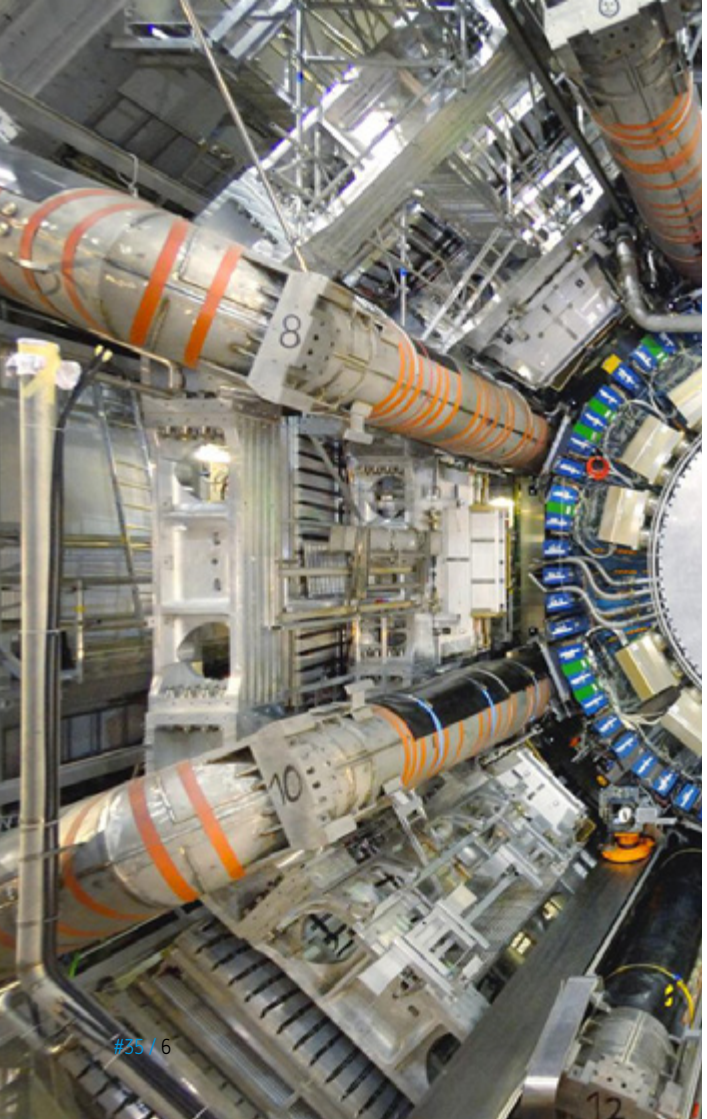
Understanding the nature

Fundamental physics' breakthroughs in technology and science over the last century have helped us to understand the nature of a **world that is hidden from our immediate senses** and that we can barely imagine now.

However, **the world described by fundamental physics defies common sense**, as many human and subatomic principles are mutually exclusive.

In order to understand the subatomic world, one needs to perceive that such domains are comprised of different properties.



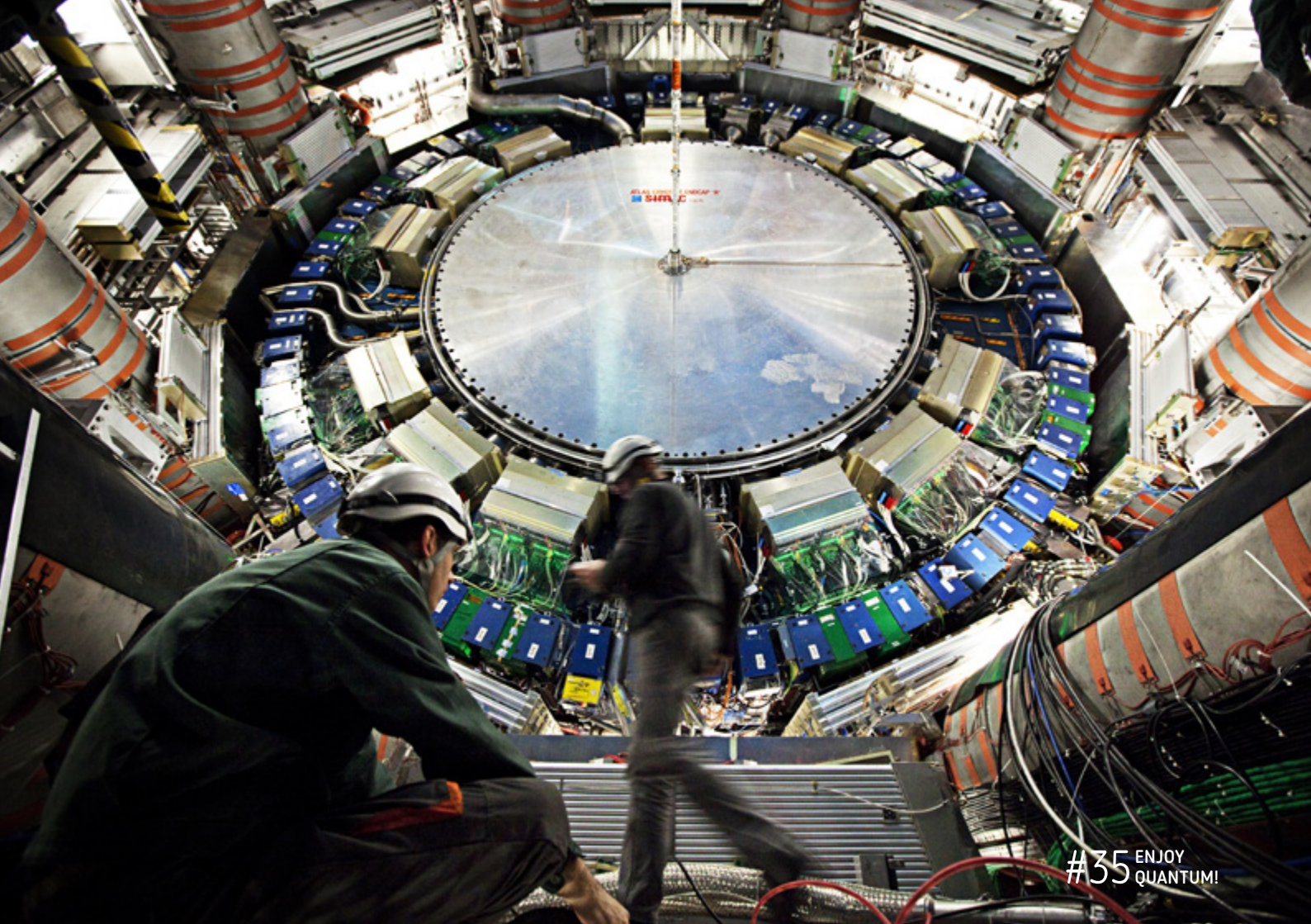


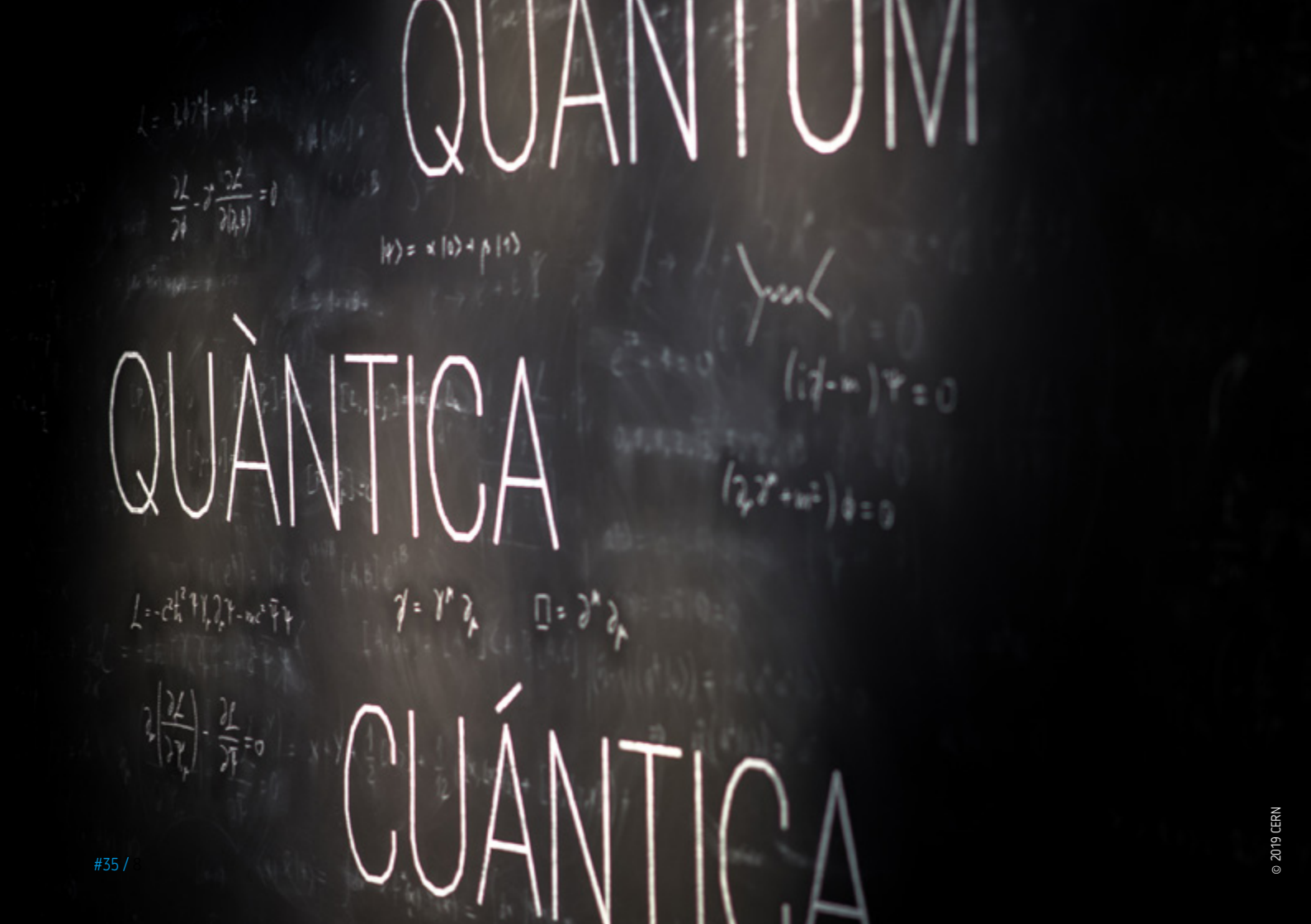
What is the universe made of?

Physicists at CERN are seeking answers, using some of the world's most powerful particle accelerators.

CERN is an eminent centre of science and technology with great relevance in the future society. It's home to the Large Hadron Collider (LHC) and the cradle of the World Wide Web.

Particle physics is CERN's focus field in order to understand **the basic structure of laws in nature**, all the way from the largest dimensions of the universe and the formation of galaxies and stars, to the smallest dimensions of the microcosmos.





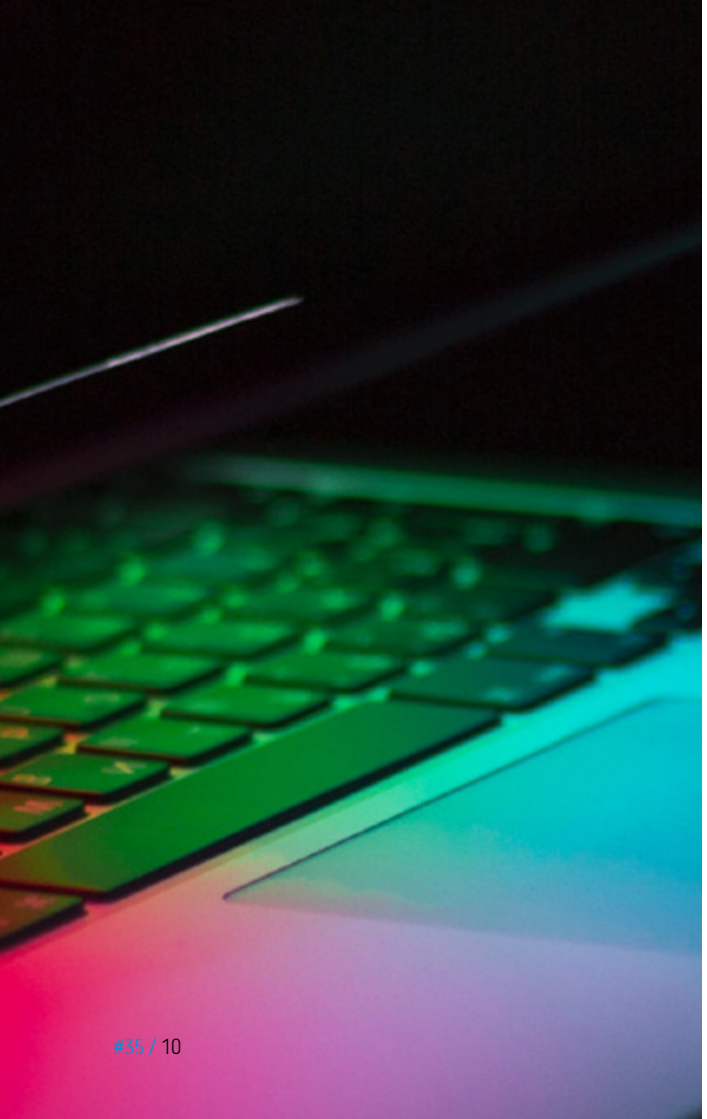
JOSÉ IGNACIO LATORRE

Scientific advisor for the "Cuántica" exhibition at the CCCB. Latorre has a PhD in the theory of quantum chromodynamics of elementary particles. He did his postdoc at MIT (Massachusetts, USA) and later at the Niels Bohr Institute (Copenhagen, Denmark). He's currently professor of Theoretical Physics at the University of Barcelona and long-term visiting professor at the Center for Quantum Technologies in Singapore. He has researched various areas of elementary particles, applications of artificial intelligence and quantum information theory. He is head of the Barcelona Supercomputing Center's Quantic group, which aims at building a quantum computer.

What is the future impact of Quantum?

This session was targeted at **health professionals with the aim of raising awareness about the different applications of quantum information and computing**; the ability to develop new products, services and processes in different fields, such as food, health and well-being; the acceleration in data processing based on new advances in quantum information, etc.

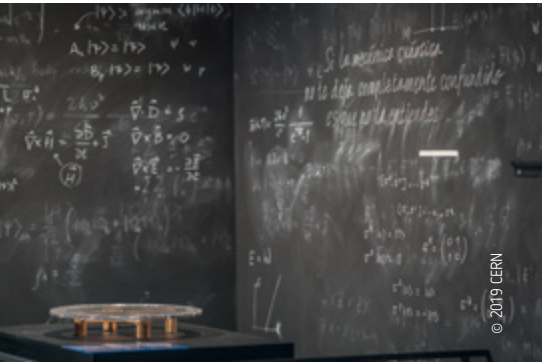
The event began with a guided tour of the "Cuántica" ('Quantum') exhibition at the Barcelona Contemporary Culture Centre (CCBB) by **José Ignacio Latorre**, the exhibition's scientific advisor.



What impact will it have on my business?

The challenge for the team at the Institute of Next was to design a workshop that would make it easier to ask and answer questions during the visit and to **understand the potential impact of quantum on each business sector**. The workshop was run by the two physicists of the team, **Josep Lluís Sànchez** and **Alfons Cornella**.

#35 ENJOY QUANTUM!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Sharing experiences

During the presentations, there was a question time that led to a wide-raging debate between the speakers and the attendees, who were anxious to know more about the topic and how it will impact the different activity sectors in the future.

Jorge Juan Fernández, head of innovation at ETI Health, shared with the attendees the first examples of quantum experiments applied to advanced medicine.

Silvia Avila, head of technology transfer at the ALBA Synchrotron, showcased different examples from the food and chemical industries that are currently conducting the first quantum experiments to solve problems related to materials based on particle acceleration in the Alba Synchrotron.

Carles Abellán, CEO of start-up Quside, explained how quantum components for connected devices are designed and manufactured and also talked about data security.

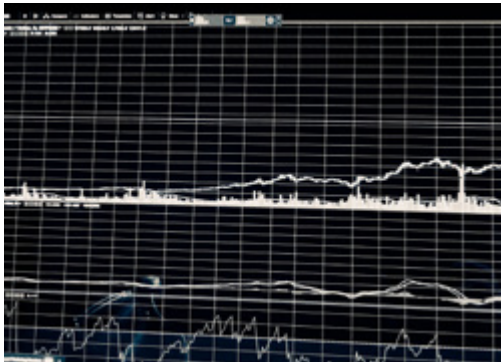
Artur García, from the Barcelona Supercomputing Center and the Qilimanjaro start-up, explained which are the new quantum computing services that are being offered to organizations and companies.

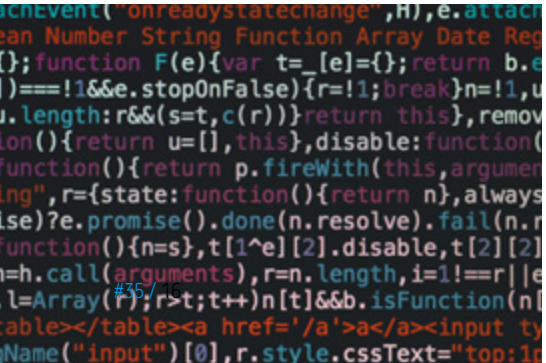
State of the art Quantum

The understanding of quantum physics that started in the first years of the 20th century has transformed the world. Much of the GNP of developed nations can be directly or indirectly linked to quantum effects (laser, GPS, semiconductors, etc.).

Now, we are entering a **second quantum revolution**, based on leveraging spooky natural effects, such as the superposition of states and the entanglement between particles. Among the disruptions and breakthroughs that we can expect for the next decade, we can remark **quantum computers, complex simulation machines, more secure communications and a new generation of sophisticated sensors**.

The promise of quantum computers goes along the need for machines able to perform more complex calculations and even calculations that are unmanageable with a classic computer. The complexity of these problems scales up quite rapidly (many times in an exponential way), such as with traffic optimization in cities, the simulation of complex chemical molecules or reactions, the optimization of financial trading strategies, or the prediction of financial crises. These are the sort of problems that not only require a new computing brawn but also a **new algorithmic approach to problems** (quantum-ready algorithms).

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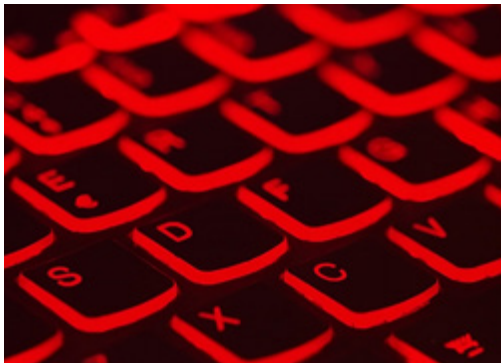

In terms of communications, the eventual emergence of quantum computers will bring along the cracking of current cryptographic systems, which will demand **new systems to enable secure transmissions** and transactions. The final goal would be an **unhackable communication system**, possibly based on the uncrackable entanglement of some particles (photons, electrons, etc.). Therefore, we have great expectations for the eventual quantum cryptography and the so-called q-Internet.

The second quantum revolution would also bring a new category of **high-precision sensors**. Firstly, more precise atomic clocks, enabling a more precise GPS system, which in turn would be the basis of better navigational instruments for autonomous cars. Those enhanced atomic clocks would make possible a new generation of gravity sensors (tiny variations of local gravity could be detected by the clocks, according to gravity-based time alteration). This means that the sensors could determine mass under them with unprecedented precision.

And secondly, the industrial applications of quantum effects could spread out quite rapidly. For instance, we could envision better quantum-based LED and photovoltaic cells, as well as a broad collection of sensors based on the idea of managing (trapped) single particles as very sensible sensors.

All across the world, many spin-offs and start-ups are working to transform the potential of quantum physics into new products and businesses.

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