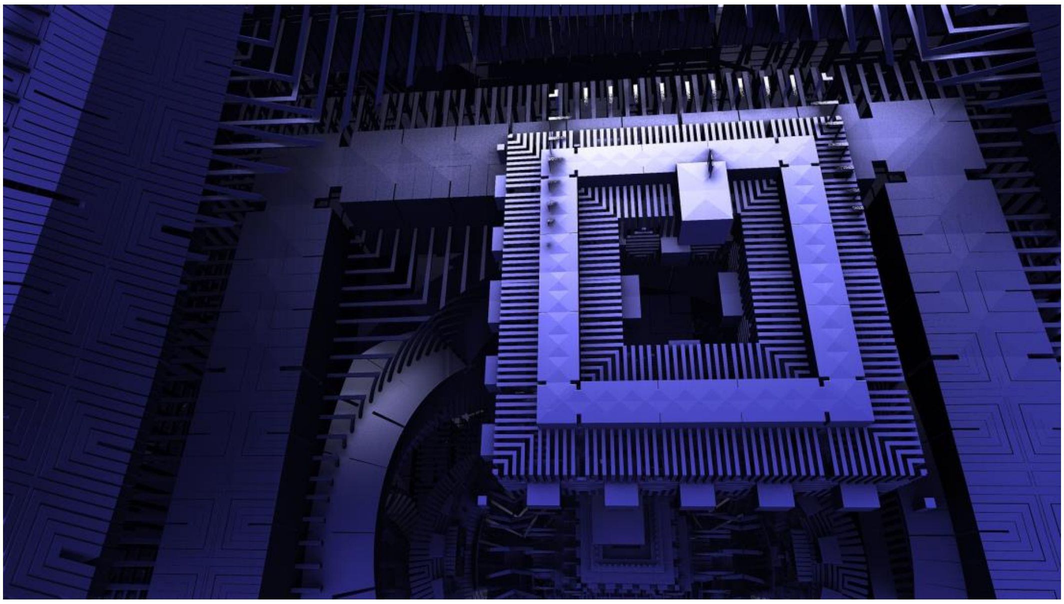
PRESS RELEASE

The quantum future passes through Trieste

A researcher at the International Centre for Theoretical Physics (ICTP), with strong connections to SISSA, is leading one of the most significant research activities envisaged in the recently launched European ten-year funding plan to develop computers and simulators more powerful than those currently available and inviolable cryptographic systems



Trieste, 3 December 2018

Marcello Dalmonte is one of the recipients of the ambitious flagship initiative of the EU on quantum technologies. He is a theoretical physicist, an expert in quantum information, who works at the Abdus Salam International Centre for Theoretical Physics (ICTP) and regularly collaborates with SISSA (International School for Advanced Studies). Both institutions are in Trieste.
With the launch of the Quantum Flagship in 2018, the European Commission has made available one billion euro over a ten-year period with the goal of supporting research in this field in order to create products of technological interest in the future. These include computers able to exceed current limits in automatic calculation and new protocols for secure communication.

Part of the scientific-technological feat, which aims to make the old continent a global reference point for what is known as the 'second quantum revolution', passes through Trieste also thanks to Dalmonte's work. After winning an ERC Starting Grant in 2017, one of the most important awards assigned by the European Research Council, the researcher, originally from Imola, chose Trieste as the most suitable place for his scientific activities.

Towards quantum simulators

Dalmonte will be among those responsible for a crucial project to make one of the five research pillars of the European flagship tangible: quantum simulation or, rather, the modelling of complex phenomena through quantum simulators able to study phenomena at the atomic level. This would be far too difficult to tackle by today's most powerful computers that are based on transistors.

The classical computer's quantum cousin, the quantum computer, can perform the same tasks as a quantum simulator, but at a much grander scale. Quantum simulators hone in on very specific classes of problems, without the need for building a complex quantum computer, and so have less-demanding requirements, according to Dalmonte. "The idea of a quantum simulator starts from the fact that building a full-fledged quantum computer is a tough business. Can we solve meaningful problems with a machine that is not as complex as a quantum computer? That is the idea behind quantum simulators," Dalmonte explains.

The PASQuanS project

Studying the quantum characteristics of materials and chemical reactions could potentially lead to the design of new materials that could revolutionize such sectors as energy and transport, as well as lead to the design of new drugs. Dalmonte and colleagues from the University of Padua are teaming up for their part of the project, joining an international consortium of research groups contributing to the overall quantum simulation stream, known as PASQuanS (Programmable Atomic Large-Scale Quantum Simulation). The EC has granted PASQuanS a three-year budget of just over €9 million.
PASQuans brings theorists and experimentalists together in the quest to advance quantum simulators. "On the experimental side," says Dalmonte,"they are trying to develop the technical parts that are required to have this quantum simulation work." The ICTP-SISSA researcher instead is investigating the theoretical side, applying what is known about the behavior of atoms at the quantum scale to benchmark, verify, and potentially certify the functioning of such machines. "We are interested in questions like, how can we check if the simulators are properly

working or not? Can we benchmark them in systematic ways? We are working on a series of theoretical aspects which are, most of the time, completely open, because these machines are relatively new."

The importance of verifying quantum simulator results

Dalmonte admits that a full solution to these problems is beyond the scope of the three-year Quantum Flagship starting grant, however he believes that they could achieve a set of diagnostics that could be used to verify and, in some cases, certify quantum simulator results. Beyond the theoretical exercises, though, is the exciting opportunity to work with the experimentalists in the PASQuanS consortium. "We also want to go to the experimentalists and present some interesting problems for them to try," he says.

Indeed, Dalmonte sees this access to experimentalists as a key benefit to ICTP's participation in the Quantum Flagship programme. "This allows us at ICTP to have an immediate connection channel to a lot of top-level experiments, which I believe in this field is really fundamental".

USEFUL LINKS
Quantum Flagship: https://qt.eu

IMAGE
Credits: Pixabay

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