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FROM FBK THE QUANTUM SIMULATOR OF THE FUTURE

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The Bruno Kessler Foundation coordinates EPIQUS, a project funded by the European Commission that aims to develop a new generation "quantum simulator"

3.2 million euros to develop the quantum simulator of the future. This is the sum that the European Commission has allocated for the financing of **EPIQUS**, a project coordinated by the **Bruno Kessler Foundation**, with the participation of the **University of Trento**, as part of the **Horizon 2020 FET – Future Emerging Technologies initiative.**

EPIQUS, acronym for **Elecronic-photonic integrated quantum simulator** platform, has the ambition to develop **a new generation of quantum simulators**, consisting of a chip-sized device, fully integrated, operating at room temperature and with scalable power, being able to support many parallel devices. These characteristics are revolutionary compared to the solutions available on the quantum market today: for example, current devices are based on qubits (the fundamental unit of quantum information) or superconductors generated at temperatures below -270 °C. The fields of application are very vast and range from the world of research to that of industry.

"What we want to achieve is extremely ambitious, – explains **Mher Ghulinyan**, researcher of the Bruno Kessler Foundation and project coordinator – t*he basic idea has not been explored yet and the execution and success of the project are based on multidisciplinary skills. These elements of complexity, absolute novelty and revolutionary perspectives for QT (Quantum Technologies) have led to* ***a positive assessment by the European Commission****, which with the FET scheme intends to finance high-risk projects but with very high impact potential*". In fact, the project combines technologies and skills from different disciplines: integrated quantum photonics, micro and nanofabrication technology, photonic and electronic circuit engineering, quantum optics and spectroscopy, quantum information theory and software design.

This is also the output of the **Q@TN** inter-institutions laboratory which was granted funding from the CARITRO Foundaton and the Province of Trento. "*The synergy among local research institutions and the ongoing collaboration between the University of Trento and FBK about silicon photonics contributed to make the proposal from Trentino credible and laid the basis for the success of the project* – states **Lorenzo Pavesi**, who is one of the supervisors of Q@TN and the EPIQUS coordinator at Unitn.

Simulators are devices capable of creating quantum states corresponding to those of complex systems being tested (chemical reactions, prediction of the properties of new materials, complex properties of molecular or atomic systems, biological systems …) and of making them evolve by predicting the results.

Currently there are "quantum simulators" able to partially carry out such operations, but they are large in size, operate at temperatures close to absolute zero (-273 °C), consist of several components that are only partially integrable and cannot be reduced in size, therefore are difficult to scale in power. The EPIQUS project promises **a paradigm shift**: "*We want to make everything in a single silicon chip* – continues Ghulinyan – *of the size of 1 cm2 (as much as 1 euro cent), capable of working at room temperature and which contains all the necessary functions inside of it. Furthermore, through an algorithm and a special software that we are going to develop, the simulator can be connected to a traditional PC from which it will be possible to receive data and give inputs, perform checks on the results and validate the simulations. The possibility to do all this at room temperature represents a huge advantage for the portability, interfacing and diffusion of the quantum simulator.*"

"*We are going to focus in particular on the photonic qbit source* – continues Pavesi – *which is basically like a pinball machine: photons are inserted in the chip and we control them through devices which act like flippers so as to hit the many targets to get the maximum score.*"

The Bruno Kessler Foundation has obtained funding of almost one million euros out of the total 3.2 million of the project, and will use its expertise in the field of integrated photonics, single photon detectors and large data management.

Partners in the project, together with **FBK**, are the **University of Trento**, the **University of the Basque Country (Spain)**, the **University of Vienna (Austria), TU Wien (Austria)**, the **Rostock University (Germany), Electronics and Telecommunications Research Institute – ETRI (South Corea)** and the industrial partner **LFoundry (Italy)**.

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