Press release

macQsimal - a European Quantum Technologies Flagship project for a new generation of sensors

Spearheading the second quantum revolution!

Neuchâtel*, 29* October 2018 – "*Establishing European leadership in the quantum sensing industry*". This is in essence the ambition of macQsimal, a new project selected by the European Commission for their recently launched Quantum Technologies Flagship initiative. Coordinated by CSEM, this consortium of 14 industrial and academic partners will create new commercial opportunities by leveraging quantum effects to achieve unprecedented sensitivity, accuracy and resolution of devices for sensing and metrology applications.

The first quantum revolution resulted in groundbreaking technologies such as transistors and lasers, without which current computers, mobile phones and the internet would have been unimaginable. Today, the ability to manipulate fundamental quantum properties in systems and materials is paving the way for a second quantum revolution. A global race has begun to exploit the enormous potential of quantum technologies (QT) and spearhead transformative advances in fields such as health, security, transport, energy and environmental science. The €1 billion Quantum Flagship initiative from the European Commission aims to position the continent at the forefront of this second revolution by supporting projects that will unlock the full potential of QT and bring commercial products to the market.

Taking sensor performance to the limits allowed by nature

Quantum sensors are expected to be key enablers of the first achievements in this new technological era. They promise to drastically increase the performance of consumer devices, medical services and future applications in the Internet of Things. They might also likely be the door opener to entirely new opportunities which the world is yet to see. As part of the Quantum Flagship initiative, the macQsimal project will exploit the potential of atomic vapor cells to provide a new generation of highly efficient sensors. The project consortium is coordinated by CSEM and includes 14 partners representing the whole knowledge chain from basic science to industrial deployment. "*We have spent a decade developing miniature atomic clocks and other systems whose core quantum technology - atomic vapor cells - has the potential to enable sensors with phenomenal performances. This could lead to huge leaps of improvement in many domains,*" explains Mario El-Khoury, CEO of CSEM. "*A new type of sensor could, for example, boost autonomous cars' 3D orientation sensing or revolutionize human brain activity measurement,*" adds Jacques Haesler, Senior Project Manager at CSEM and project coordinator of macQsimal.

Kick-starting a dynamic, multi-sector sensor industry in Europe

macQsimal is all about bringing new sensors, with greatly improved performances thanks to quantum effects, closer than ever to industrial applications. To achieve this, it will combine state-of-the-art sensor physics with micro-fabricated atomic vapor cells (based on so-called MEMS technology), allowing for high-volume, high-reliability and low-cost deployment. It will concurrently apply advanced squeezing, entanglement and cavity-QED methods in miniaturized sensors. The result will be an advanced, multi-target platform with outstanding sensitivity for five key physical observables: magnetic and electric fields, time, rotational motion and gas concentration. The consortium will use this platform to develop high-impact prototype devices for applications including autonomous navigation, non-invasive medical diagnosis and drug detection.

Manufacturing MEMS atomic vapor cells in CSEM's cleanrooms

MEMS atomic vapor cell. Dimensions: 4 x 4 x 1.4 mm.

Additional information

CSEM

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About quantum technologies

Quantum technologies harness the behavioural quirks of energy and matter at the quantum - atomic and subatomic - level to gain functionality and performance that would otherwise be unattainable. At these very small scales, the classical laws of physics break down and the laws of quantum mechanics take over, leading to peculiar quantum effects such as superposition and entanglement. Superposition, which allows a particle to exist simultaneously in two states at once, and entanglement, in which the state of a particle "here" can depend on the state of another particle – even far away, open up new and exciting possibilities and applications. A new generation of quantum technologies have now moved beyond exploiting these naturally-occurring quantum effects to actively engineering them into breathtakingly powerful and novel devices and systems.

About macQsimal

macQsimal (Miniature Atomic Vapor-Cell Quantum Devices for Sensing and Metrology Applications) was launched in October 2018 to unlock the potential of quantum technologies for sensing and metrology and stimulate the development of a dynamic and competitive European quantum-enhanced sensor industry. The project will develop sensors in five application areas: miniature optically-pumped magnetometers, miniature atomic clocks, compact atomic gyroscopes, atomic GHz and THz sensors and vector imagers as well as gas sensors. These applications have been chosen for their high potential to quickly advance to products, which will be manufactured in Europe, within the next five to 10 years.

The macQsimal consortium is made up of:

- 2 research and technology organisations: (RTOs) CSEM, and VTT – Technical Research Centre of Finland Ltd,
- 3 industrial partners: Robert Bosch GmbH, Orolia Switzerland SA and Elekta Oy (Megin),
- 8 academic partners: The Institute of Photonic Sciences (ICFO), University of Copenhagen (The Niels Bohr Institute), Centre National de la Recherche Scientifique (CNRS – Laboratoire Kastler Brossel), Aalto University, University of Basel, University of Durham, University of Stuttgart and University of Neuchâtel,

assisted by accelopment AG for the project management and the dissemination and exploitation of project results.

macQsimal is a Quantum Technologies Flagship project managed as part of the Future and Emerging Technologies (FET) programme and funded within the Horizon 2020 Framework Programme under grant agreement number 820393. The project, which will run from 2018 to 2021, has a budget of €10.2 million.

Project website: http://www.macqsimal.eu

About the Quantum Flagship

The Quantum Flagship was launched in 2018 as one of the largest and most ambitious research initiatives of the European Union. With a budget of €1 billion and a duration of 10 years, the flagship brings together research institutions, academia, industry, enterprises, and policy makers, in a joint and collaborative initiative on an unprecedented scale. The main objective of the Flagship is to consolidate and expand European scientific leadership and excellence in this research area as well as to transfer quantum physics research from the lab to the market by means of commercial applications and disruptive technologies. With over 5000 researchers from academia and industry involved in this initiative throughout its lifetime, it aims to create the next generation of disruptive technologies that will impact Europe's society, placing the region as a worldwide knowledge-based industry and technological leader in this field.

The Quantum Technologies Flagship website: https://qt.eu/

About CSEM

CSEM—technologies that make the difference

CSEM, founded in 1984, is a Swiss research and development center (public-private partnership) specializing in microtechnology, nanotechnology, microelectronics, system engineering, photovoltaics and communications technologies. Around 450 highly qualified specialists from various scientific and technical disciplines work for CSEM in Neuchâtel, Zurich, Muttenz, Alpnach, and Landquart.

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