**Creating a competitive European quantum industry: new initiative for science and technology development in Latvia**

Eugene Eteris, RSU, 30 Oct 2018

**The Quantum Technologies Flagship program with about €1 billion investment is a new initiative to fund over 5,000 of Europe's leading quantum technologies researchers over the next ten years and aims to place Europe at the forefront of the second quantum revolution. Latvian and the Baltic States' research communities shall take this initiative seriously.**

Modern science and technology has evolved through two quantum revolutions. In general, quantum technologies use the properties of quantum effects – the interactions of molecules, atoms, and even smaller particles, known as ***quantum objects*** – to create practical applications in many different fields. The so-called *first quantum revolution*, which saw the creation of the field of quantum physics, happened in the first half of the twentieth century and shaped the modern world. For instance it led to the development of lasers and transistors - two foundational technologies for building computers, telecommunications, satellite navigation, smartphones and modern medical diagnostics.

*The second quantum revolution* is now underway and involved the detection and manipulation of single quantum objects such as atoms, photons and electrons. For example, it is now possible to rotate an electron clockwise and anticlockwise at the same time, and connect particles invisibly across space and time. In many cases, the level of human control has reached a point that allows the use of quantum systems for real-world applications in sensing, secure communications and for computing and simulation, which are also the fields of quantum technologies.

In the early 20$^{th}$ century, the first quantum revolution allowed scientists to understand and use basic quantum effects in devices, such as transistors and microprocessors, by manipulating and sensing individual particles.

The second quantum revolution will make it possible to use quantum effects to make major technological advances in many areas including computing, sensing and metrology, simulations, cryptography, and telecommunications. Benefits for citizens will ultimately include ultra-precise sensors for use in medicine, quantum-based communications, and *Quantum Key Distribution* (QKD) to improve the security of digital data. In the long term, quantum computing has the potential of solving existing computational problems; the task is almost impossible to solve with the current supercomputers; they will also be able to recognise development patterns and train artificial intelligence systems.

**Quantum research in the EU science programs**

The program was launched at the end of October 2018 in Vienna hosted by the Austrian Presidency of the Council of the EU. The Flagship's long term vision is to develop in Europe a so-called *quantum web*, where quantum computers, simulators and sensors are interconnected via quantum communication networks. This will help kick-starting a competitive European quantum industry making research results available as commercial applications and disruptive technologies. The Flagship will initially fund 20 projects with a total of €132 million via the

*Horizon 2020 programme*, and from 2021 onwards it is expected to fund a further 130 projects. Its total budget is expected to reach €1 billion, providing funding for the entire quantum value chain in Europe, from basic research to industrialisation, and bringing together researchers and the quantum technologies industry.

Note: The *Horizon Europe* proposal builds on the success of the current *Horizon-2020* programme. Present evaluation of Horizon 2020 has shown that the programme already helped create jobs and growth, tackle biggest societal challenges and improved people's lives in the member states. It showed that the programme has created European added value, producing demonstrable benefits to national or regional support for science and research. For example, as of May 2018, the program has supported over 18,000 projects with over €31 billion awarded.

Source: http://europa.eu/rapid/press-release_IP-18-4041_en.htm
More on European R&D developmental prospects in:
https://ec.europa.eu/info/publications/renewed-european-agenda-research-and-innovation-europes-chance-shape-its-future_en

The Future and Emerging Technologies, FET programme promotes large-scale research initiatives to drive major scientific advances and turn them into tangible innovations creating benefits for the economy and society across Europe. Funding for the Flagship project comes from Horizon 2020, its successor programme Horizon Europe and national funding.

The Quantum Technologies Flagship is also a component of the Commission's European Cloud Initiative launched in April 2016, as part of a series of measures to support and link national initiatives for the digitisation of Europe's industry.

On the "cloud initiative" see: https://ec.europa.eu/digital-single-market/en/european-cloud-initiative
On digitalisation in industrial sector: http://europa.eu/rapid/press-release_IP-16-1407_en.htm
On "horizon Europe": http://europa.eu/rapid/press-release_IP-18-4041_en.htm.

**Commission's opinion**

Commission Vice-President for the Digital Single Market, **Andrus Ansip** underlined European potentials to lead global development of quantum technologies. Hence, the EU Quantum Technologies project becomes an integral part of the EU's ambition to consolidate and expand Europe's scientific excellence. In order to unlock the full potential of quantum technologies, the member states have to develop solid industrial and research background.

Commissioner for Digital Economy and Society, **Mariya Gabriel** added that Quantum Technologies Flagship would form a cornerstone of the European strategy for development of quantum technologies in the future. Quantum computing has potentials in increasing computing speeds by orders of magnitude; the EU states have to pool their efforts in the ongoing race towards the first functional quantum computers.

**Five application areas**

The Quantum Flagship will provide funding -under the Commission's coordination - for 20 projects during October 2018 until September 2021. The funding will focus on five application areas: **a)** ***quantum communication, b) quantum computing, c) quantum simulation,*** *and* ***d) quantum metrology and sensing*** – as well as the ***basic science behind quantum technologies***. More than one third of participants are industrial companies from a wide range of sectors, with a large share of SMEs. Quantum research and development will be funded from the EU's multi-annual financial framework for 2021-28.

Quantum technologies will be supported by the proposed Horizon Europe programme for research and space applications, as well as the proposed Digital Europe programme, which will develop and reinforce Europe's strategic digital capacities, supporting the development of Europe's first quantum computers and their integration with classical supercomputers, and of a pan-European quantum communication infrastructure (on mentioned programs see links below). Since 1998, the Commission's program "Future and Emerging Technologies" (FET) provided around €550 million of funding for quantum research in Europe. The EU has also funded research on quantum technologies through the European Research Council (ERC). Only since 2007, the ERC has funded more than 250 research projects related to quantum technologies, worth some 450 million euro.

The Quantum Technologies Flagship is currently supported by Horizon 2020 as part of the FET programme, which currently runs two other Flagships (The Graphene Flagship and the Human Brain Project Flagship).

*Note. The Graphene Flagship aims to take graphene and two-dimensional materials from laboratories to the European society to stimulate economic growth and create new jobs.*
See more in: https://ec.europa.eu/digital-single-market/en/graphene-flagship
*Note. The Human Brain Project aims to empower brain research toward understanding the human brain and its diseases to advance brain medicine and computing technology*. See more in: https://ec.europa.eu/digital-single-market/en/human-brain-project.

**Quantum technologies: perspective advantages**

Within the next 10 years, the performance enhancements resulting from quantum technologies will yield unprecedented computing power, guarantee secure communications, and provide ultra-high precision measurements. Examples include the measurement of the tiniest variations of magnetic or electric fields for medical imaging below the cell level for less invasive diagnosis and treatments, or for searching raw materials (petroleum, minerals, etc.), ultra-precise atomic clocks in smart grids allowing energy savings, or yet quantum key distribution technologies to prevent eavesdropping in finance, banking and defence by establishing secure communication links, and supercomputers outperforming existing or future classical supercomputers and at a fraction of their energy consumption.

General reference: http://europa.eu/rapid/press-release_MEMO-18-6241_en.htm

In the long term, quantum computing has the potential to solve computational problems that would take current supercomputers longer time. Numerous spheres of scientific computing could bring about breakthroughs in, for example, chemical process design, energy efficient materials, and energy harvesting, as well as machine learning and big data analysis.

**More information in the following links: =** The first 20 projects; = Official website of the Quantum Flagship; = Blog post by Vice-President Ansip on the Quantum Flagship; = Joint statement on progress to build European supercomputers; = European approach to Artificial Intelligence.
Source: http://europa.eu/rapid/press-release_IP-18-6205_en.htm . Brussels 29.x.2018.