European Metrology Research Programme

Excellent science

An overview of the funded projects from the Targeted Programme Open Excellence

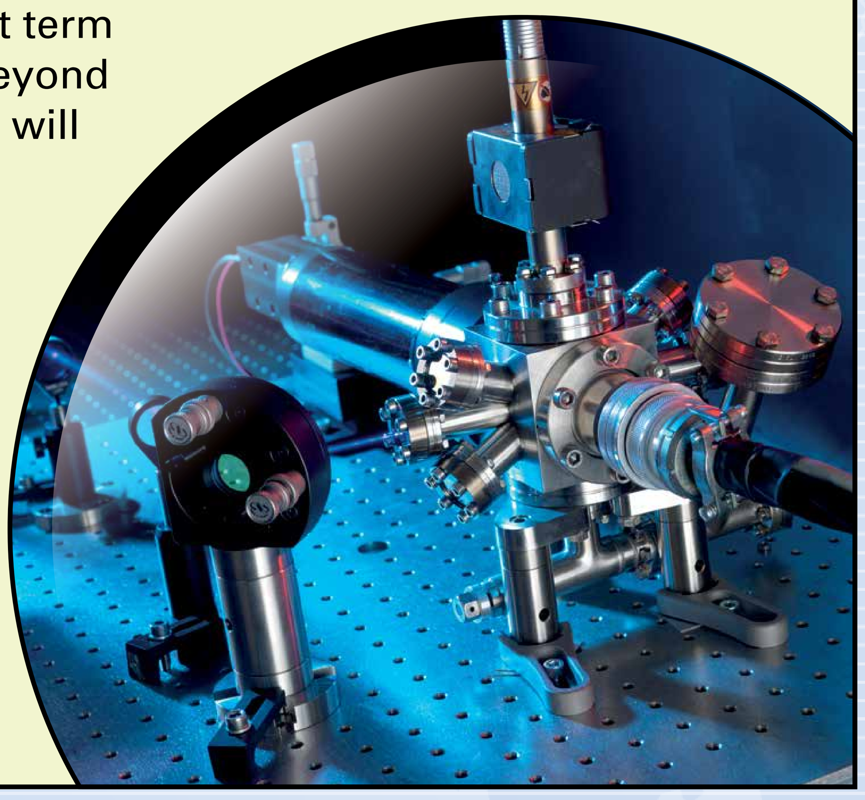
Quantum tools for better time

Quantum engineered states for optical clocks and atomic sensors (EXL01)

The detection of a quantum state can involve the destruction of that state. This law of quantum physics is one factor currently limiting the stability of the new generation of optical atomic clocks, which could redefine the second, the SI unit of time. A potential solution to solve their stability issues is to use quantum entanglement.

Entanglement allows two atoms, or ions, to exhibit the same properties as one another without being physically linked. This means that it is possible to observe the state of one of these atoms, or ions, without destroying the state of the other.

This project will use techniques based on quantum entanglement to improve the short term stability of optical atomic clocks beyond the current limitations. The results will improve precision spectroscopy based on scalable entanglement and have a direct impact on a wider range of quantum sensors such as accelerometers, gravimeters, gyrometers and magnetometers.



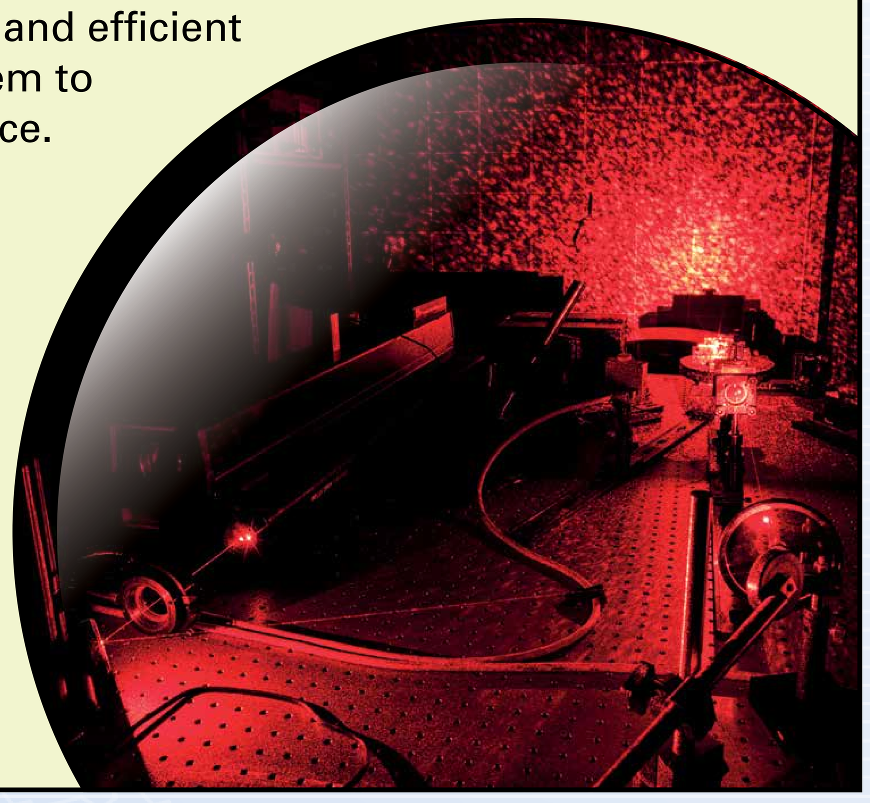
Quantum communication and security

Single-photon sources for quantum technologies (EXL02)

Photons are particles of light well suited to applications such as quantum communication, quantum computing and quantum metrology. This is because they travel at the speed of light and interact weakly with their surroundings, whilst being easily manipulated.

However, the lack of single photon sources is limiting their use. For example, quantum key distribution and quantum cryptography offer theoretically failsafe computer security but are vulnerable to attack without a true single photon source. The realisation of a practical quantum computer also requires near perfect single photon sources.

This project will develop compact and efficient single photon sources and use them to improve measurement performance. The devices developed will also represent a breakthrough in the acceptance and uptake of single photon sources by end-users and the standardisation of the components will help accelerate the development of quantum communications.



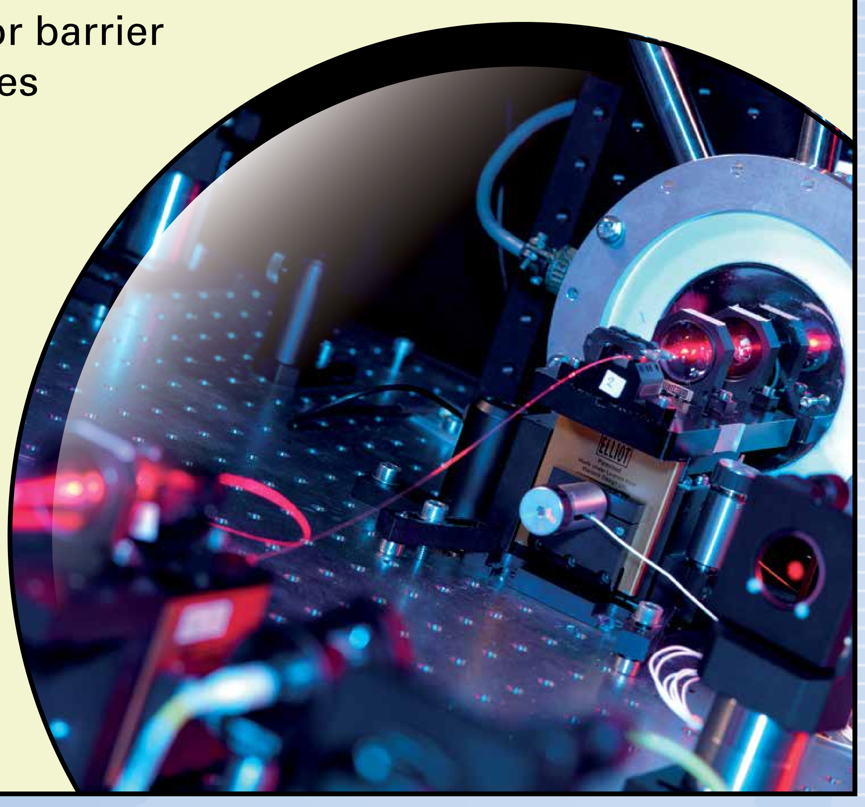
Towards quantum computing

Measurement and control of single-photon microwave radiation on a chip (EXL03)

The ability to build nanoscale electronic devices and operate them at very low temperatures allows scientists to use quantum physics to their advantage, in a range of applications. However, future progress in superconducting quantum computing technology depends on the availability of chips that can work at the single-photon, or few-photon, level.

There is currently no way to reliably detect single microwave photon events. This project will address this by developing novel microwave sources and detectors at the single-photon level and improving the performance of cryoelectronic quantum devices, which have recently benefited from improved on-chip cooling technologies.

The project could eliminate a major barrier for the progress of quantum devices and support the development of signal amplifiers for wireless communications and radiation measurements. In addition, the devices developed could be used in the realisation of a practical quantum computer based on solid-state quantum bits.



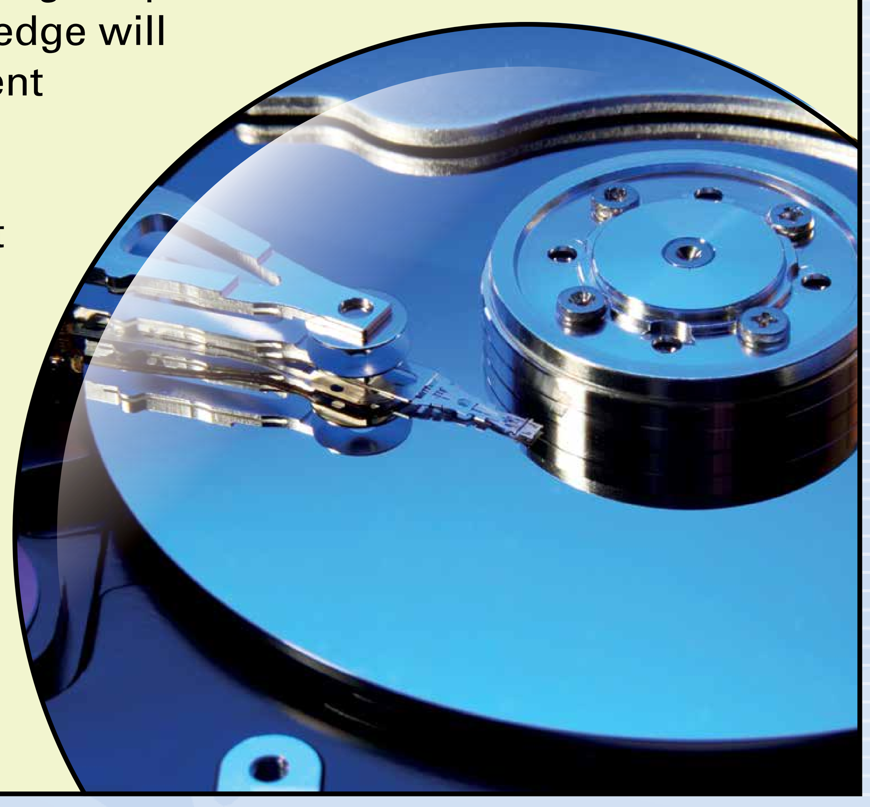
Exploiting electron spin

Spintronics and spin-caloritronics in magnetic nanosystems (EXL04)

Spintronics is a technology that exploits a fundamental quantum property of electrons, known as spin, as well as the magnetic and electronic properties. This technology has led to important scientific discoveries and industrial applications such as computer hard disk drives.

Spin caloritronics is the combination of spintronics and thermo-electricity, and focuses on the interaction of electron spins and heat currents. Its novel effects could also, like spintronics, have industrial applications but first the theory needs to be put into practice.

This project will investigate and develop nanoscale magnetic devices to build the fundamental understanding of spintronics and spin-caloritronics. This knowledge will underpin research and development and lead to future applications in computing, data storage and measurement science. The project will also publish a series of guidelines to make reliable measurements of spintronics and spin-caloritronics, representing the first step towards standardisation in the field.



Europe's National Measurement Institutes working together

The European Association of National Metrology Institutes (EURAMET) has implemented the European Metrology Research Programme (EMRP), a programme with a value of over 400 M€, organised by 23 NMIs and supported by the European Union.

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