Atomic physics for technologies of the future

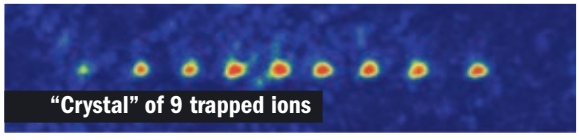
Three young Italian researchers conquer Europe with their ideas

Atomic physics is one of the most promising areas of research for the development of new technologies based on quantum mechanics. Atomic physicists capture and manipulate small clouds of gas atoms suspended in space, cooling them at the lowest temperatures possible in the universe, to which the effects of quantum mechanics are predominant. In such a regime it is possible to use atoms as "bricks" for the creation of new states of matter and quantum devices. One of the world's leading groups in the field of atomic physics, composed of about twenty professors, researchers and graduate students works at the European Laboratory for Non-linear Spectroscopy (Lens) Sesto Fiorentino. Among them stand out Doctors Carlo Sias, Giacomo Roati and Matteo Zaccanti, young researchers who perform their activities with funding from the European Research Council (Erc). The Erc grants represent the most prestigious individual European research fund, awarded following a tough selection process of the best researchers of the continent. Carlo Sias is working towards achieving the first experiment in Italia with trapped ions. In these experiments, atoms with electric charge (ions) are manipulated at the level of individual particles and used for both high precision watches and hardware for a quantum computer, a computer potentially much faster than what is currently available on the market. Carlo Sias is a senior researcher at the National Institute of Metrological Research of Torino and his work at Lens demonstrates how the synergy between renowned research institutions is an essential tool to open new perspectives in scientific research. Giacomo Roati is senior researcher at the National Institute of Optics (Ino) of the National Research Council, studying systems of ultra-cold fermions, a family of particles which includes, for example, electrons. Giacomo Roati uses Lithium fermionic atoms to study fundamental phenomena associated with the physics of electrons, such as conduction and superconductivity. It is with these studies that the physics of superconductors is sought to be understood, in the hope of finding superconductor materials at room temperature. Matteo Zaccanti is a Ino-Cnr researcher and he also studies the physics of ultra-cold fermions, but with a different strategy. In his project, he uses a mixture of different atoms, lithium and chromium, to investigate particular aspects of the phenomena of magnetism and super-fluidity, so far never observed in nature. With this ultra-cold system, Zaccanti intends to simulate, in a controlled environment, the microscopic behaviour of electrons in a superconductor, or quarks in the core of a neutron star. The research carried out by these three researchers shows that it is possible in Italia to carry out excellent research if supported by financing, influencing the future of knowledge and technology, and likening themselves to other top-class global organisations.

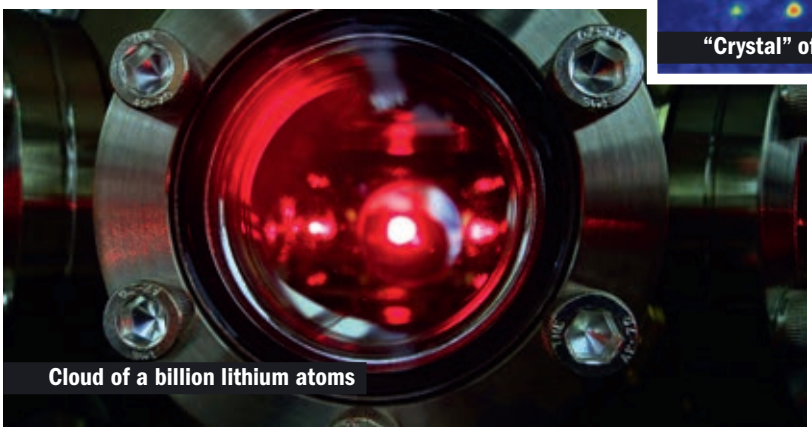
Carlo Sias

Matteo Zaccanti

Giacomo Roati



"Crystal" of 9 trapped ions



Cloud of a billion lithium atoms