Description and Control of systems for quantum technologies

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The paradigm of new quantum technologies is based on the exploitation of purely quantum phenomena, which have no analogy in classical physics, to lead to more efficient components and processes than the conventional systems currently available. There are many possible applications, ranging from new types of sensors to quantum computers. The scientific and technical challenges that must be overcome are very complex, but the advances that these technologies can provide are so important that they justify the risk taking and the investments required. One of the aspects that must be developed in this context are theoretical tools that allow a precise and efficient description of quantum dynamics, including their control through external fields, and their stability with respect to the interaction with external uncontrolled environments. Key concepts for the applications in quantum information are the production and characterization of entanglement, as well as their robustness with respect to perturbations and experimental uncertainties. Our team has a well-established experience in the domains of quantum control, field quantization, construction of effective models, analysis of resources and strategies for quantum information. The execution of the project will require a combination of mathematical tools and numerical calculation.

Key words: Quantum technologies, Quantum control, Quantum information, Entanglement, Quantum algorithm, Mathematical Physics.