Q-ESSENCE overview

Quantum interfaces capable of high-fidelity mapping of quantum information between different quantum states provide new tools to control the state of physical systems, lower the noise floor of read-out schemes to quantum levels, enable the construction of networks for distributing quantum information resources, and they are the the key component of next-generation architectures for quantum information technologies.

Generation of **quantum entanglement at new scales and distances** will lay the ground for the construction of ultrasensitive sensors that acquire information about environmental variables with exceptional precision. It will also improve the operation of quantum-based devices such as atomic clocks and extend geographic distances that can be covered by quantum communication.

Engineering **multipartite entanglement in specific topologies** of elementary systems will make feasible preparation and utilization of collective states optimized with respect to features required by concrete ICT tasks, while being robust to unwanted environmental influences. It will also open up venues to implement complex multi-user information protocols based on entanglement that resolve current concerns related to privacy protection and security.

Q-ESSENCE Project is organized into three Sub-Projects (SPs) which share the common vision of generating and utilizing entanglement at previously unreachable scales and distances in the presence of environmental effects. They are tightly intertwined by sharing concepts, methods, and techniques. The combined effort of the closely interacting SPs will facilitate the utilization of quantum phenomena for ICT purposes in real-world settings.

The SPs combine Workpackages (WPs) that deal with concrete aspects of the major project objectives. Each WP is planned to produce deliverables that will on their own present advancements in the field of quantum information foundations and technologies, as well as support the effort of other WPs. The WPs will interact closely within as well as between SPs by sharing concepts, experimental methods, and technologies.

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