**Synthetic description of the activity and expected research outcome**

Within the blooming area of quantum information, quantum key distribution (QKD) represents one of the most important lines of research where entanglement plays a key role. Besides the extensively studied entanglement between the degrees of freedom of two different particles, it is also possible to consider the *intra-particle or single-particle entanglement* (SPE) between two different degrees of freedom of the same particle [Az20,Pa20]. SPE is easier to produce since it requires linear optical components and cheap light sources, and it has recently turned out to be a valuable resource for quantum information, e.g. in the entropy certification of quantum random number generators [Ma21].

The main goal of the project is the development, the security analysis as well as a critical evaluation of new QKD protocols based on SPE. Experiments will also be performed to validate the proposed QKD protocol. The PhD student will be enrolled in the Transdisciplinary Doctoral Program in Quantum Science and Technologies of the Q@TN joint laboratory ([https://www.unitn.it/drphys/en/421/transdisciplinary-program-quantum-science-and-technologies](https://www.unitn.it/drphys/en/421/transdisciplinary-program-quantum-science-and-technologies)).

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**References**


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**Ideal candidate (skills and competencies)**

The ideal candidate will be a highly motivated student possessing a MSc in Mathematics, Physics, Computer Science or equivalent degrees.

A strong interest in interdisciplinarity as well as an expertise in modern cryptography and security analysis are highly recommended.