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embryonic Quantum Network  
Postdoctoral position

During the last fifteen years, the fundamental concept of quantum entanglement has become a practical tool for quantum communication and information processing.

The next challenge is long distance communications because of the limitation due to channel losses. Quantum relays, based on entanglement swapping have been suggested to solve this problem and even longer distances should become possible using a quantum repeater, where the relay is associated with a quantum memory.

The atomic systems investigated so far for quantum memories are only sensitive to the 800 nm wavelength range and they require a very narrow photon linewidth (A few tens of Megahertz). First, these are not wavelengths that can be propagated on telecommunication optical fibers and second the required linewidth is 3 to 4 orders of magnitude lower than what is currently obtained using parametric fluorescence.

The ANR project eQUANET (embryonic Quantum Network) has been set up to demonstrate a preliminary experimental protocol in a quantum repeater configuration. A narrow linewidth source of polarisation entangled photons at 1550 nm is being implemented in LTCl. A coherent photonic interface for polarization qubits based on sum frequency generation will enable transferring the qubit to a wavelength compatible with the quantum memory so that the storage can be tested. The partners are the "Laboratoire de Physique de la Matière Condensée" in Nice and the "Laboratoire Aimé Cotton" in Orsay.

In LTCl, our purpose is threefold :

- optimize the source and make sure it is compatible with the wavelength change interface and the quantum memory,
- set up the sum frequency interface in a bulk PPLN crystal configuration
- manage the quantum network, which means generate the necessary signals to operate the interface and memory, test the storage and restitution of a photon and check the entanglement conservation with the second photon of the photon pair.

Classical, quantum and non linear optics are needed for this work, that is planned over two or three years.