Superconducting quantum node for entanglement distribution of microwave radiation [1]

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Non-linear superconducting circuits processing microwave signals are good candidates to realize small-scale quantum networks. A quantum node of such a network has to be able to generate and distribute microwave entangled fields while controlling their emission and reception in time.
Here, we present a superconducting based on the Josephson ring modulator [2] that allows switching dynamically on or off a parametric coupling between a low-loss cavity and a transmission line by frequency conversion. We demonstrate the time-controlled capture, storage and retrieval of a propagating coherent state in a long-lived electromagnetic mode. We achieved a catching efficiency of the order of 80% with a storage time of a few us and an access time 30 times shorter. Exploiting the versatility of this circuit, we then demonstrate the timed-controlled generation of an Einstein-Podolsky-Rosen (EPR) state distributed between the long-lived mode and a propagating wave-packet. We will finally discuss how inserting a superconducting qubit in this device paves the way for investigating continuous variable quantum information processing protocols by means of photonic channels in the microwave domain.

[1] E. Flurin *et al.*, "Superconducting quantum node for entanglement and storage of microwave radiation", Physical review letters **114** (9), 090503

[2] N. Bergeal et al. , "Phase preserving amplification near the quantim limit with a Josephson ring modulator", Nature **465**, 64 (2010).