Entangling two distant high-Q microwave transmission lines assisted by a resonator terminated with SQUIDs

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We propose a multi-resonator superconducting circuit to create the entanglement state between resonators which are specially arranged. One high-frequency resonator is placed in the middle working as a quantum bus and has two superconducting quantum interference device (SQUID) ends which function as effective boundaries. The other two resonators are vertically placed on sides and the magnetic flux created by these two resonators modulates the boundaries of the middle resonator, which in turn creates a nonlinear interaction between resonators. This coupling introduces opto-mechanical type Hamiltonian terms which can be used to generate a Bell state between two high-quality resonators with fidelity of 99.2% for practical parameters. The strength of the opto-mechanical terms is tunable, which meets the cure to the crosstalk in quantum computing and allows the possibility of large-scale integration of resonators and all-resonator quantum computing.

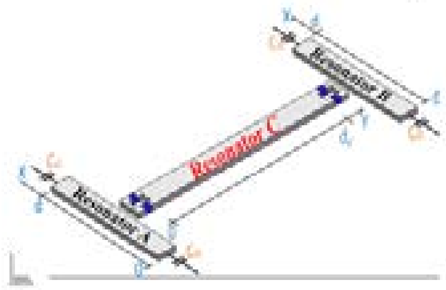

Figure 1: Sketch of the geometrical arrangement of the resonators (not to scale). Resonator A and resonator B are coupled to the high frequency resonator C via two SQUIDs which terminate both ends of resonator C.

Recent Publications

1. Song G Z, Yang G J and Zhang M (2017) Compact quantum gates for hybrid photon–atom systems assisted by Faraday rotation. Quantum Information Processing 16(2):54.
2. Han W, Zhang M and Yang J (2015) Synchronization in nonlinear oscillators with conjugate coupling. Chaos, Solitons and Fractals 71:1-6.
3. Song G Z, Wu F Z, Zhang M and Yang G J (2016) Heralded quantum repeater based on the scattering of photons off single emitters using parametric down-conversion source. Scientific Reports 6:28744.
4. Liu Q, Wang G Y, Ai Q, Zhang M and Deng F G (2016) Complete nondestructive analysis of two-photon six-qubit hyperentangled Bell states assisted by cross-Kerr nonlinearity. Scientific Reports 6:22016.
5. Zhang M, Tony E Lee and H R Sadeghpour (2015) Transport of quantum excitations via local and nonlocal fluctuations. Physical Review A 91:052101.

Biography

Ming Li is a first year PhD candidate from Department of Physics in Beijing Normal University (BNU) Beijing, China. His major is quantum optics and he is interested in the field of superconducting circuit quantum electromagnetic dynamics and its applications in quantum computation. He has conducted some preliminary research studies on the dynamical Casimir effect induced by fast-tuned boundary conditions, which can be easily implemented in superconducting circuit platform.

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