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Title: Multipartite entanglement in superconducting systems for microwave quantum quantum detection

Abstract:

After Peter Shor invented a quantum algorithm for integer factorization, promising to solve the problem exponentially faster than any classical factoring algorithm, a wealth of solutions based on quantum effects emerged targeting classically intractable problems. One of these tasks, improving the accuracy of measurements, is a key issue for the development of physics and technology.

While the fundamental limit of classical measurement schemes is set by the shot noise level, recent advances in quantum hardware resulted in novel approaches based on quantum entanglement that enable to overcome noise tyranny. Technically, quantum protocols provide a signal-to-noise ratio advantage over that of the optimum classical methods. One of the most striking example, the quantum illumination, successfully utilizes the bipartite entanglement in target detection in the presence of high levels of noise and loss. Spectacularly, the sensing performances of multiple spatially distributed parameters may be enhanced through the use of an entangled quantum network.

Distributed quantum sensing uses quantum correlations between multiple sensors to enhance the measurement of unknown parameters beyond the limits of classical systems. Quantum correlations generated by multipartite entanglement are stronger than classical correlations.

In this work, we proposed a scheme how to utilize Josephson parametric oscillator (JPO) for multipartite entanglement generation. Experimental results shows that the JPO can efficiently generate entanglement that can be further used in a microwave quantum sensing. Moreover we consider the scheme of a quantum sensing network based on the JPO.