Resources for continuous-variable quantum computation: theory and experimental proposals

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Abstract: Continuous-Variable (CV) quantum computation is emerging as a promising alternative to quantum computation with two-level systems. In this approach, typical observables have a continuous spectrum, such as the real and imaginary part of the quantised electromagnetic field. In this context, specific resources (in terms of quantum states and quantum gates) have been known for decades to be resourceful, i.e. to promote the set of classically efficiently simulatable operations to universal quantum computation. This is the case of the so-called cubic phase state, as well as of the cubic phase gate. So far, efforts for implementing experimentally these resourceful elements have been undertaken in quantum optics, however it has not been possible yet to achieve them. I will present two proposals for achieving the generation of the cubic phase state as well as the implementation of a cubic phase gate with microwave technology. Availability of these elements opens for the quest of CV-NISQs - small CV quantum processors without quantum error correction, where a limited number of operations - yet beyond the domain of the classical simulatable ones - are at disposal.