Winter school on Physics with Trapped Charged Particles

Report of Abstracts

Abstract ID : **42**

Experimental Cyclic Inter-conversion Between Quantum Coherence and Correlation

Content

Quantum resource theories seek to quantify sources of non-classicality that bestow quantum technologies their operational advantage. Chief among these are studies of quantum correlations and quantum coherence. The former to isolate non-classicality in the correlations between systems, the latter to capture non-classicality of quantum superpositions within a single physical system. Here we present a scheme that cyclically inter-converts between these resources without loss. The first stage converts coherence present in an input system into correlations with an ancilla. The second stage harnesses these correlations to restore coherence on the input system by measurement of the ancilla. We experimentally demonstrate this inter-conversion process using linear optics. Our experiment highlights the connection between non -classicality of correlations and non-classicality within local quantum systems, and provides potential exibilities in exploiting one resource to perform tasks normally associated with the other.

Summary

Here, we illustrated a cyclic scheme where coherence initially in a quantum system A is consumed locally to synthesize an identical amount of discordant correlations with some ancilla B. These correlations are then harnessed to restore coherence in A. Under ideal conditions, this cycle is lossless,
and can be repeated ad-infinitum. We realized one round of this cycle using linear optics, showing explicitly how coherence encoded within a photonic qubit can be converted to discord between it and an ancilla via incoherent operations. By measurement of the ancillary photon, we restored up to 80 percent of the coherence within the original qubit. Our experiment corroborates growing evidence non-classicality in correlations and non-classicality within singular quantum systems are closely connected.

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Comments:

This combination of two different approaches and their experimental verification is indeed a new development, and the presented results are very timely in this respect.

Status: SUBMITTED

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