Contribution ID: **223** Type: **Invited Talk**

Capturing a quantum image without a camera

Thursday 28 September 2023 09:00 (25 minutes)

Pairs of entangled photos are used to reconstruct an image in the application area known as quantum ghost imaging. It is the correlation between the photon pair that allows for the reconstruction of the image, as opposed to single photon detection. The entangled photons are spatially separated into two independent paths, one to illuminate the object and the other which is collected by a spatially resolving detector. Initially, ghost imaging experiments accomplished spatially resolving detectors by moving a single-pixel detector throughout a transverse scanning area. Advancements consisted of using ultra-sensitive cameras to avoid a system consisting of physically moving detectors. Ultra-sensitive cameras are, however, expensive and have limited spectral sensitivity. Here we demonstrate an alternative by utilising a spatial light modulator and a bucket detector to spatially resolve what is detected. Historically, imaging speeds have been slow and inefficient due to the quadratic increase in the scanning capability for spatially resolved detectors and the low light levels associated with quantum experiments. Here we additionally utilise deep learning algorithms to improve both image reconstruction time and resolution. We demonstrate this with a non-degenerate ghost imaging setup where the physical parameters such as the mask type and resolution are varied and controlled on a spatial light modulator. Thereby answering the question: can we image an object without using a camera?

Abstract Category

Atomic & Molecular Physics

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Session Classification: Atomic, molecular & laser physics

Track Classification: Physics Research