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Grover's ghost: Quantum searches in a new light

The ghost imaging protocol captures the phase details of transparent objects and encodes them into the amplitude of the reconstructed image, all through joint projective measurements between two entangled photons. Similarly, Grover's algorithm amplifies the inverted amplitude of a marked element, isolating it from a larger dataset through quantum interference. Despite their different origins, both methods achieve the same fundamental effect: mapping phase information into amplitude enhancements through interference to boost detection probability. In this work, we reveal a deep and unexpected connection between Grover's search algorithm and ghost imaging. Borrowing from Grover's algorithm, we show that incorporating its diffusion operator allows ghost imaging to access hidden phase information, mapping phase details into measurable amplitude variations without the explicit need for interference. Moreover, ghost imaging's inherent robustness to noise offers a distinct advantage, enhancing the potential of this combined approach in quantum-enhanced imaging and information retrieval.

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