Quantum Nature of High Harmonic Generation

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Quantum technologies are powered by platforms to generate complex non-classical states of matter or light to realize applications. We report the non-classical properties of high-harmonic generation (HHG) in semiconductors, an emerging photonic platform. Based on photon statistics, we evaluate witness operators to certify the non-classicality of the generated states. We show that higher-order harmonics driven by a coherent laser are squeezed and entangled. The measurements are well retrieved with an entangled Gaussian state model, obtained by numerical state optimization to multiple observables. Additionally, we perform heralded measurements to engineer the quantum state of the emission and report anti-bunched photon statistics. Further, we witness the generation of a quantum non-Gaussian state, a resource highly relevant for quantum information. With this, we establish high-harmonic generation as a platform for generating quantum optical resources.

Overall, the semiconductor HHG source is a quantum newcomer [1-3], supported by our experimental findings [4-7], opening fundamental questions and industrial perspectives in quantum information science such as quantum metrology and quantum information science.

References

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