Quantum Induced Coherence Light Detection and Ranging

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Quantum illumination has been proposed and demonstrated to improve the signal-to-noise ratio (SNR) in light detection and ranging (LiDAR). When relying on coincidence detection, such a quantum LiDAR is limited by the response time of the detector and suffers from jamming noise. Inspired by the Zou-Wang-Mandel experiment, we design, construct and validate a quantum induced coherence (QuIC) LiDAR which is inherently immune to ambient and jamming noises. In traditional LiDAR the direct detection of the reflected probe photons suffers from deteriorating SNR for increasing background noise. In OuIC LiDAR. we circumvent this obstacle by only detecting the entangled reference photons, whose single-photon interference fringes are used to obtain the distance of the object, while the reflected probe photons are used to erase path information of the reference photons. In consequence. the noise accompanying the reflected probe light has no effect on thedetected signal. We demonstrate such noise resilience with both LED and laser light to mimic the background noise and jamming attack. The proposed method paves a new way of battling noise in precise quantum electromagnetic sensing and ranging.

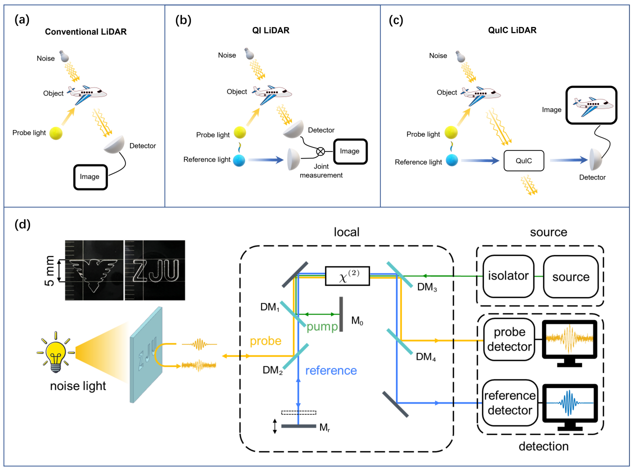

Figure 1: Physical principles for conventional, QI and QuIC LiDARs. (a) Conventional LiDAR. (b) QI LiDAR, where the SNR is enhanced by joint measurement. (c) QuIC LiDAR. Without detecting the probe light, a locally kept reference light is detected to obtain the distance of the object, enabled by QuIC. (d) The setup consists of three modules (enclosed in dashed lines), the pump laser, the local scanning module and the detection module