Improving Resolution and Sensitivity in Quantum Enhanced Imaging

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In quantum-enhanced imaging, two fundamental classical limits are challenged: the diffraction limit, which restricts spatial resolution, and the shot-noise limit, which constrains sensitivity. This talk presents two recent advances that address both obstacles. First, we briefly introduce Quantum Super-resolution Imaging by Photon Statistics (QSIPS), a novel method that harnesses higher-order photon correlations from non-Poissonian emitters, combined with structured illumination, to achieve resolution beyond the diffraction limit. Second, we extensively present Non-Interferometric Quantum Phase Imaging (NIQPI), which enables sub-shot-noise phase retrieval by exploiting intensity correlations of photon pairs generated via spontaneous parametric down-conversion. We show that, contrary to previous assumptions, this technique maintains high spatial resolution without any trade-off between quantum noise suppression and image resolution, culminating in the first experimental demonstration of sub-shot-noise quantum phase imaging on real biological samples.