High-Precision Sensing Based on Thermal Light Interference Beyond Coherence

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In the mid-fifties, the famous Hanbury-Brown and Twiss (HBT) was at the heart of the development of the field of quantum optics. Recently, a novel interference scheme was first theoretically predicted [1] and then experimentally verified [2] by sending two classically correlated beams of light, produced by beam-splitting of a thermal light beam as in an HBT scheme, to two unbalanced Mach-Zehnder interferometers before a second-order correlation measurement is performed. Differently from an HBT scheme, sinusoidal fringes can be observed as a function of the difference between the relative phases in the two Mach-Zehnder interferometers, independently of how far the two interferometers are placed with respect to each other. Therefore, this phenomenon has the potential for the development of novel remote sensing and imaging applications. Indeed, we showed how, when employed in the spatial domain, enables to monitor the transverse position and the spatial structure of two distant double-slit masks [3], as verified experimentally in [4].

More recently, we have shed new light on the understanding of the emergence of second-order coherence with thermal light by showing that spatial second order interference can be observed even when first-order interference occurs at one of the detectors. In particular, we have demonstrated the emergence of second-order correlations depending on a new critical parameter, defined as a second order correlation length [5]. We have shown how such an interference effect can be employed in high precision distance sensing, even in the presence of turbulence [5].

References

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