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Sensitivity Improvement of Quantum-Enhanced Plasmonic Sensing with Phase-Based Configuration[1] MOHAMMADJAVAD DOWRAN, ASHOK KUMAR, University of Oklahoma, BENJAMIN J. LAWRIE, RAPHAEL C. POOSER, Oak Ridge National Laboratory, ALBERTO M. MARINO, University of Oklahoma — The use of quantum resources can enhance the sensitivity of traditional measurement techniques beyond the standard quantum limit (SQL). Enabling such a quantum enhancement in real-life devices is one of the goals of quantum metrology. Achieving this goal requires devices compatible with quantum resources that are already operating at the SQL. Among these devices, plasmonic sensors represent a good candidate as they are widely used in bio-chemical sensing applications. Plasmonic sensors respond to small changes in their local refractive index through a shift of their resonance response, which leads to a change in the amplitude and phase of the probing light. Probing these sensors with quantum states of light, such as twin beams, can lower the measurement noise floor and allows us to detect signals below the SQL. Here, we compare phase- and amplitude-based quantum plasmonic sensing configurations. By considering the Quantum Cramér Rao bound for both configurations we show that the phase-based configuration can take better advantage of available quantum resources than the amplitude-based one. This is due in part to the phase response of plasmonic sensors being more sensitive to changes in the refractive index and to being able to operate the sensor with less loss.

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