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Quantum Sensing Beyond the Shot-Noise Limit with Plasmonic Sensors[1] MOHAMMADJAVAD DOWRAN, ASHOK KUMAR, University of Oklahoma, BENJAMIN LAWRIE, RAPHAEL POOSER, Oak Ridge National Laboratory, ALBERTO MARINO, University of Oklahoma — The use of quantum resources offers the possibility of enhancing the sensitivity of a device beyond the shot noise limit and promises to revolutionize the field of metrology through the development of quantum enhanced sensors. In particular, plasmonic sensors, which are widely used in bio-chemical sensing applications, provide a unique opportunity to bring such an enhancement to real-life devices. Resonance plasmonic sensors respond to changes in refractive index through a shift of their characteristic transmission spectrum. We show that the use of quantum squeezed states to probe plasmonic sensors can enhance their sensitivity by lowering the noise floor and allowing the detection of smaller changes in refractive index. In our experiment, we use one of the beams of a two-mode squeezed state generated via four-wave-mixing in Rb atoms to probe the sensor. A squeezing level of 4 dB is obtained after transduction through the plasmonic sensor, which consists of a triangular nano-hole array in a thin silver film and exhibits a sensitivity of the order of 10^{-10} RIU/$\sqrt{\text{Hz}}$. The use of quantum states leads to 40% enhancement in the sensitivity of the plasmonic sensor with respect to the shot noise limit.

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