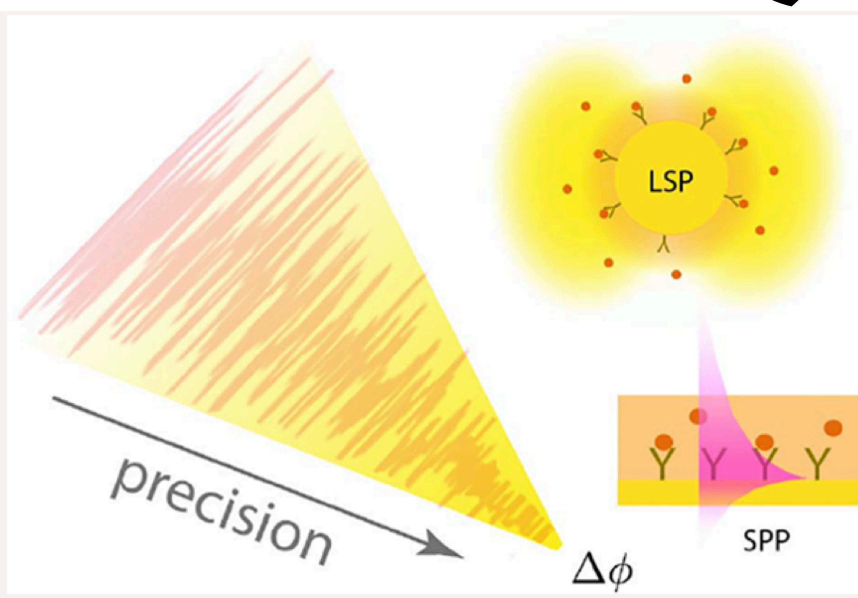
Introduction to Quantum Plasmonic Sensing



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Plasmonic systems that support surface plasmon polaritons provide one of the most practical sensing platforms, where the extreme field-confinement below the diffraction limit greatly enhances the sensitivity. The associated sensing uncertainty, however, is fundamentally limited by the statistical nature of classical light, known as the shot-noise limit or the standard quantum limit. To further reduce the uncertainty below the fundamental limit of classical sensing, the quantum metrology and sensing techniques developed in recent years suggest the use of quantum resources in plasmonic sensing, called quantum plasmonic sensing. To understand how it works in detail, we begin in this talk with discussion of the general framework for quantum sensing, i.e., parameter estimation theory that has been widely used to investigate the fundamental bound on how precisely parameters can be estimated or sensed. Based on a few paradigmatic examples of quantum optical sensors in comparison with corresponding classical sensors, we review several key theoretical and experimental works of quantum plasmonic sensing, enabling us to understand how the sensing performance of classical plasmonic sensors can be improved beyond the classical limit. With the reviewed recent advances in quantum plasmonic sensing, we envisage that the progress in quantum science and technology will reshape the field of plasmonic sensing -- a field that has already developed into mature technology for the last few decades.

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Quantum Plasmonic Sensors

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