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Quantum plasmonic biosensing

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Surface plasmon resonance (SPR) is a highly sensitive technique for monitoring changes in the optical properties of a substance in the immediate vicinity of a sensor surface, this makes it very useful in biosensing and surface science research. The most common SPR setup is the Kretschmann configuration in which surface plasmons are excited using a bulk prism and a gold-coated microscope slide. It is a key technology for the characterization of biomolecular interactions and is integrated into many stages of the drug discovery process. The characterization of these biomolecular interactions involves measuring kinetic parameters.

We constructed a two-mode sensing model which we use to measure the kinetic parameters of biomolecular interactions on an SPR setup. The model was also used to measure the precision with which we can measure the kinetic parameters. In our research we made comparisons of the precision we could measure based on the input to our model, i.e., we compared the precision when we used classical states of light versus when we used quantum states of light as input to our model.

Our model showed that using quantum states of light such as the Fock state, two-mode squeezed vacuum and two-mode squeezed displaced state improves the precision in the estimation of kinetic parameters. Quantum states of light allow us to measure the parameters more accurately in comparison to classical states of light. We used our model to study a specific binding reaction, i.e, immobilized Bovine serum albumin (BSA) interaction with anti-BSA, from which we extracted the kinetic parameters and showed the precision enhancement which quantum states bring.

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