Bridging Quantum Optics to Basic Medical Research

Vahid Sandoghdar[1,2*]

[1]*Nano-Optics, Max Planck Institute for the Science of Light, Erlangen, Bavaria, Germany*
[2]*Nano-Optics, Max-Planck-Zentrum für Physik und Medizin, Erlangen, Bavaria, Germany*

* Presenter:Vahid Sandoghdar, email:sandoghdar-office@mpl.mpg.de

Light-matter interaction at the nanometer scale lies at the heart of elementary optical processes such as absorption, emission or scattering. Over the past two decades, we have realized a series of experiments to investigate the interaction of single photons, single molecules and single nanoparticles. In this presentation, I will report on recent studies, where we reach unity efficiency in the coupling of single photons to single molecules in a microcavity and exploit this system for the realization of complex hybrid states involving a controlled number of molecules and photons. Furthermore, I will show how the underlying mechanisms that play a central role in quantum optics, help detect, image, characterize, and track single biological nanoparticles such as viruses and small proteins with high spatial and temporal resolutions and in a label-free fashion. I will argue that the theoretical and experimental toolbox of a quantum optician is ideally suited for branching out to the exciting field of medical research which confronts many important open questions.

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