PHOTONIK SEMINAR

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Plasmonics based approaches for improved imaging in biology

The dream of almost every cell biologist involves monitoring fast cellular and molecular processes with nanoscale spatial resolution over extended regions. This is unfortunately generally obscured by the diffraction limit, which can be circumvented by various microscopy techniques but not without compromising data acquisition speed and range of applicability. Here I will discuss approaches to overcome these hurdles using plasmonic structures to enhance and modify the excitation, emission and resonant energy transfer rates between chromophores. Emphasis will be placed on exploiting and manipulating the different electronic-transitions inherent to multi-level chromophores in a resonant and off-resonant manner. Inadequacy of a simple 2-level description leads us to introduce a QED and analogous semi-classical model which approximates the additional complexity without the need of resorting to elaborate molecular simulations. Some interesting results are uncovered such as directed, enhanced and controllable resonant energy transfer; modifications to the emission & absorption spectra, and a more realistic basis for modeling gain in active plasmonic components. The predictions are found to be in good agreement with our time-resolved and photoluminescence experimental results on emitters near plasmonic structures. A robust microscope setup that exploits some of these effects for enhanced spatial & temporal localization is introduced from which I will present results touching on two biological questions: (1) the morphological changes in the development cycles of a recently uncovered protein structure in a single-cell parasite responsible for sleeping sickness, and (2) the dynamics of the molecular machinery governing the movement of cancer cells.

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