Westfälische Wilhelms-Universität Münster

Fachbereich Physik

› Allgemeines Physikalisches Kolloquium

› Donnerstag, 01.12.2016 um 16 Uhr c.t.

Prof. Dr. Niek van Hulst

ICFO Barcelona

Addressing photon emitters and energy transfer on the nm & fs scale

Nature has developed photosynthesis to power life. Quantum coherences have been observed in the energy transfer of photosynthetic complexes, even at room temperature, hinting to a role of deep physics in natural light harvesting. Does nature exploit quantum concepts? Does the coherence help to find an optimal path for robust or efficient transfer? How are the coherences sustained? What is their spatial extent in a real light-harvesting network?

Specializing on combining femtosecond spectroscopy with nanoscale microscopy, I aim to address such questions by looking ultrafast into the nanoscale, to see biomolecules in action in a real system. Indeed, addressing LH2 of purple bacteria, we revealed the first coherent oscillations of a single photo-synthetic complex at physiological conditions, and even non-classical photon emission of the multi-chromophoric LH2 complex.

In this Colloquium first I'll outline the methods to trace the fs coherences and energy transfer of individual molecules, quantum dots and complexes. Single molecule detection generally relies on detection of fluorescence, yet light harvesting complexes are designed for light transport, not emission. Thus I will explore innovative alternatives: optical antennas to enhance quantum efficiency; transient absorption on singles; detection of stimulated emission.

Imaging nanoscale light transport requires local excitation and detection far beyond the diffraction limit. I'll address the use of nanoholes and scanning resonant antenna probes to confine the light field and couple effectively to single emitters on the nanoscale. The antenna acts as a nanocavity with relative strong coupling (~100GHz), speeding up the radiative decay to picosecond time scale and allowing › GHz single photon emission.

Finally combining both coherent fs excitation and localized nanoscale excitation/detection I will explore potential quantum diffusion: the transport and extent of coherences throughout the light-harvesting membrane.

I will conclude with an outlook of the challenges ahead and the perspectives of addressing coupled networks in real nano-space and on femtosecond timescale.

Kolloquiums-Kaffee
ab 16 Uhr vor dem Hörsaal

Wilhelm-Klemm-Straße 10
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