SEMINAIRE ISMO

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Light generation at scales below one billionth of a metre and one billionth of a second

Exploring and controlling the generation of light on nanometre length scales and nanosecond time scales are of particular technological importance. It enables accessing local charge carrier and luminescence dynamics in organic light emitting diodes (OLEDs), characterization of densely-packed single-photon sources for quantum application, or novel computer architectures that process optical instead of electronic signals. However, all these examples are subject to the diffraction limit, which limits the observation or manipulation of light to sizes of the order of its wavelength. We circumvent this problem by exploiting the light excited by the atomically-defined tunnel current in a scanning tunnelling microscope (STM) and combine it with high temporal resolution optical spectroscopy.

In the first part, I will discuss the nanoscale electroluminescence from C_{60} multilayer films. It turns out that the radiative recombination of electron–hole pairs is restricted to individual structural defects, at which the parity-forbidden lowest singlet transitions becomes locally allowed. Measurement of the photon statistics enables accessing the exciton lifetime and proves the single-photon emission of these defects. The local charge carrier dynamics can be extracted from the luminescence response to nanosecond voltage pulses. In the second part, I will focus on the excitation of tip-induced plasmons, which are collective oscillations of free electrons in the metal tip and substrate. I will demonstrate that the orbitals of a single-molecule act as energetically and submolecularly defined gates for the generation of plasmons in tunnel junctions. By this means, it becomes possible to modulate the plasmon generation over several orders of magnitude and well in the gigahertz frequency range.

Le séminaire sera donné en Anglais

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