LAPHIA
Laser & Photonics
in Aquitaine

université de BORDEAUX

Cluster of Excellence LAPHIA
Colloquium

April 13, 2015
From 9 :30 am to 12 :00 pm
Auditorium - Institut d'Optique d'Aquitaine - Talence

Program

9:30 am - 10:00 am: *Welcome - Coffee break*

10:00 am - 11:00 am: **Prof. Vahid Sandoghdar**

11:00 am - 12:00 pm: **Prof. Michel Orrit**

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INSTITUT d'OPTIQUE GRADUATE SCHOOL

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"Sensitivity, resolution and speed in detection and tracking of single biomolecules"

Prof. Vahid Sandoghdar

From 10: 00 am to 11: 00 am

Abstract :

Optical techniques are in high demand for the investigation of biomedical processes because they can be noninvasive, real-time and fast. In this talk, I present an overview of the recent advances in pushing the limits of sensitivity, resolution and speed in biological microscopy and how methods from laser spectroscopy, quantum optics and nanoscience have introduced a revolution in this area. In particular, I will show that photophysical improvements at low temperature can lead to optical resolution in the angstrom range, i.e. about one thousand times better than the diffraction limit. Next, I will discuss the need for fluorescence-free microscopy and how interferometric scattering detection (iSCAT) can be used for detecting individual biomolecules as small as 60 kDa in a direct and label-free fashion. The use of this method for very fast studies of diffusion and transport in lipid membranes is another important biophysical application that will be examined. If time allows, I will also discuss our recent work on trapping and manipulation of very small nanoparticles.

References:

[1] M. Piliarik and V. Sandoghdar, Nature Communications 5, 4495 (2014).

[2] C.-L. Hsieh, S. Spindler, J. Ehrig, V. Sandoghdar, J. Phys. Chem. B 118, 1545 (2014).

[3] S.Weisenburger, B. Jing, D. Hänni, L. Reymond, B. Schuler, A. Renn, V. Sandoghdar, *ChemPhysChem.* **15**, 763 (2014).

[4] J. T. Kim, S. Spindler, V. Sandoghdar, *Nature Communications* **5**, 3380 (2014).

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"Optical microscopy and spectroscopy of single molecules and single plasmonic gold nanoparticles"

Prof. Michel Orrit

From 11: 00 am to 12: 00 pm

Abstract:

Optical signals provide unique insights into the dynamics of nano-objects and their surroundings [1]. I shall present some of our experiments of the last few years.

i) We study single gold nanoparticles by photothermal and pump-probe microscopy. We recently studied the dynamics of vapor nanobubbles created in the liquid surrounding a single immobilized gold nanosphere.

ii) Photothermal microscopy opens the study of non-fluorescent absorbers, down to single-molecule sensitivity [2]. Combining this contrast with photoluminescence, we can measure the luminescence quantum yield on a single-particle basis. The high signal-to-noise ratio of this technique enables uses of individual gold nanoparticles for local plasmonic and chemical probing [3].

iii) Gold nanorods generate strong field enhancements near their tips. Matching the rods' plasmon to a dye's spectra, we observe enhancements in excess of thousand-fold for the fluorescence of single Crystal Violet molecules [4]. This method generalizes single-molecule fluorescence to a broad range of weak emitters.

References:

[1] F. Kulzer et al., Angew. Chem. 49 (2010) 854.

[2] A. Gaiduk et al. Science 330 (2010) 353

[3] P. Zijlstra et al., Nature Nanotech. 7 (2012) 379.

[4] H. Yuan et al., Angew. Chem. Int. Ed. 52 (2013) 1217-1221.

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