

Séminaire le **14 juin 2017 à 9h30** au LPICM:

Spotlight on microspherical nanoscopy: Experimental and theoretical quantification of super-resolution

Pr V.N. Astratov

University of North Carolina at Charlotte, USA

A classification of label-free super-resolution imaging mechanisms is given based on the nonlinear reduction of the point-spread function (PSF), near-field scanning, image magnification and gain, structured and sparse illumination, and information approaches. We argue that the super-resolution capability of contact microspheres stems from an image magnification effect taking place in close proximity to the object with contributions of its optical near-fields. It is shown that experimental quantification of resolution in a label-free microscopy requires convolution with 2-D PSF. We propose a combination of microspherical nanoscopy with nanoplasmonic illumination for imaging biomedical samples. We applied these techniques for imaging actin protein filaments and yeast cells and observed a resolution advantage over standard microscopy. Our theoretical approach is based on a rigorous solution of the Maxwell equations for the dipole emission near dielectric microparticles. This allows us to account for various physical effects that may differentiate the regime of microsphere-based imaging from the standard microscopy. These effects include the near-field coupling to microspheres, excitation of microsphere resonances (whispering gallery modes), coherence and polarization of dipole emission.

Brief Bio

Vasily N. Astratov is a professor in the Department of Physics and Optical Science at the University of North Carolina-Charlotte since 2002. In 1986, he received his Ph.D. degree from the A.F. Ioffe Physical-Technical Institute in Russia. In the mid-90s, he pioneered studies of synthetic opals as novel self-assembled photonic crystals for visible light in his group at the Ioffe Institute. In 1997-2001, he was a postdoctoral scholar at the University of Sheffield. His current research is devoted to microspherical photonics including optical nanoscopy, resonant light forces, photonic nanojets, and whispering gallery mode coupling effects. He was a topical editor for the journal Optics Express in 2005-2011 and a technical committee member for major international conferences including CLEO, IEEE Photonics, Photonics West, ICTON and OECC/ACOFT. In 2016-17, he organized workshops and special sessions on label-free super-resolution at IEEE Photonics, PQE and ICTON conferences. He is a recipient of a number of awards including International Visitor Awards in Spain (2015), France (2011), UK (2006), and Award of the Exchange Program adopted between Royal Society and Russian Academy of Sciences in 1996. He authored and co-authored about 150 publications and 14 patents which were cited about 5000 times.