

# Exploring the dynamic properties of molecular assemblies in live cells with single molecule imaging and manipulation.

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Single molecule techniques are becoming ubiquitous tools in *in vitro* and *in vivo* assays. In cell biology, they now can be used to count molecules, image with sub-diffraction resolution and track individual molecules as they move in their natural habitat. Thus, single molecule imaging is a tool of choice to address the dynamics, composition and structural properties of supramolecular assemblies in live cells. In this talk, I will present our effort to develop and apply ultrasensitive fluorescence methods. I will in particular present novel optical methods based on adaptive optics or multifocal imaging to enable the 3D localization and tracking of individual molecules in live cells. All these techniques will be illustrated by experiments made on a variety of biological systems, such as post-synaptic membrane receptors, molecular motors or transcription factors. Finally, I will describe recent experiments in which we used magnetic nanoparticles for locally controlling signaling activity inside cells, demonstrating the interest of using perturbative approach in cell biology.

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## *Recent publications:*

1. Ibrahim Cisse, Ignacio Izeddin, Sebastien Causse, Lydia Boudarene, Adrien Senecal, Leila Muresan, Claire Dugast-Darzacq, Bassam Hajj, Maxime Dahan, Xavier Darzacq, « *Real time dynamics of RNA Polymerase II clustering in live human cells* », Science (in press)
  2. M. El Beheiry and M. Dahan, “*ViSP: tool for visualizing 3D super-resolution data*”, Nature Methods (in press).
  3. Christian G. Specht, Ignacio Izeddin, Pamela C. Rodriguez, Mohamed El Beheiry, Philippe Rostaing, Xavier Darzacq, Maxime Dahan and Antoine Triller “*Quantitative nanoscopy at inhibitory synapses: counting gephyrin molecules and receptor binding* ”, Neuron (in press).
  4. F. Etoc, D. Lisse, Y. Bellaiche, J. Piehler, M. Coppey, M. Dahan, « *Subcellular control of Rac signalling by magnetogenetic manipulation in living cells*», Nature Nanotechnology (2013) 8, 193–198.
  5. S. Abrahamsson, J. Chen, B. Hajj, S. Stallinga, A. Katsov, J. Wisniewski, G. Mizuguchi, P. Soulle, F. Mueller, C. Dugast Darzacq, X. Darzacq, C. Wu, C. I. Bargmann, D. A. Agard, M. Dahan and M.G.L. Gustafsson “*Fast multi-color 3D imaging using aberration corrected multi-focus microscopy*”, Nature Methods (2013) 10(1):60-3.
  6. F. Pinaud, S. Clarke, A. Sittner, and M. Dahan, “Probing cellular events, one quantum dot a time”, Nature Methods 7, 275-85 (2010).
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